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C O N T E N T

1.PRODUCTION POTENTIAL OF SOME CORN GENOTYPES - RESOURCES FOR AGRICULTURAL PRACTICE AND BREEDING PROGRAMS

Alina Laura AGAPIE, Florin SALA 17

2.INTERNATİONAL MİGRATİON AND AGRİCULTURAL SUSTAİNABİLİTY İN THE ÇUKUROVA REGİON: DETAİLED ANALYSİS OF SOCİO-ECONOMİC STRUCTURE AND MİGRATİON INTERACTİONS

**Şinasi AKDEMIR, Ufuk GÜLTEKIN, Kasım Eren TUNA,
Issaka Saidou ISMAILLA.. 27**

3.SOCİO-ECONOMİC AND OPERATİONAL DYNAMİCS OF REAPER-THRESHER OWNERSHİP İN ADANA, TÜRKIYE

**Şinasi AKDEMIR, Ufuk GÜLTEKIN, Kasım Eren TUNA,
Issaka Saidou ISMAILLA, Aziz MAVRUK, Hüseyin ÖZBEK................................ 39**

4.EFFECTS OF LAND CONSOLİDATİON ON AGRİCULTURAL ENTERPRİSES İN CİHANBEYLİ DİSTRİCT, TÜRKIYE: AN EVALUATİON FROM THE PRODUCER PERSPECTİVE

**Şinasi AKDEMIR, Ufuk GÜLTEKIN, Kasım Eren TUNA,
Issaka Saidou ISMAILLA.. 51**

5.SOCIAL ASPECTS OF COOPERATIVE VALUES OF SOME TYPES OF COOPERATIVES IN BULGARIA

Georgi ALEKSIEV, Nadka KOSTADINOVA.. 63

6.RESOURCE REQUIREMENTS OF BULGARIAN CATTLE FARMING AND OPORTUNITIES FOR ADAPTATION OF DIGITAL SYSTEMS

Georgi ALEKSIEV, Nadezhda PETROVA, Evgeni GENCHEV.............................. 69

7.INFLUENCE OF LEADER ON THE SUSTAINABLE DEVELOPMENT OF RURAL REGIONS OF BULGARIA

**Georgi ANGELOV, Marina NIKOLOVA, Elena YORDANOVA,
Tsvetan MARKOV, Iliyana KRYSTEVA 77**

8.TESTING THE POTENTIAL OF INNOVATIVE TREATMENTS OF WHITE GRAPE MUST WITH VEGETAL PROTEINS – SENSORY IMPACT ON WINE

Arina Oana ANTOCE, George Adrian COJOCARU.. 91

9.TRADITIONAL SAXON HOME GARDENS AS HOT-SPOTS FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE CONSERVATION - CASE STUDY IN ROMANIA

Maria-Mihaela ANTOFIE, Camelia SAND-SAVA, Teodor VINTILA.................. 99

10.COMPARATIVE ANALYSIS OF GOVERNANCE MODELS IN MOUNTAIN AREAS. INSIGHTS FOR ASSURING SUSTAINABILITY AND RESILIENCE

**Felix ARION, Bozhura FIDANSKA, Bridget MURPHY,
Cristina Amaro da COSTA, Juan Antonio LAZARO MENENDEZ,
Mark REDMAN, Rike STOTEN.. 121**

11.THE COOPERATIVE MODEL OF AGRIBUSINESS IN BULGARIA- ORIGINS AND CONTEMPORARY STATE

**Todorka ATANASSOVA-KALAYDZHIEVA, Iskra NENCHEVA,
Ivanka ZHEKOVA.. 129**

12.PLOT QUALITY RATING AS A RESULT OF INNOVATION MANAGEMENT IN THE ARTIFICIAL INTELLIGENCE SOCIETY

Mădălina Andreea BACIU, Ștefan VIZITEU, Stejărel BREZULEANU................ 139

13.AGROPRODUCTIVE DIFFERENCES BETWEEN TWO LUVOSOL UNITS AT THE PREAJBA GORJ EXPERIMENTAL CENTER, ROMANIA

Mihaela BĂLAN, Cristian POPESCU, Oana Alina NIȚU....................................... 145

14.FOOD SAFETY PERCEPTIONS INFLUENCED BY ONLINE TRADE IN FOODSTUFFS

Gergana BALIEVA.. 157

15.ORGANIC VS. CONVENTIONAL: A COMPARATIVE REVIEW OF HEALTH-RELATED WELFARE ISSUES AND THEIR ECONOMIC IMPACT ON POULTRY PRODUCTION

**Silviu-Ionuț BEIA, Dana TĂPĂLOAGĂ, Cosmin ȘONEA,
Raluca-Aniela GHEORGHE-IRIMIA, Petronela Mihaela ROȘU,
Makki Khalaf Hussein AL DULAIMI, Paul-Rodian TĂPĂLOAGĂ....................... 165**

16.CHALLENGES AND OPPORTUNITIES FOR ORGANIC FARMING POST 2023

**Rositsa BELUHOVA-UZUNOVA, Mariyana SHISHKOVA,
Krum HRISTOV 175**

17.CAPITALIZATION WITH AGRICULTURAL MACHINES VS. SERVICES FOR AGRICULTURE

Dan BODESCU, Oana COCA, Stefania Beatrice PADURARU, Roxana MIHALACHE, Gavril ȘTEFAN.. 183

18.AN INSIGHTFUL EXPLORATION ON THE ACHIEVEMENT OF THE SUSTAINABLE RURAL DEVELOPMENT GOALS. A STUDY CASE- VALEA LUPULUI COMMUNE, IASI COUNTY, ROMANIA

Roxana Mihaela BOLOHAN (COCIORVĂ), Ramona Vasilica BACTER, Ioana BOLOHAN, Gavril ȘTEFAN... 193

19.GENOME EDITING TECHNIQUES: APPLICATIONS IN WHEAT BREEDING

Dorina BONEA.. 201

20.INTEGRATED RISK MANAGEMENT IN A SMALL-DIMENSIONAL LAVENDER PLANTATION IN SOUTHERN ROMANIA

Georgia BOROȘ-IACOB, Stelica CRISTEA.. 209

21.INFLUENCE OF FORMAL AND NON-FORMAL EDUCATIONAL ACTIVITIES ON THE ACADEMIC INTEGRATION OF FIRST-YEAR STUDENTS OF "ION IONESCU DE LA BRAD" UNIVERSITY OF LIFE SCIENCES (IULS) IAȘI, ROMANIA, FOR REDUCING EARLY DROPOUT

Carmen-Olguța BREZULEANU, Alina SÎRGHEA, Roxana MIHALACHE, Elena UNGUREANU, Stejărel BREZULEANU.. 215

22.FROM FIELD TO CONSUMER: A COMPREHENSIVE ANALYSIS OF MEDICINAL AND AROMATIC PLANT PRODUCT PREFERENCES THROUGH GENERATIONS

Roxana Larisa CADAR, Peter ŠEDÍK, Kristína PREDANÓCYOVÁ, Cristina Bianca POCOL... 229

23.STUDY REGARDING THE ANALYSIS OF TOURIST RESOURCES AND ACTIVITIES FROM A BOARDING HOUSE IN THE MUNICIPALITY OF CICANEȘTI - ARGEȘ, ROMANIA, IN THE PERIOD 2018-2022

Jenica CĂLINA, Aurel CĂLINA... 239

24.STUDY ON THE DEVELOPMENT AND EVOLUTION OF THE SUSTAINABLE AGRITOURISM ACTIVITY AT A BOARDING HOUSE IN CRASNA MUNICIPALITY - GORJ, ROMANIA

Jenica CĂLINA, Aurel CĂLINA... 249

25.AGRICULTURAL AND RURAL DEVELOPMENT IN THE CONTEXT OF A CIRCULAR ECONOMY IN THE EUROPEAN UNION AND FRANCOPHONIE STATES. CASE STUDY: ROMANIA

Aurelia-Ioana CHEREJI, Irina-Adriana CHIURCIU, Mihai SEBE...................... 259

26.CHALLENGES AND ALTERNATIVES ON THE FORAGES RESOURCES PROVIDING UNDER CURRENT ENVIRONMENTAL AND CLIMATE CONDITIONS

Rodica CHETROIU, Diana Maria ILIE.. 267

27.DETERMINING THE MARKET VALUE FOR AGRICULTURAL AND LIVESTOCK PROPERTIES

Silvia CHIOREAN, Tudor SĂLĂGEAN, Ioana Delia POP, Florica MATEI, Mircea VARGA, Mircea-Emil NAP.. 273

28.GLOBAL TRENDS ON RESEARCH TOWARDS THE VALUATION PROCESS OF AN AGRICULTURE LAND

Silvia CHIOREAN, Iulia COROIAN, Tudor SĂLĂGEAN, Mircea Emil NAP, Jutka DEAK, Ioan LUPUȚ.. 281

29.DEVELOPING A DIGITALTWIN MODEL FOR CORN, WHEAT AND RAPESEED YIELDS COMPUTATION

Catalin CHITU, Ilinca IMBREA, Stefan BATRINA, Florin IMBREA.................... 287

30.ASPECTS RELATED TO THE HONEY MARKET AND THE ETHICS OF THE BEEKEEPING ENVIRONMENT IN ROMANIA

Irina-Adriana CHIURCIU, Iuliana ZAHARIA, Elena SOARE................................ 295

31.STATISTICAL ANALYSIS OF ECONOMIC INDICATORS IN NITROGEN FIXATION OF BIRD'S FOOT TREFOIL CULTIVARS AND ITS INFLUENCE ON THE ECOLOGICAL EFFECT

Boryana CHURKOVA, Katerina CHURKOVA.. 305

32.ECONOMIC EVALUATION OF FERTILIZING WITH ORGANIC FERTILIZERS IN THE PRODUCTION OF BIRD'S FOOT TREFOIL FODDER

Katerina CHURKOVA, Boryana CHURKOVA.. 313

33.TOWARDS SUSTAINABLE AGRICULTURE: ASSESSING THE ECONOMIC IMPACT OF ORGANIC FARMS IN MOLDOVA’S AGRICULTURAL SECTOR

Liliana CIMPOIEȘ, Diana COȘALÎC... 319

34.ASSESSMENT OF THE PHYSICAL AND SOCIO-ECONOMIC POTENTIAL OF THE GRASSLANDS IN BANAT, ROMANIA IN A HOLISTIC APPROACH

Luminita COJOCARIU, Lia HOANCEA, Nicolae Marinel HORABLAGA, Loredana COPACEAN, Despina-Maria BORDEAN.. 329

35.THE WINEMAKING SECTOR IN THE REPUBLIC OF MOLDOVA-ANALYSIS AND PERSPECTIVES

Tatiana COLESNICOVA, Tatiana IAȚIŞIN, Zinovia TOACĂ............................... 341

36.THE "NĂDLAC FARMER" AGRICULTURAL COOPERATIVE – A MODEL OF GOOD PRACTICES FOR SMALL FARMERS, ROMANIA

Ioana COLF, Nicoleta MATEOC SÎRB, Tiberiu IANCU....................................... 351

37.ANALYSIS OF THE AGRICULTURAL LABOUR FORCE IN TERMS OF THE AREA CULTIVATED WITH THE MAIN CROPS IN ROMANIA, DURING THE PERIOD 2018-2022

Cătălina-Nicoleta COMAN, Răzvan PANAIT, Cristiana Silvia BUZATU, Cosmina Andreea SMEDESCU, Nicoleta Florica PĂTRĂCHIOIU, Valentina-Constanța TUDOR 357

38.AN ANALYSIS OF NATIONAL SANITARY VETERINARY AND FOOD SAFETY AUTHORITY (ANSVSA)`S ACTIVITIES DURING THE 2023 SUMMER SEASON IN CONSTANTA COUNTY, ROMANIA

Iuliana CONDULEȚ, Silvius STANCIU.. 367

39.RESEARCH ON THE INFLUENCE OF BIOSTIMULANTS ON PRODUCTIVITY IN THE MILKWEED (*SYLIBUM MARIANUM* L.)

Mihaela Anca COSERAN (BURNEA), Emilia CONSTANTINESCU, Aurel Liviu OLARU, Gabriela PĂUNESCU, Matei Marcel DUDA.......................... 373

40.FUNDING OPPORTUNITIES FOR SMART VILLAGE PROJECTS THROUGH THE LEADER INTERVENTION

Luminita (SASU) CREINEANU, Alecsandra PARNUS (RUSU), Liviu MARCUTA.. 383

41.RESEARCH ON THE IMPACT OF THE HOSTILITIES IN UKRAINE ON TOURISM IN THE DANUBE DELTA

Romeo Cătălin CREȚU, Ioan Iulian ALECU, Ionuţ Silviu BEIA, Viorel Costin BANȚA, Petrică ŞTEFAN.. 391

42.EMBRACING THE CIRCULAR ECONOMY: A PARADIGM SHIFT FOR SUSTAINABLE PROSPERITY

Ionut Marius CROITORU, Mircea Adrian GRIGORAS, Agatha POPESCU, Brîndușa Antonia GRIGORAȘ.. 397

43.THE IMPACT OF THE COVID 19 PANDEMIC ON RURAL TOURISM IN EUROPE

Cornelia Marilena DAMIAN, Dragoș Ion SMEDESCU, Răzvan PANAIT, Cristiana Silvia BUZATU, Andrei VASILE, Valentina Constanța TUDOR............. 407

44.STUDY ON TOURISM ACTIVITY IN THE WESTERN DEVELOPMENT REGION OF ROMANIA

Ana-Mariana DINCU, Manuela-Dora ORBOI, Florinel IMBREA, Ilica Merima IMBREA, Andreea Adriana PETCOV, Diana MARIN..................... 413

45.ROMANIAN RURAL TOURISM IN GUESTHOUSES - EVOLUTION PERSPECTIVES

Carina Andreia DOBRE, Aurelia Vasilica BALAN, Paula STOICEA, Adina Magdalena IORGA.. 419

46.PRELIMINARIES ON THE AGRITOURISM TOURIST'S TYPOLOGY IN ROMANIA. CASE STUDY *SATUL BANULUI GUESTHOUSE,* PRAHOVA COUNTY

Carina Andreia DOBRE, Adina Magdalena IORGA, Iuliana ZAHARIA... 425

47.QUANTITATIVE APPROACH TO INFLUENCING DRIVERS FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

Vili DRAGOMIR, Bianca BOLBOASA, Steliana RODINO, Marian BUTU........... 431

48.EVALUATION OF INSTITUTIONAL CHANGE IN TOUR AGENTS BRANCH - NEW INSTITUTIONAL ECONOMICS ANALYTICAL FRAMEWORK

Minko GEORGIEV, Boryana IVANOVA, Ivanka DIMITROVA........................... 439

49.ANALYTICAL FRAMEWORK OF THE CONTRACTS IN BULGARIAN AGRICULTURE – NEW INSTITUTIONAL ECONOMICS (NIE)

Minko GEORGIEV... 447

50.AQUACULTURE IN TRANSITION: PREDICTIVE INSIGHTS INTO ROMANIAN AQUACULTURE PRODUCTION

Raluca-Aniela GHEORGHE-IRIMIA, Dana TĂPĂLOAGĂ, Cosmin ȘONEA, Alexandru USTUROI, Paul-Rodian TĂPĂLOAGĂ.. 457

51.ANALYSIS OF SINGLE AREA PAYMENT SCHEME (SAPS) BENEFICIARIES. CASE STUDY IN TIMIȘ AND CARAȘ SEVERIN COUNTIES, ROMANIA

Loredana GHERASIMESCU, Stefan BATRINA, Simona NITA, Ilinca Merima IMBREA, Lucian BOTOS, Ana Maria DINCU, Ioana Alina HINDA, Florin IMBREA... 465

52.EGG QUALITY RESEARCH ON CONTAMINATION IN VARIOUS SEASONAL CONDITIONS

Artur GOLBAN, Rita GOLBAN.. 473

53.RESEARCH ON SOME ASPECTS OF POULTRY MEAT QUALITY DEPENDING ON STORAGE

Rita GOLBAN, Artur GOLBAN, Aurel CIUCLEA.. 479

54.ADAPTATION OF THE FARMERS' SKILLS TO THE REQUIREMENTS OF THE FUTURE AGRICULTURE

Anamaria Viorela GRAMA, Ștefan Laurențiu BĂTRÎNA.................................. 485

55.ANALYSIS OF THE EFFICIENCY OF THE IMPLEMENTATION OF FINANCING PROGRAMS FROM THE EUROPEAN SOCIAL FUND ON EDUCATION IN THE RURAL ENVIRONMENT IN ROMANIA

Mihaela GRECU (FRAȚEA), Constantin Adrian SURLEANU, Ovidiu GUȘAN Dragos Ion SMEDESCU, George VLAD, Razvan PANAIT, Valentina Constanța TUDOR.. 495

56.INSIGHTS OF ROMANIAN WINE PRODUCERS' BUSINESS AND THEIR INVOLVEMENT IN WINE TOURISM

Andra - Elena GURGU, Gina FÎNTÎNERU... 503

57.CONSUMERS' PERCEPTION OF "GEZO" IN ROMANIA: A TRADITIONAL PRODUCT FROM KURDISTAN

Rezhen HARUN.. 513

58.RAPESEED CROP MANAGEMENT CONTRIBUTION TO YIELD INCREASE THROUGH SOIL WORKS SYSTEM AND FERTILIZING TREATMENTS

Antonia HERȚEG, Florin SALA.. 519

59.GREEN DEAL AND SOLAR ENERGY- PROSPECTS FOR BULGARIAN RURAL AREAS

Krum HRISTOV, Rositsa BELUHOVA-UZUNOVA, Dimo ATANASOV, Svetoslav LAVCHIEV, Georgi MRANKOV.. 529

60.VALUE CHAINS IN RAW MATERIALS, HIGH-TECH AND AGRICULTURAL PRODUCTS. INTERNATIONAL, EUROPEAN AND ROMANIAN PERSPECTIVES

Sorin IONITESCU, Agatha POPESCU, Simona MOAGAR-POLADIAN, Nicoleta-Luminita GUDANESCU, Alina-Cerasela ALUCULESEI........................... 537

61.FARM DEBT AND INVESTMENT. EMPIRICAL EVIDENCE FROM BULGARIAN AGRICULTURE

Desislava IVANOVA, Evgeni GENCHEV 549

62.PRODUCTION AND PRODUCTIVITY ELEMENTS IN FIELD PEAS IN RELATION TO MINERAL FERTILIZATION

Andreea Lidia JURJESCU, Florin SALA.. 557

63.ANALYSIS AND ASSESSMENT OF THE USE OF PESTICIDES AND FERTILIZERS IN THE RURAL TERRITORIES OF REPUBLIC OF BULGARIA

Iliyana KRASTEVA, Marina NIKOLOVA, Elena YORDANOVA, Georgi ANGELOV, Tsvetan MARKOV... 565

64.FARM SIZE AND TECHNICAL EFFICIENCY OF THE AGRICULTURAL SECTOR IN THE EUROPEAN UNION (EU-27)

Dariusz KUSZ, Bożena KUSZ.. 577

65.WASTE MANAGEMENT IN BROILER INDUSTRY, BULGARIA

Iliyan LAZAROV, Gergana BALIEVA, Ivanka LAZAROVA................................ 587

66.THE CONTRIBUTION OF AGRICULTURE COMPARED WITH OTHER ECONOMIC SECTORS TO THE FORMATION OF ROMANIA'S GROSS DOMESTIC PRODUCT

CameliaMĂNESCU, Nicoleta MATEOC-SÎRB, Oana SICOE-MURG, Ana-Mariana DINCU, Diana MARIN.. 593

67.COMPARATIVE ANALYSIS OF INCOME AND EXPENDITURE TRENDS IN AGRICULTURAL HOUSEHOLDS IN ROMANIA

Simona-Beatrice MANOLACHE, Silvius STANCIU.. 601

68.EXTERNAL AND INTERNAL THREATS TO FOOD SECURITY

Tsvetan MARKOV.. 609

69.STUDY REGARDING THE INTEREST OF ROMANIAN CONSUMERS FOR ORGANIC AGRICULTURE

Teodor MATEOC, Ioana Anda MILIN, Ramona CIOLAC, Camelia MĂNESCU, Casiana MIHUȚ, Nicoleta MATEOC-SÎRB.......................... 621

70.ANALYSIS OF THE DYNAMICS OF ORGANIC AGRICULTURE IN THE EUROPEAN UNION WITH AN EMPHASIS ON ROMANIA

Nicoleta MATEOC-SÎRB, Paula Diana OTIMAN, Adelina VENIG, Saida FEIER DAVID, Camelia MĂNESCU , Anișoara DUMA COPCEA, Teodor MATEOC... 629

71.ANALYSIS OF THE CAUSES OF CAMEROON'S PERMANENT DEPENDENCE ON RICE IMPORTS

Pierre Bertran MBONDJI NTOMBE, Fon Dorothy ENGWALI............................. 639

72.CHALLENGES OF THE CONSUMPTION BEHAVIOUR TOWARDS THE ECO-FOOD PRODUCTS. A STUDY ON THE SUSTAINABLE HUMAN NEEDS

Mioara MIHĂILĂ, Ciprian Ionel ALECU, Andy Felix JITĂREANU..................... 653

73.FINANCIAL PROFITABILITY OF AGRICULTURE IN BULGARIA

Oleg MILEV, Emil MUTAFOV... 661

74.ECONOMIC EFFICIENCY REGARDING CASTOR BEAN (*Ricinus communis* L.) CULTIVATION IN PEDOCLIMATIC CONDITIONS IN THE CENTER OF MOLDOVA, ROMANIA

Bogdan MÎRZAN, Oana MÎRZAN, Margareta NAIE, Constantin LUNGOCI, Elena STAVARACHE, Mihai STAVARACHE, Diana BATÎR RUSU, Alexandra Andreea BUBURUZ... 667

75.INNOVATIVE STRATEGIES FOR FOOD WASTE REDUCTION AND THE USE OF MOBILE APPLICATIONS IN THE AGRI-FOOD SECTOR

Maria-Georgeta MOLDOVAN, Dan-Cristian DABIJA, Cristina Bianca POCOL... 675

76.NATURAL POPULATION GROWTH IN BULGARIAN RURAL AREAS IN THE PERIOD 2011-2021

Emil MUTAFOV, Petar MARINOV... 689

77.FINANCIAL INDEPENDENCE IN RURAL MUNICIPALITIES IN BULGARIA

Emil MUTAFOV.. 697

78.DEVELOPING A MODEL BASED ON A STATISTICAL ANALYSIS OF FOOD LOSS AND WASTE PATTERNS

Daniel NIJLOVEANU, Victor-Dumitrel TIȚA, Nicolae BOLD, Toma Adrian DINU, Gina FÎNTÎNERU, Dragoș SMEDESCU, Adrian George PETICILĂ, Cosmina Andreea SMEDESCU, Alexandru FÎNTÎNERU, Costel MIHALAȘCU, Marian STOIAN......................... 705

79.DIGITAL INNOVATIONS IN CATTLE-BREEDING - OPPORTUNITIES AND CHALLENGES FOR SUSTAINABLE DEVELOPMENT OF THE RURAL AREAS IN BULGARIA

Marina NIKOLOVA, Tsvetan MARKOV, Iliyana KRYSTEVA, Elena YORDANOVA, Georgi ANGELOV 713

80.PROFITABILITY OF SUNFLOWER CULTURE ON A CAMBIC CHERNOZEM IN WESTERN ROMANIA

Adalbert OKROS, Casiana MIHUȚ, Alexandru RINOVETZ, Sorin CIULCA, Alexander DEGIANSKI... 727

81.ECONOMIC EFFICIENCY OF SUNFLOWER PRODUCTION DEPENDING ON TECHNOLOGY

Adalbert OKROS, Casiana MIHUȚ, Alexandru RINOVETZ................................ 741

82.LOCALIZATION OF TOURIST BUSINESS IN THE RURAL TERRITORY OF BULGARIA

Pavlin PAVLOV, Krasimira SLAVEVA, Marina NIKOLOVA, Mariana PETROVA 753

83.RESEARCH ON WEED CONTROL IN AN OAT CROP

Alexandru POPA, Cristinel Relu ZALĂ, Mihai GÎDEA... 763

84.RESEARCH ON THE EFFECTIVENESS OF SOME INSECTICIDES IN COMBATING PESTS IN AN OAT CROP

Alexandru POPA, Cristinel Relu ZALĂ, Rada ISTRATE, Mihai GÎDEA.. 769

85.INITIATING A BUSINESS FOR ESTABLISHING A MODERN QUINCE CULTIVATION IN SOUTHWESTERN ROMANIA – A PROFITABLE SOLUTION FOR THE FUTURE

Roxana-Gabriela POPA, Emil-Cătălin ȘCHIOPU, Violeta-Ramona CAZALBAȘU, Irina-Ramona PECINGINĂ................................. 777

86.NEW TRENDS IN THE GLOBAL AND EUROPEAN UNION RAW SILK TRADE IN THE PERIOD 2013-2022

Agatha POPESCU, Toma Adrian DINU, Elena STOIAN, Valentin ŞERBAN, Horia Nicolae CIOCAN.. 787

87.LAND USE FOR ANIMAL FEED IN ROMANIA IN THE PERIOD 2013-2022

Agatha POPESCU, Cristina TINDECHE, Alina MARCUTA, Liviu MARCUTA, Adelaida HONTUS, Mirela STANCIU...................................... 799

88.EVALUATION THROUGH NATURAL BONITATION WORK OF THE SOILS IN THE ZONE OF CONFLUENCE OF DOLJ AND MEHEDINTI COUNTIES, ROMANIA AND THE ESTIMATION OF CROP PLANT PRODUCTIONS SPECIFIC TO THE AREA

Cristian POPESCU, Mihaela BĂLAN... 809

89.THE SPECIFICS OF PUBLIC COMMUNICATION IN PROMOTING THE IMAGE OF AGRICULTURAL HOLDINGS

Florentina Mihaela PRUNA, Stefan BATRINA... 817

90.VARIANCES BETWEEN CONTRACT AND NON-CONTRACT FARMS IN THE USE OF SUSTAINABLE FARMING PRACTICES: CASE STUDY

Marioara RUSU, Mihai Alexandru CHIȚEA, Ioan Sebastian BRUMĂ............... 825

91.PROBLEM-SOLVING GROUNDS IN SMALL-SCALE FARMING IN WESTERN ROMANIAN AGRICULTURE

Cosmin SĂLĂȘAN, Laura ȘMULEAC, Vedran TOMIC, Doris FLOARES, Alexandra IBRIC, Raul PAŞCALĂU... 833

92.ECONOMIC EFFICIENCY OF MAIZE CROP IN SMALL FARMS IN THE SOUTH WEST OF OLT COUNTY, ROMANIA

Ioan Alexandru SARACIN, Aurel Liviu OLARU, Emilia CONSTANTINESCU, Ionel OBRETIN, Ion SARACIN............................ 841

93.THE ECONOMIC CENTERS IN BULGARIA - AN OPPORTUNITY TO DISCOVER ADDITIONAL POTENTIAL IN THE REGIONAL DEVELOPMENT OF RURAL TERRITORIES

Krasimira SLAVEVA, Sergey NAYDENOV, Marina NIKOLOVA, Pavlin PAVLOV.. 847

94.MARKET TRENDS IN THE EUROPEAN UNION BEVERAGE INDUSTRY

Dragoş SMEDESCU, Valentina TUDOR, Cosmina SMEDESCU, Razvan PANAIT, Alexandru FINTINERU... 857

95.COMPETITIVENESS OF MOLDOVAN AGRI-FOOD EXPORTS AT THE REGIONAL LEVEL IN THE CONTEXT OF CURRENT CRISES

Vasilii SOVCOVICI, Viorica LOPOTENCO, Liliana STAVER............................... 865

96.ONLINE LEARNING TECHNOLOGIES AND SUSTAINABLE RURAL DEVELOPMENT: AN EUROPEAN PERSPECTIVE

Marian STAN, Mihai CIOBOTEA.. 875

97.THE APPLICABILITY OF FARMS IN ROMANIA REGARDING THE ECO-SCHEME "PD-04 ENVIRONMENTALLY BENEFICIAL PRACTICES APPLICABLE IN ARABLE LAND"

Paula STOICEA, Adrian Gheorghe BĂȘA, Elena Mirela DUȘA.............................. 885

98.FINANCIAL DIAGNOSTICS OF BANKRUPTCY RISK IN AGRICULTURE: THE CASE OF BULGARIAN ENTERPRISES

Dimitrina STOYANCHEVA, Rumyana ANGELOVA... 893

99.FINANCIAL PERFORMANCE IN THE CROP PRODUCTION SECTOR IN THE ERA OF DIGITAL TRANSFORMATION

Dimitrina STOYANCHEVA, Dora DONCHEVA... 901

100.ANALYSIS OF COOPERATIVES IN THE AGRICULTURAL SECTOR AND MANUFACTURING INDUSTRY-PRODUCTIVITY AND GROWTH IN BULGARIA

Darina STOYANOVA, Nadezhda PETROVA... 909

101.REPUBLIC OF MOLDOVA'S CROP SECTOR- DEVELOPMENT TRENDS AND ASSESSMENT OF COMPETITIVENESS AT THE INTERNATIONAL LEVEL

Alexandru STRATAN, Lica ERHAN, Eugenia LUCASENCO................................. 915

102.CONCURRENCY AND DISTRIBUTION IN ECONOMIC MARKETS: MODEL DESCRIPTION

Dumitrel-Victor TIȚA, Nicolae BOLD, Daniel NIJLOVEANU, Doru Anastasiu POPESCU, Mirela-Georgiana MATEI, Claudia-Ionela TRUȘCĂ.. 925

103.IMPORTANCE OF SOFT-SKILLS FOR MANAGING VETERINARY PRACTICES

Zdravko TODOROV, Gergana BALIEVA.. 933

104.ASPECTS REGARDING SUSTAINABILITY AND FOOD SECURITY IN ROMANIA IN THE CONTEXT OF EUROPEAN POLICIES

Cătălin Răzvan VÎNTU, George UNGUREANU, Bianca Antonela UNGUREANU.. 941

105.ASSESSMENT AND IMPROVEMENT OF FOOD SUSTAINABILITY AND THE FACTORS INFLUENCING CONSUMPTION PATTERNS

Cătălin Răzvan VÎNTU, George UNGUREANU, Bianca Antonela UNGUREANU.. 953

106.ASSESSMENT OF THE POTENTIAL OF THE HUMAN FACTOR FOR SUSTAINABLE DEVELOPMENT OF THE RURAL TERRITORIES IN REPUBLIC OF BULGARIA

Elena YORDANOVA, Iliyana KRASTEVA, Marina NIKOLOVA, Georgi ANGELOV, Tsvetan MARKOV.. 963

107.SOCIO-ECONOMIC CHALLENGES IN THE TRANSITION TO A LOW-CARBON ECONOMY AT REGIONAL LEVEL IN BULGARIA

Violetka ZHELEVA, Nedelin MARKOV... 975

108.TOURISM SECTOR IN BULGARIA - POST-PANDEMIC RECOVERY OR DECLINE

Violetka ZHELEVA, Dora DONCHEVA, Emil MUTAFOV................................... 983

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PRODUCTION POTENTIAL OF SOME CORN GENOTYPES - RESOURCES FOR AGRICULTURAL PRACTICE AND BREEDING PROGRAMS

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Abstract

The study evaluated 80 corn genotypes based on grain production under comparative crop conditions. The research took place within the ARSD Lovrin, Romania. The culture of the 80 corn genotypes was carried out in non-irrigated conditions. The hybrids were numbered in the form C01 to C80 (C – corn; 01 to 80 – genotype number). The height of the corn plants (PH) varied between PH = 2.05 – 2.71±0.02 m. The height of corn ear insertion (EIH) varied between EIH = 0.74 – 1.25±0.01 m. The weight of one thousand grains (TGW) varied between TGW = 230.10 – 345.20±2.95 g. The hectoliter weight (HW) varied between HW = 75.20 – 84.45±0.21 kg. Grain production (Y) varied between Y = 5,027.00 – 10,169.00±120.29 kg ha^{-1}. Under the aspect of the variability of the studied parameters values, based on the coefficient of variation (CV), a high value of variation was recorded in the case of production (CV=14.55874), followed by the variability within the EIH parameter (CV=11.14396), the TGW parameter (CV= 9.05588), PH (CV=5.67716) and HW (CV=2.39561). The multivariate analysis (PCA) led to the distribution diagram and principal component (PC1, PC2) explained the variance (PC1 = 44.857%; PC2 = 21.495%). The cluster analysis (CA) led to the obtaining of the dendrogram of the grouping of the maize genotypes in relation to the main parameters. The variation of production in relation to plants parameters (PH, EIH), and corn grains quality (TGW, HW) was described mathematically and in the form of graphic models, under statistical safety conditions.

Key words: *breeding programs, corn genotypes, grain production, multivariate analysis, productivity elements*

INTRODUCTION

Corn is one of the main crop plants and presents a rich diversity and genetic variability [5, 21, 23].
Corn collections were studied in different geographical basins, and were analyzed in terms of the diversity and conservation of genetic resources, breeding programs, but also the potential in relation to agricultural systems [2, 27].
Corn genetic resources have been cultivated and studied in relation to climatic conditions, soil conditions, different agricultural systems, culture technologies, stress factors, resistance to diseases and pests, etc. [4].
Different corn genotypes have been studied in terms of metabolic adaptations in relation to stress and nutrient imbalances, such as carbon, nitrogen and phosphorus [19].
The genotype to environment interaction was studied in corn varieties, in order to identify valuable genetic resources for breeding programs [3, 11].
The adaptability, stability and variability of corn genotypes (hybrid forms) was analyzed and studied in order to evaluate the manner of expression of genetic resources in relation to ecological factors, to select valuable resources in relation to the objectives of breeding programs [14, 18, 22, 25, 30].
The productivity of different maize genotypes, associated with phenotypic elements, were studied in relation to various environmental conditions and technology for yield quantification [9, 15, 17, 20].
The protein content is a quality index with high importance in the production of corn grains, and it has been studied in relation to different genetic resources and culture conditions [8, 10, 16, 26].
The oil content is also a quality index of corn

grains, studied in relation to genetic resources and environmental and technological conditions [7, 31].

The aim of the study was the comparative analysis of 80 corn genotypes, and their characterization based on plant biometric parameters, production and quality indices of corn grains, classification of corn genotypes, and formulation of models of production variation in relation to plant biometric indices.

MATERIALS AND METHODS

The experiments and the comparative study of corn hybrids were done within ARDS Lovrin. 80 genotypes of corn were cultivated, in non-irrigated cultivation system, chernozem soil, weakly glazed. The soil tillages were in the classic system. Sowing was done at the beginning of April. Complex fertilizer (15:15:15) and ammonium nitrate (250, and 200 kg ha^{-1} respectively) were applied. Cultivation was maintained by weeding. The climatic conditions for the year 2023 are presented in Table 1.

The comparative analysis of the maize genotypes was made on the basis of plant biometric parameters, production, grain quality indices. Plant height (PH, m) and ear insertion height (EIH, m) were determined. At physiological maturity, corn plants and ears samples were harvested for each separate hybrid.

Table 1. Climatic conditions, year 2023

Climatic elements		Monthly period, year 2023												
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Avg / Sum
Rainfall (mm)	Monthly value	59	43.8	34.2	42	109.2	51.4	52.8	63.2	79	23.2	63.8	49.4	671
	Multiannual monthly average	32.7	29.6	32.3	42.7	57.3	68.1	55.8	32.3	42.4	40.5	48	39.7	521.4
	Deviation	26.3	14.2	1.9	-0.7	51.9	-16.7	-3	30.9	36.6	-17.3	15.8	9.7	149.6
Temperature (mm)	Monthly average	4.45	2.66	7.77	9.86	16.69	20.43	24.26	23.95	21.07	15.28	6.71	3.41	13.0
	Multiannual monthly average	-1.1	0.9	5.25	10.7	16.3	19.8	22.2	21.7	16.8	11.1	5.5	1.1	10.9
	Deviation	5.55	1.76	2.52	-0.84	0.39	0.63	2.06	2.25	4.27	4.18	1.21	2.31	2.2

Source: Original data, ARDS Lovrin Weather Station.

The production (Y, kg ha^{-1}) was determined. The weight of one thousand grains (TGW, g) and the hectoliter weight (HW, kg) were determined.

As grain quality indices, the protein content of corn grains (Pro, %) and the oil content of corn grains (Oil, %) were determined.

The experimental results obtained in the comparative study of the 80 maize genotypes were processed and analyzed mathematically and statistically in an adequate way [6, 29].

RESULTS AND DISCUSSIONS

The corn hybrids tested, under the conditions of a chernozem type soil, non-irrigated crop system, behaved differently, depending on the genetic potential of each one. Corn is a crop intended for the production of grains, but also for fodder crops, or industrialization (protein, oil).

In relation to the interest for this crop plant, plant biometric parameters (PH, EIH), productivity, production and quality elements (Y, HW, TGW, Pro, Oil) were evaluated, Table 2.

The height of the plants (PH, m) varied between PH = 2.05 – 2.71±0.02 m, and the insertion height of the ears (EIH, m) varied between EIH = 0.74 – 1.25±0.01 m.

These parameters show an interesting relationship with the production of biomass, tall plants generating a higher biomass production, useful aspects for hybrids intended for fodder production.

Table 2. The values of the parameters studied in the tested corn genotypes

Cgn	PH	EIH	Y	HW	TGW	Pro	Oil	Cgn	PH	EIH	Y	HW	TGW	Pro	Oil
	(m)	(m)	(kg ha^{-1})	(kg)	(g)	(%)	(%)		(m)	(m)	(kg ha^{-1})	(kg)	(g)	(%)	(%)
C01	2.64	1.17	8,356	77.25	332.35	9.35	5.65	C41	2.71	1.25	6,842	81.75	294.65	9.60	6.10
C02	2.41	0.74	7,929	79.10	320.40	8.80	5.70	C42	2.71	1.15	7,748	81.90	258.20	9.55	5.80
C03	2.49	0.77	7,984	78.85	339.20	9.55	5.65	C43	2.57	1.03	8,767	79.55	285.45	8.75	5.40
C04	2.45	0.98	7,737	79.35	319.75	9.15	5.50	C44	2.49	1.19	7,388	79.40	307.60	9.35	5.90
C05	2.33	0.89	8,326	78.90	304.60	8.40	5.60	C45	2.30	0.97	5,783	75.20	254.40	9.05	5.80
C06	2.41	0.97	8,291	78.95	307.75	8.70	5.55	C46	2.23	0.78	6,207	80.55	230.10	9.50	5.80
C07	2.52	1.13	8,276	80.85	280.80	8.85	5.65	C47	2.41	1.02	7,929	76.05	293.70	8.90	5.90
C08	2.68	1.09	7,838	77.80	272.80	9.40	5.50	C48	2.41	0.91	8,502	81.65	312.40	8.60	5.90
C09	2.49	0.78	6,560	82.95	301.60	9.30	5.85	C49	2.48	0.83	7,301	75.90	301.95	8.65	5.80
C10	2.36	1.00	6,070	81.85	315.10	9.45	6.00	C50	2.44	0.99	8,823	76.40	325.70	8.85	5.65
C11	2.58	0.81	6,441	82.25	289.70	9.80	5.55	C51	2.41	0.90	7,002	81.10	278.40	9.85	5.95
C12	2.30	0.98	5,027	82.10	265.75	9.90	6.00	C52	2.52	0.98	8,837	82.20	314.85	9.45	6.10
C13	2.33	0.98	6,597	82.45	266.35	9.70	6.40	C53	2.68	0.98	8,908	77.50	319.40	9.40	5.65
C14	2.37	0.91	6,081	80.40	299.15	10.50	6.25	C54	2.62	0.90	7,410	82.00	256.25	10.55	6.20
C15	2.46	0.78	7,012	81.40	244.20	9.55	6.10	C55	2.43	1.03	6,725	80.75	295.05	9.50	5.70
C16	2.54	0.93	7,030	81.85	296.65	9.55	5.85	C56	2.22	0.96	6,737	82.45	291.80	9.50	5.75
C17	2.63	0.97	7,386	80.95	289.30	9.55	5.85	C57	2.24	0.84	6,649	81.95	272.10	9.45	6.00
C18	2.68	1.09	8,770	79.70	309.55	9.35	6.15	C58	2.33	0.95	8,498	80.80	286.05	9.15	5.50
C19	2.34	0.95	8,586	81.40	323.45	9.40	5.95	C59	2.45	1.07	6,709	80.10	241.75	9.10	5.60
C20	2.46	1.02	7,852	77.25	313.10	8.65	5.75	C60	2.36	0.96	10,169	77.05	308.35	8.10	5.45
C21	2.64	0.99	8,711	79.70	329.70	9.55	5.65	C61	2.43	1.00	7,682	80.40	274.85	11.00	6.10
C22	2.39	0.87	8,905	80.25	324.90	9.25	5.60	C62	2.56	1.04	8,448	79.35	330.05	10.00	5.55
C23	2.43	0.86	8,045	78.85	345.20	8.55	5.70	C63	2.59	1.12	6,725	82.25	282.15	9.80	5.65
C24	2.44	0.97	7,910	80.30	285.80	9.05	5.70	C64	2.50	1.23	7,411	77.60	273.15	9.20	5.65
C25	2.20	0.95	5,767	82.05	308.30	9.40	5.65	C65	2.21	0.90	7,201	81.75	285.20	9.90	5.95
C26	2.45	0.93	8,270	80.45	302.00	8.95	5.90	C66	2.49	1.01	7,559	78.40	236.20	9.25	5.65
C27	2.42	0.82	7,696	77.65	312.30	9.00	5.50	C67	2.57	0.97	9,826	80.55	291.30	10.00	5.50
C28	2.45	0.89	7,594	79.35	303.50	9.20	5.75	C68	2.41	1.12	9,043	79.15	283.10	9.45	5.75
C29	2.25	0.86	6,225	79.60	262.25	9.25	6.10	C69	2.51	1.11	8,053	80.20	315.75	10.25	5.85
C30	2.31	0.89	6,505	82.00	302.65	9.75	5.40	C70	2.05	0.92	5,694	81.20	258.80	9.45	5.85
C31	2.35	0.90	7,051	80.00	313.30	9.55	5.55	C71	2.68	1.00	7,581	79.65	295.05	9.10	5.65
C32	2.32	0.79	5,881	80.15	243.60	10.35	6.30	C72	2.48	0.85	7,873	81.50	283.65	10.35	5.85
C33	2.19	0.79	5,438	79.90	265.75	9.75	6.10	C73	2.31	0.98	5,152	80.20	277.15	10.00	6.20
C34	2.49	1.03	6,951	79.65	307.75	9.55	5.90	C74	2.49	0.90	6,532	82.50	249.50	10.40	6.25
C35	2.33	0.89	7,731	78.40	306.95	9.00	5.50	C75	2.34	0.89	6,879	82.55	245.65	9.95	6.70
C36	2.33	0.97	6,931	77.85	298.85	9.30	5.65	C76	2.42	0.98	6,373	81.60	256.30	10.80	6.25
C37	2.49	1.00	6,974	79.15	313.90	8.65	5.65	C77	2.36	0.85	6,090	84.45	283.50	10.95	6.10
C38	2.30	0.95	6,865	78.20	265.80	8.10	5.75	C78	2.36	1.01	8,306	78.55	295.45	9.45	5.70
C39	2.38	0.97	5,856	81.70	309.40	10.80	6.00	C79	2.23	0.95	6,445	83.25	276.95	9.20	6.05
C40	2.59	1.01	8,890	78.00	336.20	8.30	5.60	C80	2.23	0.95	7,069	83.55	265.70	9.85	6.00

Source: Original data from the experiment; Cgn – corn genotype number.

At the same time, larger genotypes also have a larger number of internodes and leaves, so conditions for a more intensive conversion of solar energy through photosynthesis, and a higher grain production.

Grain production (Y, kg ha^{-1}) varied between

Y = 5,027.00 – 10,169.00±120.29 kg ha^{-1}. The hectoliter weight (HW) varied between HW = 75.20 – 84.45±0.21 kg hl^{-1}. The weight of 1000 grains (TGW) varied between TGW = 230.10 – 345.20±2.95 g. The protein content (Pro) varied between Pro = 8.10 – 11.00±0.007%. The oil content (Oil) varied between Oil = 5.40 – 6.70± 0.03%.

The ANOVA Test confirmed the presence of variance and statistical reliability for the experimental data recorded, regarding the corn hybrids tested (Table 3).

Table 3. ANOVA test values

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3.68E+09	6	6.14E+08	3711.3	0	3.8060
Within Groups	91507636	553	165474.9			
Total	3.78E+09	559				

Source: Original data generated by calculation.

The level of correlation between production, quality indices and biometric parameters of the plants was analyzed. Positive correlation was recorded between production (Y) and plant height (PH), $r = 0.475^{***}$, between Y and TGW, $r = 0.502^{***}$.

Negative correlation was recorded between production (Y) and protein content (Pro), $r = -0.415^{***}$, respectively between production (Y) and oil content (Oil), $r = -0.468^{***}$.

Positive correlation was recorded between the protein content (Pro) and the oil content (Oil), $r = 0.538^{***}$, between the protein content (Pro) and the hectoliter weight (HW), $r = 0.558^{***}$, respectively between the content of oil (Oil) and hectoliter weight (HW), $r = 0.46^{***}$.

The values of the correlation coefficient, resulting from the analysis, are presented in Figure 1.

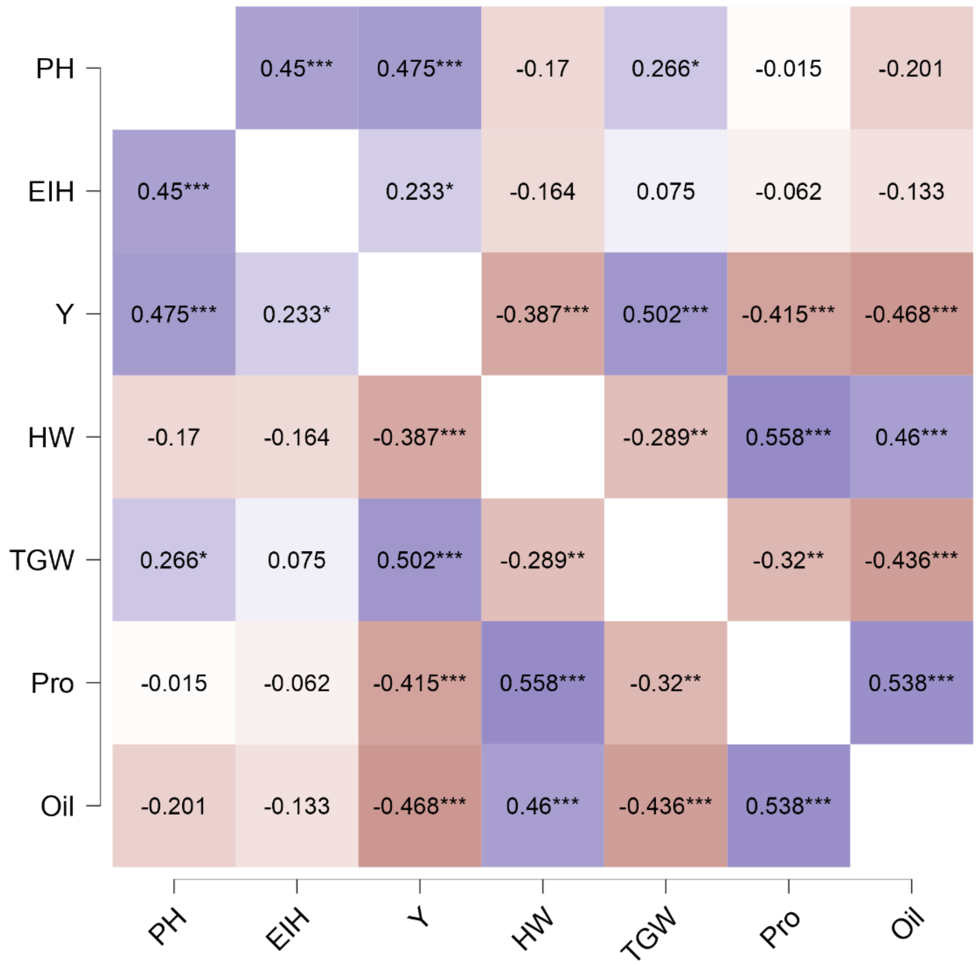

Fig. 1. Graphical representation of the correlation level in the analysis of the corn genotypes studied
Source: Original figure.

According to PCA, the diagram in Figure 2 resulted, in which the corn hybrids studied were distributed according to the values of the analyzed parameters. PC1 explained 44.857% of variance, and PC2 explained 21.485% of variance.

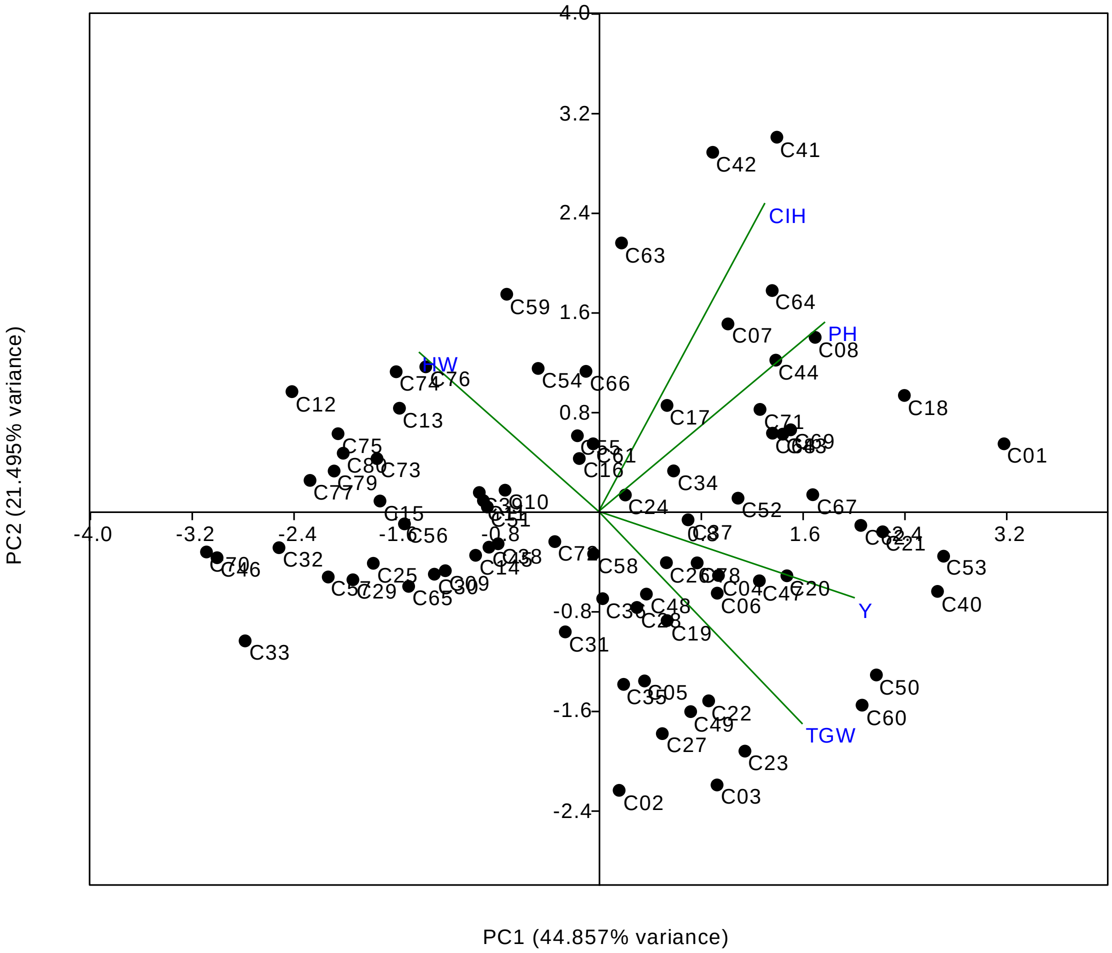

Fig. 2. PCA diagram of the distribution of corn genotypes
Source: Original figure.

The cluster analysis, in relation to the main production parameters (Y, TGW, HW) led to the dendrogram in Figure 3 (Coph corr. = 0.741). The grouping of maize genotypes into two distinct clusters was found. A cluster included genotypes C60 and C67 (marked in red) with the best production potential. The other hybrids were grouped in a cluster with several sub-clusters, based on similarity in relation to production potential.
In relation to the protein content (Pro), the Cluster Analysis led to the dendrogram in Figure 4 (Coph.corr = 0.796). The corn genotypes were grouped in two distinct clusters, with several sub-clusters each. The corn genotypes C61 and C77 presented the highest protein content and other genotypes were also included in the respective sub-cluster, based on similarity.
In relation to the oil content (Oil), the Cluster Analysis led to the dendrogram in Figure 5 (Coph.corr = 0.765). The C75 corn genotypes, positioned separately in the dendrogram, presented the highest oil content.
Within each sub-cluster in which there are the genotypes with the best results for the analyzed parameters, there are also other valuable genotypes for the respective character, which can constitute genetic sources for the corn improvement process. Also, the respective genotypes can be finalized through the improvement process as hybrids for agricultural production, with the destination for the crop for productive purposes.

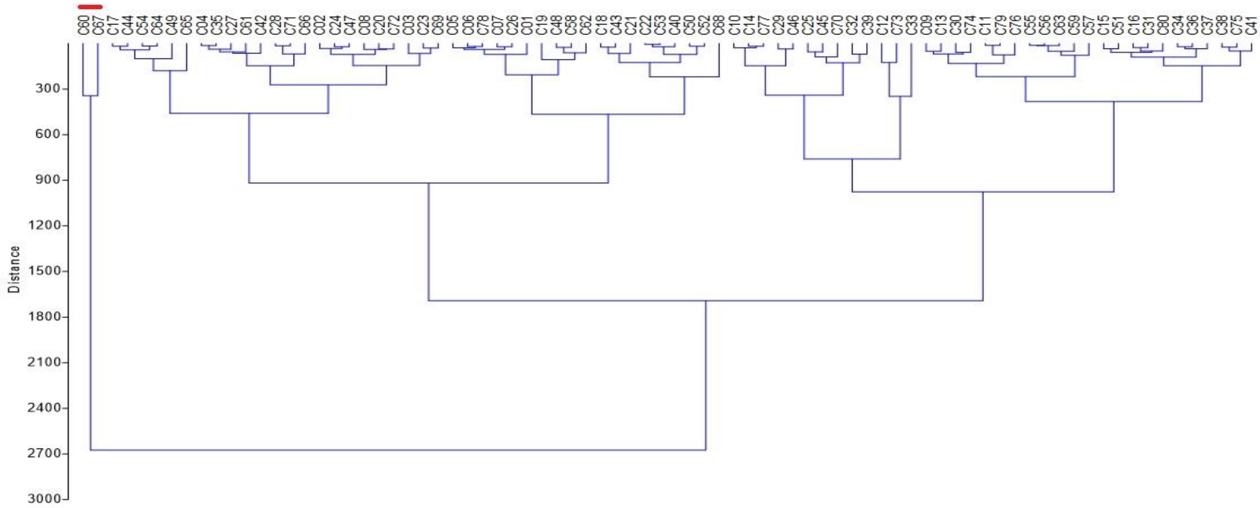

Fig. 3. Dendrogram for classification of corn genotypes based on Euclidean distances, in relation to Y, TGW, HW
Source: Original figure.

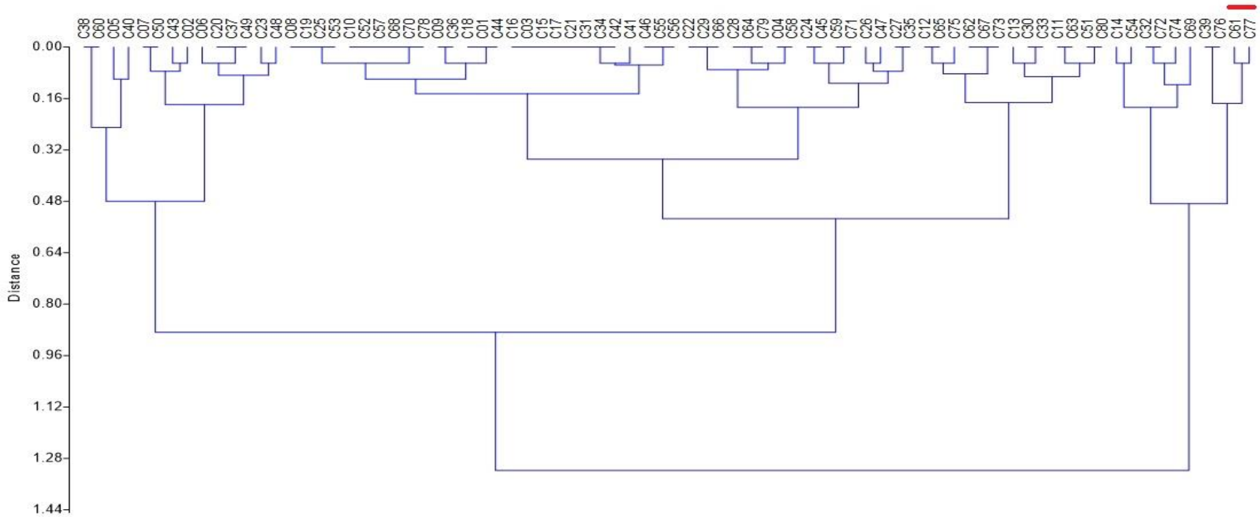

Fig. 4. Dendrogram for the classification of corn genotypes based on Euclidean distances, in relation to Pro
Source: Original figure.

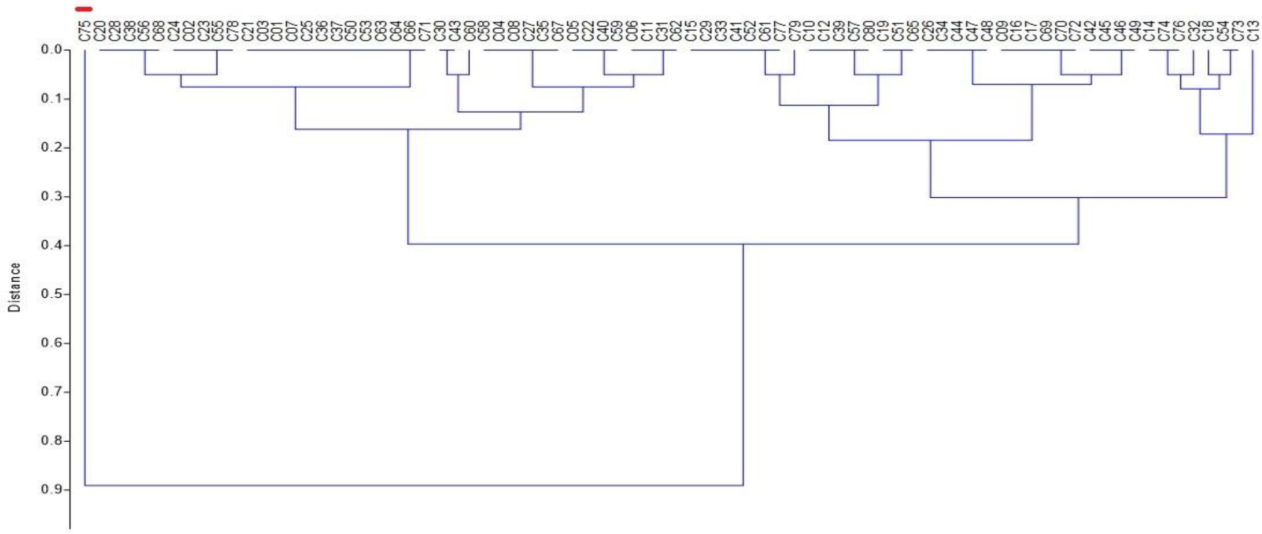

Fig. 5. Dendrogram for the classification of corn genotypes based on Euclidean distances, in relation to Oil
Source: Original figure.

The variation of grain production (Y, kg ha^{-1}) was analyzed in relation to plant biometric parameters, respectively plant height (PH) and ear insertion height (EIH). The result was equation (1), which described the Y variation in relation to PH and EIH parameters under conditions of Multiple R = 0.536, F = 5.9752, p<0.001. The graphic representation of the Y variation in relation to PH (x-axis) and EIH (y-axis) is presented in Figure 6, respectively Figure 7.

$$Y = ax^2 + by^2 + cx + dy + exy + f \qquad (1)$$

where: Y – grains production (kg ha^{-1}); x – plant height (PH, m); y – ear insertion height (EIH, m);
a, b, c, d, e, f – coefficients of the equation (1);
a= -7,824.1109672;
b= -13,108.3911987;
c= 38,232.1022416;
d= 16,608.8083044;
e= 3,779.6484971;
f= -51,712.372054.

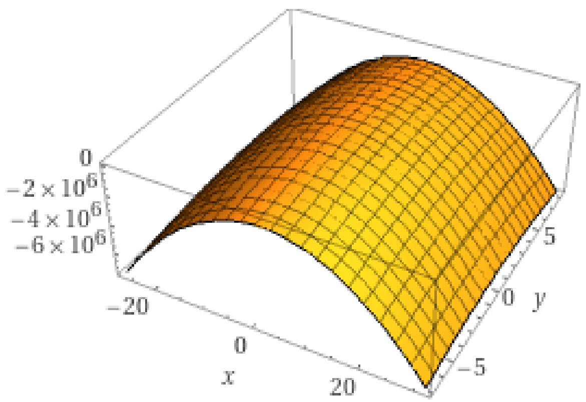

Fig. 6. 3D model of Y variation in relation to PH (x-axis) and EIH (y-axis)
Source: Original figure.

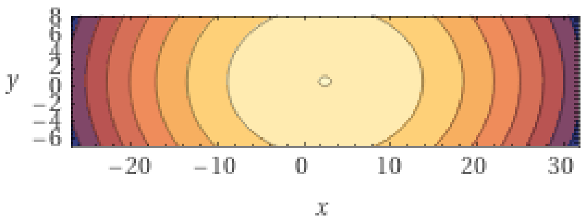

Fig. 7. Model in isoquants format of Y variation in relation to PH (x-axis) and EIH (y-axis)
Source: Original figure.

The variation of grain production (Y, kg ha^{-1}) in relation to HW and TGW was described by equation (2), under conditions of Multiple R = 0.597, F = 8.2076, p<0.001. The graphic representation of the Y variation in relation to HW (x-axis) and TGW (y-axis) is presented in Figure 8, respectively Figure 9.

$$Y = ax^2 + by^2 + cx + dy + exy + f \qquad (2)$$

where: Y – grains production (kg ha^{-1}); x – hectoliter weight (HW, kg); y – mass of 1,000 grains (TGW, g);
a, b, c, d, e, f – coefficients of the equation (2);
a= -36.5281783;
b= -0.0549752;
c= 6,734.74360966;
d= 340.9586975;
e= -3.6687497;
f= -306,626.4315039.

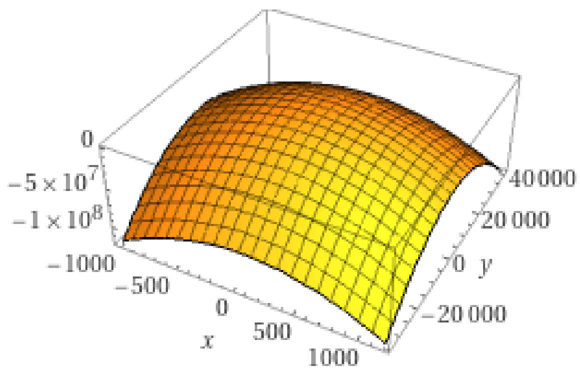

Fig. 8. 3D model of Y variation in relation to HW (x-axis) and TGW (y-axis)
Source: Original figure.

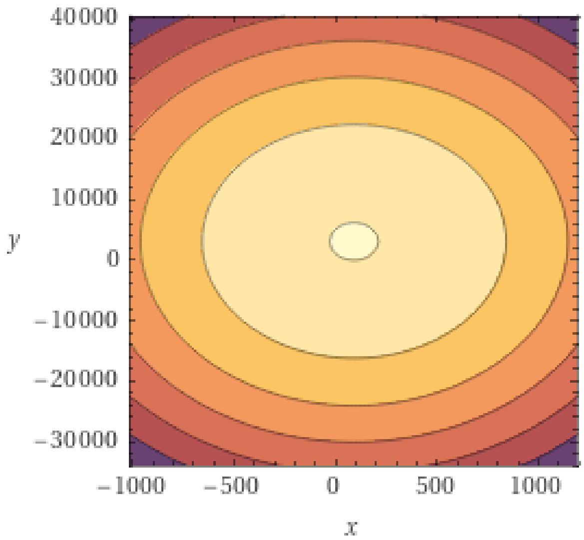

Fig. 9. Model in isoquants format of Y variation in relation to HW (x-axis) and TGW (y-axis)
Source: Original figure.

The variability of the parameters analyzed in the corn hybrids studied was described based on the coefficient of variation values. In the study conditions, the coefficient of variation presented CV values = 14.55874 in the case of production (Y); CV = 11.14396 in the case of

EIH parameter; CV = 9.05588 in the case of TGW parameter; CV = 5.67716 in the case of PH parameter; CV = 2.39561 in the case of HW parameter.

The coefficient of variation has shown interest in several studies regarding the classification of some culture areas in relation to different climates [28], the description of some crops through imaging analysis [1, 13]. Tokatlidis et al. (2023) [24] used the coefficient of variation (CV) and the homeostasis index (HI) to identify valuable lines for descent. Magar et al. (2021) [12] used the coefficient of variation to evaluate the phenotypic and genotypic variation in ten maize genotypes, as selection indices for the purpose of improving maize productivity.

The cluster analysis (CA) in relation to production elements (Y) and quality (Pro, Oil) led to specific dendrograms in which the maize genotypes were grouped based on similarity in relation to the considered parameters. This made it possible to highlight the valuable genotypes (genotypes C60 and C67 in the case of Y, TGW, HW parameters; genotypes C61, C67 in the case of protein content, Pro; genotype C75 in the case of oil content, Oil) and the clusters that include the most good genotypes. The information is useful for the selection of genotypes in future breeding programs, but also for agricultural practice.

Langyan et al. (2022) [8] reported the variation in the nutritional content of protein, and fat, along with other nutritional principles, in sources of corn germplasm, and identified valuable genotypes for breeding programs.

Similar studies were carried out by Lu et al. (2022) [10] and Varalakshmi et al. (2023) [26], within genetic studies with molecular markers. The variation of protein content in relation to stress factors was reported by Ramazan et al. (2023) [16], and numerous other studies have analyzed protein content in relation to environmental and technological factors as an interaction with cultivated maize genotypes.

From the analysis of the values of the coefficients of equation (1) and from the graphic analysis of the variation of Y production in relation to PH and EIH, figures 4 and 5, it was found the much stronger influence of the height of the plants (PH, x-axis), compared to the influence of the height of corn ear insertion height (EIH, y-axis).

CONCLUSIONS

The study carried out on the 80 maize genotypes, under the same culture conditions, facilitated the expression of the genetic potential of each hybrid, highlighted by plant biometric parameters (PH, EIH), by production (Y), grain quality indices (TGW , HW) and nutritional quality indices (Pro, Oil).

The cluster analysis facilitated the classification of the best genotypes for production (C60, C67), for protein content (C61, C77) and for oil content (C75). These results facilitate the selection of valuable genotypes for corn breeding programs, in relation to the destination of the hybrids - production, or nitritive principles.

The PCA diagram highlighted the distribution of the genotypes in relation to determined parameters, data that completes the findings of the multivariate analyzes about the collection of analyzed genotypes.

The level of correlations identified between the analyzed parameters facilitates a knowledge of the mode of interdependence (positive or negative) useful in the improvement process, as well as for agricultural practice.

The models resulting from the regression analysis, described with high precision the variation of the production in relation to the biometric parameters of the plants, useful aspects both for the improvement process and for agricultural practice.

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INTERNATİONAL MİGRATİON AND AGRİCULTURAL SUSTAİNABİLİTY İN THE ÇUKUROVA REGİON: DETAİLED ANALYSİS OF SOCİO-ECONOMİC STRUCTURE AND MİGRATİON INTERACTİONS

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Abstract

This research aims to examine international migration movements and their effects on agricultural sustainability and the socio-economic structure in Turkey's Çukurova Region. The primary goal of the study is to provide strategic recommendations for the development of agricultural policies in the region by conducting a detailed analysis of the impacts of migration movements on agricultural sustainability. The first phase of the research was to investigate the general structure of international migration movements to the Çukurova Region and their socio-economic effects. In the second phase, data collected through surveys conducted with 14 family heads selected from the three most migration-receiving districts that represent the region in January and March 2024 was used. These surveys covered topics such as the migrants' countries of origin, family structures, capital transfers, sectors they work in, socio-economic statuses, and education levels. The collected data was evaluated using statistical and thematic analysis techniques, and these analyses provided a deep understanding of the dynamics of migration and their impacts on the agricultural sector. Findings reveal significant demographic shifts, with economic motivations driving migration decisions. The study points out the importance of understanding migrants' economic circumstances and cultural dynamics in shaping integration policies. Recommendations are proposed to facilitate economic integration and foster cultural harmony, contributing to a deeper understanding of migration's impact on agricultural sustainability.

Key words: *Çukurova Region, international migration, agricultural sustainability, socio-economic analysis, survey study, impacts of migration*

INTRODUCTION

Migration involves the movement of people from one place to another, with a change in residence. It can be voluntary or forced, taking two primary forms: internal, within a country's borders, and external, from one country to another [31]. Migration signifies a change in location, driven by diverse motivations. Individuals may move permanently or temporarily, engaging in seasonal migration with periodic shifts between locations. The duration of migration sparks debates on categorizing short-term relocations for education or work as migration [18]. Distinctions also arise in terms of space, distance, and cultural factors, transcending physical proximity. For example, a permanent move from an impoverished urban area to a higher socio-economic neighborhood is considered migration, emphasizing the cultural dimension. Ultimately, migration is a population movement influenced by social, economic, political, environmental, and personal factors [26].

International migration significantly shapes agricultural sustainability worldwide, impacting labor dynamics, remittances, knowledge transfer, climate adaptation, food production, and rural development. This migration leads to the movement of skilled and unskilled labor, profoundly affecting the agricultural workforce [25]. Migrant workers contribute diverse skills, knowledge, and work ethics to agricultural operations, enhancing productivity and efficiency. Migration often involves the movement of labor from rural to urban areas or across borders, with migrant workers playing a substantial role in the agricultural sector of host countries, such as the United States relying on Mexican labor for seasonal tasks

[26]. Furthermore, migrants bring unique cultural perspectives and traditional agricultural practices, fostering innovation in farming techniques and introducing diverse crops, contributing to agricultural biodiversity [17]. The exchange of agricultural knowledge and technologies across borders is facilitated by migration. For example, Indian migrants returning from Gulf countries bring back skills and technologies that enhance agricultural practices in their home villages, contributing to increased productivity and sustainability [29]. Similarly, the transfer of organic farming expertise from European countries to emerging economies in Africa is facilitated by migration [21]. Moreover, remittances from international migrants play a crucial role in supporting agricultural sustainability in their home countries. Migrant families invest in agricultural projects, such as improved irrigation systems or sustainable farming practices, thereby enhancing local food security [19]. In countries like Mexico and the Philippines, remittances from migrants working abroad often fund agricultural investments [11]. Additionally, climate change influences migration patterns, disproportionately affecting agricultural communities. In countries like Bangladesh, where climate change exacerbates agricultural challenges, migration becomes a strategy for adaptation. Migrants may seek livelihoods in urban areas or move to more resilient agricultural regions [24, 27].

In the context of Turkey, situated at the crossroads of Europe and Asia, Turkey grapples with the dual challenge of effectively managing migration while ensuring the sustainability of its agricultural sector. The country has emerged as a significant destination for international migrants, predominantly from neighboring countries, who actively contribute to various agricultural activities, such as seasonal harvesting and cultivation [22]. Notably, regions like Hatay, near the Syrian border, and İzmir, a major agricultural hub, have experienced substantial migrant labor influx, with Syrian migrants crucial for sustaining agricultural activities in Hatay, while İzmir attracts international labor for diverse agricultural endeavors, including olive cultivation and viticulture [24]. The relationship between migration and shifts in agricultural practices in Turkey is evident, with rural-to-urban migration driven by factors like limited employment opportunities and aspirations for an improved quality of life leading to a diminishing agricultural workforce. This demographic shift poses challenges to cultivation practices, thereby threatening the sustainability of small-scale farming [27, 15]. Migration also presents hurdles for agricultural sustainability in sending countries, where the loss of skilled labor hampers local development. Internal and international migration often results in shifts in the agricultural labor force, leading to potential labor shortages that impact farming communities and the agricultural sector at large [1, 20, 12]. The reliance on migrant laborers, especially in seasonal agricultural activities, introduces arguments related to labor rights, living conditions, and social integration. Ensuring the well-being of migrant agricultural workers is vital for the sector's sustainability [35]. Rural-to-urban migration in regions like Mersin has contributed to an aging agricultural workforce, posing challenges for maintaining productivity and sustainable farming practices. Additionally, migration can lead to the abandonment of agricultural land as young individuals seek non-agricultural employment opportunities in urban areas, presenting challenges like those faced by Konya, where the agricultural workforce is aging due to the migration of younger individuals to urban areas for non-agricultural employment [9, 4, 13].

Concerning the case of the Çukurova Region in Turkey, it has experienced a significant influx of international migrants, challenging the delicate equilibrium between sustainable agriculture and demographic moves, leading to noteworthy alterations in the region's demographic landscape and influencing the labor force composition in agriculture [2]. The heightened demand for migrant labor has implications for the sustainable management of agricultural resources, introducing complexities in workforce dynamics related to wages, working conditions, and social integration. Achieving a balance that ensures the well-being of migrants while sustaining agricultural productivity is a notable challenge [5, 16]. Moreover, changes in land use patterns and agricultural practices resulting from international migration may have environmental repercussions. The adoption of different farming techniques and the expansion of agricultural areas to accommodate the growing population can impact the region's ecological balance [3].

Continuing as a significant global phenomenon, migration involves individuals relocating to new settlements, bringing diverse life experiences across social, economic, and cultural realms. Of particular importance is the economic status of immigrants, which holds significance for both the migrants themselves and the host countries. The integration of immigrants stands as a pivotal concern, impacting not only individuals but also the cohesion and prosperity of destination countries and societies. Immigrants' income levels play a crucial role in fostering social inclusion, driving economic growth, and maintaining social stability. Hence, prioritizing the understanding and facilitation of immigrants' economic integration is imperative for enhancing overall social welfare.

This study aims to explore the determinants influencing immigrants' annual income levels, thereby enhancing our comprehension of their economic assimilation. By grasping the implications of immigrants' economic status, policymakers can effectively devise immigration strategies, thereby promoting immigrants' economic well-being. This research was conducted to understand the factors affecting the income levels of immigrants and to contribute to the development of immigration policies. Additionally, help us better understand the impacts on the economic integration of immigrants and the policy interventions that can be made in this area.

MATERIALS AND METHODS

The primary data for this research were gathered through 14 face-to-face interviews with individuals who had immigrated to Adana. These interviews, focusing on aspects such as the migration process, motivations, and adaptation in settlements, constitute the core of our investigation. Despite efforts, some participants were reticent, and logistical constraints limited the number of surveys conducted. To supplement our primary data, we conducted in-depth interviews with local migration experts, administrators, and immigrants. Furthermore, we incorporated secondary data from sources like the Turkish Statistical Institute (TUIK) [34]. and existing migration research. Detailed analyses of survey data from January and February 2024 were conducted using techniques such as cross-tabulation, statistical analysis, and regression analysis. These methods allowed us to delve into the challenges faced by migrants, their integration into local society, and the broader economic, social, and cultural impacts of migration.

RESULTS AND DISCUSSIONS

The results shows that the age distribution of the survey participants, the number of people between the ages of 19-29 is 6 and constitutes 42.86% of the participants. The number of people aged 30-39 is 8 and constitutes 57.14% of the participants. There are no participants in the 40-49 age range. This finding is similar to [31]. Most of the survey participants are in the 30-39 age range.92.86% of the respondents are male and 7.14% are female. The education level distribution, we see that 50% of the survey participants are primary school graduates and 50% are secondary school graduates. This indicates that the participants mostly had a basic level of education. It may have an impact on factors such as education level, employment opportunities after migration, economic situation, and integration process. The research findings or literature discussing the impact of education levels on migration outcomes, is collaborated [14]. They showed that the relationship between education and migration outcomes, including labor market integration and economic assimilation. Addionnally, results by [25]. This overview provides insights into how education affects various outcomes, including labor market outcomes and social integration. Also, collaborated the findings of [10, 7] it was pointed out the role of education in migration decisions and outcomes, as well as the impact of migration on educational attainment and social integration. Most participants (71.43%) were not employed at the time of participating in the survey. This may indicate that unemployment and lack of certain job skills may be common among immigrants. However, a small percentage (21.43%) work as laborers and fewer (7.14%) work in unskilled jobs. These data can help us understand the challenges of immigrants' integration into the labor market. The reasons for migration are examined, it is seen that many of the participants (42.86%) migrated for economic reasons. In addition, in addition to economic reasons, family or personal reasons (21.43%) also appear to be effective in migration decisions. This diversity of reasons for migration allows us to understand migrants' motivations and post-migration experiences. The places of migration are examined, it is seen that most of the participants (57.14%) migrated to Adana. Yüreğir is another important region of migration and 28.57% of the participants migrated to this region. These data help us understand which regions migration is concentrated in and evaluate the regional impacts of migration.

Most participants (71.43%) state that they worked as workers in the agricultural sector before migration. Those working in the agricultural sector are often those who migrate from villages or rural areas, and this is an important component of agricultural migration.

In addition, some of the participants (21.43%) were working in unskilled jobs and a small part (7.14%) were tradesmen. This finding is similar to [28] who highlighted the prevalence of unskilled labor migration and the presence of skilled workers such as tradesmen in migration streams. All participants (100.00%) state that they worked as workers in the agricultural sector after migration. This shows that employment and professional change are limited after migration, and the agricultural sector is the main source of employment for immigrants. These data provide important information about immigrants' professional background, work experience, and post-migration employment status. It can also deepen our understanding of immigrants' economic integration and their position in the labor market. All respondents (100.00%) indicate that they do not currently receive any support from the old region. This shows that immigrants are trying to stand on their own feet in new settlements and do not tend to use their networks in the old region. Most of the respondents (85.71%) state that they do not provide aid to the places they immigrated to. This may indicate that migrants often focus on their home settlement for economic or social reasons and allocate limited resources for their return to their former settlement. The result is similarly to finding found by [32]. Most respondents (64.29%) state that their current job is related to their pre-migration profession. This shows that immigrants often continue to work in the same sector and that occupational continuity is important in post-migration employment.

Most respondents (64.29%) state that they are considering starting their own business in their new settlement. This indicates that immigrants seek economic independence and stability by starting their own businesses. While 42.86% of the survey participants stated that they worked with insurance, 57.14% stated that they worked without insurance. The low rate of insured employment among immigrants may indicate issues such as lack of economic stability and social security.

Additionally, most respondents (85.71%) state that their children are receiving education. This shows that immigrant families value and care about their children's education.

More than half (50.00%) of the participants with children receiving education stated that they encountered various difficulties such as language barriers, cultural differences, economic difficulties, and social adaptation problems. These highlight the various barriers that immigrant families face in their children's education.

Table 1. Socio-economic characteristics of respondent

Variables		Number	Percentage
Age	19-29	6	43
	30-39	8	57
	40-49	0	0,0
Gender	Male	13	93
	Female	1	7.0
Education Level	Primary school	7	50
	Middle school	7	50
Occupation	Worker	3	21
	Not professional	10	71
	Unskilled	1	7.0
Reason for Migration	Family/Personal	1	7.0
	Economic	6	43
	Economic, Family/Personal	3	21
	Economic, Education	1	7.1
	Economic, Education, Family/Person	1	7.1
	Economic, Education, Security	1	7.1
	Economical, Security	1	7.1
Place of Migration	Adana	8	57
	Adana Seyhan	1	7.1
	Türkiye Cukurova Adan	1	7.1
	Yuregir	4	29
Job Description	Small business	1	7.1
	Labor (agricultural sector	10	71
	Unskilled	3	21
Support Status	Nope	14	100
Help Status	Yes	2	14
	Nope	12	86
Insured Employment Status	Yes	6	43
	Nope	8	57
Educational Status	Yes	12	86
	Nope	2	14

Source: Result of survey, 2024.

All respondents (100.00%) state that they work between 9 and 12 hours daily. This shows that migrant workers are often subjected to long and intense working hours. Most participants (64.28%) adopted the culture of the local people moderately or completely. This may reflect immigrants' efforts to adapt to the local culture in their new settlement. Many of the respondents (57.14%) stated that they sometimes experienced misunderstandings with the local people due to cultural differences. This situation shows that immigrants may face some difficulties in adapting to new cultural environments. Most participants (57.14%) stated that they experienced cultural differences regarding family structure in their new settlement. These results show that immigrants may face some difficulties in adapting to traditional family structures. All respondents (100.00%) stated that the cultural differences they experienced did not have legal consequences. This may indicate that immigrants generally do not have problems adjusting to their new settlement in a legal sense. Similarly, the result found by [33]. Most respondents (92.86%) state that their current situation has improved compared to before migration. This may indicate that immigrants find better opportunities in their new settlements and living conditions generally become better. Most respondents (50.00%) state that two people in their family work regularly. This may reflect the need for more than one family member to work to supplement families' income and provide economic stability. This result is collaborating with finding found by [6]. Most of the respondents (35.71%) stated that they were working in a low-skilled job before migration or that they had no profession or education and were working in a low-skilled job. Many participants (57.14%) stated that their average annual income was between 170,000 TL and 250,000 TL. Income distribution is generally moderate and diverse.

Most respondents (35.71%) describe their pre-migration occupational situation as "I had no profession or education; I was working in a low-skilled job." This shows that immigrants often work in low-skilled jobs and do not have pre-migration job training or experience. This finding is collaborated to result found by [8]. Many of the participants (64.29%) define their post-migration occupational status as "I work in a low-skilled job" or "I have a profession or education; I work in a low-skilled job." This shows that immigrants often continue to work in low-skilled jobs during the post-migration job search process.

Most respondents (64.29%) state that two people in their family work regularly. This may reflect the need for more than one family member to work to supplement families' income and provide economic stability. Similarly, the result found by [23]. All respondents (100.00%) stated that their children do not work. This may indicate that they are focused on children's education and school life. Most participants (57.14%) state that their children have both reading and writing skills in their native language. However, 42.86% of the respondents stated that their children could neither read nor write. This is an important indicator for understanding the educational status of children of immigrant families. More than half of the participants (50.00%) state that they occasionally visit the places they migrated to. This shows that immigrants tend to visit their old places from time to time to maintain ties and not forget their roots. Most of the participants (42.86%) state that they sometimes return to their hometowns for religious holidays, special occasions, or family events. This shows that immigrants care about preserving their roots and cultural ties. The same result found with [23]. Most participants (21.43%) state that factors such as being separated from family and friends and adapting to a new culture are influential during the migration process. This reflects the difficulties immigrants experience in their social and cultural adaptation processes. Many respondents (57.14%) state that they occasionally participate in social activities in their new settlements. However, a small group (7.14%) stated that they did not agree at all. This may reflect immigrants' differing approaches to the process of adapting to their new communities and expanding their social networks. Many respondents (92.86%) indicate that they feel some solidarity with people from the same region. This may indicate that immigrants are trying to find support by establishing relationships with people who have had similar experiences. Similarly, with results found by [30] that most participants (42.86%) state that they carry out social activities with their own communities and with local people. This may reflect immigrants' need to both maintain their own cultural identity and interact with their new communities. Considering these results, it is important to focus on the economic, social, and cultural dimensions of migration to understand the lives of immigrants and support their integration processes. Considering this information, information and understanding can be provided to design and implement migration and integration policies more effectively. Supporting the economic and social integration of immigrants is an important step in managing the diversity of societies and creating an inclusive society.

Table 3 indicates that there is no statistically significant difference in average annual income among visit frequency groups to the place of migration (p-value = 0.889).

The data analysis reveals a significant difference in salaries between the reasons for migration and pre-migration occupational status (p-value < 0.05).

However, no significant difference exists in terms of annual average income among other response groups.

Table 2. Challenges, Adaptation, and Socioeconomic Dynamics Among Migrant Workers

	Variables	Number	Percentage
Challenges	Language Barrier, Cultural Differences, Economic Difficulties, Social Adaptation Problems	7	50
	Economic Challenges	3	21.43
	Economic Difficulties, Social Cohesion Problems	2	14.29
	Cultural Differences, Economic Difficulties	2	14.29
Working Hours	9-12 Hours	14	100.00
Adoption Degree	Less Adopted	4	28.57
	I adopted it very much	5	35.71
	Moderately Accepted	4	28.57
	I Completely Adopted	1	7.14
Frequency of Misunderstanding	Sometimes	8	57.14
	Rarely	5	35.71
	Often	1	7.14
Cultural Differences	Family structure	8	57.14
	Family Structure, Marriage Traditions	3	21.43
	Family Structure, Marriage Traditions, Religious Practices	1	7.14
	Religious Practices	1	7.14
	Since everything is money-oriented, it becomes difficult to adapt to society.	1	7.14
Status	Unchanged	1	7.14
	get better	13	92.86
Number of Employees	1.00	2	14.29
	2.00	7	50.00
	3.00	4	28.57
	7.00	1	7.14
Professional Status	I was working in a low-skilled job	2	14.29
	I had no profession or education	3	21.43
	I had no profession or education; I was working in a low-skilled job	5	35.71
	I had no profession or education, I was working in a low-skilled job, I was in a mid-level job.	2	14.29
	I was working in a mid-level profession	2	14.29
Income Range	170,000 - 250,000	8	57,14
	270,000 - 425,000	5	35,71
	450,000 - 600,000	1	7,14
Number of Employees	1	1	7,14
	2	9	64,29
	3	3	21,43
	7	1	7,14
Children working	Nope	14	100.00
Status	Yes, You Know Both	8	57.14
	Neither Reading nor Writing	6	42.86
Current situation compared to your pre-migration	Search Secret	7	50.00
	None	3	21.43
	Rarely	3	21.43
	Often	1	7.14
Religious holidays	Sometimes	6	42.86
	None	2	14.29
	Rarely	6	42.86
The things that affect or move you the most during the migration process	Being Separated from Family and Friends	2	14.29
	Being Separated from Family and Friends, Language Barriers, Meeting New People	1	7.14
	Being Separated from Family and Friends, Adapting to a New Culture	2	14.29

	Separation from Family and Friends, Adapting to a New Culture, Language Barriers	3	21.43
	Being Separated from Family and Friends, adapting to a New Culture, Language Barriers, Meeting New People	4	28.57
	Adapting to a New Culture, Meeting New People	2	14.29

Source: Result of survey, 2024.

Table 3. Socio-Cultural Dynamics of Immigration

	Variable	Average	N	Std. Deviation	p value
Regularly visit the place you immigrate	Search Secret	295714.3	7	135105.8	0.888731
	None	350000	3	100000	
	Rarely	281666.7	3	130416	
	Frequent	350000	1		
	Total	308214.3	14	115602.2	
Reason for migration	Economic	266428.6	7	65237.66	0.039795
	Economical, Security	431250	4	143432.6	
	Family/Personal	250000	2	0	
	Total	314615.4	13	117711.9	
Profession before immigration	1	294500	10	120056.7	0.425621
	2	381666.7	3	97510.68	
	3	225000	1		
	Total	308214.3	14	115602.2	
Adopted the culture of the local people in your new settlement	1	400000	4	156790.7	0.125203
	2	305000	4	121518.2	
	3	249166.7	6	14288.69	
	Total	308214.3	14	115602.2	
Gender	Male	305000	13	119669.7	0.723387
	Woman	350000	1		
	Total	308214.3	14	115602.2	
Profession	I am not a professional	296500	10	119397.8	0.48045
	Unskilled	450000	1		
	Employee	300000	3	108972.5	
	Total	308214.3	14	115602.2	
Country/region	Adana	325000	8	130247	0.572754
	Adana Seyhan	225000	1		
	Türkiye Cukurova Adan	170000	1		
	Yuregir	330000	4	90921.21	
	Total	308214.3	14	115602.2	
Experience misunderstandings with local people due to cultural differences	Sometimes	400000	4	156790.7	0.125203
	Rarely	305000	4	121518.2	
	Often	249166.7	6	14288.69	
	Total	308214.3	14	115602.2	
Current situation compared to your pre-migration situation	Changing	170000	1		0.228297
	get better	318846.2	13	112974.1	
	Total	308214.3	14	115602.2	

Source: Result of survey, 2024.

These results suggest that reasons for migration and occupational status may influence participants' salary levels, whereas factors like education level or gender do not appear to impact income. Based on the findings from tables and cross-tabulations, the following conclusions can be drawn:

Significant differences in salaries have been identified based on reasons for migration and professional status, indicating that these factors may impact earnings levels among migrants.

Effect of Gender and Education Level on Income: Gender and education level do not appear to significantly influence participants' income levels, as observed from the data analysis.

Economic reasons emerge prominently among migration motives, with individuals migrating for economic reasons exhibiting lower average income levels compared to other motives.

Similarly, income levels vary across different regions or countries of migration. Also, the extent to which migrants embrace local culture or encounter cultural misunderstandings does not significantly affect their income levels.

These findings underscore the importance of understanding immigrants' economic circumstances when formulating immigration policies.

However, further data and detailed research are necessary for a more comprehensive analysis.

The socio-economic structures of individuals migrating to Adana and their reasons for migration were examined.

Surveys and in-depth interviews revealed that economic, security, and family/personal reasons drive migration decisions, with economic factors playing a predominant role. This research sheds light on the challenges faced by migrants and the cultural dynamics they encounter.

It explores immigrants' adaptation to local culture in new settlements and the impact of cultural differences.

Additionally, it investigates the relationship between immigrants' occupational status, income levels, and reasons for migration. Our findings highlight the influence of economic conditions and employment opportunities on migration decisions.

Furthermore, the study delves into immigrants' coping mechanisms with cultural differences and their impact on lifestyle adjustments in new environments. These insights are vital for understanding immigrants' experiences and enhancing migration policies.

Policy recommendations can be devised to facilitate immigrants' economic integration and foster cultural harmony.

This study contributes to the body of research on migration, providing valuable insights into the challenges faced by migrating individuals.

CONCLUSIONS

The research provides a detailed analysis of the socio-economic structure and migration interactions in Turkey's Çukurova Region, focusing on the impact of international migration on agricultural sustainability. The study reveals that international migration significantly influences various aspects of agricultural sustainability, including labor dynamics, remittances, knowledge transfer, and climate adaptation. It highlights the complex relationship between migration and shifts in agricultural practices, emphasizing the challenges and opportunities that migration brings to both sending and receiving regions.

The research findings underline the importance of understanding the motivations behind migration, with economic reasons being predominant. It also reveals the socio-economic characteristics of migrants, such as their age distribution, education levels, and employment status, shedding light on the challenges they face in integrating into the labor market and society. Additionally, the study explores migrants' adaptation to local culture and the impact of cultural differences on their lives.

Furthermore, it provides visions into the economic integration of migrants, revealing that factors such as pre-migration occupational status and reasons for migration significantly influence income levels. The findings emphasize the need for tailored policy interventions to support migrants' economic integration and foster cultural harmony in host communities.

Overall, the research contributes valuable insights into the dynamics of international migration and its implications for agricultural sustainability and socio-economic development in the Çukurova Region. It calls for comprehensive policy approaches that address the diverse needs and challenges of migrants while harnessing the potential benefits of migration for agricultural development and community well-being.

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SOCİO-ECONOMİC AND OPERATİONAL DYNAMİCS OF REAPER-THRESHER OWNERSHİP İN ADANA, TÜRKIYE

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Abstract

This research is aiming to illuminate the socio-economic and operational dynamics of reaper-thresher ownership in Adana and to provide valuable insights for future strategic planning in the sector. The primary data for this research were gathered through 16 face-to-face interviews with combine harvester operators in Adana. Constraints such as operators' hesitancy, time limitations, budget constraints, and their dispersed locations in various villages hindered the possibility of conducting a larger number of surveys. Moreover, considering the limitations mentioned, secondary data from sources such as the Turkish Statistical Institute (TUIK) and other relevant research reports were incorporated. Survey data collected between January and February 2024 underwent thorough analysis using techniques including cross-tabulation, statistical analysis, and regression analysis. The result of regression analysis indicates significant relationships between variables such as total area harvested, harvest price, and annual repair and maintenance expenses, and combine harvester profitability. These findings contribute to a nuanced understanding of the factors influencing harvesting revenues and their impacts on stakeholders. The explanation rate of these variables for the dependent variable (R square) is 99.3%. Since tolerance is greater than 0.10 and VIF is less than 10, there is no multiconnection problem. The findings reveal a predominant demographic profile of combine harvester owners, consisting largely of young and middle-aged individuals with varying levels of education, often continuing family traditions in agriculture. These operators typically operate small-scale agricultural enterprises, deriving most of their income from agricultural production. Through analysis it was found that the age ranges and education levels of the participants vary. While the age distribution varies between 20 and 51, the education level varies from primary school to master's/doctoral degree. The majority of the participants have a nuclear family structure and there is an average of 5 members in their families. The land holdings are generally below 100 decares. Additionally, the majority of respondents own a combine harvester, and this is often due to family business tradition. There are participants who have other sources of income other than harvesting. However, agricultural production is often the main source of income. The share of combine harvesting income in total income is generally high. The majority of participants want to continue harvesting and recommend it to new producers. However, there is dissatisfaction on some issues such as the appointment system of the Soil Products Office and the supply of workers. Harvest start time is usually in May, and the majority of combine harvester owners adapt to the specific requests of landowners. These special requests usually relate to mowing speed and tillage. The findings reveal significant information that will contribute to the development of agricultural mechanization strategies in the Adana region.

Key words: *Reaper-Thresher Owners, Logistic regression, socio-economic logistics, Adana*

INTRODUCTION

The agricultural sector is pivotal for the economic development and food security of many nations. Its efficiency and sustainability are contingent on various factors, including the utilization of modern agricultural equipment such as combine harvesters, which significantly enhance agricultural productivity. Reaper-thresher machines play a crucial role in the world, particularly in agricultural economies, by significantly enhancing efficiency, productivity, and sustainability in the farming sector."Reaper-thresher" might refer to a combination of a reaper (which cuts the crop) and a thresher (which separates the grain from the stalk and chaff). These machines, commonly used for harvesting and threshing crops, have transformed traditional farming practices and contributed to the modernization of agriculture in several ways [1]. Reaper-thresher machines are mechanized harvesters that can harvest and thrench crops faster than traditional methods, reducing crop loss risks. They also boost agricultural productivity by covering large areas quickly, ensuring food security. They reduce labor dependency, addressing labor shortages in rural areas. Reaper-threshers minimize post-harvest losses by swiftly harvesting and threshing crops, especially in regions with high post-harvest losses [2]. They also allow for multiple harvest cycles within a single growing season, promoting sustainable practices. These machines also optimize resource use, promoting technology adoption and fostering innovation in agriculture. The increased efficiency and productivity positively impact farmers' economic well-being, leading to improved profitability and economic growth in rural areas. Also, reaper-thresher machines play a pivotal role in shaping the future of agriculture worldwide. Their adoption is instrumental in achieving food security, economic growth, and sustainability, making them indispensable tools for modern farming practices in agricultural economy [7].

Various countries using Reaper-thresher machines or modern combine harvesters would include major agricultural producers like the United States, Canada, Brazil, Russia, China, India, Turkey, and many European countries. It's important to note that the specific agricultural machinery used can vary based on factors such as the type of crops grown, farm size, and technological advancements. The European Union and North American nations dominate global tractor and agricultural machinery production. According to VDMA (Verband Deutscher Maschinen- und Anlagenbau - German Engineering Federation) data [16], the sector's size, which amounted to 64.6 billion Euros in 2010, is regionally distributed as follows: the EU contributes approximately 35%, North America holds a 28% share, China contributes 10%, and Latin America has around 7%. These regions collectively manufacture 80% of the world's agricultural equipment, with their combined production constituting 80% of the sector's overall size. Our country's slice of this market stands at about 3%, amounting to 2 billion Euros [16]. The global production value of agricultural tools, machinery, and tractors was 53.8 billion Euros in 2006, 58.7 billion Euros in 2007, and 68.5 billion Euros in 2008, experiencing a notable surge. However, this growth gave way to a downturn in 2009, with production falling to 59.4 billion Euros, resulting in a 13.2% market contraction. By 2010, the production value rebounded to 64.6 billion Euros, indicating an 8.75% increase from the previous year and an expansion of the market. Western Europe saw an above-average decline in production. In the realm of technology-intensive agricultural equipment, such as tractors and combine harvesters, the world produced 1.4 million tractors and 37,000 combine harvesters in 2007 [14].

A type of machinery for agriculture management is a combined harvester operation. This is due to combined harvesters' high initial investment costs and expenses, allowing them profitable while being technically self-propelled machinery [15]. Combined harvester contracting is a mechanism used for management that operates based on market conditions between supply (combine harvester owner/operator) and demand (farmer). According to [6] the contractual approach is used in Turkey to harvest 90.2% of the total land with combined harvesters. Although this system's ability to regulate a balance between supply and demand provides economic benefits, there are refers to new technology introduction, loss decrease, and auditing/traceability [1]. The capacity of the Turkish combine harvester has now reached a point where it can efficiently handle all grain growing areas. The efficiency and speed of harvesting and threshing with a combine exceeds that of other mechanization alternatives, as highlighted by [4]. Turkey's Combined Harvester Park has reached a capacity value where all grain cultivation fields can be produced. The development of alternative mechanization options is impacted by the efficiency and speed of harvesting and threshing with a combined harvester, which can achieve up to 90% in the Konya region [4]. The two most crucial machine parameters for combined harvester operation that go against the intentions of the farmer and operator are the height of the mowing table from the ground and the operating speed. The operator's goal to finish the harvest-threshing task faster is what gives birth to the disputed disparity. On the other hand, this is a result of the farmer's desire to purchase additional grain, stalk, or straw. Losses rise and fuel and time economies are impossible to attain when the outdated combine harvesters, the inadequate and improper usage of supplementary equipment, and their deficiencies in areas like adjustment and maintenance are combined with this problem [5]. In Turkey, the management of combine harvesters has seen remarkable advancements, particularly in recent years, driven primarily by the diversification of harvested products. Previously limited to grains like wheat, barley, and rye, combine harvesters now handle a multitude of crops including corn, soy, cumin, lentils, and cotton. This diversification, coupled with the varying maturation periods and harvest seasons across regions in Turkey, has resulted in widespread and year-round utilization of combine harvesters, ensuring their continuous and long-term use.

Harvesting constitutes a crucial aspect of agricultural operations, facilitating enhanced efficiency and effectiveness for farmers. Yet, comprehensive research examining the economic and social impacts of harvesting activities remains limited. Consequently, there's a pressing need to investigate harvesting revenues and analyze the associated economic and social dimensions comprehensively.

The surge in combine harvester numbers in Turkey over the years aligns with the mechanization and technological advancements in agriculture. While there was a slight decline in numbers during the early 2000s, subsequent reforms, supports, and technological innovations spurred a resurgence in combine harvester adoption.

Recent years have witnessed a significant uptick in combine harvester numbers, attributed to modernization efforts, productivity enhancement targets, and government support for farmers. Additionally, the increasing acceptance of agricultural mechanization and farmers' inclination towards productivity-boosting machinery contribute to this rise, indicating a shift towards a more technologically driven and efficiency-oriented agricultural landscape in Turkey.

Analysis of combine harvester density at the provincial level reveals higher numbers in regions with intensive agricultural activities, notably in provinces like Adana, Antalya, and Konya, which serve as pivotal agricultural hubs. Moreover, the preference for newer and more technologically advanced combine harvester models underscores the influence of agricultural technological advancements on farmers' choices, reflecting a preference for efficiency and modernity.

Despite the significant strides in combine harvester management in Turkey, operators still face technical and economic challenges such as transportation, hygiene, and managing small parcels. Moreover, the lack of socioeconomic studies addressing these issues is evident, indicating a crucial gap that necessitates more comprehensive research and solution-oriented approaches.

In context of Adana, the operation cost, one must first understand the characteristics of a combined harvester operation and its effective values. When the combined harvester strategies have an amortization phase and there are no finances sufficient to buy a new one, this issue generally arises. Due to this, using an old combination harvester with significant repairs leads to higher expenses for labor, fuel, maintenance, and repairs. The farmer that uses the combine harvester for rent is liable for paying the cost of these high operating expenses. Additionally, the dynamics of reaper-thresher ownership in Adana present a complex landscape marked by multifaceted challenges. In this region, where agricultural practices play a focal role in the economy, the ownership of reaper-threshers, while addressing labor shortages and minimizing post-harvest losses, introduces its own set of difficulties. Factors such as initial investment costs, technological proficiency, and access to financial resources pose hurdles for prospective owners. Additionally, the integration of these machines into traditional farming practices requires adaptation and training, influencing the socio-economic fabric of the farming community. Striking a balance between technological advancement, economic viability, and societal implications constitutes a formidable challenge for stakeholders engaged in reaper-thresher ownership in Adana.

This research is aiming to illuminate the socio-economic and operational dynamics of reaper-thresher ownership in Adana and to provide valuable insights for future strategic planning in the sector. And then, scrutinize the factors influencing combine harvester income and provide a comprehensive evaluation to grasp the economic and social dimensions of combine harvester activities. It endeavors to identify the primary factors affecting harvesting revenues and examine their impacts on key stakeholders within the sector.

MATERIALS AND METHODS

The primary data for this research were gathered through 16 face-to-face interviews with combine harvester operators in Adana. Constraints such as operators' hesitancy, time limitations, budget constraints, and their dispersed locations in various villages hindered the possibility of conducting a larger number of surveys. To complement the primary data, in-depth interviews were conducted with chambers of agriculture and district agricultural officials.

Moreover, considering the limitations mentioned, secondary data from sources such as the Turkish Statistical Institute (TUIK) and other relevant research reports were incorporated. Survey data collected between January and February 2024 underwent thorough analysis using techniques including cross-tabulation, statistical analysis, and regression analysis. These analytical methods were employed to gain insights into the challenges faced by combine harvester operators and their expectations.

RESULTS AND DISCUSSIONS

The socio-economic characteristics of combined harvester operators were examined and their income levels, expenses, and economic activities were evaluated based on the data obtained. Additionally, the problems faced by combined harvester operators and their expectations are discussed in detail.

Table 1. Demographic Characteristics of Combine Harvester Owners Participating

Demographic Characteristic		**Frequency**	**Percentage (%)**
Age Group (years)	18-30	12	20
	31-45	28	47
	46-60	18	30
Gender	Male	50	83
	Women	10	17
Education level	Primary school	8	13
	Secondary school	12	20
	High school	20	33
	University	18	30
Family Type	Nuclear Family	32	53
	Extended Family	18	30
	Multiple Family	10	17

Source: Results of the survey.

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Table 1 indicates that most participants in the research who own combine harvesters are males aged between 31-45. In terms of education, it's notable that the majority are high school graduates. Furthermore, a significant number of participants have a nuclear family setup.

Table 2 shows that the majority of combine harvester owners possess land ranging from 0 to 20 decares, indicating that they predominantly operate as small-scale agricultural enterprises.

Table 2. Land and Harvester Ownership Information

Land Asset Owned (Decares)		
Variable	**Frequency**	**Percentage (%)**
0-10	15	25
11-20	18	30
21-30	14	23
31-40	10	17
41-50	3	5

Source: Results of the survey.

It's evident that the majority of the other equipment falls within the price range of 1,200,000 TL to 3,000,000 TL. This indicates a tendency among combine harvester owners to favor machines situated in the mid to lower price segments for other equipment (Table 3).

Table 3. Material Value of Other Equipment (TL)

Material Value Range (TL)	Number	(%)
1,200,000 - 1,750,000	8	50
2,000,000 - 3,000,000	7	44
25,000,000	1	6

Source: Results of the survey.

Table 4 shows that the income source of the majority of combine harvester owners (56%) is agricultural production.

Table 4. Sources of Income

Income Source	Number	(%)
Livestock	1	6
Worker	1	6
Agricultural production	9	56
Agricultural production, Pension	1	6
Agricultural production, industrial machinery manufacturing	1	6
Agricultural production, Trade	1	6
Trade	1	6
None	1	6

Source: Results of the survey.

Other sources of income include labor and various other fields. This suggests that combine harvester owners are trying to diversify their income.

Table 5 shows a significant majority (94%) of individuals who ventured into the combine harvester business did so due to family reasons. This indicates a prevalent trend of family enterprises, with many combine harvester proprietors carrying on their familial traditions.

Table 5. Reason for Starting Harvester Management

Why	Number	Percentage (%)
Family	15	94
Hobby	1	6

Source: Results of the survey.

Table 6 indicates that the majority of combine harvester owners (69%) own only one combine harvester. However, a small percentage (19%) operates businesses with more than one combine harvester. This shows that most of the combine harvester owners in Adana are small-scale businesses.

Table 6. Number of Harvesters Owned

Number of Harvesters	Number	Percentage (%)
1	11	69
2	3	19
4	2	12

Source: Results of the survey.

Based on the result presented in Table 7, it is indicated that 25% of combine harvester owners made their purchase between 2005-2010, while 38% did so between 2011 -2015, and another 38% between 2016 -2018. This suggests a relatively even distribution of combine harvester purchases over the specified time periods.

Table 7. First Harvester Purchase Year

Year of Purchase	Number	Percentage (%)
2005-2010	4	25
2011-2015	6	38
2016-2018	6	38

Source: Results of the survey.

In Table 8, it is seen that the majority of combine harvester owners (75%) employ 2 drivers in their businesses. However, a small percentage (13%) employ only one driver. This shows that the number of drivers varies depending on the size of the businesses.

Table 8. Number of drivers

Number of Drivers	Number	Percentage (%)
0	1	6.
1	2	13
2	12	75
3	1	6

Source: Results of the survey.

Table 9 shows that combine harvester owners start the harvest season between January and May. However, a small percentage (6%) starts harvesting in June. This indicates that the harvest period is generally between January and May.

Table 9. Harvest Start Month

Starting month for harvesting	Number	Percentage
January	1	6
April	1	6
May	13	81
June	1	6
Total	16	100

Source: Results of the survey.

Table 10 shows us 31% of combine harvester owners are not satisfied with the Soil Products Office Appointment System. 31% are undecided. Others' satisfaction is dispersed across various levels.

Table 10. Satisfaction with Soil Products Office Appointment System

Satisfaction Status	Number	Percentage (%)
Less Satisfied	3	19
Slightly Dissatisfied	2	13
Very Satisfied	1	6
Very Dissatisfied	5	31
Undecided	5	31

Source: Results of the survey.

75% of combine harvester owners want to continue harvesting in the future. However, 25% tend not to continue illustrates in Table 11.

Table 11. Desires to Continue Harvesting in the Future

Attendance Status	Number	Percentage (%)
Yes	12	75
No	4	25

Source: Results of the survey.

Table 12 indicates that 56% of combine harvester owners want to recommend harvester farming to others. However, 44% are hesitant or negative about this issue.

Table 12. Requests to Recommend Harvesting to Others

Recommendation Status	Number	Percentage (%)
Yes	9	56
No	7	44

Source: Results of the survey.

For short-term stays lasting 2-4 months, 4 individuals account for 25.00% of the total. Medium-term stays spanning 5-6 months are represented by 10 people, constituting 62.50%. Long-term stays, lasting 7 months or more, are inhabited by 2 individuals, making up 12.50% of the total in Table 13.

Table 13. Duration of Staying Away from Home During the Year (Months)

Stay Away Range	Number of People	Percentage (%)
Short Term (2-4 Months)	4	25
Medium Term (5-6 Months)	10	62.5
Long Term (7 Months and Above)	2	12.5

Source: Results of the survey.

Table 14 explain that more than half of the participants (50%) stated that they experienced customer loss due to the appointment system.

Table 14. Problems Related to the Appointment System

Problem	Number of People	Percentage (%)
Impatience to Wait	4	25
Obligation to Find a New Harvester Immediately	4	25
Customer Loss	8	50

Source: Results of the survey.

Table 15 indicates that 75% of the participants stated that they wanted to continue harvesting in the future.

Table 15. Willingness to Continue Harvesting in the Future

Willingness to Continue	Number of People	Percentage (%)
Yes	12	75
No	4	25

Source: Results of the survey.

Table 16 shows that 56% of the participants stated that they would recommend harvesting to others.

Table 16. Willingness to Recommend Harvester Harvesting to Others

Willingness to Recommend	Number of People	Percentage (%)
Yes	9	56
No	7	44

Source: Results of the survey.

The table 17 encompassed individuals aged between 20 and 51, with an average age of around 36.63 years and a standard deviation of about 9.21. Family sizes involved in farming varied from 3 to 6 members, with an average of approximately 4.69 individuals per family and a standard deviation of around 1.01. Land ownership ranged from 0 to 300 decare, with an average holding of approximately 68.94 decare and a standard deviation of about 73.58. The value of owned combine harvesters ranged from TL 4,750,000 to TL 25,300,000, with an average value of approximately TL 10,440,625 and a standard deviation of around TL 6,154,516. Other equipment values ranged from TL 1,200,000 to TL 3,000,000, with an average of approximately TL 1,790,625 and a standard deviation of about TL 530,791.50. Ownership of combine harvesters ranged from 1 to 4 per individual, with an average of approximately 1.56 and a standard deviation of around 1.03. Employment of drivers ranged from 0 to 3, with an average of about 1.81 drivers and a standard deviation of approximately 0.66. The harvested land area varied from 5,000 to 50,000 decare, with an average of approximately 23,125 decare and a standard deviation of around 12,526.64. Income from harvesting activities ranged from 30% to 100%, with an average of about 53.25% and a standard deviation of approximately 20.19%. Harvest prices ranged from TL 142 to TL 180 per unit, with an average price of around TL 159.94 and a standard deviation of approximately TL 11.95. Annual income from harvesting activities varied from TL 900,000 to TL 7,700,000, with an average income of about TL 3,662,188 and a standard deviation of around TL 1,928,802. Fuel costs per decare ranged from TL 20 to TL 64, with an average cost of approximately TL 33.69 and a standard deviation of around TL 10.06. The expense-to-income ratio ranged from 13 to 36, with an average ratio of about 21.06 and a standard deviation of approximately 5.35. Annual fuel expenses for combine harvesters varied from TL 200,000 to TL 1,600,000, with an average expense of approximately TL 732,500 and a standard deviation of around TL 377,708. The total fuel and other expenses rate ranged from 27 to 43, with an average rate of about 33.06 and a standard deviation of around 4.17. The fuel expenses ratio to total expenses ranged from 8% to 18%, with an average ratio of approximately 12.31% and a standard deviation of about 2.24%. Annual repair and maintenance expenses for combine harvesters varied from TL 25,000 to TL 220,000, with an average expense of about TL 89,062.50 and a standard deviation of approximately TL 49,191.42. Income derived from labor ranged from 5% to 15%, with an average rate of around 9.31% and a standard deviation of approximately 3.32%. Annual labor expenses for combine harvesters varied from TL 100,000 to TL 600,000, with an average expense of about TL 311,562.50 and a standard deviation of approximately TL 153,663.30. Other annual expenses related to combine harvesters ranged from TL 20,000 to TL 65,000, with an average expense of around TL 40,062.50 and a standard deviation of approximately TL 12,315.13. Additionally, there were possibly unrelated variables, with values ranging from 748,000 to 7,020,000, and another variable, possibly unrelated, with values ranging from 16 to 54. The duration of time spent away from home during the year ranged from 2 to 8 months, with an average of about 5.44 months and a standard deviation of approximately 1.50 months.

Table 17. Provide comprehensive information about various aspects of farming activities, including demographic details, equipment ownership, expenses, and income

Variable	N	Minimum	Maximum	Average	Standard deviation
Age	16	20	51	36.625	9.207787
Total Number of Individuals in the Family	16	3	6	4.6875	1.014479
Land Asset (Decare)	16	0	300	68.9375	73.57578
Financial value of your Combine Harvester (TL)	16	4,750,000	25,300,000	10,440,625	6,154,516
Financial value (TL) of other equipment such as tractors and trailers that you use with the Harvester and Harvester	16	1,200,000	3,000,000	1,790,625	530,791.5
Number of Harvesters Owned	16	1	4	1.5625	1.030776
Total number of drivers	16	0	3	1.8125	0.655108
Total Area Harvested in the Year (Decares)	16	5,000	50,000	23,125	12,526.64
Share of harvester income in total income (%)	16	30	100	53.25	20.19076
Harvest Price	16	142	180	159.9375	11.95251
Average annual harvester income (TL)	16	900,000	7,700,000	3,662,188	1,928,802
Fuel cost per decare	16	20	64	33.6875	10.05796
Ratio of expense to income	16	13	36	21.0625	5.347507
Annual Fuel Expenses (TL) for your Combine Harvester	16	200,000	1,600,000	732,500	377,708
Fuel and other expense total rate	16	27	43	33.0625	4.170831
Fuel expense ratio	16	8	18	12.3125	2.24258
Annual Repair & Maintenance Expenses (TL) for your Combine Harvester	16	25,000	220,000	89,062.5	49,191.42
Labor income rate	16	5	15	9.3125	3.321019
Annual Labor Expenses (TL) for your Combine Harvester	16	100,000	600,000	311,562.5	153,663.3
Other annual expenses (TL) for your Combine Harvester	16	20,000	65,000	40,062.5	12,315.13
Snow	16	748,000	7,020,000	3,221,500	1,775,064
Capital	16	16	54	31.5625	12.23639
Duration of Staying Away from Home During the Year (Months)	16	2	8	5.4375	1.504161

Source: Results of the survey.

Table 18 is a significant relationship between the answers to the questions (p value <0.05) While every person who recommended harvesting to someone else declared that they would continue this business in the future, 42.86% of those who did not recommend it said they would continue this business. There are no significant relationships between the variables tested below (p>0.05).

Table 18. Recommend and continue harvesting

Continue harvesting in the future					
		Yes	No	Total	p value
Recommend harvesting to others	Yes	100.00	0.00	100.00	0.02
	No	42.86	57.14	100.00	
Total		75.00	25.00	100.00	

Source: Results of the survey

The findings in Tables 19 and 20 represents a regression analysis. Regression analysis is a statistical method used to determine the relationship between dependent variables and one or more independent variables. The profit variable is the dependent variable and the variables on the right are taken as dependent variables, Total Area Harvested in the Year

(Decare), harvest price and Annual Repair & Maintenance Expenses (TL) for your Combine Harvester, the variables remain significant in the model. The explanation rate of these variables for the dependent variable (R square) is 99.3%. Since tolerance is greater than 0.10 and VIF is less than 10, there is no multiconnection problem. The R square value for each model is given in the model summary table. R square expresses the percentage of independent variables explaining the variance of the dependent variable. For example, in Model 19, the R square value is 97.1%, indicating that the independent variables used explain 97.1% of the dependent variable.In the coefficients table, the coefficient, standard error, t value and p value of each independent variable are given. The T value is the ratio obtained by dividing the coefficient by the standard error and shows the significance of this ratio. P value expresses the significance of the independent variable. If the p value is less than a specified significance level (usually $p < 0.05$), the independent variable is statistically significant. In the multicollinearity statistics table 20, tolerance and VIF (variance inflate factor) values are given. These values measure multicollinearity between the independent variables used. The tolerance value is between 0 and 1, the closer it is to 1 it indicates the absence of multicollinearity. VIF is the inverse of tolerance, that is, the smaller the VIF value, the less multicollinearity between the independent variables.

Table 19. Model summary D

Model	R.	R Square	Adjusted R Square	Std. Error of the Estimate
1	.985a	0.971	0.969	314670.4835
2	.994b	0.989	0.987	202056.3144
3	.997c	0.993	0.991	165482.0754

a. Predictors: (Constant), Total Area Harvested in Year 13 (Decares)?; b. Predictors: (Constant), Total Area Harvested in the 13th Year (Decare)?, harvest price; c. Predictors: (Constant), Total Area Harvested in the Year (Decare)?, harvest price, Annual Repair & Maintenance Expenses (TL) for your Combine Harvester?; D. Dependent Variable: profit
Source: Authors' results.

Table 20. Regression model

Model	Unstandardized Coefficients		T	Shallow	Collinearity Statistics	
	Coefficient	Standard error			tolerance	VIF
Fixed Term	-3588897.009	624857.199	-5.744	0.000		
Total Area Harvested in the Year (Decares)?	169.336	9.634	17.577	0.000	0.125	7.977
Harvest price	21,758.698	3,732.837	5.829	0.000	0.917	1.090
Annual Repair & Maintenance Expenses (TL) for your Combine Harvester?	-6.574	2.420	-2.717	0.019	0.129	7.762

Source: Authors' results.

Normality assumption is ensured according to the normal pp graph of the errors as presented in Fig. 1.
According to the prediction and error term distribution, the points do not form a certain pattern. Therefore, there is no heteroscedasticity problem.

Analysis of social demographic and economic data sheds light on the general profile of combine harvester owners in Adana. This group, young and middle-aged, generally with a low level of education, generally continues the family tradition in agricultural activities. Economically, they can be described as small-scale businesses and derive most of their income from agricultural production. However, there are also some difficulties faced by these enterprises, for example, there is dissatisfaction with the soil products office appointment system and the supply of workers. These findings should be taken into account when developing agricultural mechanization strategies and contribute to the creation of solution-oriented policies. This result collaborated with [11]. It was found that this group, predominantly composed of young and middle-aged individuals with a low level of education, tends to uphold family traditions in agricultural activities. The above findings and interpretations help us understand the social and economic profile of combine harvester owners in Adana. This information can play an important role in developing strategies for effectively managing agricultural mechanization and increasing agricultural productivity. The found is similar to [9] that the amount of land owned by the participants is quite variable, the minimum is 0 decares and the maximum is 300 decares. On average, participants own 68.94 decares of land. The finding is simillar to result found with [8]. Concering material value of combine Harvesters that the financial value of combine harvesters varies between 4,750,000 TL and 25,300,000 TL. The average material value is 10,440,625 TL.

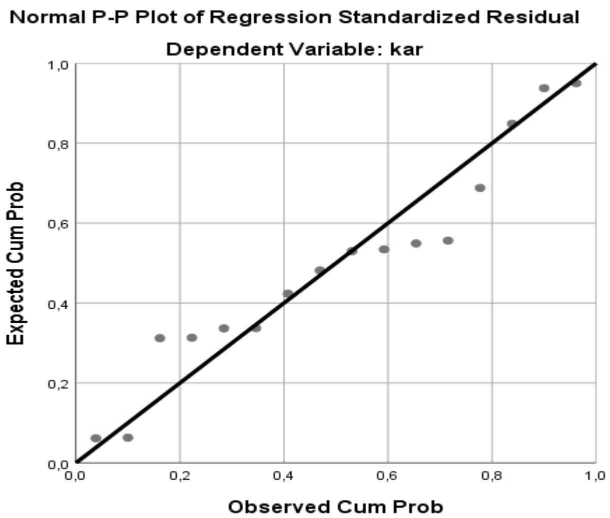

Fig. 1. Normality assumption is ensured according to the normal pp graph of the errors
Source: Authors' results.

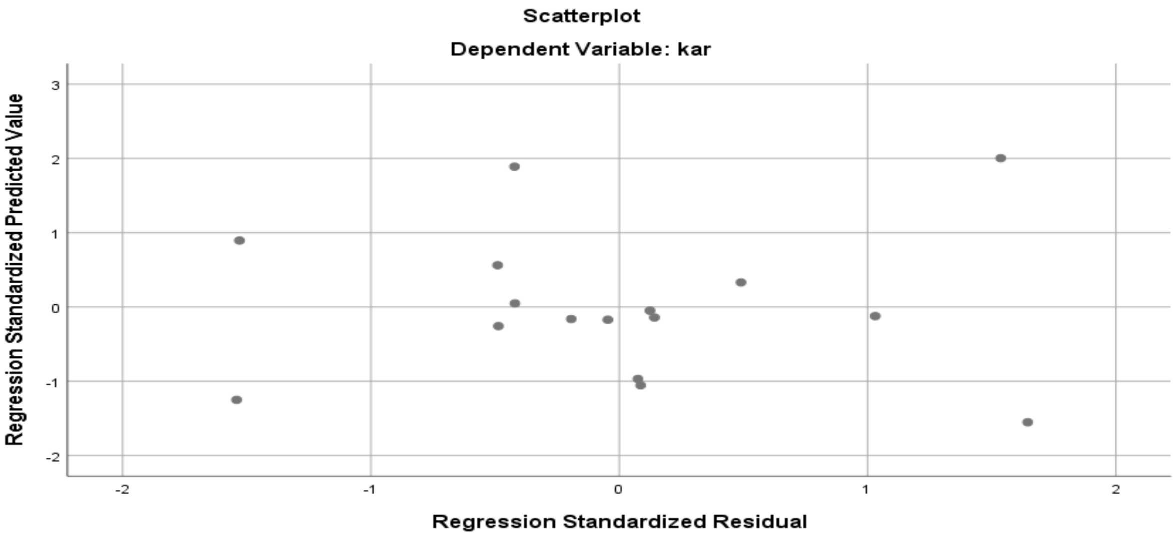

Fig. 2. A scatterplot.
Source: Authors' results

The majority of the participants own 1 combine harvester, but on average there are 1.56 combine harvesters. The findings are similar to [3] and [13] concerned the number of combine harvesters owned. The share of combine harvester income in total income varies between 30% and 100%. On average, this rate is 53.25%. The findings are collaborated to [11] who found that the share of combined harvester income in total income exhibited considerable variability, spanning from 30% to 100% across different regions or communities. The average proportion of income derived from harvesting activities was calculated at 53.25%, indicating a substantial reliance on this aspect of agricultural production for livelihoods within the studied populations. Concerning an annual combine harvester income varies between 900,000 TL and 7,700,000 TL. The average income is 3,662,187.50 TL. This result is similar to [10].
There is a strong relationship between the tendency to recommend of Reaper-Thresher to others and the decision to continue this business in the future, this relationship is not evident with other variables. This grounded research examined the relationship between intention to recommend harvesting to others and various social, demographic, and economic variables. The research revealed that the majority (100%) of those who recommend harvesting to others intend to continue this business in the future, while only 42.86% of those who do not recommend it tend to continue this business. No significant relationship was detected between other variables and this recommendation status (p value> 0.05). These results indicate that the tendency to recommend harvesting to others is strongly associated with the decision to continue this business in the future. However, it is stated that this relationship cannot be explained by other factors. The variables remain significant in the model. The explanation rate of these variables for the dependent variable (R square) is 99.3%. Since tolerance is greater than 0.10 and VIF is less than 10, there is no multiconnection problem. Similarly, to finding found for [12].

CONCLUSIONS

The study reveals that combine harvester owners in Adana are predominantly young to middle-aged individuals, often with a lower level of education, who continue family traditions in agriculture. Economically, they operate small-scale businesses, with agricultural production being their primary source of income. However, they face challenges such as dissatisfaction with the soil products office appointment system and difficulties in labor supply.
The findings accentuate the importance of considering these socio-economic dynamics in the development of agricultural mechanization strategies. Solutions-oriented policies should address the specific needs and challenges faced by combine harvester operators to enhance efficiency and productivity in the sector.
Moreover, the research identifies significant factors influencing combine harvester income, such as the total area harvested, harvest price, and annual repair and maintenance expenses. These factors play a crucial role in determining the profitability of combine harvester operations, highlighting the importance of managing these variables effectively.
Additionally, the study emphasizes the strong relationship between the tendency to recommend reaper-thresher operations to others and the decision to continue this business in the future. This underscores the importance of word-of-mouth recommendations in sustaining and expanding combine harvester operations.
The research provides valuable ideas that can guide policymakers, stakeholders, and operators in Adana towards developing strategies for enhancing agricultural mechanization, improving productivity, and addressing socio-economic challenges in the sector. The dynamics of reaper-thresher ownership and its implications, stakeholders can work towards building a more resilient and sustainable agricultural landscape in the region.

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EFFECTS OF LAND CONSOLİDATİON ON AGRİCULTURAL ENTERPRİSES İN CİHANBEYLİ DİSTRİCT, TÜRKIYE: AN EVALUATİON FROM THE PRODUCER PERSPECTİVE

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Abstract

This study examines the effects of land consolidation works carried out in Cihanbeyli district to provide solutions to important structural problems in Turkey's agricultural enterprise structure. The aim of the research is to evaluate in detail the socioeconomic effects of the consolidation process on farmers' land holdings and number of parcels and the legal dimensions of the process. The study was carried out using multi-layered data sources such as land registry and cadastral records, court cases and field observations, as well as surveys conducted with 26 farmers in villages such as Damlakuyu, Karatepe, Sağlık, Ülerziktepe and Taşpınar in Cihanbeyli district. The research was supported by various statistical tests such as regression analyzes and Wilcoxon Sign Test using the SPSS version 25 statistical package program. Analyzes revealed that there is a significant relationship between factors such as education level, agricultural experience and number of tractors and changes in farmers' land holdings and number of parcels after land consolidation. Satisfaction levels were found to be closely related to the success of the land management and consolidation process, and it was also emphasized that cooperative membership and participation in agricultural training programs were effective in the success of this process. Findings highlight challenges and opportunities associated with land consolidation, including concerns about property rights, legal disputes, and infrastructure development. Despite some dissatisfaction among farmers, the research underscores the potential of consolidation in enhancing agricultural productivity and informing policy decisions for rural development strategies. The study provides valuable insights into the development of agricultural policies and rural development strategies and guide policy makers and practitioners for the effective management of consolidation processes. The research provides a scientific basis for future applications by illuminating the factors that will increase farmer satisfaction and the effectiveness of the consolidation process.

Key words: *land consolidation, farmer's satisfaction, agricultural productivity, socio-economic impacts, statistical analysis, legal issues, regression analysis, Wilcoxon Sign Test*

INTRODUCTION

Land consolidation refers to a process of reorganizing and restructuring fragmented land holdings within a specific area to create larger and more cohesive agricultural units. The goal is to improve the efficiency, productivity, and overall sustainability of agricultural land use. This process typically involves redistributing land parcels, adjusting property boundaries, and optimizing the layout of agricultural holdings. The specifics of land consolidation can vary significantly depending on the legal, social, and economic context of each country [6]. Land consolidation aims to increase farm size and efficiency, leading to economies of scale and increased productivity. It also improves infrastructure, such as irrigation systems and roads, and enhances environmental sustainability. Legal and regulatory frameworks are crucial for successful consolidation efforts. Social and economic considerations, such as displacement of smallholders or landless individuals, should be addressed. Technological integration, such as Geographic Information System mapping, can aid in planning and implementing land consolidation projects [16].

Various countries have implemented land consolidation initiatives tailored to their specific needs. For instance, several European countries boast a rich history of successful land consolidation. Germany, renowned for its well-established tradition of land consolidation called "Flurbereinigung," focuses on the reorganization and consolidation of fragmented land parcels to create more extensive and efficient agricultural units [20]. The Netherlands, with its "Land Consolidation Act," has a history of initiatives aimed at enhancing the spatial organization of agricultural land [22]. Hungary, too, has implemented measures to improve agricultural efficiency and land use through land consolidation projects, restructuring holdings to form larger and more efficient farms. These projects often entail the redistribution of fragmented and scattered land parcels to create consolidated, contiguous plots [17].

China has embarked on land consolidation projects to enhance the efficiency of agricultural land use, frequently involving the merging of small land parcels into larger, more manageable units [4]. Additionally, South Korea, in the aftermath of the Korean War (1950-1953), underwent substantial land reforms and consolidation efforts. The country grappled with a situation where agricultural land was fragmented into small, inefficient plots, impeding modernization and mechanization in agriculture. To address this, the government implemented land redistribution programs aimed at consolidating small land holdings into larger units, fostering equitable distribution. Investments in rural infrastructure enhanced farming practices and market access. Adoption of modern farming technologies, coupled with larger fields, facilitated ease of use. Supportive policies encouraged farmer participation, and community involvement ensured that consolidation efforts aligned with local needs and aspirations. Notably, the "New Community Movement" (Saemaul Undong) included initiatives to consolidate small and scattered land parcels for more efficient agricultural management [6]. (14, 15, 13. It's crucial to acknowledge that the implementation and success of land consolidation programs can vary based on the specific social, economic, and institutional contexts of each country.

Land consolidation work first started in 1961 in Turkey. Studies were carried out by various general directorates affiliated with the Ministry of Agriculture. Finally, with the amendment made on 2.7.2018 in Law No. 6200 on the "Organization and Duties of the General Directorate of State Hydraulic Works," the authority to implement land consolidation was given to the General Directorate of State Hydraulic Works (DSI). In the Additional Article 9 of the Law, the purposes of land consolidation practices are given as follows [10]: “Preventing the deterioration and fragmentation of lands by natural and artificial effects, in fragmented lands, combining more than one land plot by considering their natural characteristics, usage integrity, and property rights, creating new parcels that are more functional in terms of economic, ecological, and social aspects, and determining the usage patterns of these parcels by evaluating the land characteristics and area. Land consolidation is carried out to provide village and land development services [11].

One of the primary challenges in the Turkish agricultural sector is the fragmented and dispersed ownership structure of enterprises [9]. Agricultural land in the country has diminished and fragmented for various reasons, resulting in productivity and profitability levels far below their potential. The reduction in farm size poses a hindrance to the practice of economically viable agriculture [19, 1]. Moreover, due to inheritance, agricultural enterprises undergo division, proliferating in number, and deviating from economic scales [3]. Agricultural enterprises in Turkey exhibit fragmentation and insufficient scale. The land allocated for producer-based activities is limited and spread across numerous small parcels, presenting challenges in establishing robust businesses and attaining the anticipated production performance [2].

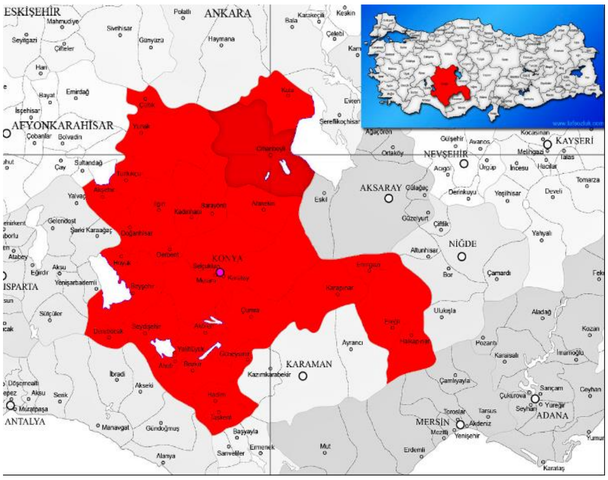
In Turkey, challenges such as land scarcity, an uneven distribution of land ownership, and the presence of small, fragmented, scattered, and irregular parcels contribute to increased investment costs, labor expenses, and time requirements within the production system [21]. Land consolidation has emerged as a crucial tool for addressing the shrinkage, fragmentation, and irregularity of agricultural land [19]. Studies indicate that a typical farmer in Turkey possesses approximately six different land parcels with varying sizes and characteristics. Those owning only one parcel represent the lowest percentage at 9.46%, while those with 2–9 parcels account for 70.84%, and individuals with more than 10 parcels make up 19.70%. The agricultural community is distributed across around 4,000,000 parcels. The management of fragmented land incurs high costs, impeding the achievement of high yields. The challenge lies in the inability to conduct efficient farming across parcels with diverse locations, sizes, qualities, and shapes, consequently hindering the realization of the desired yield [9].

In the Cihanbeyli district, various challenges and implications have surfaced. Farmers frequently encounter a decrease in the number of individual land parcels they own due to consolidation. This can result in a significant alteration in the structure of their land holdings, potentially impacting their capacity to oversee diverse crops or participate in specialized farming practices. The consolidation process may also influence the traditional patterns of land inheritance, presenting challenges for generational farming and the passing down of agricultural assets. Additionally, the legal aspects of the consolidation procedure give rise to questions about property rights, land tenure, and the rights of individual farmers. Concerns may emerge regarding the fairness and transparency of the consolidation process, potentially leading to disputes and conflicts among farmers, particularly if the compensation mechanisms for land redistribution are perceived as unjust. A thorough examination of the legal framework governing the consolidation process is essential to ensure that it safeguards the rights and interests of farmers. Provisions related to compensation, land valuation, and the participation of farmers in the decision-making process are critical aspects that demand attention to address potential grievances and ensure the sustainability of agricultural communities. This study investigates the impact of land consolidation initiatives in the Cihanbeyli district, aiming to address critical structural challenges in Turkey's agricultural sector. The research focuses on a comprehensive evaluation of the socioeconomic effects of the consolidation process on farmers' land holdings, parcel numbers, and the legal aspects of the procedure.

MATERIALS AND METHODS

The research was carried out in the villages of Damla Kuyu, Sağlık, Karatepe, Üzerliktepe, Taşpınar, Yapalı and Günyüzü. First, there is a total of 219,992 decares of land in Cihanbeyli district, which constitutes 9.7% of Konya's agricultural land and 1% of Turkey. (Map 1).

The total population of these villages is 6628 and this population includes approximately 9% of the Cihanbeyli district. One of the important issues to be taken into consideration in the consolidation process is the residence status of the residents of the neighborhood in summer and winter. In addition, the number of farmers and the proportion of the neighborhood population living abroad, in the district and in the city are also important issues. Although the rate of people residing abroad varies by village, it is generally around 10%. The rate of people residing in the district is 21%, and the rate of people residing in the city is 16%. The most important reason for residing outside the neighborhood is job opportunities (54%), followed by education (10-30%) and health (16%). In recent years, new construction has been seen in neighborhoods, especially those living abroad, who have built new houses, and these new house construction rates are generally around 5%. SPSS version 25 statistical package program was used for statistical analysis. Normality tests of the scores of the scored questions in the survey were made with the Shapiro-Wilk Test and it was found that the scores were not normally distributed. In the study, the difference test for the average number of parcels before and after consolidation was performed with the Wilcoxon Sign Test due to the dependent sample [12]. The differences between the satisfaction and dissatisfaction with consolidation and the average scores given by the subjects to the items regarding the land consolidation in their neighborhood were investigated by applying two-group independent sample Mann- Whitney Tests. The significance level was taken as 0.05 for all tests performed [7].



Map 1. Map of Cihanbeyli district of Konya Province, Turkey
Source: [23].

RESULTS AND DISCUSSIONS

Table 1 presents the frequency distribution of specific variables, including measures of central tendency and dispersion, revealing the distribution of participants across factors such as age, experience, land availability, number of parcels, and number of tractors.

The analysis indicates that participants have an average age of 56.48, with ages ranging from 30 to 74 and a standard deviation of 12.08, illustrating variability in age distribution.

The average experience level is 31.12, ranging from 10 to 55, with a standard deviation of 12.95, indicating variation in experience levels.

Post-consolidation, participants held an average of 4.40 parcels, compared to 2.80 parcels pre-consolidation, consistent with findings by [18], indicating a decrease in parcel numbers.

On average, participants own 1.08 tractors, though some do not own any.

The average land ownership is 335.20 decades, but the high standard deviation of 280.33 suggests considerable variability, with some owning large plots and others smaller ones.

Table 1. The distribution of the participants in terms of factors

Variables	N	Minimum	Maximum	Average	Standard deviation
Age	25	30	74	56.48	12.08
Experience	25	10	55	31.12	12.95
Land asset	25	72	1,000	335.20	280.33
Number of parcels after consolidation	25	1	12	4.40	2.97
Number of parcels before consolidation	25	1	6	2.80	1.58
Number of tractors	25	0	3	1.08	0.64

Source: Results from the survey.

Table 2 illustrates that the majority of the participants were married and had a secondary or high school education. Most of their main occupation is farming.

The majority of survey participants showed interest and took out insurance.

And then, the rates of cooperative membership and receiving education in the last year are low.

Table 3 shows that one of the most important questions stated by the producer’s regarding consolidation was the change of hands of treasury lands.

In some villages, treasury lands were left in place to avoid problems due to ownership issues, while others were gathered in some villages, so these new lands created both problems and new riches.

The unit that carried out the consolidation was at its discretion. treasury lands were left in their old places in some villages, so no problem of ownership was created.

Table 2. Socio - Economic Characteristics

Variables		Frequency	Percentage
Neighbourhood	Damlakuyu	8	32
	Karatepe	4	16
	Health	4	16
	Taşpınar	2	8
	Ülerziktep	2	8
	since done	5	20
	Total	25	100
Marital status	Married	23	92
	Single	2	8
	Total	25	100
Education	Primary school or less than primary school	10	40
	Middle School-High School	13	52
	Associated degree and above	2	8
	Total	25	100
Main Profession	Farmer	11	44
	Officer	3	12
	Employee	1	4
	Tradesman-Merchant	7	28
	Retired	3	12
	Total	25	100
Interest	Yes	23	92
	No	2	8
	Total	25	100
Residence	Province	1	4
	City+District	1	4
	District	3	12
	Neighbourhood	11	44
	District+Province	8	32
	Abroad	1	4
	Total	25	100
farming	Yes	5	20
	No	20	80
	Total	25	100
Credit Paid	Yes	13	52
	No	12	48
	Total	25	100
Insurance	Yes	15	60
	No	10	40
	Total	25	100
Co-op Membership	Yes	7	28
	No	18	72
	Total	25	100
Education in the last year	Yes	3	12
	No	22	88
	Total	25	100

Source: Results from the survey.

In some villages, they were completely concentrated in one place and created big problems in the village. In some places, different practices were applied depending on the people. The road layout was not established adequately. The roads were built without qualifications. There was discrimination among people. There was a store system in the region.

Registration and distribution of title deeds for consolidation took about two years, people who were following and preparing for planting had to fallow again because their parcels were relocated, producers who later became aware of the consolidation and relocated, 48 % of the producers in the villages where consolidation was carried out were satisfied with the consolidation against 52%. 50% of them stated that they did not have aggregation, and 52% of them stated that they recommended aggregation to other producers and other villages. 20% stated that they encountered a legal problem in aggregation and filed a lawsuit.

In fact, the rate of producers experiencing legal problems is quite high, however, due to reasons such as lack of legal knowledge in filing a lawsuit, not being aware of it at the time, and being in different settlements.

The rate of those who had legal problems and filed a lawsuit remained low.

When we evaluated the producers' perspective on land consolidation according to approximately 25 criteria, how many criteria are there, 24% of the producers declared that the number of Persians did not decrease at all, and 10% of them stated that it did not decrease.

This rate is 40% in total. That is, in a region where consolidation is taking place.

It is significant that the producers make such an evaluation in consolidation, the main purpose of which is to reduce the number of parcels.

The producers' perspective on consolidation is scored from one to five, according to different variables, one strongly disagrees, two disagree, three a medium, four agree, and five strongly agree.

Table 3. General Evaluation and Satisfaction

Variable	Yes (%)	No (%)	Total (%)
Satisfaction with Consolidation	48	52	100
Recommend consolidation	52	48	100
Legal Problem	20	80	100
Perspective on the Project Positive	80	20	100

Source: Results from the survey.

If we interpret the criterion that there is a decrease in the input costs, 64% of the producers stated that there is absolutely no decrease in the input costs.

Similarly, the percentage of those who say that the ownership and shareholding problem is solved is answered as solved by 88%.

When we look at the rates given to these variables below four and five points and the rates below the average, we see that these rates are quite low illustrated in Table 4.

Table 5 offers an insight into respondents' attitudes and experiences concerning various aspects of land consolidation.

It indicates that 52% of respondents strongly agree (rated as 5) that land consolidation facilitates mechanization and enhances its efficiency, with 8% somewhat agreeing and 8% strongly disagreeing. Regarding input costs post-consolidation, 60% of respondents strongly agree they decreased, while 16% somewhat agree.

Additionally, 88% strongly agree that ownership and shareholding issues were resolved through land consolidation, along with 4% somewhat agreeing.

Furthermore, 79.2% strongly agree that land consolidation enhances soil fertility, with 12.5% somewhat agreeing.

In terms of agricultural work, 64% strongly agree that land consolidation reduces associated difficulties, while 16% somewhat agree.

Moreover, 56% strongly agree that transportation costs decreased after consolidation, with 16% somewhat agreeing.

Table 4. Perspective on Land Consolidation

Opinions	1 point	2 points	3 points	4 points	5 points	Total
Parcel count decreased	24	16	8	32	20	100
My input costs decreased	64	4	16	20	0	100
Ownership and shareholding problems have been resolved	88	4	0	8	0	100
Soil fertility increased	79.2	8.3	0	12.5	0	100
Agricultural work has reduced vision difficulties	64	12	8	16	0	100
My transportation and transportation costs decreased	56	8	12	8	16	100
My access to main and secondary roads has become easier	36	12	28	4	20	100
I can use the lands I cannot use	62.5	16.7	0	12.5	0	100
Opportunity	59.1	9.1	4.5	4.5	22.7	100
Be aware of others cultivating my land	68	12	4	16	0	100
There was no decrease in the number of parcels	48	8	4	12	28	100
The shape of the parcels has been completely corrected	41.7	16.7	12.5	4.2	25	100
Everyone was treated equally	44	12	20	4	20	100
Getting information and defending your rights	40	8	8	44	0	100
There were no parcel changes	41.7	4.2	8.3	16.7	29.2	100
Your objections have been taken into consideration	40	8	8	12	32	100
Title deeds were delivered on time	34.8	0	26.1	17.4	21.7	100
Same plot left fallow	44	4	12	16	24	100
There was no inheritance fight	41.7	4.2	4.2	20.8	29.2	100
Processed treasury lands continue	64	4	4	4	24	100
Pasture lands were protected	33.3	4.2	8.3	29.2	25	100
The exchange was made fairly	37.5	4.2	20.8	20.8	16.7	100
The evaluation of the parcels was done correctly	33.3	4.2	29.2	12.5	20.8	100
No profit was made from buying and selling parcels	36	4	24	20	16	100
Total Satisfaction	48	0	24	0	28	100

Source: Results from the survey.

Accessibility to main and secondary roads also improved, with 36% strongly agreeing and 20% somewhat agreeing. Additionally, 62.5% strongly agree they can utilize lands previously unusable due to fragmentation, smallness, and shareholding issues, with 16.7% somewhat agreeing. Satisfaction with consolidation is mixed, with 48% expressing satisfaction and 52% dissatisfaction. Finally, regarding equal treatment, 44% of respondents strongly agree that everyone was treated equally, while 20% somewhat agree.

A linear regression model was applied, taking all other variables as dependent variables and all other variables as independent variables. The R^2 value obtained is 0.85.

The explanation rate of significant variables in the model for the variance in the dependent variable is 85%.

Since the tolerance value is less than 0.10 and the VIF value is less than 10, there is no multicollinearity problem illustrated in Table 6.

Table 5. An overview of respondents' attitudes and experiences regarding various aspects of land consolidation

Variables		Frequency	Percentage
Land consolidation facilitated the use of mechanization and increased the efficiency of mechanization.	1.00	13	52
	3.00	2	8
	4.00	2	8
	5.00	8	32
	Total	25	100
After land consolidation, my input costs decreased.	1.00	15	60
	3.00	1	4
	4.00	4	16
	5.00	5	20
	Total	25	100
My ownership and shareholding problems were solved with land consolidation.	1.00	22	88
	3.00	1	4
	5.00	2	8
	Total	25	100
Land consolidation increased soil fertility.	1.00	19	79
	2.00	2	8
	5.00	3	12
	Total	24	100
Land consolidation reduced the difficulties I had in performing agricultural work.	1.00	16	64
	2.00	3	12
	3.00	2	8
	5.00	4	16
	Total	25	100
After land consolidation, my transportation and transportation costs decreased.	1.00	14	56
	2.00	2	8
	3.00	3	12
	4.00	2	8
	5.00	4	16
	Total	25	100
After land consolidation, my access to main and secondary roads became easier.	1.00	9	36
	2.00	3	12
	3.00	7	28
	4.00	1	4
	5.00	5	20
	Total	25	100
I can also use my lands, which I could not use before the land consolidation due to fragmentation, smallness, and shareholding, after the consolidation.	1.00	15	63
	2.00	4	17
	4.00	2	8
	5.00	3	12.5
	Total	24	100
My objections and requests to the hangers were taken into consideration sufficiently.	1.00	10	40
	2.00	2	8
	3.00	2	8
	4.00	3	12
	5.00	8	32
	Total	25	100
Legal Issue	Yes	5	20
	No	20	80
	Total	25	100
Perspective on the Project	Positive	20	80
	Negative	5	20
	Total	25	100
Satisfied with the consolidation	Yes	12	48
	No	13	52
	Total	25	100
Everyone was treated equally; the notables of the neighborhood were not given any privileges.	1.00	11	44
	2.00	3	12
	3.00	5	20
	4.00	1	4
	5.00	5	20
	Total	25	100

Source: Results from the survey

Table 6. Linear regression model

					Multi Connection	
Variable	Coefficient	Standard error	t statistic	p value	Tolerance	VIF
Fixed Term	1.653	1.012	1.634	0.126	-	-
Land consolidation facilitated the use of mechanization and increased the efficiency of mechanization	2.045	0.405	5.048	0.000	0.733	1.364
Would you recommend consolidation? 1=yes, 2=no)	-1.352	0.392	-3.447	0.004	0.733	1.364

Source: Authors' results.

The above table shows that two variables remained significant in the model. Due to the positive coefficient, it is seen that those who find the statement "land consolidation facilitated the use of mechanization and increased the efficiency of mechanization" positively are satisfied with the consolidation carried out in their neighborhoods. With the negative coefficient, it is understood that those who do not recommend consolidation are not satisfied with the consolidation carried out in their neighborhoods. This finding is supported by the results of [8].

Table 7 below illustrates that the R^2 value obtained is 0.697.

The explanation rate of significant variables in the model for the variance in the dependent variable is 69.7%. Since the tolerance value is less than 0.10 and the VIF value is less than 10, there is no multicollinearity problem.

Table 7 highlights the persistence of three significant variables within the model.

The positive coefficient suggests that as land availability increases, so does the pre-consolidation land presence.

Conversely, the negative coefficient implies that participants in agricultural training possess more land assets. Furthermore, non-recommendation of consolidation correlates with dissatisfaction regarding neighborhood consolidation efforts. Additionally, absence from any cooperative is associated with higher land assets.

Table 7. A linear regression model was applied, taking land assets as the dependent variable and all other variables as independent variables

					Multi Connection	
Variables	Coefficient	Standard error	t statistic	p value	Tolerance	VIF
Fixed Term	5.72	256.01	0.02	0.982		
Number of parcels before consolidation	79.13	12.41	-3.45	0.004	0.73	1.36
Attended any agricultural training program (course, meeting, demonstration, etc.) in the last year (1=yes; 2=no)	-289.92	107.82	-2.69	0.014	0.93	1.07
A member of any cooperative? (1=yes;2=no)	184.08	80.91	2.28	0.034	0.87	1.15

Source: Authors' results.

There was no increase in parcels for any producer after consolidation. There are producers whose parcel numbers remain the same or decrease. The R^2 value obtained is 0.851.

The explanation rate of significant variables in the model for the variance in the dependent variable is 85.1%. Since the tolerance value is less than 0.10 and the VIF value is less than 10, there is no multicollinearity problem illustrated in Table 8.

Table 8 indicates that the variables remained significant in the model. Due to the positive coefficient, it is seen that as education, experience, and the number of tractors increases, the number of parcels of the producer decreases more at the end of consolidation. It is seen that as the land availability increases, the land existence before consolidation also increases.

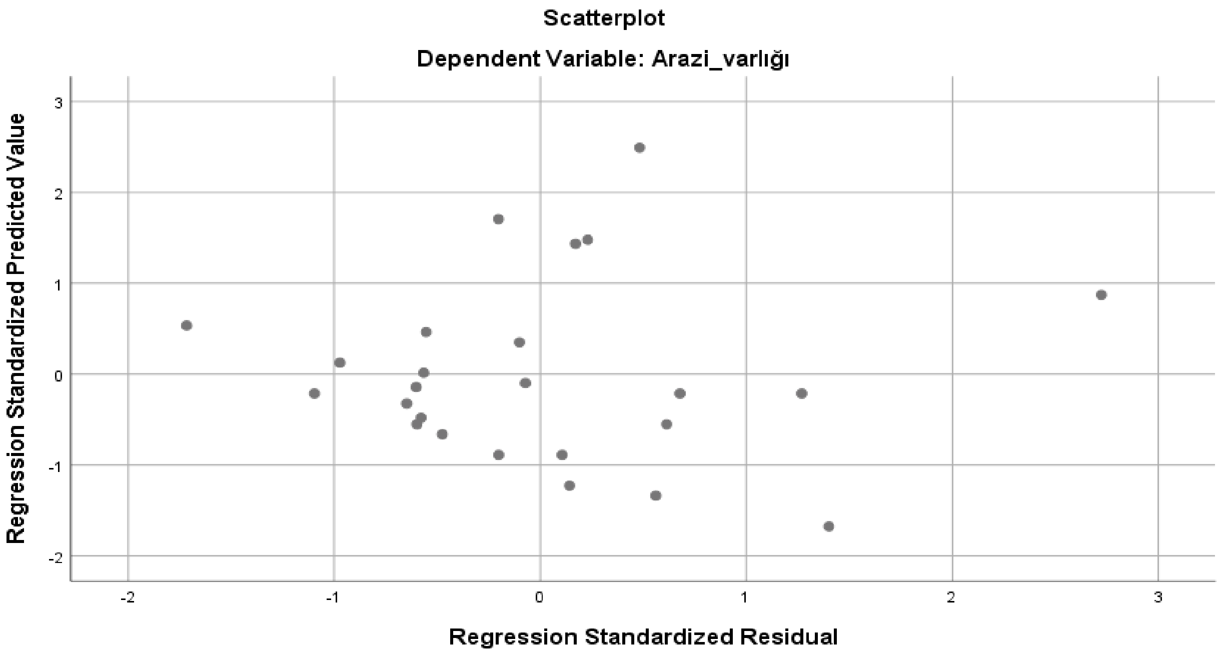


Fig. 1. Regression standardized Residual
Source: Authors' results.

Table 8. A linear regression model was applied by taking the parcel reduction amount as the dependent variable and all other variables as independent variables

					Multi Connection	
Variable	**Coefficient**	**Standard error**	**t statistic**	**p value**	**Tolerance**	**VIF**
Fixed Term	-0.26	3.30	-0.08	0.938		
Education (primary school, middle-high school, language arts and above)	3.18	0.46	6.95	0.000	0.75	1.34
Experience (years)	0.15	0.03	5.87	0.000	0.56	1.80
Number of tractors (units)	2.99	0.49	6.13	0.000	0.63	1.59
A member of any cooperative? (1=yes; 2=no)	-3.61	0.58	-6.22	0.000	0.87	1.15
Satisfied with the land consolidation? (1=yes;2=no)	-3.63	1.14	-3.18	0.005	0.18	5.52
Rate the land consolidation carried out in your neighborhood: 1-Very bad, 5-Very good?	-0.87	0.36	-2.46	0.025	0.18	5.57

Source: Authors' results.

With its negative coefficient, it is understood that the number of parcels of those who are not members of a cooperative decreases compared to those who are, because of consolidation. It is seen that the number of parcels of producers who are not satisfied with the land consolidation decreased compared to those who are satisfied after the consolidation, and similarly, those who are dissatisfied with the consolidation carried out in their neighborhoods do not have a decrease in the number of parcels compared to those who are satisfied. In this case, satisfaction after consolidation is closely related to the decrease in the number of parcels. This finding is consistent with the results reported by [5].

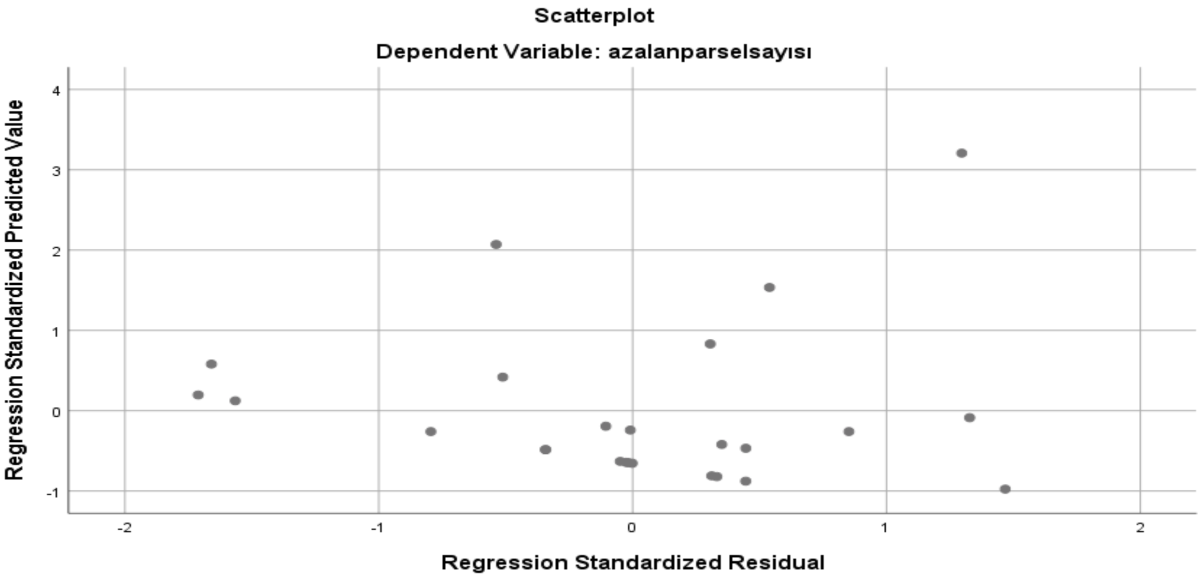


Fig. 2. Scatterplot
Source: Authors' results.

CONCLUSIONS

The study highlights the importance of consolidating fragmented land holdings to create more cohesive and economically viable agricultural units. Despite challenges such as legal complexities and concerns over property rights, land consolidation emerges as a crucial tool for improving agricultural efficiency and productivity.

The research shows the importance of factors such as education level, agricultural experience, and participation in cooperative programs in influencing the success and satisfaction of farmers with the consolidation process. Notably, farmers with higher levels of education and agricultural experience tend to experience greater benefits from land consolidation, indicating the importance of knowledge and expertise in optimizing the outcomes of consolidation efforts.

Moreover, the study emphasizes the role of farmer satisfaction as a key determinant of the effectiveness of land consolidation initiatives. Satisfaction levels are closely linked to the success of land management practices and cooperative participation, highlighting the need for inclusive and participatory approaches in consolidation projects.

Overall, the findings of the study provide valuable insights for policymakers and practitioners in the development of agricultural policies and rural development strategies. With the challenges and leveraging the opportunities associated with land consolidation, policymakers can promote sustainable agricultural development and enhance the livelihoods of farmers in rural areas. Additionally, the study underscores the importance of continued research and monitoring to evaluate the long-term impacts of consolidation efforts and inform future policy decisions.

The research contributes to a better understanding of the effects of land consolidation on agricultural enterprises in the Cihanbeyli district and provides valuable recommendations for enhancing the effectiveness and sustainability of consolidation processes in Turkey's agricultural sector.

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SOCIAL ASPECTS OF COOPERATIVE VALUES OF SOME TYPES OF COOPERATIVES IN BULGARIA

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Abstract

From their inception until now – the last 180 years – cooperatives are organizations that unite and balance the social and economic demands of society with the expectations of their members. Cooperative values and principles have been preserved for almost two centuries, which is proof of their sustainability and permanence. These values impress upon the societal values of freedom, equality and democracy. The aim of the present study is to study the social aspects of cooperative values in some types of cooperatives in Bulgaria. To achieve the goal, the following tasks are solved: (a) to examine the nature and character of cooperative values; and (b) to reveal the social aspects of these values by following their manifestation in individual Bulgarian cooperatives. To achieve the goal and solve the tasks, the methods of analysis and synthesis, induction and deduction, the structural-functional approach are applied. The main result of the study is that meeting the social needs of the member-cooperators in Bulgarian cooperatives occupies an important place, and for a significant part of the cooperators - a priority. From the analysis in this research, we can conclude that the social aspects of cooperative values in Bulgarian cooperatives makes them unique as a legal-organizational form, since these values are close to universal human values.

Key words*: *cooperatives, social responsibility, social enterprises, mutual aid, equality, Bulgaria

INTRODUCTION

Cooperatives are one of the main subjects of the social economy, through which a number of economic and social problems of a significant part of the population in the world, including in Europe, are solved.
The European Union itself is being built as a union of equal welfare states, which proves the importance of the cooperative system and its values.
For the last two centuries since their inception, cooperatives have served as organizations that harmonize the social and economic needs of society with the expectations of their members.
Throughout their long history, cooperative values and principles have remained steadfast, demonstrating their enduring sustainability. The present research aims to examine the social dimensions of cooperative values within various types of cooperatives in Bulgaria.
To achieve this objective, the following tasks are undertaken:
-To delve into the nature and essence of cooperative values;
- To uncover the social impact of these values by observing their manifestation in specific Bulgarian cooperatives.
In pursuit of these goals and tasks, methods such as analysis and synthesis, induction and deduction, and a structural-functional approach are employed.
The association of economic entities within a cooperative can allow the rapid construction of value chains and lead to an increase in both their economic results and the production capacity of the agrarian sector.

MATERIALS AND METHODS

Within the framework of the present study, information from centralized information sources and databases is used - Agrostatistics of the Ministry of Agriculture and Food of Bulgaria. The methods used are analysis and synthesis, correlation analysis.
The necessary information for the analysis has been acquired from the Bulgarian trade registry. The national and European legal

framework in the cooperative field have been studied in order to classify the cooperatives and to establish the development of the administrative environment.

RESULTS AND DISCUSSIONS

The concept of cooperatives is becoming broader and includes more forms of partnership and cooperation than the ordinary activities of traditional agricultural cooperatives.

The cooperative, as a voluntarily created organization, which, based on cooperation and mutual assistance between its members, carries out activities to satisfy their interests, changes over time [16].

In recent decades, social cooperatives, community cooperatives, social solidarity cooperatives, collective interest cooperatives and multifunctional cooperatives have been created in a number of countries (Italy, Canada, Portugal, Great Britain, etc.). This type of organizations is considered by some researchers as a combination of association and cooperation [5]. But in fact, these social enterprises are in tune with the main mission of cooperatives – to provide services in all aspects through self-help and mutual assistance to carry out activities of a common nature.

Self-help and mutual help are one of the core cooperative values [4]. Historically determined, as the most important, with a traditional character are the following cooperative values:

-self-help (autonomy, mobilization)
-mutual aid (cooperation, solidarity)
-democracy (equality)
-freedom (voluntariness)
-equality (fair distribution)
-lack of discrimination (openness)
-personality development (improvement of individual abilities, education)
-universality
-a duty to society.

The social goal, and the social aspects of the cooperative's activity is determined historically by its origin - the first consumer cooperative established in 1843 in the English town of Rochdale had as its main objective the opening of a shop for essential goods and the construction of homes for its members [23].

Today, almost two centuries later, the interests of cooperative members take precedence over those of the cooperative as a legal entity [22].

Article 1 of the Bulgarian Law on Cooperatives (1999) [6] states that the relations between the members of the cooperative are based on mutual assistance and cooperation between them, as commercial activity is carried out to satisfy their economic, social and cultural interests.

The performance of activities primarily for the benefit of the members of the cooperative is observed in the cooperative legislation of other countries (Germany, Austria, Spain, etc.), as well as in Article 1, item 3 of Regulation 1435/2003/EC regarding the Statute of European Cooperative Society [15], according to which it has as its main objective satisfaction of the needs and/or development of economic and/or social activity of the members.

To change the design and practice of current industries in ways that help realize the economy's great potential, stakeholders can take advantage of four levels of cooperation: information sharing, consultation, joint action, collective decision-making.

Cooperatives are people-oriented enterprises owned, controlled and managed by and for their members to realize their common economic, social and cultural goals and needs [9]. Concepts of sustainable economic development require the integration of different sectors and economic activities, which can be achieved through regional/cross-border cooperation. However, the stakeholders of the cooperative must have trust, responsibility and accountability.

Bulgarian legislation, through the Law on Social and Solidarity Economy Enterprises (2019) [10], defines cooperatives as one of the three entities (apart from non-profit legal entities and social enterprises) of this economy (Law on veterinary medical activity) [11]. This circumstance in the law is based on the fact that the principles of the social and solidarity economy, specified in Article 4 of this law, are traditionally highlighted in cooperatives - priority of social over economic goals, association for public and/or cooperative benefit, publicity and transparency, independence from state authorities, participation of members, workers or employees in making management decisions. A number of researchers of the theory and practice of the cooperative define it as a social model of an enterprise [8] and an economic system with social content [17]. Cooperatives in Bulgaria have a long history, and a significant part of it bears the imprint of the planned economy in the country between 1945 and 1989. The cooperative forms applied in this period have a specific character, which differs significantly from the basic cooperative model, and this leads to the mistrust of economic entities to this form of association.

One of the most popular forms of cooperation in Bulgaria are agricultural cooperatives, focused on the production, processing and sale of agricultural products. The 2020 census of agricultural producers in Bulgaria reports the presence of 713 agricultural cooperatives in the country in 2020, cultivating a total of 471,903 ha. or about 10% of the cultivated areas in the country (Table 1).

These cooperatives have focused mainly on the production of several agricultural crops: cereals and legumes, technical crops and oilseed crops (sunflower and rapeseed). Throughout the presented period, the agricultural areas managed by cooperatives decreased, while the total volume of areas, especially at the end of the period, increased. This process leads to the gradual decrease in the relative share of the areas managed by cooperatives and, accordingly, their potential for development [18].

Table 1. Relative share of the areas used by agricultural cooperatives

Used agricultural areas, ha			
Period	2013	2016	2020
Total agricultural holdings	3,794,910.54	3,795,534.35	4,564,152.00
Cooperatives	565,372.87	510,697.63	471,903
Relative share	14.90%	13.46%	10.34%

Source: Ministry of Agriculture, "Agrostatistics", Results of the census of agricultural holdings in Bulgaria in 2013, 2016, 2020 [12].

The number of agricultural cooperatives also decreased during the research period (Table 2), and in 2020 only 713 such cooperatives were operating in the country. The relative share of cooperatives, as part of all agricultural producers, is extremely small - only 0.56%.

The significant difference between the relative share of agricultural cooperatives in the total number of producers and their relative share in farmed areas shows that their average size is greater than the average values for the sector.

This fact creates an opportunity for these cooperatives to improve their position in the sector in the future if they apply more innovative cooperative models and include more activities from the value chain.

Table 2. Relative share of agricultural cooperatives

Agricultural cooperatives in Bulgaria			
Period	2013	2016	2020
Total agricultural holdings	244,594	184,448	127,278
Cooperatives	811	767	713
Relative share	0.33%	0.42%	0.56%

Source: Ministry of Agriculture, "Agrostatistics", Results of the census of agricultural holdings in Bulgaria in 2013, 2016, 2020 [12].

The application of such innovative models of cooperation can be supported by borrowing experience from other European countries and their cooperative associations. Within the European Union, there are dozens of working examples of added value chains built within a cooperative association of producers pursuing both their own economic and cultural goals, as well as responding to public interests.

Cooperative values and principles, their social aspects were evaluated and implemented more than 130 years ago in Bulgaria - the first cooperative was established in 1890 in the village of Mirkovo, Pirdopsko as an agricultural credit cooperative [13].

According to data from a large-scale study conducted by [2] for the period 2005-2023, a total of 9,037 cooperatives were registered in Bulgaria, of which the largest number of active cooperatives was in 2005 - 5,274, and the least in 2021.

In this study we analyse the status of the cooperatives according to the Commercial Register and found that as of June 2023, for the researched period there were:

-2,818 cooperatives with an "active/active" status,

-4,747 with an "inactive/inactive" status

-871 cooperatives were deleted,

-443 ceased economic activity

-104 are in liquidation

-33 are in reconstruction

According to the cited authors, during this period, cooperatives developed activity in almost all economic sectors. The largest number of established and functioning cooperatives are in:

-"Agriculture, Forestry and Fisheries" sector - over 50% of the total number

-"Trade, Car and Motorcycle Repair" sector - 16%

-"Real Estate Operations" sector - 8.5%,

-"Processing industry" sector - 7.8%.

Bulgaria's integration into the global arena, coupled with the liberalization of animal trade and products, ongoing agricultural and processing industry transformations, and its geographical location, heighten the risks associated with the emergence and widespread transmission of infectious animal diseases and zoonoses.

In the decade following 1990, Bulgaria witnessed a shift in animal husbandry practices marked by the deconcentration of large farms. While these changes helped address veterinary issues by reducing the disease propensity of intensive animal farming, challenges persist in combatting certain diseases like leukosis, where progress in containment remains limited.

The veterinary medical service in our nation boasts a rich history spanning centuries. Bulgaria's strategic location as a potential pathway for the spread of animal diseases and toxins from Asia to Europe underscores the vital role of our veterinary medical service in implementing proactive measures to combat epidemics and safeguard both our nation and the broader European community from infectious diseases and zoonoses.

Given the predominantly private nature of veterinary practice, it stands as one of the primary professions allowing for independent practice, akin to fields such as law and humanitarian medicine (Haas, 1990). In industrially and agriculturally advanced nations, the ratio of private practitioners to public service veterinarians typically ranges from 1:3 to 1:9, mirroring a similar trend observed within our country (Register of veterinary medical institutions with registered veterinarians, BABH, 2023) [14].

In Bulgaria the battle against anthrax, brucellosis, trichinellosis, tuberculosis, and cysticercosis (canine tapeworm) remains particularly pertinent. Effectively combating these diseases necessitates systematic and comprehensive approaches that extend beyond the capabilities of individual veterinarians and cooperation among them might become a necessity. It requires coordinated efforts by large-scale veterinary organizations at national and international levels, equipped with the necessary technologies and specialized teams capable of mounting rapid and qualified responses to these challenges [3].

In the 1940s, Bulgaria saw the establishment of a veterinary and livestock cooperative, which by the end of 1945 boasted 452 members and possessed assets exceeding BGN 10 million [7]. During the same period, the cooperative generated sales of nearly BGN 18 million in goods and BGN 1.5 million in tools. Additionally, it engaged in the production of cheese yeast, verulin, and crystallin [23].

Several factors drove the collaboration among veterinary specialists within the cooperative:

-Swift response to requests from farmers and businesses.

-Internal specialization enabling the performance of diverse veterinary services.

-Mutual support in executing large-scale state veterinary initiatives.

-Cost savings through collective procurement of medications, equipment, biological preparations, and other necessities.

-Enhanced efficiency in utilizing outpatient clinics, offices, and inventory resources.

Regardless of the tendency to decrease the number of active cooperatives in the country, they have an important role in significant sectors of the economy. Cooperative values continue to satisfy social needs of cooperative members.

The authors of this study have in 2023 randomly selected and analyzed a number of statutes of various cooperatives in Bulgaria. It was established that the studied cooperatives largely protect the social interests of their members. Thus, in Article 5 of the Statute of the comprehensive agricultural cooperative "Saglasie" [19], in the village of Lovnidol, municipality of Sevlievo, it is written that part of the subject of the cooperative's activity is "Meeting the needs of its members and their social support in accordance with its economic capabilities", as and "Providing assistance to build and support the functioning of the social infrastructure in the settlement".

Article 5 of the Articles of Association of the Electricity Production Cooperative "Vineyard Committee Zheravica", Montana [1], also states that the cooperative aims to provide its members with quality and continuous electricity supply.

In the Statute of a water supply cooperative from the city of Ruse [20], Article 6 states "The purpose of the cooperative is: Construction and management of a plumbing installation, ensuring the supply of drinking water to the real estates of its member-cooperators located in the city of Ruse .... , as well as the accounting of the drinking water consumed and the collection of the amounts due".

Main function of "Aidemir-98" cooperative, Aidemir village, Silistra municipality [21], acc. Article 4 of its Statute requires the cooperative to work and assist in satisfying the interests of its members by carrying out commercial, social, cultural and other activities.

The statutory provisions of the other cooperatives analysed by the authors are similar. Meeting the social needs of the member-cooperators occupies an important place, and for a significant part of the cooperators - a priority. The social aspects of cooperative values give uniqueness to the cooperative as a legal-organizational form, since these values are close to universal human values, which are immutable.

CONCLUSIONS

The practice of veterinary medicine is governed not only by legal regulations but also by moral, ethical, and biomedical standards. Given its nature, which involves the provision and delivery of services, the cooperative emerges as a fitting organizational structure. However, it's important to recognize that no single form of organization can resolve all challenges automatically. Success and prosperity in this field depend on individuals who can exhibit entrepreneurial spirit, leveraging their professional expertise and adeptness in navigating market opportunities.

Building a sustainable network aimed at the creation and maintenance of new cooperative models may be a prerequisite for their application, especially in their initial deployment.

The various cooperative models can help the development of the economy in Bulgaria and the construction of a new generation of value-added chains based on it.

Achieving this goal requires the activation of local management and investment resources through the proper targeting of various forms of public support.

In conclusion, it can be summarized that the cooperative, through its cooperative values such as democracy, voluntarism, and mutual assistance, has real opportunities to participate in the sustainable development of economic sectors in all countries.

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RESOURCE REQUIREMENTS OF BULGARIAN CATTLE FARMING AND OPPORTUNITIES FOR ADAPTATION OF DIGITAL SYSTEMS

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Abstract

Bulgarian cattle farming plays a key role for the advancement of local agriculture. Bovine milk is an important product for local consumers, with dairy products forming a large part of the local diet. Cattle farming has not stray from the tendency of transformation that Bulgarian agriculture has undergone, resulting in lowering production capacity at the end of the 20th century and continuing development under the CAP of EU after 2007 (the accession of Bulgaria to the EU). Resource management has been an issue for local producers, that face fierce competition on the Common market for most of the processed products. Improving production efficiency through the adaptation of digital resource management can create opportunities for the development of the sector and improving its competitiveness. The purpose of this study is to analyse the resource requirements of Bulgarian animal husbandry farming and disclose some opportunities for application of digital solutions for resource management. The methods used are analysis and synthesis, statistical analysis based on data from centralised databases. The main result from the study is focused on the growth of cattle farming in Bulgaria during the studied period and thus the feeding material requirement, while at the same time the prices of these materials have risen significantly. The conclusion is focused on this significant market change, which leads to the necessity of better resource management for Bulgarian cattle farms and the introduction of digital systems to support it.

Key words*: *fodder stock, digital management, supply chain management

INTRODUCTION

In recent years, livestock breeding in Bulgaria has developed dynamically, with an increase in the number of animals, investments in modern technologies and production practices. This sector has a key role in feeding the population and provides basic raw materials for the processing industry. It creates jobs for people, improves food security, promotes rural development, and contributes to economic growth.
Bulgaria has good natural conditions for the development of animal husbandry and the state policy is aimed at creating conditions for the sustainable development of the sector and protecting the interests of farmers. The sector is supported through various financial instruments with funds from the European budget under the two pillars of the CAP (for direct payments and market measures and for rural development), as well as with national funds.
Ensuring a favourable regulatory and economic environment enables more efficient management of farms, improving the profitability of production, increasing safety and quality of production. This contributes to guaranteeing farmers' incomes and accelerating the sector's economic growth.
The main goal of this research is to evaluate the state of Bulgarian cattle farming, assess its resource requirements and analyse the opportunities for adaptation of digital system for improved resource management.

MATERIALS AND METHODS

In order to achieve the goal of this research, the following tasks are solved:
-to analyse the state of the cattle farming sub sector of Bulgarian farming and its role;
-to evaluate the requirement for resources of Bulgarian cattle farming;
-to propose and assess the opportunities for adaptation of digital technologies for improved resource management.
This study is based on data from multiple sources, among which are the Agrostatistics desk of the Ministry of agriculture and food of

the Republic of Bulgaria [8], as well as its System for agro-market information, as well as the FAOSTAT database [4]of the UN.

The methods used in this study are literature review, analysis of data sourced from centralized databases and synthesis of information.

RESULTS AND DISCUSSIONS

By the end of 2022, a total of 559,544 cattle were bred in the country - 5.1% less than a year earlier. The total number of cows decreased by 5.2% on an annual basis, to 361,476 cows, with a more significant decrease recorded in dairy cows - by 7.9% (to 197,996 cows), and a weaker one in beef cattle - by 1.8% (up to 163,480 units). The share of beef cattle in the total number of cattle increased to 45.2%, at 43.6% in 2021. This is a result of the ongoing process of specialization of production in cattle breeding, which is characterized by a shift from dairy to meat.

Bulgarian cattle farming has improved in 2021 by 3.7% with cattle rising to over 589 thousand. The increase in the number of cows in the country was leading the trend with growth rate of 3.8% or 381,419 producing animals, this process was also evident in the significant rise of 19.1% of beef cattle, that was to the expense of dairy cows, which reduced by 5.6%. This process has led to the improvement of the role of bovines, as they reached 43.6%, compared to 38% in 2020.

Cattle bred in the country in 2020 totalled 568,726 - 11.4% more than a year earlier. The total number of cattle increased by 10.9% on an annual basis (up to 367,529), with the increase being less pronounced in dairy cows - by 5.8% and more significant in beef cattle - by 20.3%. Thus, the share of beef cattle in the total number of bovines reached 38%, compared to 35% in 2019. In 2020 in connection with the global pandemic of COVID-19 and the introduced state of emergency and anti-epidemic measures, eligible farmers are supported to offset the increased costs under measure 21 "Extraordinary temporary support for farmers and small and medium-sized enterprises that are particularly affected by the crisis, caused by COVID-19" from the Rural Development Program 2014-2020, including under measures 21.1 "Extraordinary temporary support for farmers COVID 1" also covering the sector "Livestock" (cattle, buffalo, sheep and goats), and 21.3 "Extraordinary temporary support for small and medium-sized enterprises and recognized groups and organizations of producers COVID 3".

In 2019, the negative trend of decreasing as the size of Bulgarian cattle farming is maintained. By the end of 2019, the number of cattle in the country dropped by 16,031, meanwhile, the number of buffaloes grew by 7.1%. In 2019, the trend of increasing the number of large ruminants from the meat sector continues, and by the end of the year, the number of beef cattle increased by 8.8% compared to a year earlier. The reason for this negative trend is the difficulties faced by livestock breeders - lack of markets for milk, low purchase prices, huge bureaucracy, and heavy European requirements.

In the case of buffaloes, there is a persistent trend of increase in animals during the study period. By 2022 – the tail end of the studied period, the number of buffalo has raised by nearly 60% compared to 2017, the first year studied.

Although buffalo products - both milk and meat are valued and have a high price, buffalo breeders also complain about difficulties in selling milk, which many dairies buy at the price close to the cost of production [5].

For the studied period, a trend of increase in large ruminants from the meat sector was observed. This contributes to the deepening of the process of production specialization in cattle breeding, which is characterized by a shift from dairy to meat production. The applied schemes for production-linked support in animal husbandry (including schemes for beef cows and animals under selection control) favour this process.

In 2022, for almost all types and categories of farm animals, the number of farms reduced, but their average size expanded in comparison with the prior year (Table 2). The most significant rise in the average number of animals observed on average was recorded for buffaloes - by 20.1% (up to 37). The year-on-year rise in the average number of buffaloes is 12.8%, of cattle - by 12%, of cows - by 10%.

Table 1 Number of bovines bred in Bulgaria for the period 2017-2022

Kind of animals	2017	2018	2019	2020	2021	2022
Cattle - total, incl.	540,115	526,491	510,460	568,726	589,512	559,544
Cows in general	348,691	340,818	331,415	367,529	381,419	361,476
- dairy cows	252,056	234,055	215,219	227,795	214,936	197,996
- beef cows	96,635	106,763	116,196	139,734	166,483	163,480
Buffaloes-total, incl.	12,809	15,625	16,734	20,179	21,686	20,317
buffaloes	8,720	10,309	11,471	14,147	15,407	14,841

Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

By the end of 2021, there were 460 farms raising buffaloes - 5.5% less on an annual basis, while the number of buffaloes in them increased by 8.9%. The number of farms raising cattle and cows also decreased by 10% and 8%, respectively, but the average number of animals raised in them increased by 15% for cattle and 13% for cows.

By the end of 2022, farms raising buffaloes decreased by 11.7% on an annual basis, to 406, and the number of buffaloes in them - by 3.5%.

In improvement of the number of farms raising all types of bovines was registered in 2020, as well as the amount of producing animals and animals for fattening in them. Buffalo farms expanded by 53.1% up to 487, and the animals in them by 23.3%. Cattle farms have risen by 25.2%, and the number of animals in them - by 11.4%. The number of farms with cows increased by 22.5%, and the number of animals in them - by 11%.

In 2020, there was a contraction in the average size of livestock holdings, which is explained by the larger number of farms. The most serious is the decrease in the number of buffalo per farm - from 38.3 in 2019 to 28.2 in 2020, which is a decrease of over 26%. The annual decrease in the average number of buffaloes is by 19.4%, of cattle by – 11%, of cows – by 9.5%.

Table 2. Number of farms and animals in Bulgaria for the period 2018-2022

Years	Indicators	Cattle - general	Cows in general	Buffaloes-general	Buffaloes
2018	No. of animals, thousand	526.5	340.8	15.2	10.3
	Farms, thousand nos.	27.2	25.6	0.4	0.3
	Avrg. No. of animals/farm	19.4	13.3	39.0	34.3
2019	No. of animals, thousand	510.5	331.4	16.7	11.5
	Farms, thousand nos.	22.6	21.3	0.4	0.3
	Avrg. No. of animals/farm	22.6	15.6	41.8	38.3
2020	No. of animals, thousand	568.7	367.5	20.2	14.1
	Farms, thousand nos.	28.3	26.1	0.6	0.4
	Avrg. No. of animals/ farm	20.1	14.1	33.7	28.2
2021	No. of animals, thousand	589.5	381.4	21.6	15.4
	Farms, thousand nos.	25.5	24.0	0.6	0.5
	Avrg. No. of animals/ farm	23.1	15.9	36.0	30.8
2022	No. of animals, thousand	559.5	361.5	20.3	14.8
	Farms, thousand nos.	21.6	20.7	0.5	0.4
	Avrg. No. of animals/farm	25.9	17.5	40.6	37.0

Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

In 2019, the trend of sectoral withdrawal continues with farms raising cattle and cows decrease 17% each, while at the same time the buffalo farming has preserved its positions.

The average farm size has been improved providing a base for further development and technological performance. When analysing cattle farming this increase is 16.5%, while dairy farming has an improvement of 17.3%, in buffaloes of 7.85%.

The trend of reduction in the number of farms raising animals is maintained in 2019, mainly due to the termination of part of the small farms. The process of consolidating the sector contributes to the greater sustainability of farms, more efficient and profitable production.

Compared to the previous year, cattle farms decreased by 16.9% and buffalo farms decreased by 3.1%.

The development of Bulgarian cattle farming trough the studied period has led to the further concentration of production. These larger farms are characterized by more sophisticated management techniques in most cases and a closer attention to resource management. The demand for compound feed and other feeding materials needed for the farms is continuous and managing the farm's supply chain is of great importance for its final economic results.

The processes underway in Bulgaria's cattle farming are complex. Some of the smaller farmers are closing due to higher EU production standards and low economic results. The milk production part of cattle farming in the country has seen a slight decline in its production capacity, but a significant decline in overall production – 23% from 2016 to 2022 (Figure 1).

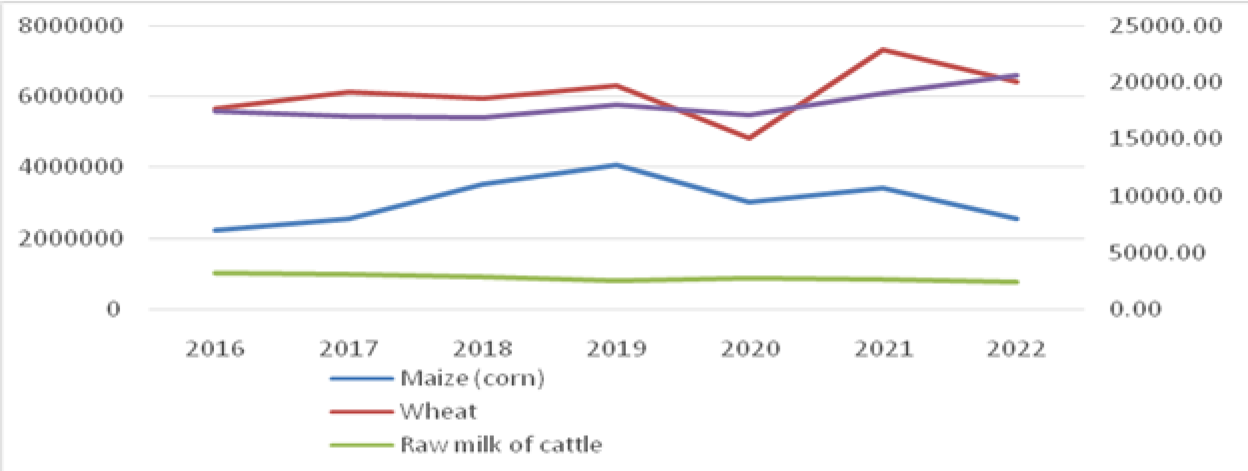

Fig. 1. Production of key feeding materials and their relation to main products in cattle farming
Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

While milk production has declined, the overall production of meat has increase throughout the period (Figure 1 scale for meat is on the right axis). This slow change in production type for some farms and focus more on meat than milk production has led to changes in the used feeding materials. The main feeding materials in the country are bran of maize and other by maize byproducts as well as wheat as the main ingredient for compound feed. Combined they attribute to over 60% of the feed used by local farmers (Mihaylova, et al., 2015) [7]. This has led to a high economic impact of the price increase of these products on the international market, as Bulgarian producers are export oriented (Figure 2).

The prices for both products follow the same trajectory throughout the studied period. With small early changes the overall tendency is toward an increase and at the end of the period both maize and wheat are exported at a price close to 350 USD per ton. This 75% increase in the price of maize in just two years – from 2020 to 2022 and its significant importance as feeding material in Bulgarian cattle farming has raised production costs significantly. Some producers have tried to replace maize with other materials, but their prices have also increased.

These higher prices are also reflected in the compound feed offered on the local market with an average price of over 450 euro per ton (Figure 3). That market increase in prices for the main production resources has led to significant decline in farms economic results. The buffalo farms, as previously noted has suffered the most from these raises in feeding material costs.

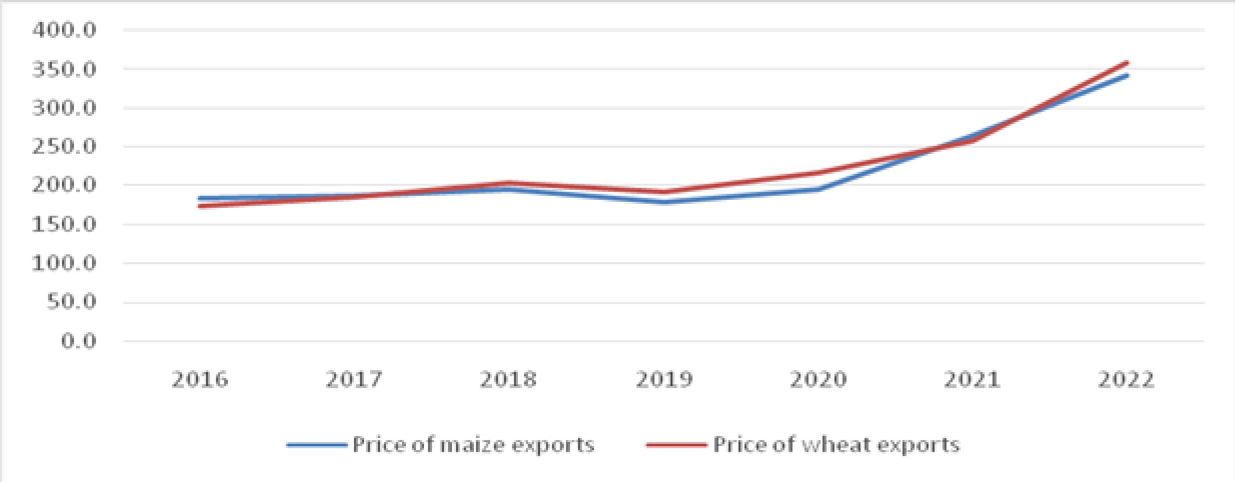

Fig. 2. Average yearly export prices of maize and wheat (in USD per ton)
Source: Own calculation based on data sourced from FAOSTAT Database [4].

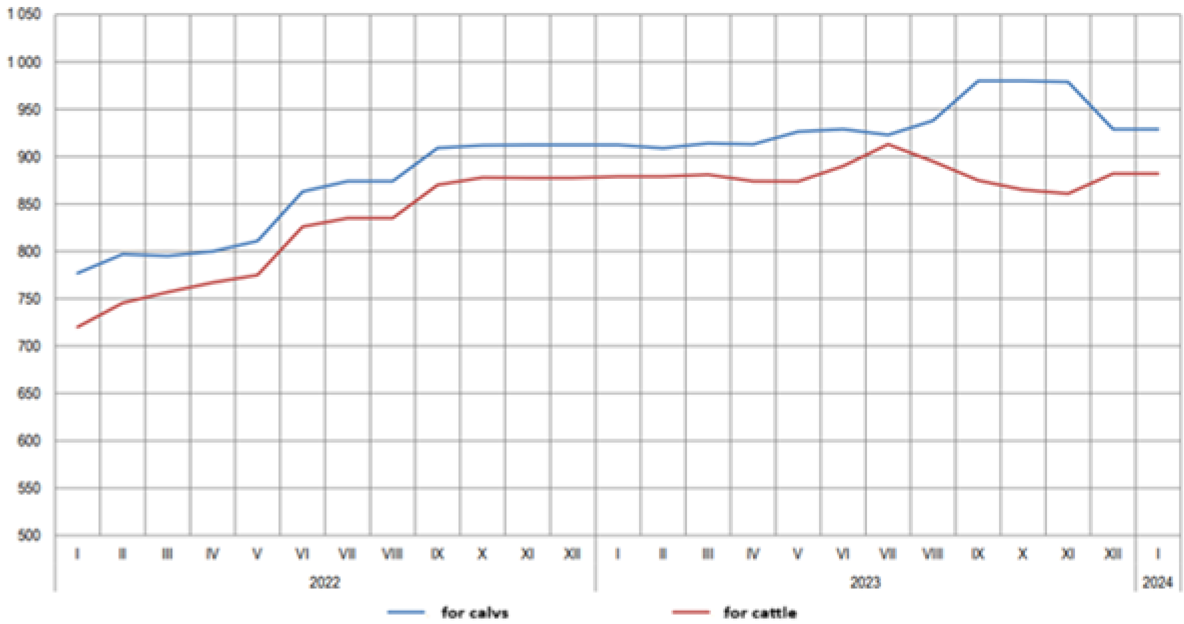

Fig. 3. Wholesale price of compound feed in Bulgarian lev per ton (1 Euro = 1.95583 BGN, or 1 BGN = 0.51 Euro)
Source: Ministry of Agriculture and Food Industry, Agrostatistics, SAPI [8].

The increase in material prices has led to the underlined importance of better resource management on a farm level. Some producers have chosen to implement digital tools to help them optimize their feed stocks and adjust faster to market fluctuations.

In 2019, within the financial support framework of the Horizon 2020 program, AgroHub.BG was started in Bulgaria. The main objectives of this organisation are the digitization of Bulgarian agriculture and rural areas in cooperation with Bulgarian stakeholders in order to assess their needs of digital skills and ensure access to them (Kostadinova, 2021) [6].

Agroberichten Buitenland (2022) [1] emphasized the need of reforms and investments in the digitalization and innovation of agriculture within Bulgaria's National Recovery Resilience Plan, destined to extend various technological stages based on digitalization (feeding, milking, watering and cleaning, management and monitoring of livestock farms, fertilization, GPS systems for identifying permanent grass areas, drones, etc.

Petkov and Dimov (2022) developed a mathematical model for estimation of the digitalization of the production structure in animal husbandry [10].

Data-driven solutions within the supply chain are now seamlessly integrated through the utilization of tools and methodologies developed by big data analysts. Enhanced and expedited solutions aid businesses in analysing and comprehending real-time outcomes pertaining to extensive data sets, encompassing aspects like integrity, volume, variety, and velocity (Alkahtani, M., et al. 2021 [2]; Stoyanov et al. (2021) [12].

Organizations can enhance their supply chain by curbing costs and mitigating risks. The amalgamation of data technologies and agri-food initiatives is pivotal in fostering novel insights by broadening farmers' data accessibility, advancing services, refining processes, and software. It also contributes to the evolution of future factories and the adoption of information and communication technologies alongside pertinent agricultural and big data frameworks.

Cutting-edge innovations in warehouse logistics and automation, encompassing digital and robotic solutions, are revolutionizing contemporary warehouses from traditional physical entities into interconnected and intelligently operating ecosystems. Amidst the era of global connectivity, e-commerce, and online retail, the supply chain landscape has grown exceedingly intricate, leading major corporations to establish and manage warehouses and distribution centres across diverse and remote geographic locations. Various challenges confront the effective management of modern farm warehouses, yet they often find a common resolution in automation. Visionary technological concepts such as IoT (Mo, 2011) [9], Big Data, artificial intelligence, mobile robotics, specialized warehouse management software, and others empower facility managers within the realms of warehousing and logistics to not only synchronize with the dynamic nature of the supply chain but also secure competitive advantages. These advantages encompass improved efficiency, security, and safety, expedited and more precise order processing, and increased capacity. Furthermore, the automation of operational tasks like packing, sorting, and tracking liberates intellectual resources, redirecting them towards critical, tactical and strategic endeavours (Büyüközkan and Göçer, 2018) [3].

Stoeva et al. (2021) pointed out that digitalization in Bulgarian agriculture will increase the branch competitiveness [11].

CONCLUSIONS

The digitalization of cattle farms is a slow and undergoing process with some farmers already having RMS products introduced and supported by local companies. The overall level of automation is still low as farmers choose to react to market changes as they happen and not have systems that can react on their behalf.

The main causes for disruption in the farm’s feed supply can be the poor organization of the procurement process - delayed delivery, the inability of the contractor to fulfil supply obligations for objective reasons - production causes, accidents, etc., logistical issues and the increase of purchase prices. All of these issues can be combated with a large-scale digitalization of the sector with the introduction of a large number of data collection points on production and the automated supply of market date to the managers.

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INFLUENCE OF LEADER ON THE SUSTAINABLE DEVELOPMENT OF RURAL REGIONS OF BULGARIA

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Abstract

The present study is oriented towards Leader approach and its contribution to the sustainable development of rural territories in Bulgaria. The upgraded model for decentralized and integrated development of rural regions has been implemented in Bulgaria since 2014. The goal of the study is to trace and analyze the actual contribution and the effect from the work of the local initiative groups and the implementation of the approach on a local and national level, and identify the problems and derive the solutions for optimization of the processes, aiming at achieving greater sustainability in the territorial development of rural regions. The main hypothesis is that the approach is universal and sustainable instrument for development of rural regions, but its full potential has not been completely deployed under the conditions in Bulgaria, yet. To this end, the implementation of the strategies for development of pre-selected local action groups is analysed, depending on certain criteria. Empirical data have been summarized and the opportunities for increase of the efficiency of the acquired European funds on territorial scale have been substantiated.

Key words*: *Leader approach, CLLD, development, rural regions, sustainability

INTRODUCTION

Leader approach has been subject of studies of different Bulgarian institutions and authors like Ministry of Agriculture, Food and Forestry, Court of Auditors, (2023) [2], [9], [11], [7], [14, 15], [16], [4] and others. Their reports, opinions and viewpoints although oriented towards Leader cover different aspects of it, the investigations of [1], [3], cover the results and problems from the first programming period 2007-2013, [11], studies Leader as an instrument providing opportunity for development of rural regions, [12], and [13], turn the attention to the endogenous approach of management in Leader and the definition for rural regions, [6], reviews the contribution and the place of Leader in the preservation of the natural resources and so on.

Also, the European Network for Rural Development provides information about LAGs in Bulgaria and the other EU countries [5].

The results obtained from them mainly have a quite general and broad scope, while the present study is oriented towards specifically selected Local Action Groups (LAG) according to the pre-set criteria described in section Materials and methods. The goal is a more detailed and in-depth study of Leader approach over the programming period 2014-2020. This way we will be able to derive and specify on a local scale the main problems and factors, giving rise to them.

The study thesis is that the approach is a universal and sustainable instrument for the development of rural regions but it has not deployed its full potential, yet in the Bulgarian conditions.

The goal of the study is to trace and analyse the actual contribution and effect of LAG and the implementation of Leader approach/CLLD locally, by identifying the problems LAG encounters and deriving solutions for the optimization of the processes for the development of rural regions, which will be taken into account in the next programming period.

Regarding the goal set we have identified the following **tasks**:

-To study the contribution and the influence of Leader approach upon local development of six LAG;

-To establish the main problems in implementation of Leader approach and the factors originating them;

-To derive solutions for optimization of the results of Leader approach.

To this end, we will review the implementation of the strategies for development of six LAG from the programming period 2014-2020 of the Rural Development Programme (RDP) selected according to the pre-set criteria and the implementation of the approach. This will be done by having established, summarized and analysed the data from their reports and the information from MZHG on results achieved.

MATERIALS AND METHODS

Primary and secondary sources of information were used for the purposes of the study. Primary sources were official documents, reports of LAG, strategies and policies for development on a national level, statistical and analytical materials from NSI (National Statistical Institute), MZHG (Ministry of Agriculture, Food and Forestry) and others. Secondary sources were scientific publications and the results of interviews held with experts from the six LAGs and representatives of the local community and stakeholders from the covered region, on-site and over the phone. Traditional scientific research methods have been used: general scientific, historical and logical; empirical and theoretical – observation, description and measurement; logical-theoretical – comparison, analysis, synthesis, induction, deduction.

The six LAGs have been selected according to the respective criteria, to have one implemented strategy from the preceding programming period 2007-2013 and an approved and on-going strategy from the present programming period. 28 LAGs met these criteria out of which we selected six, one LAG from the six areas into which is divided Bulgaria according to the strategic plan for development of the country, north-western area, north-central area, north-eastern area, south-eastern area, south-central and south-western area. We also strived to select a LAG representing one, two and three municipalities and at the same time one with single-fund and multi-fund financing. That suggests that these are people, who coped with all problems and disorders accompanying the approach in the past years, who managed to implement thousands of projects, consultations, trainings and activities accompanying the implementation of Leader. They have proven that they have the required capacity and competence to work with the different funds, know the problems of the beneficiaries and enjoy their confidence. Everyday commitments for the implementation of the strategies, the different trainings, the exchange of good practices and the field work for 16 years now turn them into one of the best experts in the implementation of Leader approach. It is namely for these reasons that the institutions should take into consideration their views concerning the implementation of Leader approach.

Due to the delayed start of RDP 2014-2020 and the numerous administrative and regulatory disorders in the first years of the period there is almost no data to report in the annual reports of LAG about the progress of the implementation of the strategies. For these reasons, the study of the six LAGs takes into account the data about the three years - 2020, 2021, 2022, during which there is a tangible progress in the implementation of the strategies.

RESULTS AND DISCUSSIONS

The present study is oriented towards Leader approach and its contribution to the sustainable development of rural territories. Leader has proven to be one of the best instruments in the policy of the European Union (EU) for dealing with the social-economic, cultural and infrastructural problems of rural regions.

Specific characteristics of Leader approach in Bulgaria

During the 2007-2013 programming period the approach was mandatory for all EU Member States. In Bulgaria, officially for the first time Leader has been implemented as AXIS 4 of the Rural Development Programme (RDP) for the period 2007-2013.

During the 2014-2020 programming period, its direct successor and upgraded model for decentralized and at the same time integrated development of rural regions is the Community-led local development (CLLD). It has been implemented in Bulgaria as measure 19 of the RDP. The approach had an extended scope of implementation and received financing from almost all European funds. It also gives rise to the Common strategic framework for development of the territories. Furthermore, it is in harmony with all priorities of the EU, the national and regional strategies and plans for development. That also includes the strategy of the EU for smart, sustainable and inclusive growth („Europe 2020") [17].

Regulation 1303/2013, Regulation 1305/2013 of the EU, and the goals and priorities adopted by them originates the multi-fund financing of Leader for the present period. These goals have been transformed into six common priorities for the entire EU, out of which RDP of each member state must be developed so that apart from its specific needs it should cover at least four of the six priorities. RDP 2014-2020 of Bulgaria [8] has been elaborated so that it covers all of the six priorities (Figure 1).

All measures included in RDP 2014-2020 contribute to the implementation of at least one priority. Horizontal interventions including innovations, counteraction to the climate problems, preservation of the environment and sustainable management of the resources have also been elaborated to achieve all goals, which will be inserted in the implementation of all measures, where possible. As already mentioned herein above the CLLD approach itself, was presented as measure 19 of the RDP of Bulgaria, the effect and interventions of which are expressed through the implementation of multisectoral and integrated strategies for development, that take into account the specifics and the characteristics of the respective territory which they have been planned for.

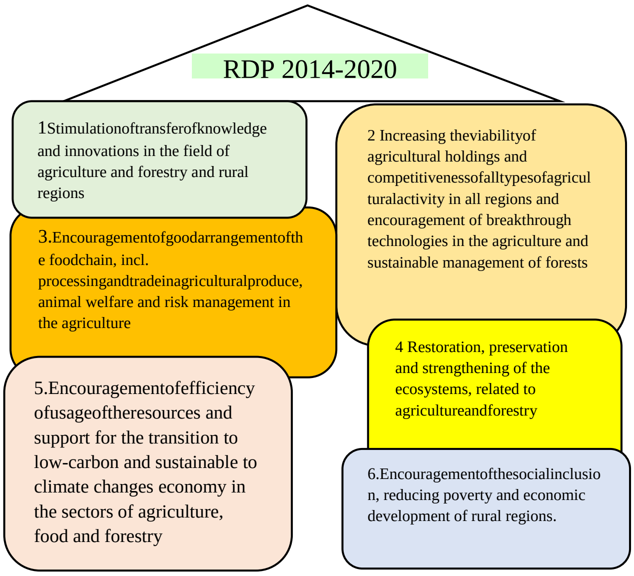

Fig. 1. The six priorities of RDP 2014-2020 of Bulgaria
Source: Bulgaria Rural Development Programme, 2014-2020 [8].

The strategies have been developed by local action groups (LAG), which comprise representatives of the local community. Their members are representatives of the public bodies, the business, the non-governmental organizations and others, none of which exceeds 49% of the votes. LAGs are the basic structural element of the CLLD approach; they are expression of the decentralized management of these regions. They also rely on the thesis that these are the people that best know the local problems and their solutions.

The strategies have also been planned in harmony with the national, regional and municipal plans for development; their main goal is the social and economic development and preservation of the natural and cultural values. And namely, this overlapping and synergy in the activities results in additionally upgraded and added value, which is of paramount importance for these regions, and this is also the origin of the greater efficiency and efficacy of the approach.

Even with the single-fund financing for the approach, enviable results could be achieved by resolving different local problems, activating and mobilizing local communities, development of the local potential and building up of the public-private partnerships.

Unlike the first programming period, the present Leader has much greater scope of action – both, territorially and by number of sectors. It covers almost all regions of the country with the exception of cities with more than 30,000 inhabitants and their adjacent territories. It receives support from the Operational Programmes (OP) through the multi-fund financing with the help of which its budget has been tripled against the 2007-2013 period. Which is a great recognition for the approach and its contribution to the development of rural regions on an European level.

Leader is in harmony with the policies for development of EU, it is multisectoral and its goal is transformation of these sites into attractive regions for living with high social, economic, cultural and sustainable for nature standard of life.

Results from the implementation of Leader in Bulgaria

There are a total of 105 LAGs existing in Bulgaria. We included six of them in our study. The LAGs selected by us are quite various according to their scope and selection of strategies. Three of the LAGs include 1 municipality, two of them comprise 2 and one consists of three municipalities. The 6 LAGs cover a total territory of 4,465.2 km with 162 800 inhabitants.

To get a more real idea as to the effect from the implementation of the strategies on the rural municipalities we will present a summarized information and analysis of the reports of implementation and the data in ISUN (Information System for Management and Monitoring) and MZHG of the strategies for development of the six LAGs selected according to the criteria set by us, and namely – LAG Razlog, LAG Isperih, LAG Yablanitsa – Pravets, LAG Novi pazar – Kaspichan, LAG Belovo, Septemvri and Velingrad, LAG Sredets.

Approval of the strategies of LAG in Bulgaria for the programming period 2014-2020 is carried out in two stages. The first was in 2016. with 39 approved strategies, 20 single-fund (Figure 2). Due to the weak and disordered information campaign of the Managing Body (MB) of the approach in the initial period regarding the multi-fund financing, the interest in it was not quite big. The second stage, which completed in 2017, had 25 strategies approved, out of which 5 were single-fund. The percentage of the multi-fund strategies was significantly better. The total value of the financial resource, included in the strategies for CLLD from the programmes financing the CLLD approach was BGN 305 million, or 59 per cent of the planned funds under all programmes for inclusion in the strategies (Court of Auditors, 2023) [2], which is a great omission of resource for rural regions.

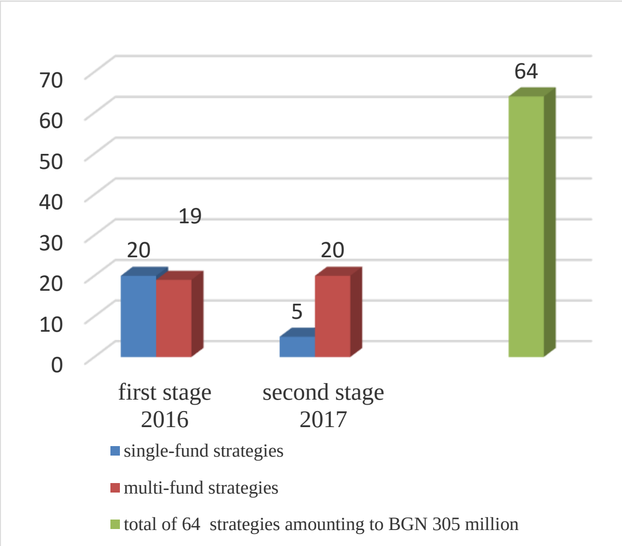

Fig. 2. Stages upon approval of LAG development strategies in Bulgaria
Source: [8].

The next two years (2017 and 2018) were concurrent by numerous disorders and contradictions between the requirements for application of the strategies for CLLD and the ordinances of the MZHG, the Management of Resources from the European Structural and Investment Funds Act, and Decrees 161 and 162 of the Council of Ministers, particularly for LAG applying multi-fund strategies. In fact, due to these circumstances, the work on implementation of the strategies began at a later stage, upon their approval.

In 2019 there were hardly any projects started, the intense work on the strategies began in

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2020. In fact, the negative results specified were just before the expiry of the programming period of RDP 2014-2020. The implementation of the approach in Bulgaria is hardly possible, with a view of the deadlines set for implementation of the strategies. Thanks to delays of the legislative procedures of the European Commission related to the next programming period, Regulation 2020/2220 of 23.12.2020 of the European Parliament and of the Council, the period of operation of RDP 2014-2020 was extended and 2021 and 2022 were declared transitional and the completion deadline is 2025. Extension of the programming period provides opportunity to everybody involved in the implementation of the approach for a good implementation of CLLD in Bulgaria over this programming period. The fault for the delay lies entirely with the MB of RDP and it is at the expense of the development of rural regions.

The main structural elements of a strategy are **the projects** under the measures and goals selected. The projects planned for implementation from the six LAGs include projects under the measures from the RDP, Human Resources Development Operational Programme (HRD OP) and Operational Programme Innovations and Competitiveness (OPIC); their total number under all programmes is 307 projects. Under RDP there are 272 planned, under HRD OP 25 and under OPIC - 10. During the analysis of the reports we found that the total number of applications filed by candidates before the end of 2022 were 373; LAG approved 272 of them, and out of them 162 contracts were signed, and the subsidies paid for completed projects were just 67 (Table 1).

Table 1. Completion of projects of the six LAGs

LAG CONTRACTOR	Projects under individual programmes		Signed contracts by years			Signed contracts 31.12.2022	Completed projects as of 31.12.2022	Contracts with paid out subsidy
	programmes	number	2020	2021	2022	number	%	number
Razlog	RDP	39	6	7	7	20	51	8
Isperih	RDP	55	1	12	13	27	49	7
	HRD OP	6	2	2	0	4	66	4
	OPIC	4	1	2	1	5	125	5
Yablanitsa Pravets	RDP	45	1	8	4	13	28.0	4
Novipazar Kaspichan	RDP	60	10	6	8	25	41.6	9
Belovo, Septemvri Velingrad	RDP	36	12	5	6	23	63	0
	HRD OP	16	5	5	0	11	68	10
	OPIC	6	7	1	0	11	183	0
Sredets	RDP	37	6	12	12	20	64	17
	HRD OP	3	0	0	0	3	100	3
Total		**307**	**51**	**60**	**41**	**162**	**54**	**67**

Source: Own calculations, Based on data from LAG [4].

Our research shows the great difference between the applications approved by the LAG and the signed contracts: 110 projects were dropped out, of which 22 have been withdrawn. This was due to the duplication of one and the same task: applications pass through two- and three-stage verification on the part of MB of RDP and its sub-units, and their function should be reduced to only a check-up for irregularities and conformity with the guidelines, without performing additional assessments. In Bulgaria, approval of projects is structured so that the last word for approval and paying out (the funds under the) projects will have the State Fund Agriculture (DFZ); this way the principles of the approach for decentralized management are violated, and furthermore, the complicated procedure creates numerous problems for everybody, including leading to a loss of interest on the part of the beneficiaries.

It should be noted that withdrawal of applications was through the fault of MB of the RDP, which was due to a great extent to the extensive delays of the deadlines and changes in the regulatory framework on the part of MB.

The total percentage of implemented planned projects against the signed contracts amounts to 54%, and when compared to the subsidies paid for completed projects it is 21%. As seen in Table 1, if we consider the results of the different programs, we shall see that the poorest results belong to RDP with it the percentage against the signed contracts is 47% and the percentage against paid and completed projects is 16%, unlike the previous programme where the ratio of HRD OP is 72% to 68%; with OPIC there is a certain over fulfilment of 160% to 50%, considering the paid and the completed projects. Taking into account that the greater part of the measures and projects of the strategies are from the RDP, it becomes clear why the results from implementation of the strategies are not so good. The poor results of the implementation of the measures under RDP are due to a great extent to the very management of the Programme [18]. According to the interviewed LAG experts, working with the MB of the other operational programmes is much easier and proliferative. Weaknesses in the management of the approach influence negatively both acquisition of funds and the overall implementation of the approach.

The six strategies include 9 measures of RDP and 1 measure included in the Regulation (EU) 1305/2013, 4 – outside of the Regulation, but complying with its goals, 9 under HRD OP and 3 under OPIC. Their total number is 26 measures with 307 projects under them, of the most diverse nature. Aiming at better representation of the scope of influence of the approach, we will present in a synthesized form the most used measures from the 6 LAGs analysed in our study (Table 2).

Table 2. Completion of projects of the six LAGs

MEASURES	Financing Programmes	Measure title
Measure 1.1	RDP	Vocational training and skills acquisition.
Measure 4.1	RDP	Investments in agricultural holdings.
Measure 4.2	RDP	Investments in processing/marketing of agricultural products.
Measure 6.4	RDP	Investment support for non-agricultural activities.
Measure 7.2	RDP	Investments in creation, improvement or extension fall type of small- scale infrastructures.
Measure 7.6	Included in Regulation 1305/2013	Research and investments, related to maintenance, restoration and improvement of the cultural and natural heritage in the villages.
Measure 20	Outside of Regulation 1305/2013	Creation of local tourist product related to the local heritage and food.
Measure 1	HRD OP	Development of entrepreneurship.
Measure 2	HRD OP	Social-economic integration of marginalized communities.
Measure 1.1	OPIC	Support for integration of innovations in the enterprises.

Source: Own calculations, Based on data from LAG [4].

On the basis of the measures mentioned the broad pallette of the effect on rural territories becomes clearly visible. Interventions assisted by LAG are of the most varied nature, comprising strengthening of the local identity, restoration and conservation of architectural and cultural values, rural tourism, creation of local marks, building up infrastructural sites, preservation of the biodiversity and environment, support and modernization of the agriculture, numerous trainings for integration of the minority groups, development of entrepreneurship and crafts and many others.

The requested funds under the six strategies amounted to BGN 27,570,424, the amount from the signed contracts BGN 18,702,605, the actually paid money were BGN 7,226,995 as of 31.12.2022 (Table 3).

The average value of one of the six strategies amounts to BGN 4,595,070, but the misbalance between them is significant.

Table 3. Comparison between target and acquired budget of the six LAGs

CONTRACTOR	Target budget for the period 2014 – 2020 according to CCLLD in BGN	Signed contracts as of 31.12.2022 in BGN	Achieved for the period from signing of CCLLD, paid-out funds up to 31.12.2022 in BGN	Percentage ratio of target against competed %
LAG Razlog	3,732,700	2,094,181	637,677	17
LAG Isperih	5,830,247	4,299,858	2,007,895	34
LAG-Yablanitsa-Pravets	2,754,800	1,785,999	557,979	20
LAG Novi pazar-Kaspichan	3,732,745	2,028,397	677,178	18
LAG-Belovo, Septemvri and Velingrad	8,005,646	6,545,041	1,796,874	22
LAG- Sredets	3,514,286	1,949,129	1,549,392	44
TOTAL	27,570,424	18,702,605	7,226,995	26

Source: Own calculations, Based on data from LAG [8].

The strategy with the greatest valueis the one of LAG Belovo, Septemvri, Velingrad - BGN 8,005,646 and respectively, the one with the lowest from the LAGs included in the studyis that if LAG Yablanitsa-Pravets BGN 275,480; it is evidence that the difference is a bit more than three times. This difference is due to the single-fund financing, which a great loss for rural regions. On a national level, there are 4 LAGs, which have measures included from all OPs and their strategies amount to more than BGN 10,000,000. Around BGN 214,000,000 were transferred from the budget of LEADER under the OP to other items of the OP due to non-acquisition. Here alsothe fault is to found to a great extent in the MBand in the Ministry (MZHG). Upon opening of the first admission of documents for approval of the strategies of LAGs there was still not sufficientclarity as to the process of workwith the operational programmes, not to mention passing any kind of training or anything, which could prepare LAGs in that aspect, which reveals insufficient capacity on an institutional level. It is not by chance that during the first admission, the major part of the strategies were single-fund ones. Which preconditioned the low level of acquisition of means under the other funds, as early as then. Another indicator that we will turn our attention to is **the number of workplaces created**.

As a contribution from the completed projectsfor the increaseof the scopeof the work places, opening up of a total of 212 workplaces were planned under the six strategies. As of 31.12.2022 there were 160.5 work places opened, where the half means a work place for halfworking hours. As a percentagethe figure reaches up to 75% of completion of the target set, which isvery good, but as seen in Table 4, the good result comes from the significant over fulfilment of two of the OP.

When calculating the target and achieved values, table 4 shows clearly that for RDP is 26%, for HRD OP is 278% - i.e. the huge over fulfilment comes from LAG Sredets, which did not plan opening up of new work places for the projects under the OP, but at the same time, they succeeded in opening up 58 work places, and for OPIC - 104% - another over fulfilment. For this indicator, the LAGs with multi-fund financing showed much better results, and the OP, respectively, thanRDP. Which again returns us to the negative effect of the MB of RDP rendered upon the implementation of the approach.

From the reports of implementation of the strategies for the period 2014-2020, the target number of people, who will make use of the improvements made under the LAG projects like the IT services provided, different infrastructural sites etc. is 95,245, achieved by LAG for the period analysed were 39,772 or 41% of the planned.

Again the best results show LAG Sredets, with an over fulfilment 135%, with total for LAG Sredets planned - 7,406 people versus 10,035 - achieved.

Table 4. Number of opened up work places by the LAG projects

Contractor	Target for the period 2014 – 2020 according to CCLLD Work places, opened as a result from the support of the projects	Achieved for the respective year			Achieved for the period from signing of CCLLD up to 31.12.2022	Percentage of the target againstachieved
		2020	2021	2022		%
LAG - Razlog	RDP 39	0	5	9	14	35
LAG-Isperih	RDP 24	0	0,5	3,5	4	16
	HRD OP 10	4	0	4	9	90
	OPIC 8	4	0	4	20	250
LAG-Yablanitsa-Pravets	RDP 21	0	4	3	7	33
LAG Novi pazar-Kaspichan	RDP 35	0	0	12	12	34
LAG-Belovo, Septemvri and Velingrad	RDP 29	0	0	1	1	3.4
	HRD OP 15	0	0	0	2,5	16
	OPIC 15	0	20	4	28	186
LAG- Sredets	RDP 16	0	0	5	5	31
	HRD OP 0	58	0	0	58	
Total	212	66	29.5	45.5	160.5	75

Source: Own calculations, Based on data from LAG [8].

Taking into account that inhabitants within the six LAG are 162,800 people according to them, and 39,772 are making use of the interventions done by LAG, the result is good: approximately every fourth person in these municipalities is enjoying somehow the benefit of the Leader approach. The positive influence of Leader on a certain region is not only due to the direct interventions. Considerable part of improvement of the standard within a given territory is due to the indirect contributions and the added value from the implementation of Leader in one region. As a good example, we can point out any given project for building up of tourist infrastructure for visiting nature's or archaeological landmark. Supposing, for example, that the given project plans for no opening up of workplaces. But via increasing of the tourist flow, resulting from the contribution of the project, restaurantsneed to be opened to take care of the catering needs of the tourists, the accommodation facilities need to be increased in number, as well as the transport lines, etc. All of this is an additional contribution of Leader to the social and economic status of rural regions.

Figure 3 shows the results from the implemented strategies and their effect upon **the unemployment**. Although the results of the LAG for opening up of work places, as a number, against the affected population are not great, according to the data from the National Statistical Institute (NSI), the unemployment in the studied 9 out of 10 municipalities sustainably was dropping during the three-year period analysed by us. In 2022, only in the municipality of Belovo we can observe the unemployment percentage to get back from 8.1 in 2021 to 9.5 in 2022.

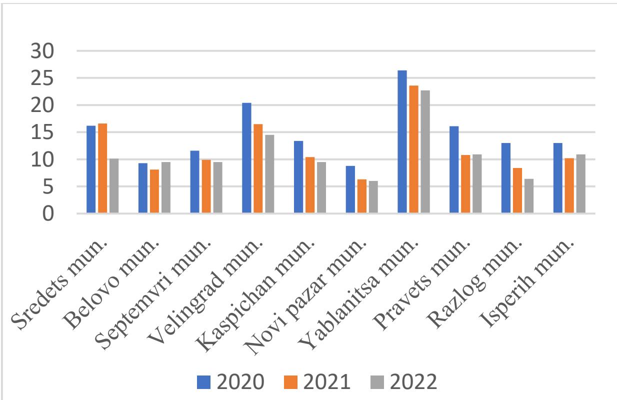

Fig. 3. Unemployment coefficient in the municipalities covered by the six LAGs
Source: based on data provided by NSI [10].

In all other municipalities studied by us, the reduction of the unemployment coefficient is in a stable decline. Most significant it is in the municipality of Razlog – from 13% in 2020 to 8.4% in 2021, and reaching 6.4% in 2022.

To what extent the unemployment reduction is due to the Leader approach is contestable but it has certainly rendered considerable effect in the positive direction. For more than several decades, no investments connected with certain strategies and projects for development in these territories have been

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made. Even on the occasions when some particular intervention was implemented, it did not have any complex nature and synchronisation with any other more general plan for development of the given region - these were isolated cases.
In support of the above statement are also the replies we got during the interviews we did with experts from the six LAGs and representatives of the local community (Figure 4). When asked whether other similar instruments supporting the general development of the region were implemented in their regions, 73.2% replied with “no”, 14.1 “did not know” and barely 12.7% responded positively. Concerning the opinion of the respondents, in which of the sectors specified the approach rendered its most significant effect for their development, each of the people asked gave two answers, graded as 1st and 2nd rank, according to the data of Figure 4. The answers obtained were from almost all possible sectors which Leader could influence, which shows that the strategies for local development and the projects fulfilled are diverse and universal. It turns out that the greatest support received, the infrastructure (19.2%) in general. Second place was for the tourism (17%), third place occupied the combat with the unemployment (10%) followed by the business, enterprises, factories.

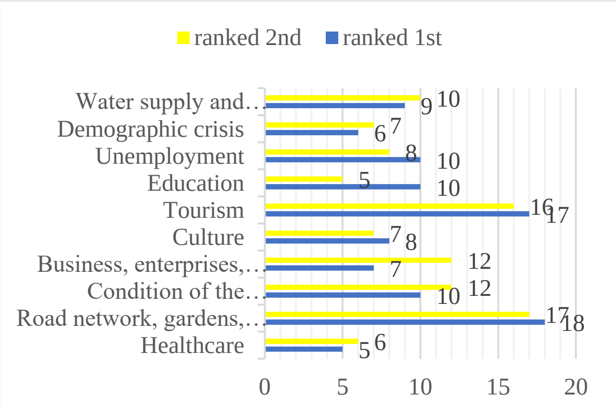

Fig. 4. Leader’s effect on the development of the sectors
Source: Own design based on the respondents' answers.

According to the opinion of the interviewees, the weakest support of the approach was for the demographic crisis, considering that a major part of interventions, as a secondary contribution in the future are contributing namely to the combat with the demographic crisis, and there an effect in the positive direction is expected.
The problem with the demographic crisis is also the greatest challenge before these regions and its overcoming would be the best indicator for the successful work of the Leader approach in these territories.
Although in Bulgaria the approach did not deploy its full potential, Leader is particularly important for the rural municipalities and the small populated places and the interest in it is related to the belief that there is no other such instrument, helping the complete and sustainable development of the territories.

Additional contribution of LEADER/CLLD on the rural territories

The influence of CLLD upon the respective territory is not measured only via the planned and completed within the strategy indicators of number of projects and supported holdings and enterprises, services, number work places, etc. The effect of Leaderon a given territorystarts as soon as the LAG was built. They (LAGs) create a network of relationships between different organizations on a local level, municipalities, administrations, public, private and civil organizations, as well as maintain connections with institutions on local, regional and national level. This way, apart from building up good strategies, municipal management of the municipalities is improved. With its characteristic interrelations Leader places the region in a much more favourable environment for development. Coordination between the civil and private sector, in the face of LAG and the municipal authorities and the created partnership relations between them, facilitate significantly achievement of the synergy and the multiplication effect of the implemented projects for the given territory. Through creation of horizontal and vertical connections in the different units of management, Leader acquires the image of a powerful, decentralized, integrated and territorial instrument for management of local level.

Application of the principles of the Leader approach contribute to a balanced and sustainable development of rural regions. Even when financing from only one fund is used, according to the regulation, the three pillars of the sustainable development must be followed – economy, environment and social improvement. And considering that the people preparing the strategy are representatives of different layers of the local community, the balance is guaranteed. The Leader approach is oriented towards increasing of the quality of life of the entire community and it is in harmony with all policies for development, unlike the other OP, which are oriented towards a certain sector or group. Here lies also the further boost of the results of the projects and the added value of the approach.

Through the CLLD approach the capacity of the LAG itself and of the local community is increased, they pass and organise hundreds of trainings and consultations, promote and disseminate the strategies for development, assist in the processing and adoption of numerous projects. Through LAGs the social capacity is increased, different meetings for exchange of experience, ideas are organised, knowledge is expanded and the entrepreneurial spirit is developed in people [11]. Unlike direct candidates, beneficiaries of CLLD become active builders of the future of their regions and gain the self-esteem and confidence to work with all programmes on a national level. Trust and mutual help is built between the local actors and LAGs and despite how small they are, they manage to implement their ideas. The different events held by LAG develop the civil society in the rural regions and contribute to the combat with the social exclusion, which in many places is a significant problem.

Problems and challenges before LAG/LIG

Although the approach is being implemented in Bulgaria for a second programming period, the barriers in front of its implementation are many and of various nature. The interviews carried out with experts from LAG and representatives of the local community point out the main problems which they see for the implementation of the Leader. Their view points are united in the following problematic areas (Figure 5).

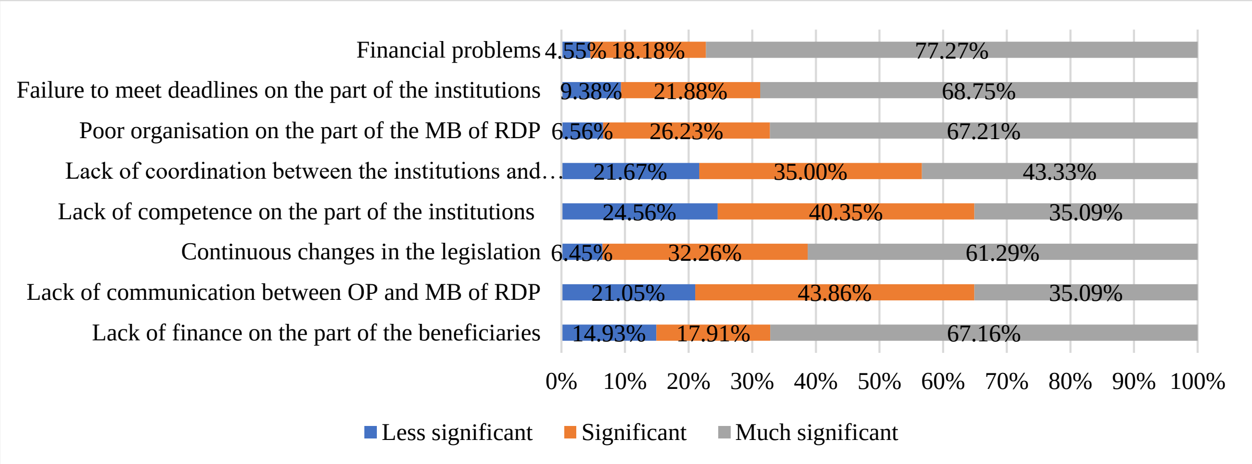

Fig. 5. Basic problems upon the implementation of Leader, evaluated by significance by experts of LAG and representatives of the local community
Source: Own design based on the respondents' answers.

As the most significant problem they specified the financial problems - with 77.27%, second by significance problem – with 68.75% was failure to comply with the deadlines (delays) on the part of MB and their subordinate units and third place – with 67.21% took the poor organisation on the part of the overall implementation of the approach.

Their viewpoints overlap to a great extent with the conclusions and summarizations we made both, on a local and national level.

As a result of our study with the listed the six groups and representatives of LAG, we identified the following problems:

-Reduction and lack of time resource, due to the permanent delays in the approval and the assessment procedures within the different stages of the implementation of the approach.

-Lack of sufficient in number and competent staff in the management and in some LAG

-The regulatory and the administrative framework is subjected to permanent changes and it is too complicated and clumsy.

-There is no sufficiently good coordination between the different institutions and the stakeholders, which delays all steps in the work process.

-Untimely and insufficient financing hinder the work of the LAG and results in failure to acquire the budget, allotted for the Leader approach.

A major part of the problems identified in the first programming period are carried forward and deepen in the second programming period.

Delays in the implementation of the approach is to be outlined as a characteristic feature for the entire period of implementation from 2007 till the present day. Their occurrence is in quite various aspects –upon approval of the strategies, approval of the planned and incurred expenses, approval of procedures for assessment of projects, contracting projects of beneficiaries and so on. Thus, for example delays at the beginning of the programming period 2014-2020 would result in overall delay in the implementation of the approach and undoubtedly, renders its effect on the next programming period 2021-2027. In some cases it is about a delay of more than two years.

In their vast majority, these are caused by **lack of sufficiently in number and competence staff** in the management of the approach, which is outlined as another key problem. Within the current programming period there is a great turn-over of staff and experts on the part of almost all structures involved in the implementation of Leader. Lack of sufficient administrative capacity and the disorders it causes, which are encountered upon implementation of the CLLD approach, render their negative effect on the implementation of the strategies and create risk for acquiring of the planned funds [16]. Due to delays in payments (caused) by the State Fund Agriculture (DFZ) to LAG this problem was also frequent in the LAG, and for the smaller municipalities this problem is quite serious. Which, in turn, gives rise to numerous other problems, leading to insecurity and repellence of beneficiaries.

Another characteristic problem for the overall implementation of Leader, again originating from the management of the approach, is **the regulatory and administrative framework**. The problems in this aspect can be in the form of unclear, incomplete and constantly changing regulatory framework, heavily regulated environment, severe and complex requirements for financing of LAG and beneficiaries.

Within the current and the past programming period, on many occasions LAG were left without financing for long periods of time, in many cases, more than a year. This deadlock places LAG in a financial and political dependence causing mistrust in the local communities. There have been occasions where LAG, did not even have any funds for the salaries and remunerations of the experts, which compels them to search for loans from municipalities and banks. Similar are the problems related to the beneficiaries, originating from the complex regulations, failures to comply with the deadlines, bureaucracy, and all of this results in loss of interest and withdrawal of the beneficiaries and failure in implementation of the projects.

Another quite essential and repeating problem is **the dialogue between LAG and MB of RDP and all units involved in the implementation of the approach**. The correspondence on the part of MB of the RDP only in the form of periodic meetings with the representatives of LAG and forwarding documents of the European Commission, is a meagre contribution to the good communication. The process of exchange of the information for implementation of RDP, for the CLLD approach, is clumsy, unreliable and does not suggest quick receipt of the necessary data and making timely and adequate decisions [2]. Lack of trust, lack of sufficient dialogue in many cases is a precondition for the loss of coordination and harmony, which is needed in order to optimize the processes for implementation of the approach. In case there is good dialogue we can save plenty of time and funds and significantly improve the efficiency and the results of the strategies for local development.

As the most essential and significant problem is the **acquisition of the allotted financial resource for the Leader approach**. In the first programming period the contracted funds were 92% of the entire budget allotted for Leader, out of which a mere 56% did successfully come as investments in rural regions. In the present period out of a total budget of BGN 596,722,781, for CLLD the funds planned under the strategies are BGN 305,163,531 or 58%. The result of which will be that as soon as the funds are requested, the local community would be deprived of the use of a resource amounting to BGN 213,678,511. Failure to acquire major part of the financial resource originates from the high percentage of strategies with a single-fund financing.

The maximum budget of one strategy for development of LAG that can make use of all OP can be up to 12 million levs, and the average value of the strategies in Bulgaria amounts to BGN 4,700,000. Considering for example, the LAG studied by us, out of the funds planned for them under the strategies amounting to BGN 27,570,424, contracts have been signed for just BGN 18,702,605 or 67%, out of which the fund actually paid and entered the economy of these region were a mere BGN 7,226,995 or 26%, as of 01.01.2023.When distributing the above percentages on a national scale, which are approximately the same, we will get the following figures. All paid-out funds will be 26% of BGN 305,163,531, which are just BGN 79,342,518, on the background of the entire budget planned of nearly BGN 600,000,000, which had to enter the economies of these poorly developed territories, so – the losses for the rural regions are huge. Taking into account that these interventions were planned for the programming period 2014-2020 and for several years now we should have been working with the resources for the next programming period 2021-2027 and the wasted time resource, the loss for the rural territories is truly enormous. This is a resource, which would have rendered its significant effect on the life and means of living of the people living in theseplaces.

The implementation of the approach in the structured in this way functioning environment moves away the approach from the true nature of the LEADER idea. Which lies in the decentralization, equality, multisectoral orientation, compliance with the specifics of the local culture and identity, the right to make your own decision on your own future. This calls for a greater freedom of action, for greater flexibility of the local community to really resolve its problems and to observe the principle „bottom-to-top“(Economic and social advises, 2023), as there are quite a few attempts for making decisions in the reverse order „top-to-bottom“. Overcoming of the identified weaknesses, which hinder the work of LAG and of the Leader approach, would result in increasing of the efficiency and to the desired by everybody transformation of these places into attractive places for living.

CONCLUSIONS

The goal, scope and multisectorality of the measures included in the strategies confirms the thesis that the approach is universal and sustainable instrument for the development of rural regions. Regardless of the problems, which the local initiative groups encounter in Bulgaria, the approach remains a basic working engine for sustainable social and economic development of poorly developed territories. The influence of the assiduous work of the LAG and the contribution of the approach is visualised in diversifying the local economy with the emergence of new business sites and services, modernisation of the municipal buildings, infrastructure, in preservation of the cultural heritage and the local identity. The effect from the interventions done is visible and valued by the local community, which is confirmed by the immense interest to Leader in Bulgaria.

As a summarization from this study, we can say that the full potential of Leader approach/CLLD in Bulgaria has not yet been fully deployed. Local communities and the persons in charge for the management of the approach should not allow any poor and incomplete implementation of Leader, which would discredit and put the approach in an office mode with regulatory and financial dependence, in an environment quite different from the methodology of Leader.

For the optimization of the results of LAG, it is necessary to ensure expansion of LAG's powers, providing greater autonomy in implementation of the strategies, increasing of the financing and freedom in the possible set of measures and activities. Improvement of the dialogue and trust between MB and LAG can reduce to a minimum the dependence of LAG on the institutions, reduction of the administrative and regulatory burdens, as well as model of management in the implementation of the approach under the Bulgarian conditions. The harmony between them would undoubtedly provide the opportunity for more rational and useful implementation of Leader in Bulgaria.

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TESTING THE POTENTIAL OF INNOVATIVE TREATMENTS OF WHITE GRAPE MUST WITH VEGETAL PROTEINS – SENSORY IMPACT ON WINE

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Abstract

In white wine production, for some grape varieties, it is beneficial to technologically reduce the concentration of the polyphenols to make the final wine less bitter and astringent. Normally, the removal of excessive polyphenols is addressed by fining the wine with polyvinylpolypyrrolidone (PVPP), a synthetic polymer, or animal proteins, which bind the tannins. However, the nowadays trend is to replace the products of animal or synthetic origin with vegetal or inorganic ones. In this paper innovative technologies based on treatments with pea protein, alone and in combinations with other vegetal or inorganic products, were tested. Also, as another innovation, the treatments were performed directly on the must, to remove some of the polyphenols before they can be oxidized. Six variants of Tamâioasa romaneasca, treated with pea proteins and combinations of agents, were compared with a non-treated variant and with the classical treatment with PVPP. The resulting wines were evaluated by professional tasters based on a complex sensory evaluation sheet and sensory profiles were determined for all variants. Multivariate statistics analysis was also applied to determine the most promising alternative treatments acceptable for the wine consumers.

Key words: *innovative wine fining, pea protein, wine consumers, wine sensory profile*

INTRODUCTION

White wines, especially those produced with maceration, as it is the case of aromatic wines, have often too many bitter substances extracted from the skins and seeds, most of them polyphenols. To remove some of the polyphenols and reduce the bitterness a very good oenological product is the polyvinylpolypyrrolidone (PVPP) [6, 18, 5]. Due to its synthetic origin [18], PVPP is a controversial oenological product for which alternatives are actively sought. As it acts by absorption of polyphenols in a similar way as proteins [8], animal and vegetal proteins are the first choice for its replacement, with the vegetal proteins [11] being the most acceptable alternative. The newest researches have focussed on several vegetal alternatives, of which some are already accepted for use including by the OIV [13], namely the potato [3] and pea protein. However, besides the proteins, chitosan, a polysaccharide used for protein haze prevention [14] and other purposes [21], also proved to be effective on removing some types of polyphenols [4, 19]. Chitosan is also approved for the use in oenology as long as it is not obtained from crustaceans, but from fungi, such as *Aspergillus niger* [7] or *Agaricus bisporus* [12], in this way being of a vegetal origin.
Combinations of these new materials with other already consecrated materials such as bentonite or activated carbon are also actively tested in several laboratories.
In the present paper pea protein was tested as an alternative for removing bitterness from an aromatic wine of Tamaioasa romaneasca. Several combinations of pea protein and other approved oenological materials were applied and compared with the classical non treated or PVPP treated variants. The main focus was to determine how these treatments affect the sensory perception of the resulted wines, as each of these substances can remove different compounds, thus potentially changing the

overall sensory profile. Applying alternative technologies is crucial to modulate the wine quality and attract more consumers in a market in which production and consumption face various challenges [17].

MATERIALS AND METHODS

The oenological materials used in this study were purchased from authorized providers of oenological materials. Thus, the pea protein Proveget 100 is from Agrovin (Spain), PVVP SMARTVIN, chitosan Kitosmart andactive carbon Acticarbone 2SW are from Enologica Vason (Italy), and calcium bentonite Microcol CL G and yeast hulls OENOLEES are from Laffort (France).

To produce the variants, the following combinations of materials were used (Table 1):

Table 1. Variants and oenological materials used for treatments

Vari-ant code	Pea protein (PP)	Chito-san (K)	Yeast hulls (Y)	Car-bon (C)	Bento-nite (B)	PVPP
V0	-	-	-	-	-	-
PV	-	-	-	-	-	√
PP	√	-	-	-	-	-
PPYB	√	-	√	-	√	-
PPCB	√	-	-	√	√	-
PPCY	√		√	√	-	-
PPKY	√	√	√	-	-	-
PPKC	√	√	-	√	-	-

Source: Own experimental design.

A total dose of 20 g/hL oenological materials was used for each variant and repetition. Three repetitions were produced for each experimental variant in stainless steel tanks of 50 l volume.

The treatments were applied directly in the must obtained from Tamaioasa romaneasca grapes, harvested on October 16, 2023. The main parameters of the must, determined in accordance to the OIV methods [15], before treatments, were: density = 1.111 g/mL, fermentable sugars 246 g/L, total acidity 4.28 g/L as tartaric acid, pH= 3.66, acetic acid 0.04 g/L, L-malic acid 0.7 g/L and polyphenols 526 mg/L. For the clarification and polyphenol removal the materials were allowed to stay in contact with the must for 24 hours, after which the must was racked and inoculated with the same *Saccharomyces cerevisiae* yeast (Arome plus Fermol AEB yeast). After 2 weeks of fermentation at 14ºC the resulted wines were racked again, treated with a dose of 50 mg/L sulfur dioxide for antioxidant protection and bottled in glass recipients of 0.75 L. A month after bottling the wines were submitted to sensory analysis using a method patented in our laboratory [1]. Based on this method, which was fully explained in previous papers [2], the main taste, visual and aroma descriptors were evaluated on intensity scales from 0-10 by a team of professional tasters. Where possible, detailed aroma descriptors were also provided by the wine tasters. Scores on an evaluation sheet of 100 points were also allocated to each wine (variants and repetitions).

The results collected from the wine tasters were analyzed with appropriate statistical methods (ANOVA, post-hoc Tukey test and PCA) using the software packages Origin 2018 (OriginLab, USA).

RESULTS AND DISCUSSIONS

Influence of oenological treatment on main sensory parameters

To determine the sensory influence of the various fining treatments, the results collected on evaluation sheets from each taster for each experimental variant and repetition were gathered in a database and statistically analysed.

For the main taste parameters (acidity, sweetness, astringency, bitterness and extract perceptions) and for the perception of colour intensity the results are included in Table 2.

As it can be seen, the perception of acidity is inversely correlated with the perception of sweetness.

The wine variants which did not receive any treatment were perceived as sweeter and less acid than others, which shows that in the absence of a good clarification by any type of fining, the fermentation was not completed up to dryness.

Table 2. Main taste and visual sensory parameters of experimental wines (values on intensity scales up to 10)

Wine sample groups	Taste related and visual parameters					
	Acidity	Sweetness	Astringency	Bitterness	Extract	Colour intensity
V0	2.4±0.5^{a}	4.0±1.9^{a}	2.2±0.7^{a}	4.5±0.8^{a}	6.0±0.0^{a}	5.7±1.3^{a}
PV	3.5±0.3^{b}	2.1±0.3^{b}	1.8±0.3^{ac}	4.3±0.6^{a}	5.8±0.3^{a}	3.8±0.6^{b}
PP	3.2±0.3^{bc}	2.4±0.2^{b}	1.7±0.3^{ac}	2.2±0.6^{b}	5.3±0.3^{b}	4.5±0.4^{bc}
PPYB	2.8±0.3^{ac}	2.5±0.3^{b}	1.8±0.4^{ac}	2.3±0.5^{b}	6.6±0.1^{c}	4.9±0.3^{abc}
PPCB	3.6±0.5^{b}	2.2±0.3^{b}	2.5±0.4^{b}	3.1±0.4^{b}	6.0±0.1^{a}	4.3±0.5^{b}
PPCY	3.7±0.5^{b}	2.2±0.3^{b}	1.7±0.5^{ac}	2.5±1.2^{b}	5.1±0.1^{b}	5.0±0.0^{ab}
PPKY	3.0±0.0^{ac}	3.0±0.0^{a}	1.3±0.5^{c}	2.8±0.7^{b}	4.7±0.5^{b}	5.7±0.8^{ac}
PPKC	3.5±0.0^{b}	3.5±0.0^{a}	1.0±0.0^{c}	1.3±0.4^{c}	4.3±0.5^{b}	4.8±0.7^{abc}

*Average values ± standard errors (n=3). The letters show the statistical difference among results for $p<0.05$. For the same compound, common letters for 2 or more variants show no significant difference among them. Post-hoc analysis was performed using the Tukey test.
Source: Own results.

Table 3. Aroma sensory parameters of experimental wines (values on intensity scales up to 10*)

Wine sample groups	Aroma related parameters					
	Aroma	Flower	Fruits	Vegetal	Spicy/Burnt	Complex
V0	2.3±0.5^{a}	1.0±0.9^{a}	1.7±1.4^{a}	2.8±1.0^{a}	4.7±0.5^{a}	1.7±0.8^{a}
PV	3.3±1.5^{ab}	1.2±0.4^{a}	2.8±1.2^{ab}	3.8±1.0^{a}	3.8±0.4^{a}	1.6±0.5^{a}
PP	5.2±0.3^{bc}	2.7±0.5^{b}	5.5±0.5^{bc}	4.3±0.5^{b}	5.0±0.0^{b}	2.8±0.8^{b}
PPYB	5.0±0.4^{b}	0.7±0.5^{ac}	3.3±2.0^{ab}	3.0±0.0^{a}	3.7±0.5^{b}	0.3±0.5^{c}
PPCB	4.3±0.5^{b}	0.0±0.0^{c}	4.3±1.4^{b}	2.7±0.5^{a}	2.3±0.5^{c}	0.3±0.5^{c}
PPCY	5.3±0.3^{ab}	2.0±0.0^{b}	3.7±0.5^{abc}	2.7±0.5^{ab}	2.7±0.5^{c}	2.3±0.5^{ab}
PPKY	4.3±0.3^{ab}	0.2±0.4^{ac}	5.3±0.5^{bc}	3.3±0.5^{ab}	3.3±0.5^{b}	1.5±0.8^{a}
PPKC	3.8±3.0^{ab}	0.2±0.4^{ac}	5.7±0.5^{c}	3.3±0.5^{ab}	2.7±0.5^{c}	1.2±0.4^{a}

*Average values ± standard errors (n=3). The letters show the statistical difference among results for $p<0.05$.For the same compound, common letters for 2 or more variants show no significant difference among them. Post-hoc analysis was performed using the Tukey test.
Source: Own result.

The samples containing also chitosan (PPK) were perceived as sweeter too, similarly to the control wines, but their acidity was maintained as in the rest of the PP treated samples. This sensation of sweetness is perhaps induced by the chitosan itself, which has the ability to mask some tastes, blocking taste receptors, especially those detecting bitterness [22]. For the astringency, as well, the samples containing PP and chitosan (PPKY, PPKC) were the least astringent, while the control samples were the most astringent. Bitterness, however, was lowest in the PPKC samples (containing also activated carbon in the fining combination), while he PPKY (containing also yeast hulls in the fining combination) and the rest of the PP-containing samples had medium bitterness. The highest bitterness was present, as expected, in the control samples, but also in the samples treated with PVPP. As explained, chitosan has the ability to mask the bitter taste, by blocking the nucleophilic groups of the bitter substances, hindering their reaction with the bitter taste receptors [22]. In PKKY samples this mechanism may be affected by the presence of yeast hulls, which also have nucleophilic groups which can bind the chitosan. This assumption is based on the documented fact that one of the antifungal mechanisms of chitosan is binding with the yeast cell wall [10].

It is also noticeable the lowest extract perception in the samples also containing chitosan in the fining combination with PP.

Concerning the rest of the samples treated with PP or combinations based on PP, the main sensory parameters are, in most cases, significantly different than those of the control samples, showing that the application of PP has good overall influence on the sensorial quality of the wine.

The samples treated with the classical PVPP are different than the control, as the clarification induced in must permitted a good fermentation, similar with the PP treatments (thus, acidity and sweetness are not significantly different than in the case of PP treatments). The most obvious change induced by PVPP is in the colour intensity, which is significantly and positively affected, showing that oxidizable polyphenols were removed in accordance to the documented mechanism of PVPP [5]. However, in our case, the expected effect of PVPP on astringency and bitterness was not significantly different as compared to control, being outperformed by almost all treatments with PP.

Aroma intensity (Table 3) as compared to the unclarified control samples proved to be higher, for all fining treatments, the samples with PVPP and the PPKC being slightly lower than the rest, the latter being maybe the effect of the activated carbon present in the fining combination.

The aroma components, split in several classes which contribute to the overall aroma sensation, presented many differences which are included in Table 3.

The flowery terpenic aroma, typical for this variety, was better preserved in the samples treated only with PP, and also in PPCY. Control and PVPP both had medium intensity flower aroma, while the samples treated with bentonite (PPCB, PPYB) or chitosan (PPKY, PPKC) in addition to PP had significantly lower flower aroma. However, the samples containing chitosan (PPKY, PPKC) and PP alone showed the highest intensity of fruity aroma, significantly increased as compared to control and PVPP samples. When used alone, PP increased the vegetal aroma as compared to combinations and even with control and PVPP samples. This vegetal not was not "beany", typical of pea [20], but rather reminding of a freshly crushed green bell pepper. This can mean a better expression of the thiol compounds from the grape variety in the samples clarified with pea protein in full dose.

The typical spicy aroma of the grape variety – garden thyme, wild thyme and basil – is better preserved in the non-intervention samples (control V0), but also in the ones treated with PVPP and PP alone. All the other variants, through the other compounds present in combinations, attenuated in a significant way these aromas, better expressing the fruitiness of other compounds. The aroma complexity was significantly reduced only in the presence of bentonite (PPCB, PPYB), an effect which is not surprising when the bentonite is used [9].

Considering the diversity of the aroma present in Tamaioasa romaneasca, to have a clearer idea of the treatment effects, the results were also analysed by multivariate statistics, which allows for a reduction of the variables.

Aroma of wines evaluated by Principal Component Analysis

The large data sets obtained from analysing all the variants and repetitions were reduced by Principal Component Analysis, to better observe the main sensory influences induced by the oenological treatments.

For the main classes of aromatic descriptors, the Principal Component Analysis (Figure 1) showed that the first two components, PC1 and PC2, included most of the aroma variance, up to 81.01%.

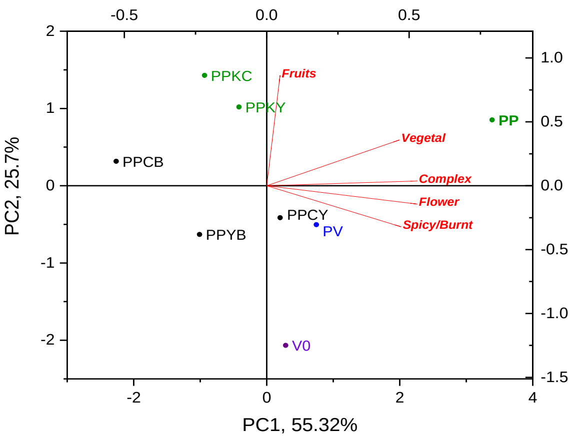

Fig. 1. Principal Component Analysis (PCA) of the main aroma descriptors for the experimental wines (V0-control-no treatment, PV-with PVPP, PP-with pea protein, K-with chitosan, C-with activated carbon, Y-with yeast cell walls, B-with bentonite).
Source: Own results.

The component PC1 accounted for 55.32% of the variance and includes flower, vegetal spicy/burnt and complex aroma, while PC2, with 25.70% is dominated by fruity aroma. This can be easily observed in Table 4 where the amount of variance retained by each principal component is expressed for each aroma descriptor as eigen values. The PC1 axis is therefore describing well the flowery-vegetal-spicy aspect of the aroma, while PC2 describes the fruity aroma.

Table 4. The extracted eigenvectors of the main aroma descriptors on the principal components

Aroma variable	Coefficients of PC1	Coefficients of PC2
Flower	0.52813	-0.14341
Fruits	0.04658	0.86367
Vegetal	0.46602	0.35895
Spicy/Burnt	0.47177	-0.32132
Complex	0.52836	0.03751

Source: Own results.

As observed, the alternative treatments induce detectable variations in the aroma of the final product. Control samples (V0), produced using the classical technology without any intervention, are the simplest wines, their sensory values being inversely associated with the fruity aroma and very little flowery-vegetal-spicy aroma. The samples treated with PVPP (PV) have better aromatic profile than the control wines, but their flowery-vegetal-spicy aroma is still low and the fruity aroma, even if more perceptible, the sensory values are still not directly associated with it. The alternative treatments with the vegetal protein from peas have, however, a detectable positive influence on the aroma profile. The most well balanced in terms of aroma are the wines treated only with pea protein (PP), whose sensory profile is positively associated with all aroma parameters, on both PC axes, being especially high in flowery-vegetal-spicy. The samples treated with both pea protein and chitosan (samples PP+K) display the highest fruity aroma and little flowery-vegetal-spicy (small inverse correlation of aroma profile is observed in Figure 2). The rest of the combined treatments, while maintaining a better fruitiness than the classical V0 and PV technologies, are stripping the wines of their flowery-vegetal-spicy components. This is especially the case of the samples which along with pea protein have also been treated with bentonite (samples PP+B).

In each aroma category, wherever possible to identify, the specific aroma was detailed.

The most cited descriptors were acacia flower for the flower aroma, grapefruit, lime, apples and apricot for fruity aroma, green pepper for vegetal, and thyme and basil for spicy.

Their perception intensity was also evaluated on numeric scales and the average values were used for another Principal Component Analysis which is shown in Figure 2.

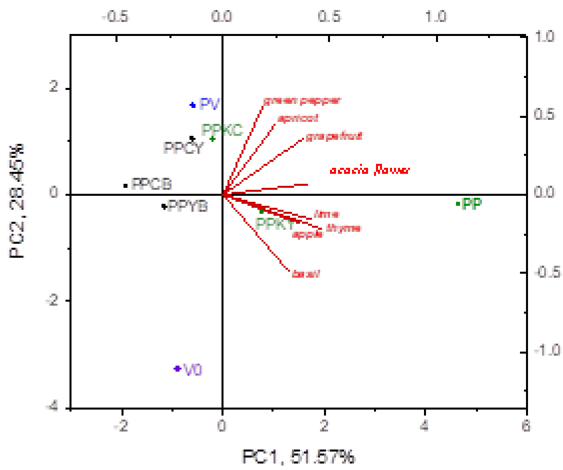

Fig. 2. Principal Component Analysis (PCA) of the specific aroma descriptors for the experimental wines (V0-control-no treatment, PV-with PVPP, PP-with pea protein, K-with chitosan, C-with activated carbon, Y-with yeast cell walls, B-with bentonite).
Source: Own results.

The first 2 components of the PCA explained only 80.02% of the total variance for the specific aroma identified by the tasters. Considering the complexity of these wine aromatic profiles, the result is very good. PC1 incorporates 51.57% of the total variance, including in it most of the fruity and all the spicy aroma. As presented in Table 5, grapefruit aroma is equally distributed in both components PC1 and PC2. All acacia flower, lime, apple, thyme and basil aromas are included in PC1, which can be considered to represent the axis of terpenic Tamaioasa varietal aroma. Green pepper and fresh apricot are mostly included in PC2which can be considered to represent the axis of thiolic Tamaioasa varietal aroma.

Table 5. The extracted eigenvectors of the specific aroma descriptors on the principal components

	Coefficients of PC1	Coefficients of PC2
Grapefruit	0.38043	0.36293
Lime	0.4102	-0.1545
Apple	0.45936	-0.21602
Thyme	0.35307	-0.17989
Basil	0.312	-0.49191
Green pepper	0.18808	0.56964
Fresh apricot	0.24106	0.44041
Acacia flower	0.40064	0.07044

Source: Own results.

As can be observed in Figure 2, the group of samples only treated with pea protein (PP) display the most typical varietal aroma, with the notorious terpenic profile. Also, typical, but more complex are the samples prepared with chitosan in addition to the pea protein (PPKY, PPKC). The least typical are the groups of samples placed in the opposite quadrant to the one containing the vectors of the specific aromas, those containing bentonite especially, but also some with carbon (PPCY, PPCB, PPYB). The samples treated with PVPP (PV) are relatively close in aromatic profile to the samples treated with combinations of pea protein and other products. Only the control samples are far in their aromatic profile from all of the samples produced with fining treatments.

To evaluate if these differences in profile are positive or not, scores were also attributed for the wine quality.

Scores of wines on evaluation sheets of 100 points

The quality of wine was evaluated on the score sheet proposed by the OIV for the use in the wine contests [16]. These evaluation sheets contain scores for visual aspects, odour and taste quality and intensity, taste balance as overall quality, which summed go up to a maximum of 100 points.

The average scores for each group of treatment and the standard deviations are presented in Figure 3.

Following this evaluation, it became obvious that the control wines produced without any fining to remove polyphenols were the least appreciated, the score of 76 being not enough to obtain a medal in a wine contest. Samples treated with PVPP (PV) also received a low score, even though higher than the control wines, the difference being statistically significant.

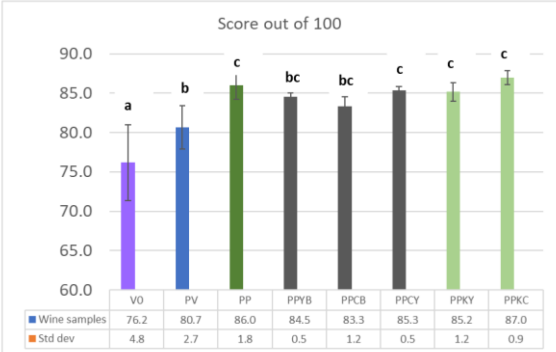

Fig. 3. Scores on the OIV wine contest evaluation sheets for the experimental wines (V0-control-no treatment, PV-with PVPP, PP-with pea protein, K-with chitosan, C-with activated carbon, Y-with yeast cell walls, B-with bentonite).
Source: Own results.

The best ranked wines were those produced with PP alone and the combination of PP and chitosan. With scores between 85-87, these samples could receive a gold medal in a wine contest.

CONCLUSIONS

According to these results it is clear that the alternative treatment of Tamaioasa romaneasca musts with the pea protein leads to wines with improved aromatic profile as compared to the wines produced by the usual technology with no interventions or with the use of the synthetic compound PVPP.

Pea protein used alone produces the most well-balanced aromatic wines, with all the aroma components specific to the variety well preserved. Chitosan, used together with pea protein, increases significantly the fruitiness. Although this combination also reduces the vegetal-spicy aroma, these wines are more appreciated by consumers and also by wine professionals due to the powerful and pleasant overall fruity aroma. Bentonite, however, even used together with pea protein, has a negative impact on the overall aroma, reducing both fruitiness and complexity as compared to the samples treated only with pea protein. The most important observation is that all the samples treated with pea protein, single or in combination with other agents, led to better quality wines than the control wines or those treated with PVPP, making this alternative treatment a viable solution that could be considered more acceptable by the environmentally-focused consumers.

ACKNOWLEDGEMENTS

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TRADITIONAL SAXON HOME GARDENS AS HOT-SPOTS FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE CONSERVATION - CASE STUDY IN ROMANIA

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Abstract

One of the future challengesin ensuring food securityis accessing a broader diversity of plant genetic resources for food and agriculture (PGRFA). Today, heterogenous agricultural lands are considered hotspots for biodiversity, and they also exist in the hilly mountain areas of Romania's Carpathians. The scope of this article is to describe Saxon traditional home-gardens related to the land use of households and cultivated crop species in Moșna commune, Sibiu County, Romania. The survey was conducted with the support of authorities and local stakeholders. The results of this study revealed that the maintenance of crop species structure and land use in traditional households has been ongoing for more than two centuries. Today, these home gardens cover 26% of the total area of a household and are cultivated mainly with vegetables. Generally, a household should have a surface area ranging between 5,000 and 1,500 m^2. The first local council decision in Romania in 2019 supporting the recognition of 20 landraces, the Saxon church garden, and 15 traditional home gardens as heritage values was officially adopted. Among the oldest and most popular landraces cultivated in home gardens, we identified Moșna cabbage, garlic, celery, dill, and Saxon raspberry. The results of our study also support the idea that these traditional households are functional agro-ecosystems with a positive impact on food security for the future and generally on biodiversity conservation.

***Key words*:** agricultural land use, intangible culture heritage, landraces, on farm conservation, traditional knowledge, Saxon origin home-gardens

INTRODUCTION

Traditional knowledge (TK) is a concept that was coined for biodiversity conservation at the global political level through the Convention on Biological Diversity in 1992 in the Preamble as well as in Art. 8 j. [22]. The same concept was further used in the provisions of Art. 5 and in direct relation to plant genetic resources for food and agriculture (PGRFA) by the International Treaty on Plant Genetic Resources for Food and Agriculture or Plant Treaty that was adopted in 2001 and has today 150 parties, including Romania [44]. In direct connection with the plant breeding strategy, we mention that also The International Union for the Protection of New Varieties of Plants (UPOV) first adopted in 1961, has recognized the genetic value of landraces [45]. Today, 73 parties, including Romania, are signatory to this Treaty that regulates the trade of new crop breeds at the global level. A direct connection was proven to exist between TK and landraces cultivation due to the need to clarify terms for researchers working in crops breeding [105]. Based on this analysis, Zeven is first defining the autochthonous landraces as genetic resources that have been cultivated for more than 100 years in the same agroecosystems, and they are also under traditional low input agricultural systems. We mention that it is not an easy process to investigate the TK and local knowledge (LK) related to the conservation of biodiversity which is of intangible heritage value [33,62]. In this regard traditional landscapes, agricultural lands, households, and home gardens should be investigated for crop diversity, structure and land use that should be maintained for more than 100 years to become reference traditional agricultural ecosystems in the support of the future rural sustainable development. It became more than obvious that TK should be based on a historical approach covering all these subjects when we are performing such assessments [60]. From 1989 on, the term TK included the knowledge related to environmental protection and agricultural sustainability; however, later, scientists became aware of new barriers based on which new subjects needed to be defined when applying such a concept in real-life situations [101]. Thus, Prof. Matsui defines new topics brought up by the evolution of various civilizations in direct relation to community development mechanisms, which may or may not be faster. For this reason, TK may now be regarded as archaic for the current historical period [60]. Nonetheless, the application of a historical perspective may serve to provide scientific validation for the customary or indigenous knowledge of a particular kind of community assessment [23,61]. Among these, we may include historical evidence of community existence in daily life as well as the continuity of its existence as a side effect of the progress and continuous transformation of the community, as traditional and local knowledge are the expression of the society’s choice and being open, including towards trades exchanges [15, 48, 67].

In the case of traditional and local knowledge associated with agriculture, there is nowadays a high level of interest due to the need to ensure food security for the future as well as to develop resilient rural communities [37]. Such ideas are also considered at the European level, as we are facing dramatic climate change effects, especially affecting the food chain and endangering food security for the future [59]. At the global level, one of the relevant definitions regarding TK included subjects such as agricultural practices, seed selection systems, and environmental protection issues [46]. Other researchers are interested in developing this term by defining specific indicators that are related to the investigations of traditional agricultural practices for supporting food security at the global level [35, 71, 98]. Of high interest is to continue following these scientific achievements to understand better innovative approaches and mechanisms applied and to further extend them to specific rural communities that may need such assessments to support food security for the future [25].

Based on the latest scientific evidence, traditional and local knowledge includes knowledge related to wild and domesticated diversity conservation (i.e., species collecting, use and management), agricultural practices (i.e., seed selection systems, cultivation practices for crops, shrubs, and fruit trees), as well as knowledge related to land use management at household and community levels (i.e., urban, and outside urban areas) [95]. Thus, traditional land use management is discussed for different well-settled communities all over the world [76], including nomadic communities [91].

The traditional land use in urban and/or outside urban areas of rural communities is considered today to be of outmost importance when applying the historical approach, proving in this way its role in supporting biodiversity conservation at the landscape level [100]. It is well established today that such relevant examples for European countries are those represented by terroirs in France and similar landscapes in other European countries [29], as well as drystone enclosures in Ireland [57] or traditional agricultural plots in Germany or Austria [52]. At the global level, specific traditional transformed landscapes are well documented, and their roles in biodiversity conservation, such as the Satoyama in Japan [51], or rice traditional landscapes in Asia [18], are worldwide recognized. Relevant similar studies have been published for North America [28, 56], Central America [54], and South America [81]. In Africa, such traditional landscapes are mostly connected to indigenous local communities [1, 58, 84]. In all these scientific publications, the direct relationship between traditional landscapes and biodiversity conservation is well documented, and therefore, at the global level, they are recognized as hotspots for biodiversity conservation [41]. The above-mentioned authors are stating that heterogenous agricultural lands that also include forests, riparian areas, live fences, and isolated threes are relevant for the conservation of biodiversity in Meso-America. Furthermore, the Convention on Intangible Heritage, adopted by UNESCO in 2003, includes TK related to husbandry and nature conservation [21]. Even though the subject of 'traditional agricultural practice' is not specifically defined, the TK related to the maintenance of the Mediterranean Diet, may include traditional agricultural practices [12, 19]. It is also the case of studies concerning the traditional pomegranate from Azerbaijan [4]. The traditional cultural landscapes (TCL), which include heterogenous agricultural lands mostly conserved by subsistence agricultural practices, become the real focus where such heritage values should be studied for local communities [39], especially in relation to developing innovation for fighting against climate change effects and maintaining food security [32, 87].

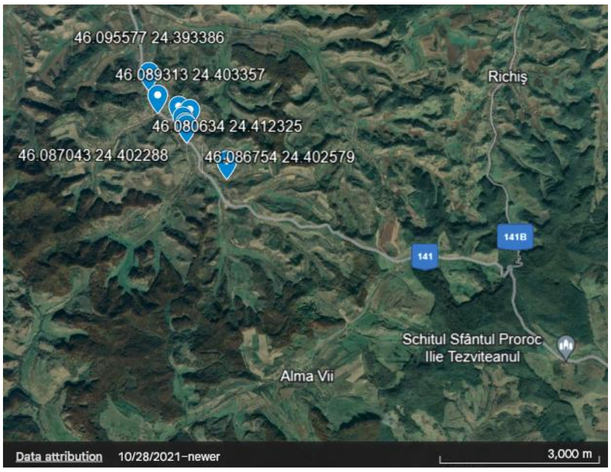
During the past 20 years, different tools and methods have been developed and published for the evaluation of traditional agro-ecosystems or heterogenous agricultural lands [97]. However, these cannot be applied without amendments or the need to explore more variables that are imposed aside from the relief and heterogeneity of the landscapes by local communities' beliefs and traditions. Nowadays, it is well established that traditional rural agro-ecosystems are hotspots for biodiversity conservation, which is why they have been in the attention of scientists for many years [31, 41, 63]. Moreover, the results of scientific investigations developed inside these traditional areas raise the idea of crop erosion, and new approaches have been published to scientifically substantiate the need for crop red listing in Nepal [47]. A historical approach of the crop's species cultivated since some 7,000 years ago proved the loss of at least eight crops' species from the Fertile Crescent [38]. In case of Germany, the need for red listing crop species was based on the phasing out of the diet of important crop species due to a specific crop-oriented trade at the global level with dramatic effects at the national level [99]. Applying such approaches in heterogenous agricultural landscapes may further support at the global level based on the mechanism of the Multilateral System, crop breeding strategies in ensuring food security for the future [7]. Pests, diseases, and the continuous existence of landraces as PGRFA inside traditional agroecosystems will further enrich genetic heterogeneity at the landraces level for future breeding programs [26]. Moreover, the careful integration of certain activities already existing in these types of agroecosystems may be part of future adaptation strategies to climate change [53]. By ensuring connectivity with seed keepers from traditional households through the national Seed Gene Banks, it will improve access to such genetic resources in the future based on the Multilateral System [7, 102]. All these scientific results also underlined the need for an official monitoring system to be in place for making effective functioning of such networks and, furthermore, of crop's red lists. Consequently, the need to create an on-farm conservation network at the national level should be the very first step [7, 70].

In Romania, heterogeneous agricultural lands exist, especially in hilly mountain areas [64, 85], but they have not yet been evaluated for their relevance in supporting food security in the future. However, part of these subjects, mostly connected with socio-economic features in the former province of Transylvania, have already been investigated by different groups of researchers from Romania and Hungary [14, 40, 73, 74]. Our team was involved in describing home gardens from Sibiu County, Romania, for cultivated species and a potential identification of TK related to landraces and agricultural practices. During more than 20 missions between 2013 and 2019, in more than 12 Saxon-origin villages, we succeeded in identifying potential landraces and defining some indicators for defining traditional Saxon home-gardens [8, 9, 10].

The scope of this article is to study the potential existence of traditional Saxon home gardens and traditional and/or local knowledge related to land use in households and landraces cultivation in Sibiu County, Romania. The study was conducted in Moșna commune (it includes 3 localities: Moșna, Alma Vii and Nemșa), which is part of the historical Saxon villages founded between the XIII and XIV centuries. Traditional land use inside traditional Saxon households was investigated as part of the local knowledge to understand if there is a potential connectivity to land use outside urban areas, including forests, pastures, grasslands, and creeks. As a result of these surveys, we will present an innovative procedure development related to the local official recognition of landraces and home gardens based on a bottom-up approach with the support of researchers. Such a procedure may be followed by similar communities in our country, Europe, or in communities that may share the same social, political, and economic peculiarities.

MATERIALS AND METHODS

*Studied area.*In 2019, more than 20 missions were realized in Moșna commune, which includes Moșna, Alma Vii, and Nemșa localities in Sibiu's County, Romania [8, 9, 10]. The geographical coordinates of the sites are as follows: 46°04'39''N, 24°24'31''E (Map 1).



Map 1. Mapping the traditional Saxon households of Moșna commune (i.e., Moșna, Alma Vii, and Nemșa, Sibiu County, Romania)
Source: Made by authors with the support of the free mapping software provided by Google Earth Map [34].
Note: It is relevant the diversity of natural relief of locality for this image.

*Land-use mappingof households*was realized with the support of Google Earth Map [34] and a Bosch GLM 50-22 laser telemeter. The telemeter was used inside and outside the property of householders and general data were compared to the Google Earth Map results. The ratio between households and home gardens land areas was investigated. All in field investigations were conducted during July-September 2019. The free GPS software 3.3.1.2. of Virtual Maze was used for maps creating.

Questionnaire applied. A scientific based questionnaire was applied through direct interviews on local authorities and householders [11]. This questionnaire was developed in the period 2010-2018 based on the experience during field missions in Sibiu County. The purpose of the published questionnaire was to make local authorities aware of the importance of each household or farm's interest in local native genetic resource conservation, such as landraces or animal breeds. Aside from this questionnaire, based on observations related to Saxon home gardens mainly cultivated with vegetables in the region, the idea of studying the ratio between the household coverage area and that of the home garden area only if it has not changed for more than 50 years. Based on the former in situ surveys we noticed that a Saxon household comprises smaller constructed areas (i.e., house and outhouses) and larger green areas (Saxon home garden, orchard, vineyard, and grassland). The borders of these properties are mostly to the forests, pastures, grasslands, or creeks.

Therefore, the questionnaire includes for this study relevant information related to landscape properties, land use inside households, home garden practices, and cultivated species.

Three principles have been defined for the study: 1. investigate only households as landowners that are supported by the local community not to be changed for more than 50 years; 2. protect the owner's identity; and 3. authorities should endorse landowners that they apply traditional agricultural practices, full seed selection systems, seedling cultivation, preservation, and maintenance.

Questionnaire for householders. The main objective of the questionnaire was to provide information based on which the Saxon home gardens to be characterized. A set of questions was released during the on-spot survey: 1) the coverage areas of home gardens and households. This information was relevant to calculating the ratio between household total surface area and home garden related only to vegetable cultivation. The surface of other green areas inside the household was also included in the survey (i.e., orchards, grasslands, vineyards), as well as the vicinity with forests, grasslands, pastures, and creeks; 2) the composition of the cultivated vegetables inside the home gardens. During the survey, we were interested in the reasons why they are cultivating certain species or integrating new crop varieties from the market. Such information was relevant to substantiate the existence of traditional or local knowledge related to crop practices,and 3) the survey includes knowledge related to the cultivation of fruit trees, shrubs, ornamentals, and vineyards in households, as well as knowledge related to species collection from the wild, such as medicinal plants and edible mushrooms. Such information was relevant to substantiate traditional or local knowledge related to wild species.

Questionnaire for authorities. Authorities were surveyed for official public data monitored at the commune level and at the national level with respect to agriculture: agricultural land use and crop production at the species level [8, 9, 10]. They provided owners' addresses to be surveyed as well as a counselor to support our interviews during the surveys.

Survey implementation. In 2019, 20 full days were dedicated to field missions for the surveying of the Evangelic church garden and 15 household owners endorsed by local authorities. In the first part of the survey, each of the household owners provided information related to the history of the property and the surface area dedicated to home gardens for vegetables cultivation. In the second part of the survey, all crops were inventoried inside the home garden and household property (i.e., fruit trees, shrubs, ornamentals, and weeds). The third part of the survey covered only data related to the surface of the home garden in the neighboring houses.

Official procedure development for the recognition of local/traditional knowledge related to agriculture to support food security was discussed at the mayor's level, followed by the main stakeholders in the commune (i.e., non-governmental organizations, local school) and with local Council Members. Thus, it was agreed to first present the results of surveys as tables and, after discussions, to finalize the council decision to be voted on. The principles for capacity building have been applied [78].

Data bases accessing. The official scientific names of plant species are documented based on the International Plant Name Index [43] as well as other related and connected information inside the website.

*Data analysis.*All collected data, based on specific criteria, were introduced, and processed in Excel. Margalef index, a species diversity index, was calculated to characterize the level of landraces richness for surveyed households. Margalef index was automatically generated based on the calculation of the Shannon index and Simpson index.

RESULTS AND DISCUSSIONS

The analysis of the official reports and scientific data revealed that, at a major scale, the landscape units for Moșna commune are defined by natural relief formations such as hills, valleys, and creeks. Forests, pastures, and meadows define the ancestral landscape units of the former spatial planning and occupy almost 50% of the total surface of such types of villages with the highest altitude of 600 m. The territory of the commune is defined by 47.54% of natural and semi-natural landscapes (forests, pastures, meadows, and riparian) that continue with agricultural landscape units such as vineyards, agricultural lands covered with crops, and grasslands fenced mostly by natural vegetation (i.e., 46.31%) [5, 6, 80, 89]. The rest of the land is covered by roads, watercourses, reeds, and the constructed areas of the three villages (i.e., 6.15%) (Fig. 1).

Today, the whole commune relies on products and services that are provided by agriculture and forest by trying to keep the forest ratio towards the entire agricultural lands, such as pastures, grasslands, and arable lands as this ratio has remained unchanged for more than six centuries based on historical evidence [5, 6, 80, 89].

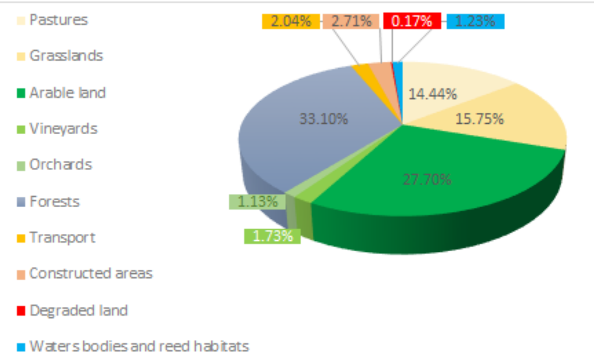


Fig. 1. Land use in Saxon origin Moșna Commune, Sibiu County, Romania.
Source: Made by authors based on open sources official data provided by local authorities during 2019 [80].
Note: It can be observed that there is an obviously equilibrium between forests (i.e., 33.10%), agricultural land (i.e., 27.7% arable land, 1.73% vineyards and 1.17% orchards) and seminatural land (i.e., 15.75 grasslands and 14.44% pastures).

Heterogenous agricultural land not defined up today for Moșna was investigated for land use inside households as well as for the potential landraces cultivated inside home gardens, and the results will be presented below.

1. Traditional land use of Saxon-origin households

120 properties have been investigated with the support of local authorities for land use inside households that are considered traditional by the local community in terms of home garden preservation and household land use. Also, 15 former traditional Saxon home gardens and the Evangelic church garden in Moșna commune were investigated for cultivated crops species. During the survey, we also collected data for vineyards, orchards, ornamentals, and common garden-weeds.

The analysis of land use investigations for 120 properties and considering the preservation of the former land use of the original Saxon population, revealed that at least three main categories of households still exist: 1.1. *traditional Saxon properties* where land use has been preserved for more than 100 years, 1.2. *slightly modified traditional Saxon properties* where land use inside the household has slightly changed over the last 100 years, but where the main characteristics of land use, such as the ratio between the property area coverage and home garden area, have been retained, and 1.3. *profoundly modified properties* where no traditional land use can be observed.

These three categories are further discussed for the traditional land use of households and the continuous use of traditional home gardens in our research.

1.1. Traditional Saxon properties. Two types of traditional Saxon properties were identified based on telemeter measurements and interviews such as: traditional Saxon households from Moșna commune and the Evangelic Church's Garden of Moșna locality (Photo 1).

1.1.1. Traditional Saxon households. Based on measurements realized with the Bosch telemeter at the local level and compared to data provided by Google Earth Map, it can be considered thattraditional Saxon households cover a land area ranging between 6,000 and 2,000 m^2. In the case of traditional Saxon home gardens, they still cover 20,17% from constructed areas at the commune level that means that they include all three localities (i.e., 268 of 1,330 properties and over 3,300 people according to previous reports) [80].The land use of household property inside constructed area of the commune was relevant in this study. In the case of traditional Saxon households, which are older than 100 years, the covered area for house construction was between 80 and 140 m^2 for the investigated households. The built area is covered by different dependencies or outhouses, and the covering area ranges between 1,400 and 300 m^2. We identified that it may be applied a ratio between the house and outhouse terrain of at least 1:3 or higher. Generally, the rest of the land was covered by vegetable gardens or home garden, orchards as well as grasslands and it was identified to be in a ratio of 2:1:2. Vineyard are now usually associated with gardens and/or built houses.A construction peculiarity for these groups of households is

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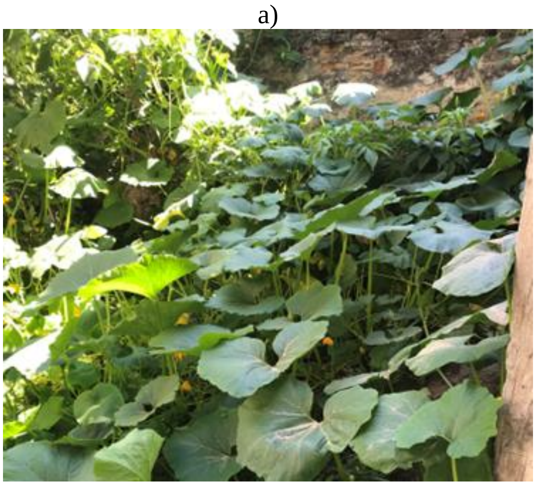
that some of the outhouse buildings are placed at street level (i.e., warehouses for hay) and integrated into the rural landscape of the locality. Such land use was due to the presence of a marshy land area inside the urban area and alongside one of the streets where one of the oldest properties was located. Therefore, the house construction locations in that area were placed at the foot of the hill level, the upper part of the properties behind the outhouse constructions. We mention that the orchard and grassland area were integrated into the upper part of the marshy land, and to the street view are the home garden and vineyard (Map 2.a. and Photo 1). The same land use inside the households was found for all eight properties (Map 2.b).

a)

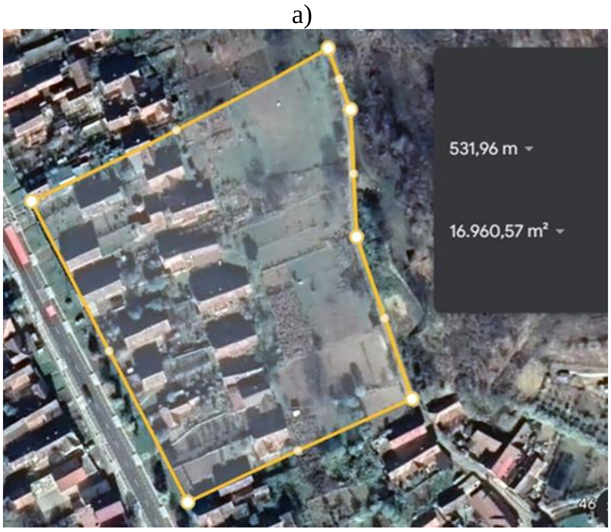


b)

Photo 1. Image of a household where no boundaries exist between urban and outside urban areas (a). The direct connectivity to the grassland and forest can be observed, and the presence of ornamental plants as well (i.e., *Zinnia elegans* L.) in the home garden. In the Evangelic Church Garden mainly species adapted to humidity and shadow are cultivated (i.e., *Cucurbita maxima* Duchesne) (b) (Moșna, Sibiu County, Romania).
Source: Made by authors.

The measurement analysis carried out for all 120 properties claimed that they are applying traditional practices according to local authorities and householders and that they are in the possession of traditional home gardens, which revealed, among others, that roughly 26% of the households are covered by traditional home gardens (Fig.2, upper part of the graph).

a)



b)

Map 2. Google Earth Map modified: aerial view of Moșna locality. The oldest property of the village, unchanged for more than 100 years (a) as part of a group of households located in the marshy area. In both images, the yellow perimeter follows the household property (a) and the group of households (b). The household has a perimeter of 273.51 m^2 and a total surface area of about 3,000 $m^2$and these can be seen in the black square automatically generated by Google Earth Map. The group of 8 households has a total perimeter of around 532 m and a total surface area of almost 16,960 m^2. In this image the street view can be observed, as well as the hilly area in the remote part of the households towards the forests area.
Source: Made by authors.

Similar traditional Saxon households can be found in Nemșa village, with an average surface area between 5,000 m^2 and less than 1,500 m^2. The two houses involved in our

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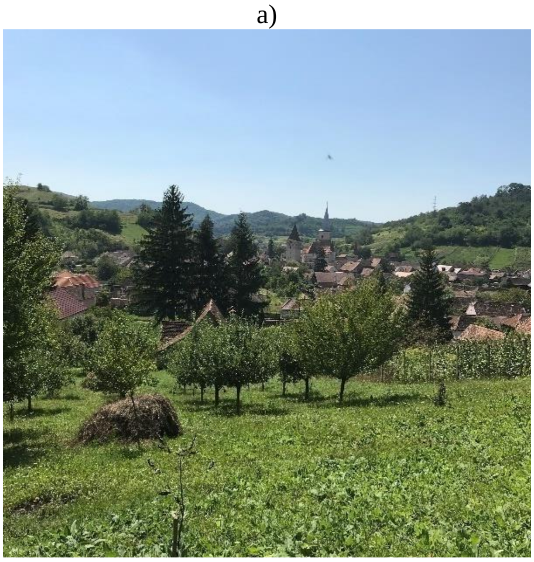
survey occupied 2,500 m^2 and were covered by less than 1/3 of the constructions, with the rest of the households being covered by gardens, orchards, and grasslands.

a)



b)

Photo 3. General views for the oldest household of the village: the street view (a) and the upper remote part of the household in Moșna locality. (b) Different land use inside the household can be identified: a vegetable garden, a vineyard, a grassland, and an orchard.
Source: Made by authors.

In Alma Vii, the survey of one property considered at the limit of a traditional Saxon household covered some 1,200.00 m^2.

In this respect, the traditional rural landscape was permissive with the place-choosing of the built areas inside the households due to the relief conditions but, at the street level it was compulsory to have a uniform distribution of the property's boundaries (i.e., fences and gates).

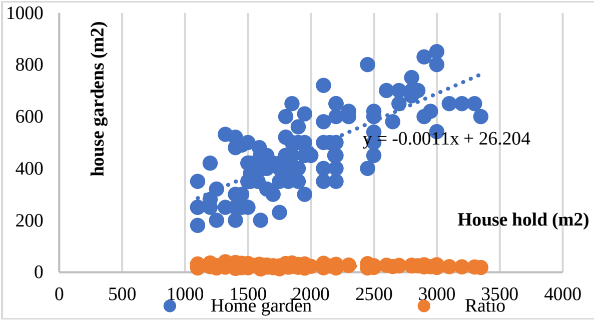
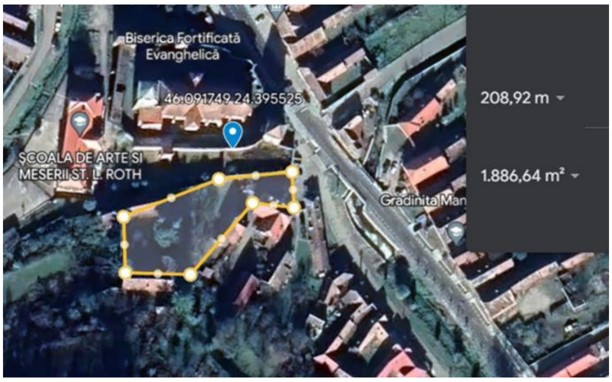


Fig. 2. Traditional Saxon gardening preserves a media range ratio of 26% (y = -0.0011x + 26.204). The survey was realized on 120 households' properties in Moșna, Sibiu County, Romania. The highest density of properties is between 1,500 and 2,000 m^2, with an average of home-gardens of 400 m^2.



Map 3. The aerial view of the Evangelic Church Garden
Source: Made by authors with the support of Google Earth Map. https://www.google.com/maps/d/u/0/ and https://earth.google.com/web/.
Note: The Evangelic Church Garden is located inside the first defense wall (GPS coordinates: 46.091749, 24.395525). The perimeter, as a yellow line, is 208.92 m, covering a surface area of approximately 1,886 m^2.

As a general remark, for agricultural practices, these traditional Saxon home gardens are functioning as integrated parts of households and cover 24% of 3,000 m^2 and less in cases where the property is larger (i.e., in case of 6,000 m^2), whereas a home garden may cover up to 16% and the rest is covered by field crops for the rest of the green areas.

1.1.2. Evangelic Church Garden. The Evangelic Church Gardenis positioned next to the church, covering around 1,900 m^2 (Map 3), and it is cultivated mainly with plant species that are resistant to shade and high humidity due to the defending brick walls surrounding the church. Thus, most of the cultivated species belong to the shrub group. Today, the surface of the Church Garden is unchanged since the church construction (i.e., XVI century). Upon discussions with the church curator, it appears that for more than 100 years the cultivated species have been almost unchanged, and this should be considered today as a traditional garden too.

1.2. Slightly modified traditional Saxon properties. The second pool of properties in Moșna commune is represented by households that own smaller properties than 1,500 m^2, but they preserve the traditional way of land use inside their property, and especially for traditional home gardens. In this respect, they used to have gardens no larger than 500 m^2 and down to 200 m^2 that were managed in a traditional way (i.e., seeds selection system, preservation, cultivation, use) [see central part of Figure 2. Such households developed more after the Second World War, especially after 1970, when an important part of the Saxon population migrated to Germany and their properties were sold to the Romanian population from the region. Most of the larger properties have been split into two or more. Today, based on the householders' survey, these home gardens are assumed to be enough to cover the needs for 3-4 persons and cover more than 40% of all properties of commune based on authorities' data.

1.3. Profoundly modified properties Today, based on authorities' data a proportion of 38.72% of households are smaller compared to traditional Saxon households in terms of surface area as well as land use in the urban area (see left-down part of Map 4). However, in some of them the traditional way of gardening is still well preserved, but there are also householders not interested in applying traditional agricultural practices. In our analysis we consider only householders that still apply traditional practices. Thus, such a property was surveyed at house no. 254, which covers around 1,100 m^2 and comprises a green area of 800 m^2. In this case, their vegetable garden is not integrated into the household because it is too small, but it is cultivated outside the urban area, in a crop field near the forest area. At the border to the forest, there are only natural fences between gardens facing the field or the forest, and usually the large herbivores such as boars or dears as well as other wild species, including bears, are in constant contact with these gardens. However, the vineyard cultivated into the field and covering 500 m^2 is protected against rodents with a simple crafted fence. In the same area the common peach trees are cultivated based on the self-selecting seeds technology, which takes no longer than 6 or 7 years. In a similar situation, more than 50% of the householders' properties are positioned inside urban areas but oriented and near the forests. We mention that most of these properties are placed in urban areas, and at the limits of the forests, they are fenced towards the forest areas. Mainly, the vegetable gardens positioned inside the field crops are not fenced and cover roughly about 2,000 m^2.

Map 4. The aerial view of the profoundly changed property and preserving the traditional Saxon gardening in the field outside the urban area
Source: Made by authors with Google Earth Map. Moșna Sibiu County Romania.
Note: The garden is represented as a yellow line positioned next to a forest with a perimeter of 236.6 m and covering 2,159.72 m^2. The yellow arrow is indicating the householder location in the village in the included aerial view, who owns a surface area of 1,113.64 m^2 with a perimeter of 157.97 m. In the left figure, the perimeter is also represented by a yellow line.

2. Traditional home gardens: species and traditional knowledge

The survey of household owners as well as of the representatives of authorities revealed that the cultivation of all vegetables is part of their traditional knowledge, as it has been orally transmitted from their ancestors or at the community level [8, 9, 10]. In this case, we are witnessing the use of agricultural practices that are either part of their traditional knowledge or are newly integrated and it can be considered local knowledge.

2.1. Traditional and local knowledge related to agriculture. It can be considered that the knowledge associated with the selection of crop species for cultivation inside their garden or in the field is part of the traditional knowledge transmitted nowadays as local knowledge. In this case they are cultivating small plots areas in their traditional gardens (i.e., a plot area is of 3- 4 m^2) and the mosaic of cultivated vegetables inside the plot areas is part of the traditional knowledge. Thus, they know that some species should not be cultivated next to others. More than that, they also inherited TK related to shrubs, vineyards, and orchards cultivation and management, and from the beginning, they knew what part of the garden they needed to use for their cultivation, how to graft new varieties, or how to apply maintenance cuts. Some of these results have been published already [8, 9, 10].

As a general feature, in all home gardens, whether they are in the urban area or outside urban areas, the local people cultivate ornamental plant species for the beauty of their flowers that are mainly blooming during summer up to autumn period (i.e., most abundant are *Zinnia elegans var. purpurascens* DC., and *Callistephus chinensis* Nees). Another plant species cultivated among the ornamental plants and not missing from traditional gardens is basil (*Ocimumbasilicum* L.).

We mention that this community is still applying agricultural practices based on the Christian calendar (i.e., either Orthodox, Evangelical, or other confessions). Thus, they stated that all agricultural practices that are traditional follow the religious calendar, and inside the garden, they start working at least one week before St. George (i.e., April 15), and in the field, they start one month later (i.e., May 15).

Traditional knowledge is also associated with weed species management. All these families have the knowledge related to the usefulness of some of the species or for the futility of others, up to being considered as real pests for their gardens.

Among the undesired weed species, we mention: *Ecballium elaterium* (L.) A. Rich. *Agropyron repens* (L.) P. Beauv., *Cirsium arvense* (L.) Scop., *Sonchus arvensis* L.

Some of the weed species are appreciated for being used in their traditional practices (i.e., for cuisine, on farm or for different remedies), which is why they preserve them inside the gardens such as *Melissa officinalis* L., *Geranium robertianum* L., *Portulaca oleracea* L., *Symphytum officinale* L., *Polygonum aviculare* L., *Equisetum arvense* L., *Achillea millefolium* L., *Matricaria chamomilla* L. Collecting, drying, preserving and using the medicinal plants in their home is a continuous process that is enriched all the time, and nowadays it can be considered local knowledge developed based on traditional knowledge.

In the case of wild species, the local community is also in the possession of traditional knowledge related to mushroom collection from the wild (i.e., collecting from the forests or pastures, preserving, and cooking) as well as other wild fruits from the forests. The most appreciated mushrooms are *Macrolepiota procera* (Scop.) Singer, *Armillaria mellea* (Vahl) P. Kumm. *Cantharellus cibarius* Fr., and *Agaricus arvensis* Schaeff. Only six families of 15 admitted that they know, based on traditional knowledge, when and where to find all these food resources. Preserving and preparing are part of local knowledge developed on traditional knowledge too.

The major risks for the community are the invasive alien species spreading inside arable land areas, such as *Erigeron annuus* (L.) Desf. and *Solidago canadensis* L. Both species have been seen in the marginal parts of the arable land, mostly on the paths from the village to the field of crops. In these three villages, the abandonment of the arable land is under 0.1% (i.e., part of the degraded arable land of 0.17%, Figure 1), and these species could not spread too much compared to neighboring villages such as Ațel or Dupuș, also from Sibiu County [7].

2.2. PGRFA listing for their heritage value.

Based on the results of the applied survey and published in 2020 [9,10] we identified for this study 20 PGRFA that are important for locals to be cultivated in their home gardens for more than 100 years (Table 1). These results have been endorsed by local authorities and stakeholders due to their experience.

Table 1. Local PGRFA, which have been used in the traditional home gardens of Moșna commune for more than 100 years, in Sibiu County, Romania.

Crt. no	Scientific name	Household house no. in Moșna localities
1.	*Allium sativum* L.	Alma Vii (182), Moșna (19, 254*, 268, 418) Nemșa (51,111)
2.	*Anethum graveolens* L.	Alma Vii (182), Moșna (268, 418, 420), Nemșa (51,111)
3.	*Apium graveolens* L.	Alma Vii (182), Moșna (254*, 268, 417, 418), Nemșa (51,111)
4.	*Armoracia rusticana*G.Gaertn., B.Mey. & Scherb.	Alma Vii (182), Moșna (420), Nemșa (51,111)
5.	*Artemisia dracunculus* L.	Moșna (417)
6.	*Brassica oleracea* var. capitata L. (Moșna cabbage)	Alma Vii (182), Moșna (1/C, 254*, 268, 418, 402, 461),Nemșa (51,111)
7.	*Petroselinum crispum* (Mill.) Fuss	Moșna (268, 417, 420)
8.	*Phaseolus vulgaris* L. var 'nana'	Alma Vii (182), Moșna (418), Nemșa (51,111)
9.	*Rheum rhabarbarum* L.	Evangelic Church Garden Moșna 530
10.	*Satureja hortensis* L.	Moșna (254*, 206, 420)
11.	*Zea mays* L., (yellow)	Moșna (12)
12.	*Zea mays* L. (red of Moșna)	Moșna (543)
13.	*Cydonia oblonga* Mill.	Moșna (19, 206)
14.	*Prunus armeniaca* L.	Moșna (19, 268)
15.	*Prunus domestica* L.	Alma Vii (182), Moșna (268), Nemșa (51,111)
16.	*Prunus persica* (L.) Batsch	Alma Vii (182), Moșna (254*, 268), Nemșa (51,111)
17.	*Rubus idaeus* L. (Saxon raspberry)	Alma Vii (182), Moșna (19, 417, 530), Nemșa (51,111)
18.	*Vitis vinifera* L. 'Perla negra'	Alma Vii (182), Moșna (254*, 417)
19.	*Vitis vinifera* L. 'Risling'	Moșna (254*), Nemșa (51)
20.	*Vitis vinifera* L. Hybrid	Moșna (417)

*Traditional gardening is located outside the urban area.
Source: Data results based on the home garden survey and locals' statements.

As an exception authorities agreed in the same survey that for animal breeds, they would recognize for the local Bazna Pig as having heritage value. For this, the householder from No. 268 in Moșna was also recognized at local level for its TK related to animal husbandry in line with provisions of the UNESCO Intangible Heritage Convention.

A second set of data covered genetic resources that are recognized by local householders only, and that are slightly different compared to the first list and covers additional 10 crop species (Table 2). In this specific case some of the landraces are cultivated for less than 50 years and therefore they can be considered as creole and have good chances to become landraces.

Table 2. Local PGRFA, which has been used in the traditional home gardens of Moșna commune for more than 50 years in Sibiu County, Romania.

Crt. no	Scientific name	Household house no. in Moșna localities
1.	*Allium cepa* L.	Alma Vii (182), Moșna (254*, 268, 417, 418, 420), Nemșa (51,111).
2.	*Cucumis sativus* L.	Moșna (254*, 268, 417, 418, 420), Nemșa (51,111)
3.	*Cucurbita maxima*Duchesne	Evangelic Church Garden, Moșna (530).
4.	*Lactuca sativa* L.	Alma Vii (182), Moșna (19, 254*, 268, 417, 418, 420), Nemșa (51,111)
5.	*Mentha* L. sp.	Moșna (420)
6.	*Phaseolus vulgaris* L.	Alma Vii (182), Moșna (19, 418, 417, 420), Nemșa (51,111)
7.	*Solanum lycopersicum*L.	Alma Vii (182), Moșna (19, 206, 254*, 268, 420, 417, 418), Nemșa (51,111), Evangelic Church Garden
8.	*Solanum tuberosum L.* (white potatoes)	Moșna (417)
9.	*Spinacia oleracea* L.	Moșna (417)
10.	*Zea mays* L., Turda 200	Moșna (254*)

*Traditional gardening is located outside the urban area.
Source: Data results based on the survey and the locals' statements.

Very important for seed selection systems and agricultural practices are the species with two years per life cycle, such as onions or cabbage. The cultivation of such species implies the knowledge required for seed selection, seedling cultivation, crop maintenance, and use in the future. These skills are essential for applying the best agricultural practices in these traditional villages. By analyzing Tables 1 and 2 it became obvious that householders are integrating new crops into their gardening or field crops today. We mention 'Turda 200', an old Romanian maize cultivar that entered the market in 1976 and is considered by locals to be relevant for cultivation in this region. For the same reason the vineyard cultivars are considered as important for community [7, 9].

There is also the case of 'apple'-pepper variety especially cultivated by the Hungarian population, which is very much appreciated in this region and integrated into their gardens as well as yellow raspberry variety without thorns in one case [9]. In addition, to understand the landraces abundance all data were statistically interpreted for calculating the following indexes: Shannon index, Simpson index and Margalef index. Based on the results of these analysis the richness in landraces reflect a medium value for Margalef index (i.e., low bellow 2, medium between 2 and 6, and high over 6) (Table 3).

Table 3. The statistical analysis of landrace abundance is expressed based on the Shannon index and Simpson index as well as on the Margalef index calculations

Landraces as crops species	No of investigated home gardens	Shannon index	Simpson index	Margalef index
20	16	2.509138	0.096217	4.461375

Source: Own calculation.

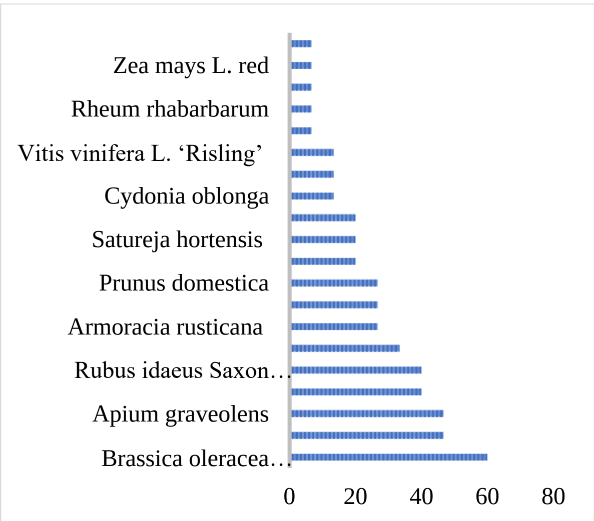


Fig. 3. Most popular species as landraces cultivated in surveyed home gardens as crops, shrubs, and fruit trees Moşna, Sibiu County, Romania
Source: Own design and results.

3. Traditional home gardens recognition for their heritage value at local level. Upon the analysis of the composition of home gardens, it was established based on the proven knowledge, including seed selection systems and agricultural practices, for at least 15 householders as families their continuing implementation during their lives of the same agricultural practices (i.e., seed selecting system, cultivation, storage, and use) as they were transmitted and inherited from their ancestors (Table 4).

We mention that all surveyed locals proved to be able to test and introduce new species and keep co-existence for different cultivars (e.g., Saxon raspberry and without thorns raspberry, new peppers varieties, 'apple' pepper and other classic cultivars, tomato cherry versus old landraces of tomato) [8, 9, 10].

Table 4. Traditional Saxon home gardens in Moşna commune, Sibiu County, Romania, recognized by local authorities.

Crt. No	Household no. in Moşna localities	Landraces and animal bred in home gardens of heritage values
1.	Moşna 254*	Garlic, onion, tomatoes, Moşna cabbage, thyme, yellow maize with 8 rows cobs, celery.
2.	Moşna 418	Moşna cabbage, tomatoes, dwarf beans, thyme, celery.
3.	Nemşa 111	Onion, garlic, plum-trees, thyme, celery, Saxon raspberry.
4.	Moşna 206	Thyme, celery, horseradish.
5.	Moşna 268	Salad, tomatoes, Moşna cabbage, dill, cucumbers, Bazna pig.
6.	Moşna 12	yellow maize with 8 rows cobs, thyme, celery.
7.	Alma Vii 182	Garlic, onion, Moşna cabbage, eggplants, Saxon raspberry.
8.	Moşna 420	Tomatoes, thyme, beans, parsley, dill.
9.	Moşna 417	Vine Nova, beans, potatoes, Saxon raspberry, thyme, celery
10.	Moşna 19	Saxon raspberry, quince, apricot, thyme, celery.
11.	Moşna 530	Pumpkin for pies, tomatoes, Saxon raspberry, rhubarb, thyme, celery.
12.	Nemşa 51	Garlic, onion, Saxon raspberry, plum-trees, thyme, celery.
13.	Moşna 461	Moşna cabbage, thyme, celery.
14.	Moşna 1/C	Moşna cabbage producer for selling, thyme, celery.
15.	Moşna 402	Moşna cabbage, thyme, celery.

* Traditional gardening is located outside the urban area.

Source: Information collected from local authorities.

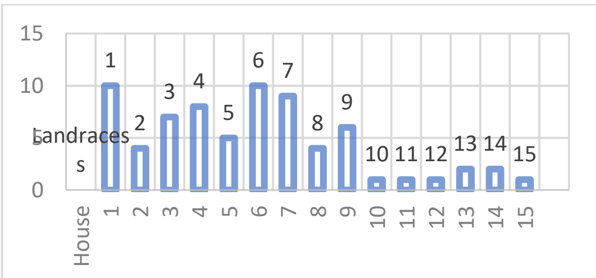


Fig. 4. The abundance of landraces in the 15 surveyed traditional Saxon house gardens.
Source: Own design and results.

Note: It can be observed that 9 householders are cultivating most of the surveyed landraces.

The most cultivated landrace is Moșna cabbage, followed by garlic. In the fifth position is the Saxon raspberry, which has been cultivated for more than six centuries in the region (Figure 3). A maximum of ten landraces per home garden were recognized (Figure 4). During these discussions, all lists suffered slight changes. upon which all agreed to be part of the future local Council Decision.

4. The historical context of traditional land use of Saxon-origin households. The evolution of human civilization in the past 100 years has created tremendous changes at the interface between humans and the environment, associated nowadays with huge costs over nature restoration and conservation [27, 90]. The quest for accessing new natural resources as well as for developing or maintaining polluting technologies for the past two centuries is paid today with the tremendous loss of biodiversity at the global level [13, 26, 79, 83]. Among the major threats to the future of our civilization at the global level, we may cite the decreasing access to nutritional food [30, 53, 71, 102] and potable water [103] as the groundwork for our continuity [17]. However, human civilization is today facing additional challenges such as those generated by biodiversity loss [7, 20, 53, 70], shook effects of climate change, and desertification [42, 46]. Of particular interest in our future development are the appropriate measures to be implemented for agriculture under the sustainable development goals [92], where a focus should be on soil fertility preservation and improvement [94]. On the other hand, by recognizing the values of intangible cultural heritage, rural communities become once again the subject of such types of analysis at the global level [23, 50]. Moșna locality has been historically documented since 1280 as a Saxon village with a fortified church called "Mäschn" in German, or sparrow. Saxons are ethnics of German origin that were settled in Southeast Transylvania, mainly during the XII century. Today, the commune includes the villages Nemșa (original German name is "Nymps") first historically documented in 1359, and Alma Vii (whose original German name is "Almasium"), mentioned in 1356 all three of which were originally inhabited by Saxons. Other at least 11 similar communes exist, located especially in the northeast of Sibiu County, and all of them have been constructed based on rigorous village spatial planning dominated by fortified churches for creating independent, resilient communities that prove their success during history [3, 5]. During the XIX century, these localities started accepting Romanians ethnics, and after 1970, the ratio changed for Romanians [69, 89]. Nowadays, the above authors have identified and defined a strong local cultural identity for these communities of Saxon origin.The general spatial planning and land use management, including agricultural land, of the commune were well preserved and included in the current spatial planning, mostly due to the relief peculiarities not supporting intensive agricultural practices. The main access roads are towards Mediaș (i.e., 10 km), being at least in the 19th century the main producer of high wine quality in the region. As the distance towards Sibiu was high (i.e., 66 km) and the location was off the national roads, these localities remained archaic or remote compared to others in terms of implementing intensive agriculture practices [5, 69, 89]. As a result, we are embracing nowadays a high nature value of biodiversity in this village and in similar Saxon origin villages as well [3, 5, 69, 93].

The commune Moșna is also located in a hilly area covered for 43.38% of its territory by the ROSPA0099 Podișul Hârtibaciului, the most extensive SPA in the interior of Romania, and 0.01% by ROSCI0227 Sighişoara–Târnava Mare [54, 66].

In this case, by starting survey research for landraces in Moșna commune on several occasions after 2013 up to 2019, new subjects became of high interest for us. Thus, the interviews with local authorities and householders revealed new subjects of high interest, such as the discovery of TK related to agricultural practices. Moreover, it was underlined once again the relevance of these villages for nature conservation as a whole and related to the heterogeneous landscape.

Thus, in our attempt to define specific home gardens we discovered that up until today no study was realized in Romania on this subject. However, certain studies revealed the relevance of farming positive impact on nature conservation [24, 69]. Therefore, based on our observations, several indicators were already defined for home gardens survey and assessment, among which we may mention the following: 1) the historical topography inside the households; 2) the continuous cultivation of old landraces; 3) the integration of wild genetic resources into the household needs; 4) risks and vulnerabilities for traditional and local knowledge erosion; and 5) capacity building at the local level [9]. However, the topography for traditional land use inside the households was not studied yet in Romania. Such studies have been realized also in different countries being recognized the lack of academic studies that may further substantiate the spatial planning for the sustainable use of natural resources [68]. In this respect we mention the results of similar studies in China [104], Ghana [2], or Ecuador [72]. In Europe, similar studies have been published for Spain [36], Greece, and others [49], but not too many for the Eastern European countries.

The major attribute of these Saxon origin villages is their position in natural fragmented landscapes due to the relief properties, having access to major natural resources, and ensuring all communities' needs to survive as fortified churches [3, 89]. As mentioned above, during the XIXth century, these villages were occupied mostly by the Saxon population but slowly also integrated Romanians [89]. The transfer of traditional knowledge related to agriculture was ensured at the community level and transmitted up to nowadays, based on similar principles already identified in different indigenous communities [96]. Our results supported the idea that in these remote villages, it was possible to be further preserved customs and knowledge related to agriculture, such as seeds selecting systems, crop cultivation, traditional land-use inside the household, and sustainable access to natural resources.

As a general peculiarity we mention that for home gardens of Saxon origin, the heterogeneity of agricultural land is in direct connectivity to forests, pastures, creeks, and grasslands (Photo 1a) which is in line with previous studies [5, 80, 89]. However, the mosaic appearance of arable land provides excellent conditions for the richness of biodiversity in direct connectivity to wildlife. Under these conditions, which are also imposed by relief, arable land plots can be found both inside and outside urban areas [80]. Each agricultural plot outside the urban areas is cultivated with different crops on less 10 ha, most of them less than 1 ha and larger plots areas are integrated into the semi-natural landscape.

The main characteristics of these households belonging to the three Saxon origin villages that can support further sustainable rural development ideas for circular economies under the Green Deal [82] in the regions and are relevant for this study are as follows: 1) general land use inside households is similar (i.e., constructed areas are occupying less than 1/3 of green areas); 2) traditional home gardens (i.e., for vegetable cultivation), orchards, vineyards, and grasslands are mostly located inside the household in the urban area; and 3) the intimate contact of households and home gardens with forests, pastures, meadows, and creeks ensures the long term wild-life contact with agro-ecosystems and further support the status of these heterogenous agricultural lands as hotspots of biodiversity conservation.

The fact that traditional Saxon-type home gardens still exist in localities such as Moșna, Alma Vii, Nemșa entrusts us to consider that future spatial planning in rural areas in Romania needs to refer to such households to ensure the resilience of rural communities for the future [77].

Based on these study results, three different types of land-use households exist today in these villages: 1) traditional Saxon properties; 2) slightly modified traditional Saxon properties; and 3) profoundly modified properties. Also, we mention that generally, the alteration of the traditional land-use of household is not so profound, and it is relevant for the future that urban spatial planning be realized according to the principles of ensuring sustainable access to resources. These principles may further support the development of strong, resilient rural communities facing the dramatic effects of climate change while also ensuring the integration of new agricultural technologies based on existing local knowledge [96].

Investigating home gardens for crop diversity, we are able to underline that they are occupying a central role inside the household. The position of the home garden is not changing often due to the orchard and vineyard's locations. However, the location of cultivated vegetables inside the home garden is changed annually, and all 15 owners proved to have knowledge related to seed selection systems, seedling cultivation, preservation, and use of these PGRFA. The best place of construction area is chosen to be in the upper part of the household. Therefore, the home garden can be positioned with the best sun orientation and access to water. The dimensions of the home garden cover the food needs of the owners for a one-year period in the case of traditional Saxon home gardens. The rest of the investigated home gardens cover the same needs, but there are changes in household land use. Having these, the home gardens can be considered traditional if they are applying the same principles for crop cultivation, seed selection systems, seedling cultivation, preservation, and use, ensuring the resilience of the householders. A similar situation was already described in Spain [82]. In our case the reference household is that of the group of eight houses that was build up in 1785 and the household land use remained unchanged for more than 100 years. And more, these communities proved to be resilient over time, like others [77].

4.2. Home gardens and PGRFA with heritage value. The official *listing* process upon the PGRFA listing of identified landraces and discussions with all involved stakeholders, a list of legal reasons why such lists should be recognized at the local level as having cultural heritage value for their communities was presented. The major question raised was: Who can certify that these genetic resources are unique? This is a pertinent question. However, the need to identify their existence as specific landraces is imposed due to the risks of genetic erosion [7]. Thus, if there is TK already transmitted through generations in their families or in their community, the process itself should be preserved, which will further ensure the access of local communities that are well trained in the cultivation of specific PGRFA [7]. Consequently, the discussion of paradigm certified- versus self-recognized seeds, gained local authorities' interest in the second in similar cases, like in Amazonia [88]. And way? Because of proving the existence of erosion processes in terms of the social dimension of the local community for more than 30 years [7]. In this case, 12 owners are over 70 years old, proving that there is a major vulnerability to continuing the process of local and traditional knowledge transmission through generations. These remark in line with official reports data [5].

In this case, old families are cultivating traditional gardens with traditional genetic resources, and such recognition should support the promotion of these values in all communities furthermore supporting food security for the future.

Aside from such discussions, the traditional and local management of heterogenous agricultural lands was recognized as becoming more complex under the shock events of climate change as well as food insecurity at the local rural level. Consequently, the very first measure should be the securing of all resources (i.e., tangible and intangible) [75]. Among these resources, we underline that local knowledge securing need for direct connectivity with agriculture management [86]. Moreover, if this activity is associated with local pride, the future implementation of innovative agricultural practices is ensured for the long term [16, 65].

Two European directives were mentioned as reasoning for local council decision issuing and approval [7]: 1) Commission Directive 2008/62/EC of 20 June 2008 providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion and for marketing of seed and seed potatoes of those landraces and varieties; and 2) Commission Directive 2009/145/EC of 26 November 2009 providing for certain derogations, for acceptance of vegetable landraces and varieties which have been traditionally grown in particular localities and regions and are threatened by genetic erosion and of vegetable varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions and for marketing of seed of those landraces and varieties.

In terms of capacity building, the list of reasoning refers to the national regulatory framework on the subject and for administration, as well as the European regulatory framework on the subject of the local decision to prove that it is in line with the EU legal framework [7].

The text of the local decision recognizes the provisions of 10 articles that are including among others the heritage value of the following items: 1) The list of crop plant species cultivated in Moșna commune according to the AGR 2A form (the current data sheet form for collecting data related to agriculture production and land use) [8, 9, 10]. 2) The list of cultivated plant species cultivated for more than 50 years [8, 9, 10]. 3) The list of local populations cultivated for more than 100 years. 4) The list of ancient animal breeds. 5) The list of families owning local varieties with heritage value. 6) The list of traditional home gardens.

The text of this decision stated that *future development strategies for agriculture will take into account the conservation and sustainable use of local varieties and ancient breeds of animals, as well as the promotion of families that own such resources.*

The local council decision was approved by the Commune Council on 29.11.2019.

We mention that it was the first decision on this subject taken at the local level in Romania. The promotion of pride at the local level related to agriculture, which is among their daily life activities, may support rural communities to further ensure food security for the future and to increase their resilience. Such an approach was needed to be exercised in our country, as Romania does not yet have a national strategy adopted for the conservation and sustainable use of PGRFA under the Plant Treaty [7, 9]. Certain constraints of the process should also be underlined. Communication with the householders was not possible without the support of local authorities and stakeholders. Local communities are not open to foreigners. However, once they open their homes, they instantly offer all the needed information for this type of survey. Another constraint is coming from the authorities as well. They are also not very open to discussing this with universities without the support of local stakeholders. Our support was ensured by local stakeholders after more than 10 years of working together. This might be a long process of building trust between science, authorities, and local communities. With this, we consider that it was a real success to have the very first official local council decision related to the recognition of landraces as having heritage values for their communities. This approach will further support capacity building at the authority's level in charge of the conservation of genetic resources as a basis for new breeding programs all over the country. The Multilateral System may provide access for crop breeding laboratories working on different plant species in a broader genetic pool, including from on-farm, officially recognized gene banks [55].

CONCLUSIONS

A major role in a households' life aretraditional home gardens preservation and a specific land-use pattern inside the household for supporting the needs of their family in Moșna commune, Romania. Today, about 26% of the current household land use is covered by Saxon origin home gardens and 20.17% of households are still preserving the original traditional land use for more than two centuries. In these households, a mix of traditional and modern agricultural practices are applied, from seed selection system to, preservation, cultivation, and further use. 20 landraces have already been recognized as being of heritage value at the local level.

Aside from these, creole landraces have been recognized for their heritage value, including an old Romanian maize cultivar ‘Turda 200’ placed on the market in 1976. The existing continuity between these heterogenous agricultural lands and forests, pastures, grasslands, meadows, and creeks further contributes to biodiversity conservation and may be reference models as functional agro-ecosystems. The value of Margalef index supports the richness in landraces for these home gardens. TK related to wild species collection, preservation, and use further supports biodiversity conservation. These Saxon origin households provide us with historical reference and traditional land use cover, to better understand what a resilient rural community should be. This would respond to current sustainable rural development policies for supporting a circular economy, low costs of energy under the Green Deal, and fast connectivity to breeders through the Multilateral System based on seeds gene banks.

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COMPARATIVE ANALYSIS OF GOVERNANCE MODELS IN MOUNTAIN AREAS. INSIGHTS FOR ASSURING SUSTAINABILITY AND RESILIENCE

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Abstract

The main aim of the article is to explore essential aspects of mountain governance, with a particular emphasis on the principles of Good Governance. This includes emphasizing soft skills, knowledge, innovative solutions, and the allocation of necessary resources. The core concept centres on adopting a community-focused governance model, which establishes a structure for proactive stakeholder engagement and sustainable conflict resolution. The primary audience includes practitioners, communities, businesses, and others, providing them with potential strategies to enhance their involvement in the decision-making process. The paper aims to offer pertinent insights into effective practices within European mountain governance. The goal is to extract distinct experiences and glean valuable lessons, evaluating both the potential and constraints for their applicability in varied geographical contexts. The methodology used includes identifying comparative study cases – studying good and bad lessons to be learned – from Europe, and their analysis based on how much the community the contributed to build governance. Commencing with detailed contextual backgrounds, objectives, and developmental trajectories, these practices undergo comprehensive analysis, considering the essential elements outlined earlier. It was observed a large variety of governance models, and there were examined in details 6 of them (2 from Romania, 1 from Spain, 1 from Bulgaria, 1 from Ireland and 1 from Portugal). The results emphasised that the specificity of each mountain is of a major importance for a resilient governance, and the replicability of each governance is possible only on certain conditions, including a real bottom-up and participatory approach, flexibility and local adaptability, but, also, conserving the traditions and landscape.

Key words: *community participation, replicability, participatory approach, competences*

INTRODUCTION

In Europe, a mountain region has no universally accepted definition, although it is usually determined by administrative, topographical, and geological factors. If more than half of the land is covered in snow or if half of the population resides in mountainous areas, Eurostat designates mountain regions as NUTS level 3 regions [10]. In addition, throughout earlier Common Agriculture Policy (CAP) programming periods, nations that are members of the European Union have designated mountain locations that have difficult climatic conditions, restricted growing seasons, and steep slopes that require expensive machinery and equipment.

Mountainous areas present unique governance challenges [42] that require a proactive, inclusive strategy [18]. This distinctive feature is a result of specificity of the requirements for efficient government in mountains, emphasizing the value of stakeholder interaction [17], dispute resolution [1]. and community involvement [43, 34, 24, 44]. In such a way, it is a real challenge to offer insights into effective techniques and their possible applicability in a variety of contexts across Europe.

Scholars agreed that soft skills are important in order to promote cooperation among stakeholders [40], as any effective governance requires interpersonal, communication, and conflict resolution skills. Also, for a well-informed decision-making, a thorough understanding of socioeconomic processes, cultural quirks, and mountain ecosystems is essential [13, 19].

In order to tackle the intricate problems of mountain administration, innovative methods and flexible tactics are crucial [8]), while to support governance initiatives and maintain long-term results a sufficient deployment of financial, human [27], and technological resources [15] is required [6].

Some insights on the concept of the community-oriented governance framework focused on active stakeholder participation [2, 26, 46], by looking how practitioners, companies, and local communities are included in decision-making procedures increases accountability and advances sustainable development [48, 36] and on sustainable conflict management, exploring how the use of cooperative dispute resolution techniques reduces hostilities and encourages the development of consensus amongst a range of stakeholders [31, 41, 4, 11].

The importance of studying diverse forms of governance, especially in the mountain areas, is due to see their possibility of sustainability [28], and resilience [16] and of their replicability on other areas [5, 21]. At the same time, innovative approaches are required to determine the potential novel governing models and techniques that have the potential to be replicated in many mountainous regions [29].

However, the issue of assuring the replicability of governance models is far too complex [37], involving the need to correctly evaluate its internal elements, including flexibility, scalability, and local contextualization, as the base of successful replication.

Applying general sustainability concepts to ensure that governance initiatives that are duplicated are viable over the long run is advisable [14], but sustainability itself is seen as an elusive concept [20].

This article intends to emphasize how crucial community-oriented governance is to overcome the difficulties associated with mountain government. It seeks to support the continuous growth and improvement of successful mountain governance techniques, eventually promoting sustainable development in mountainous places worldwide, by examining successful European practices and identifying and addressing research gaps.

MATERIALS AND METHODS

A number of 6 studies cases (2 from Romania, 1 from Spain, 1 from Bulgaria, 1 from Ireland and 1 from Portugal - as seen in Figure 1) of mountain governance have been identified, documented and analysed to provide a valuable basis upon which to formulate conclusions concerning the possibility of utilizing creative strategies to guarantee sustainability and replication in the governance of mountains.

The examination of case studies for research is widely used [30, 25] as they offer contextual details as are the goals, development, and contextual elements [39] and so is the case effective mountain governance approaches in Europe.

Extensive analysis of the case studies is critically [47] in light of the issues encountered and the key components that have been discovered [30, 32].

Fig. 1. Location of the study cases
Source: authors' own work.

The community's involvement - the so-called bottom-up approach - was seen to be the most sensitive aspect affecting sustainability and governance in the mountain area. In this view, the identified governance models were compared based on the level of involvement of the community on creation, implementation and run of each governance model.

The six study cases have been ordered hierarchically based on this criterion, with the study case that is more relevant to the community being approached last (and thus at the bottom of Figure 2). On this view, the selected cases are:

6.Mountain Law for the 're-organisation' of mountain area governance (Romania)
5.Barroso Globally Important Agricultural Heritage Systems – GIAHS (Portugal)
4.Camin de la Mesa LAG in Asturias region (Spain)
3.Upland Commonages (Ireland)
2.Smart Villages (Bulgaria)
1.EcoMuseum of Apuseni Mountains (Romania).

The variety of the selected case studies, which include a range of geographic, socioeconomic, and environmental situations, makes it possible to conduct a thorough analysis of governance approaches designed for particular mountainous regions. Adaptive management approaches, technology-driven solutions, and cooperative decision-making procedures involving stakeholders and local communities are all examples of this.

These case studies give particular insights and lessons learnt from actual instances of effective governance techniques applied in various mountainous locations. Through a thorough analysis of these situations, we can pinpoint shared components of efficient governance as well as creative solutions that have proven replicable and potentially sustainable.

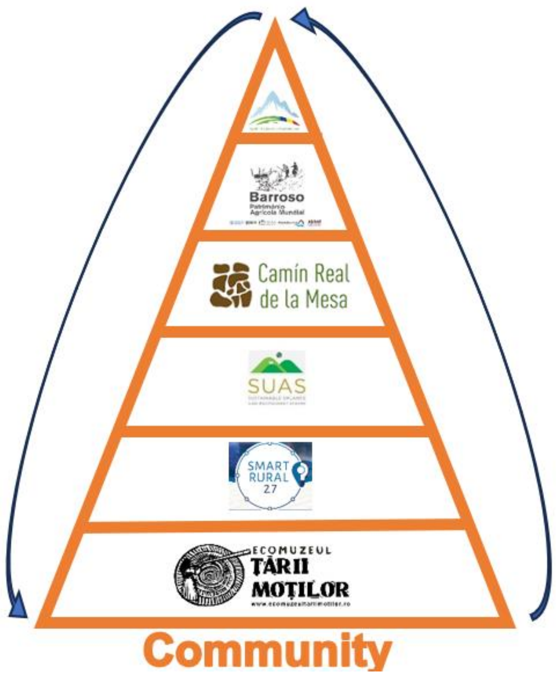

Fig. 2. Governance models position to bottom-up approach (community involvement)
Source: authors' own work.

Taking into account both opportunities and restrictions, important lessons and insights are extracted, as recommended by scholars [45], for possible replication in other geographic locations.

RESULTS AND DISCUSSIONS

There are different models that may be used to design, think through, and use resilient and sustainable forms of government in mountainous areas. The cultural, social, political, economic, and environmental aspects of the area are strongly ingrained in these models. All of the models presented are examples that have worked well in a certain place, at a certain time, and with a certain set of conditions that might not be totally replicable in other places. The creation of governance models for mountainous regions can be influenced by the insightful and instructive lessons they provide, both positive and negative.

Mountain Law for the 're-organisation' of mountain area governance (Romania)

According to the Mountain Law, Romania's mountainous areas cover 91,336 km^2, or 38.3% of the country's total area, and are home to about 4.8 million people, or 25% of the country's total population. Encouraging inclusive and sustainable development in Romania's mountainous regions is the main goal of the Mountain Law [33]. The restructuring of governance in mountainous regions into nine different "mountain groups" or massifs, each representing a cohesive physical, economic, and social entity with similar features, is a noteworthy feature of the strategic framework defined in the Mountain Law. Nevertheless, there are no particular measures in the 2018 Mountain Law that would increase community involvement in the management of Romania's hilly regions, either directly or indirectly. This omission constitutes a serious shortcoming in the current statute and calls for its amendment, similar to recent initiatives in France. The creation of a new Integrated Development Strategy for Mountain Areas was started in 2022 by the Ministry of Agriculture and Rural Development, with assistance from the European Social Fund and the World Bank [23]. The objective of this approach is to improve the overall effectiveness of mountainous area development and significantly increase the present level of support for it.

Barroso Globally Important Agricultural Heritage Systems – GIAHS (Portugal)

Traditional agricultural systems thrive in various regions, providing vital elements like food security, agrobiodiversity, local knowledge, cultural values, and distinctive landscapes. Recognizing their significance, the United Nations designates them as Globally Important Agricultural Heritage Systems (GIAHS). These encompass diverse landscapes, from village-level home gardens to regional mountain rice terraces and traditional hunting-gathering systems. Primary stakeholders in preserving GIAHS are the local traditional farming communities. Support from local and national levels should enhance governance processes and economic activities like eco-tourism and niche markets. These efforts aim to address challenges while maintaining agroecosystem integrity. GIAHS play a crucial role in territorial development, ensuring resilience to challenges like aging territories and climate change. Through sustainability, proximity, and governance, they remain relevant and sustainable for the long term [12].

Ireland's Upland Commonages (Ireland).

In Ireland's uplands, grazing on state or privately-owned commonages is regulated by specified livestock units, but governance structures among shareholders are lacking, leading to individual management practices. These commonages cover around 420,000 hectares managed by 15,000 farmers, mainly in the western seaboard. The aim is to establish effective governance and modernize management for sustainability. Without this shift, declining environmental, economic, and social conditions may worsen conflicts and inequalities. Effective governance is crucial for meeting stakeholders' needs and ensuring sustainable land management. Currently, individual land management practices are insufficient, lacking community involvement and conflict management mechanisms. Embracing communal resource management and adopting participatory methods are necessary for improvement. Transitioning to regenerative practices, including the reintroduction of transhumance, is vital for positive environmental and economic outcomes [38].

Camin de La Mesa Local Action Group (LAG) in Asturias region (Portugal)

The Camin Real de la Mesa region features predominantly high mountain terrain and is served by Local Action Groups (LAGs) in Asturias with broad competencies, including diversification aids and primary sector support. These LAGs encompass various mountainous territories, fostering a comprehensive understanding of the region. Effective governance requires surveying defined territorial scales, transcending administrative barriers, and maintaining a balanced social and territorial dimension. The Camin Real de la Mesa LAG serves as a nexus for managing funds, promoting collaboration, and ensuring diverse representation. Initially focused on the LEADER program, the LAG has evolved to administer various programs and projects, enhancing its credibility and partnerships. Community participation is organized through representative collectives, facilitating conflict resolution and promoting inclusivity. Despite the complexity of mountain territories, LAGs serve as inclusive structures, fostering collaboration and addressing depopulation through initiatives like the Nuevos Pobladores project [3].

Smart Villages (Bulgaria)

The concept of "Smart Villages" aims to establish a comprehensive ecosystem involving diverse stakeholders to improve rural quality of life and surroundings. Smart Villages encompass rural communities regardless of administrative boundaries or population size, with a primary focus on enhancing development opportunities in mountainous regions through EU funding [22, 35]. While the concept is relatively new in Bulgaria, its implementation is seen as crucial for fostering rural development. This approach necessitates engagement from various actors, including governmental institutions, businesses, academia, and rural representatives. Key elements include capacity building, participatory decision-making, and effective management structures, with organizations in rural areas playing a vital role as catalysts for social innovation [9]. Sustainable governance networks and support for local entrepreneurship are essential for long-term success. Ultimately, Smart Villages offer a strategic opportunity to integrate policies for rural development, environmental conservation, and regional connectivity.

EcoMuseum of Apuseni Mountains (Romania)

Over the past thirty years, external grants have fuelled numerous projects aimed at bolstering local community development, focusing on bridging socio-cultural and economic gaps with neighbouring regions. Initially cantered in the Apuseni Natural Park, designated as Natura 2000 sites, the Ecomuseum aims to preserve local identity and resilience amidst socio-economic shifts, including land abandonment and gentrification. This bottom-up initiative involves all local stakeholders, requiring certification through agreements between the park administration and participating communes [7], The Ecomuseum operates with community involvement, its own regulations, and management structures, aiming to resolve internal issues internally and external disputes legally. Stakeholders contribute resources within legal limits, with specialized staff training. The overarching aim is to ensure community resilience, with management coordinated among the park administration, local governments, and residents.

The analysis, in terms of their impact on resilience and sustainability, of the governance models presented above, offered the chance to observe important insights into both excellent and bad organizational management and governance approaches, which led to the success and, consequently, to the failure of the analysed governance.

Positive aspects to be implemented

- Bottom-Up Approach: By giving stakeholders a say in decision-making, incorporating bottom-up participation in governance promotes inclusivity and increases success.
- Participatory Approach: International recognition and stronger ties are fostered by decision-making procedures that involve engagement with pertinent parties, including locals.
- Flexibility: Introducing adaptable types of government, such rotating representatives, strengthens community leadership and unity.
- Local Adaptability: Integrated decision-making processes are ensured by governance frameworks that are tailored to social, cultural, and economic conditions.
- Traditions and Landscape Conservation: The resilience of local communities and ecosystems is enhanced by the sustainable use

of natural resources and landscape conservation.

- Replicability: Establishing workable frameworks for regional socioeconomic growth makes it possible to replicate the results in adjacent communities and other localities.

Challenges to be avoided

- Lack of Predictability: Strategic development and cooperation may be hampered by stakeholder vision disparities.
- Excessive Dependence on One Sector: Distinctive systems' sustainability may be jeopardized by an over-reliance on one sector.
- False Leadership: Collaboration and inclusion may be hampered when a single leader monopolizes decision-making.
- Spatial Inhomogeneity: Places with artificial layouts may be less effective and cause imbalances.
- Ignoring Diversity: Various community requirements are not met by governing models that are designed to accommodate all situations.
- Individual Governance of Common Resources: Sustainability depends on the collective management of common resources.
- Lack of Governmental Support: The implementation of innovative governance is hampered by representatives' lack of enthusiasm and knowledge.

There isn't a perfect governance model that can be implemented everywhere, although flexible approaches have showed potential in a number of hilly areas. Effective models combine conventional relationships with cutting-edge governance techniques, such as community involvement and participatory decision-making procedures, especially for underrepresented populations. It is important to overcome obstacles such as entrenched conventional structures and political resistance. Effective implementation requires soft skills like empathy and communication, as well as ongoing community involvement and education to sustain support for governance goals. In order to ensure the viability of government systems, dedicated external resources are required to bridge gaps between urban and rural communities, particularly mountain regions.

CONCLUSIONS

The identification of knowledge gaps and areas in need of more research in order to develop mountain governance is a major research need. Ideas that are timely: suggestions for upcoming breakthroughs, such as technology-driven fixes, interactive approaches, and multidisciplinary teamwork.

The paper identified a number of important further research topics, such as using a true cost model of public goods to conduct cost-benefit analyses of various regions and examining the limits of intensive economic exploitation - which includes modern forestry, agriculture, tourism, and other industries - in mountainous areas. It is also possible to discuss the identified research needs that come from actual observations in the field. These needs include figuring out what inspires young people to return to mountainous areas and actively participate in maintaining local governance, evaluating the need for soft skills education for locals living in mountainous areas, and promoting cross-border exchange of best practices and experiences.

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THE COOPERATIVE MODEL OF AGRIBUSINESS IN BULGARIA- ORIGINS AND CONTEMPORARY STATE

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Abstract

The contemporary Bulgarian cooperative business model emerged at the end of the 19th century in response to specific socio-economic conditions. It developed progressively with the realization of various businesses – agricultural, credit, or as provision of services to member-cooperators, etc. Throughout the years, the cooperative model underwent periods of significant growth, yet also of stagnation, which has justified the interest that both theory, and business practice have shown in it. Generally recognized is the contribution of a number of national and international researchers who in the past have analyzed the features of the cooperative model and defined it accordingly. From the analyzed literary and normative sources, we can deduce that the definitions and opinions on the cooperative nearly overlap. It is defined as a voluntary union of persons who mutually assist and cooperate with each other with equal responsibilities and rights. The member-cooperators delegate part of their functions to democratically elected leading representatives when they establish a cooperative enterprise. The main goal of the cooperative is to meet the needs of its members in its non-profit oriented activity. Considering the multi-aspect character of the studied topic, we outline the aim of this paper as making an analysis of the origin and development of the cooperative model and its applicability to the agricultural sector in Bulgaria. The chosen methodological approach is based on the statistical groupings of a big corpus of official data on cooperatives entered in the Bulgarian Commercial Register since 2005 to date. We have established certain indicators, reflecting the tendencies in the development of cooperatives by region of planning, economic sectors, annual revenue, etc. We used Microsoft Office and the licensed version of Statistics Grad Pack for Windows for data processing. Main inferences: In Bulgaria, the cooperative business model emerged first in villages to satisfy the needs of the local population. Later, these cooperatives appeared in larger towns. This process in Bulgaria is reverse to other European countries with more developed market economy. The agricultural orientation of the developing Bulgarian economy at the end of the 19th century explains the establishment of the first national cooperatives of the agricultural credit type in villages. In Bulgaria, the cooperative business model as a legal organizational form penetrated almost all branches of the national economy. The role of Sector A "Agriculture, forestry and fish farming" was dominant. To a great extent, this resulted both from the specifics of the Bulgarian economy, and the existing cooperative traditions.

Key words**:** *cooperative, model, agribusiness, origin, state, development*

INTRODUCTION

Contemporary cooperatives emerged in Bulgaria in response to particular local socio-economic conditions at the end of the 19^{th} century. With time, they developed specific models based on various economic activities – agricultural, consumer, credit, miscellaneous, etc. Throughout the years of their development, they witnessed periods of significant growth and stagnation, which has justified the interest that both theory and business practice have shown in them. Generally recognized is the contribution of a number of national and international researchers who in the past have analyzed the features of the cooperative and have defined it, such as Popov (1910), Dikov (1927), Pashev (1936), Donchev, Bonev, Valev (1941), Kanev (1943), Palazov (1946), Valkov (1945), Kanchev (2000), Kanchev and Doychinova (2006), Atanassova (2003), Yovkova (2007), Aleksandrov (2007), Boevski (1997, 2016, 2020), Kauffman (1907), Sombart (1919), Baranovski (1922), Draheim (1952), Boettcher (1980), Aschoff (1995), Münkner (1995), Wilson (2017) [24, 12, 23, 13, 16, 17, 18, 3, 30, 1, 6, 7, 8, 19, 26, 4, 14, 5, 2, 21, 29] and many others. The legislations of many European countries

(Germany, Switzerland, Austria, Spain, Portugal, etc.), where the cooperative had long traditions and has spread to different economic sectors, see it as a social model of doing business [15].

We can deduct from the analyzed literature and legislation sources that the definitions and opinions on the cooperative almost overlap. It is defined as a voluntary union of persons for mutual assistance and cooperation, who hold equal responsibilities and exercise the same rights. The member-cooperators delegate part of their functions to democratically elected leading representatives when they establish the cooperative enterprise. The main goal of the cooperative is to meet the needs of its members as a non-profit oriented organization. As a result, Shaarz and Casselman (1980) [25] call it "an economic system with social content".

The European Economic and Social Committee in 2012, which was the International Year of Cooperatives, adds to the definition of the cooperative in the following way: "it manages the changes in an economically efficient and socially responsible way, contributes to the social and territorial adhesion and creates innovative business models in order to increase its competitiveness. It is generally agreed that cooperatives are part of the social economy".

Departing from the multi-aspect character of the studied topic, we can outline the aim of the paper as making an analysis of the development of cooperatives and their applicability to the economic life of Bulgaria.

In order to reach the set goal, we have addressed the following **tasks**:

-Noting the key moments since the establishment of the first cooperatives in Bulgaria

-Examining the major features of the cooperatives in Bulgaria, revealed in the last two decades

-In view of the period of emerging cooperatives in the country we attempt to explain the manifested tendencies of their development at the beginning of the present century

The used methodological approach is based on the statistical grouping of a large corpus of official data on cooperatives entered in the Bulgarian Commercial Register since 2005 to date. Selected indicators that reflect the trends in the development of the cooperatives by regions were established, such as planning, economic branches, annual income, etc. We used Microsoft Office and the licensed version of Statistics Grad Pack for Windows to process the data. Through a historical analysis, certain moments of the origins of the first Bulgarian cooperatives have been revealed.

Origin of the first cooperatives in Bulgaria

On 11 June 1890 two school headmasters – T. Yonchev and T. Vlaykov established the first agricultural credit cooperative in the village of Mirkovo, Pirdop district.

The second to emerge was the agricultural credit society "Zashtita" (protection) in the village of Lyubenova Mahala, Nova Zagora district.

Seven years later (1897) the agronomist N. Kardzhiev and N. Bachvarov (manager of a farm near Rousse), assisted by A. Gradev (teacher in the village of Schtraklevo) launched an active campaign among the peasants to establish cooperatives in our country.

Thus, in November, the first credit cooperative in the region appeared. Several days later another cooperative was founded in the village of Chervena Voda (Table 1).

A key role for the emerging of the first cooperatives in Bulgaria was played by the Bulgarian Agricultural Bank (BAB)[9].

A. Ivanov, manager of the credit department of the bank, implemented a policy for founding cooperatives in the country.

On this basis, "kernels" of employees were formed to popularize the cooperative ideas. On one side, due to obstacles, caused by the regulations of the first Commercial Law in Bulgaria, and on the other, due to the resistance of usurers, the process of cooperating proceeded slowly.

Several years after the emergence of the first cooperatives in the villages, such structures were established in some bigger towns in the country.

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Table 1. First cooperatives in the Bulgarian villages

Year	Initiators	Type of cooperative	Reason for establishment
11 June 1890	T. Yonchev – inspector; T. Vlaykov - teacher	**AGRICULTURAL CREDIT COOPERATION** in the village of Mirkovo, Pirdop district	Model Statute, translated from German, compiled by Fassbender, student of Raiffeisen. Created as per the Commercial Law
1890		**AGRICULTURAL CREDIT FUND "ZASHTITA"** in the village of Lyubenova Mahala, Nova Zagora district	First registered as Economic Shareholding. Created as per the Commercial Law
1897	N. Kardzhiev – agronomist; N. Bachvarov – farm manager near Rousse; A. Gradev - teacher	**COOPERATIVE ASSOCIATION** in the village of Shtraklevo, Rousse district	Honorary chairperson is Gr. Nachovich – Minister of Commerce and Agriculture. Members of the Management Board contribute to 1/10 of the capital, according to art. 163 of the Commercial Law
1897	N. Kardzhiev - agronomist; N. Bachvarov - director; A. Gradev - teacher	**COOPERATIVE** in the village of Chervena Gora, Rousse district	Members of the Management Board contribute to 1/10 of the capital, according to art. 163 of the Commercial Law

Source: Own research on historical documents.

The first urban cooperative was established in 1899 in Plovdiv as a consumer type of enterprise (bakery). Afterwards, in May 1900 the consumer cooperative “Saglasie” (concord) was founded in Samokov, and in January 1901 – “Bratstvo” (brotherhood) in Kazanlak. In November 1902 the consumer cooperative “Bratstvo” was registered in Yambol (Table 2).

In the city of Sofia in 1903 P. Cholakov established the consumer cooperative “Bratski Trud” (brotherly labour). In the same year, a teacher’s savings and insurance cooperative was registered.

Later in November, under the leadership of A. Ivanov the first of its kind Sofia Popular Bank was founded.

Table 2. First cooperatives in Bulgarian towns

Year	Town	Type of cooperative	Activity
1899	Plovdiv	**First urban consumer cooperative**	Bakery
May 1900	Samokov	**Consumer cooperative “Saglasie”**	Commerce
January 1901	Kazanlak	**Cooperative “Bratstvo”**	Commerce, services
November 1902	Yambol	**Consumer cooperative “Bratstvo”**	Commerce
1903	Sofia	**Consumer cooperative “Bratski trud”**	Services
1903	Sofia	**Teacher’s savings and insurance cooperative**	Financial services
November 1903	Sofia	**First Sofia Popular Bank**	Financial services
1905	Sofia	**Cooperative savings and insurance association**	Financial and insurance services

Source: Own research on historical documents.

Two years later, the first Cooperative Savings Insurance Society was registered in Bulgaria (Table 2).

BAB analyzed the process of cooperating and published information on the period from 1899 to 1910 in which it noted the establishment and operation of 238 Bulgarian cooperatives diverse in their economic activity (Table 3).

Table 3. Number and membership in the first Bulgarian cooperatives per year

Year	Number of registered cooperative	Changes in the number of registered cooperative	Member cooperators	Changes in the number of member cooperators vs. 1899
1899	4		236	
1900	2	- 2	234	- 2
1901	2	- 2	140	- 126
1902	17	+ 13	683	+ 447
1903	77	+ 73	739	+ 503
1904	24	+ 20	1,447	+ 1,211
1905	91	+ 87	5,458	+ 5,222
1906	147	+ 143	11,224	+ 10,988
1907	238	+ 234	19,422	+ 19,186

Source: BAB, 1900-1910 [9].

Slowly, the process of cooperation in the country continued. After the participation of

A. Ivanov and H. Chakalov in the International Congress of Cooperatives in Budapest (1904) the managers of the established cooperatives decided that they should be regulated by a special cooperative law. Thus, in 1907 the first Cooperative Act was adopted (promulgated in State Gazette, issue 45/ 28.02.1907, amended in State Gazette, issue 48/ 01.01.1911) [11]. The act regulated the creation, structure and organization of cooperatives. Thus, a green light was given to the development of the cooperative action in the country.

In summary, the analyzed facts can lead to several main inferences:

-In Bulgaria, the cooperatives appeared first in villages to satisfy the needs of the local population. Later, cooperatives were established in larger towns. This process in our country was reverse, compared to other European states with more developed market economy.

-At the end of the 19th century the Bulgarian intelligentsia were avid supporters of the cooperative ideas, however the population needed time and systematic encouragement to become adherents of these ideas. The initiative for establishing the first Bulgarian cooperatives did not arise from the peasantry, but rather from progressively thinking Bulgarians (teachers, agronomists, bank employees, etc.). The Bulgarian intelligentsia foresaw the opportunities through cooperation to assist and support the poor rural population and to unite the urbanites. A considerable support was provided by BAB.

-The agricultural orientation of the development of the Bulgarian economy at the end of the 19th century explained the establishment of the first cooperatives in Bulgaria, such as the agrarian credit cooperatives in villages. Years later, at the beginning of the 20th century, the consumer cooperatives appeared, followed by the popular city banks, as well as some professional cooperatives/ associations.

-Despite the fact that after more than a century had passed, the process of emergence of the first cooperatives in Bulgaria left its mark on and to a certain extent continues to impact the contemporary development of cooperatives in the country.

Aspects of the contemporary development of Bulgarian cooperatives

The definition, given in art. 1 of the first Cooperative Act (1907) in our country says: “A cooperative is any association formed by an indefinite number of members which is established in order to develop the economic interests of its associates and encourage the credit, agriculture, industry and trade through a cooperative action or mutuality.”

A similar phrasing of article 1 of the Cooperative Act in force (last) (adopted in December 1999 [18], amended and restated fourteen times up to now): “The cooperative is an association of physical persons with varying capital and number of members who through mutual assistance and cooperation realize commercial activity in order to satisfy their economic, social and cultural interests.”

These, and some other analogies may be found in both laws. Therefore, the claim that the cooperative’s past reflects its future is confirmed to a certain extent.

In the studied period between 2005 and 2023 in Bulgaria a total of 9,037 cooperatives were established. A considerable change in their amount with a clear trend for decline is observed (Figure 1).

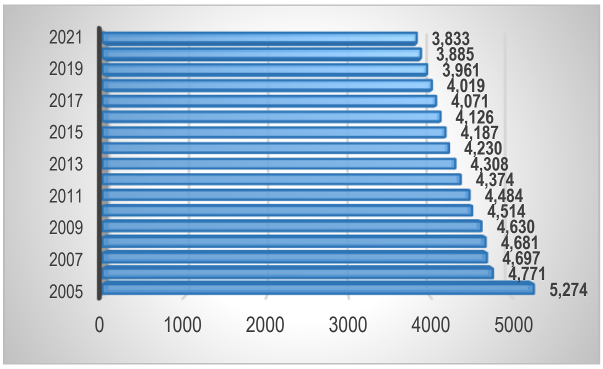

Fig. 1. Change in the number of registered cooperatives in Bulgaria by years.
Source: Ciela Norma and own calculations [10].

The highest number of active cooperatives was noted in 2005: 5,274, and the lowest in 2021: 3,833. The trend of decreasing the number of cooperatives both in the country as a whole, and per economic sectors is explained largely with the change in their status (Tables 4 and 5).

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Table 4. Status of the cooperatives in Bulgaria: 2005-2023

Cooperative status as per the Commercial Register	Number	Relative share (%)
Acting/ active	2,818	*31.2*
Non-acting/ inactive	4,747	*52.5*
Eliminated	871	*9.6*
Termination of economic activity	443	*4.9*
In a liquidation procedure	104	*1.2*
Termination of the liquidation procedure	3	*0.0*
Continuation of the commercial activity	8	*0.1*
Restructuring of the cooperative, form: merging	30	*0.3*
Restructuring of the cooperation, form: separation	3	*0.03*
Undergoing insolvency procedure	8	*0.1*
Declared insolvent	1	*0.01*
Terminated insolvency procedure	1	*0.01*
TOTAL	**9,037**	***100.0***

Source: Source: Ciela Norma and own calculations [10].

Towards the beginning of June 2023 the cooperatives with a status of "active/acting" were as low as 2,818, and those with the status "inactive/ non-acting" were 4,747. The relative share of the former was 31.2% of the total number, and of the latter – 52.5%. The number of cooperatives "eliminated" from the Commercial Register is considerable – 871 (9.6%). Those who discontinued their economic activity were 443 (4.9%). 104 (1.2%) cooperatives are undergoing liquidation. Only 33 cooperatives have a status of "restructuring, in the form of merging and separation" (Table 4).

The change in the status of cooperatives in Bulgaria reflects on the annual income from their activity (Figure 2). We have found that the largest is the group of cooperatives with an annual income of 300 000 BGN, followed by those with 301 600 BGN. A declining trend in their number towards the end of the studied period compared to the beginning is noticeable. Simultaneously, the smallest are the groups of cooperatives with annual revenue of over 6 million and 3-6 million BGN. A reverse trend to a gradual increase in their number at the end of the period against the beginning is established. The latter can be somewhat explained by the status of 30 cooperatives which are "cooperative restructuring, with a form of merging".

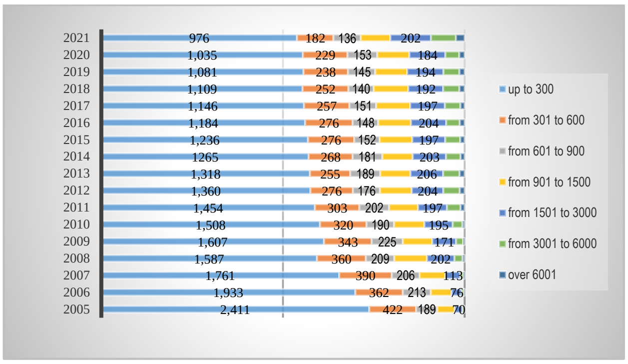

Fig. 2. Grouping of the cooperatives in Bulgaria by annual income in thousands of BGN: 2005-2021
Source: Ciela Norma and own calculations [10].

With respect to the distribution of the cooperatives by regions for planning (Figure 3) we have found that most of them are in the South-central region – 1,609, or 17.8% of all, as most numerous are in Plovdiv and Haskovo regions. Next is the Southeast region – 1,578, or 17.5% of all, as the leader in this ranking is Stara Zagora region.

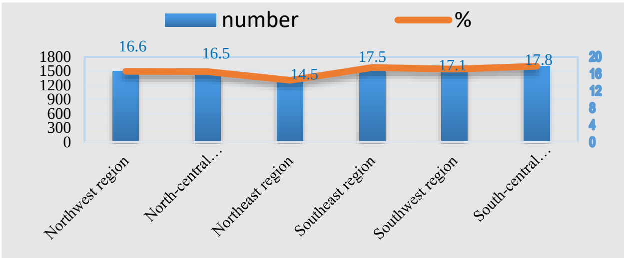

Fig. 3. Regional distribution of cooperatives in Bulgaria: 2005-2021
Source: Ciela Norma and own calculations [10].

Third comes the Southwest region with 1,534 registered units, or 17.1% of all. The largest number of cooperatives exist in the city of Sofia. The number of cooperatives in the Northwest and the North-central region is almost the same, respectively 1,502 (16.6% of all), and 1,494 (16.5%). In it the largest number of cooperatives operate in Pleven region, followed by Rousse region. The smallest is the number of cooperatives in the Northeast region – 1,311, or 14.5% of all, as the highest number of active cooperatives in the region are situated in Varna region.

In the entire country during the observed period, the significantly lowest number of registered and acting cooperatives is found in two regions – Kardzhali and Smolen, respectively 98 and 129. We believe that the present regional distribution of the cooperatives follows the pace of the economic development of the country regions. The fact that some are still influenced by the existing traditions of the cooperative movement dating back to the last century can be exemplified in the regions of Stara Zagora, Rousse, Sofia, etc.

The largest is the group of cooperatives with assets of up to 3.9 million BGN, and a trend to a small to negligible decline from 100% to 91.7% over the studied period. A significantly lower is the relative share of cooperatives which own from 3.9 million to 19.5 million BGN with a tendency to a gradual increase from 0 to 7.9% over the observed period. An insignificant is the relative share of the cooperatives which own assets of over 19.5 million BGN – below 0.5% of all (Figure 4). The results obtained for the owned assets show that the size of the realized activity of the cooperatives matches the capacity of micro and small enterprises.

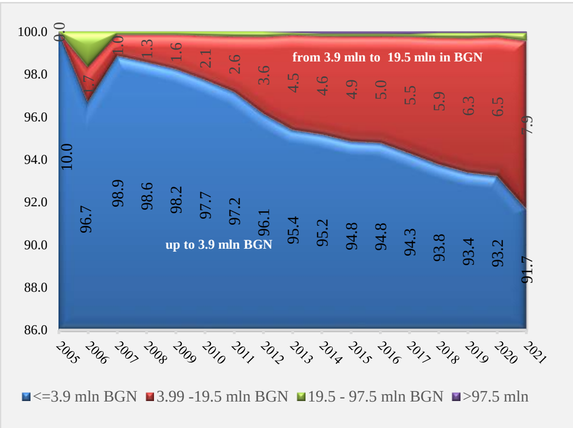

Fig. 4. Grouping of the cooperatives by value of the owned assets in %
Source: Ciela Norma and own calculations [10].

The indicator "number of employees" confirms the supposition that cooperatives are predominantly micro and small enterprises. The group of cooperatives composed of up to 10 persons is the largest, however, a decreasing trend is also noticeable. Second is the group of 50-250 persons, i.e. those cooperatives whose size of economic activity matches the middle-sized enterprise. In Bulgaria, there are no cooperatives with more than 250 employees (Figure 5).

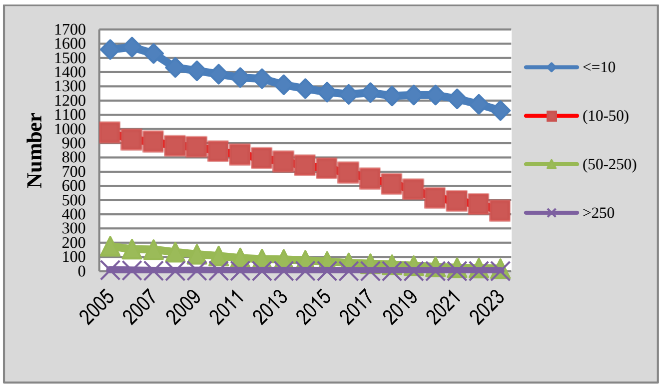

Fig. 5. Average number of employees in cooperatives: 2005-2023
Source: Ciela Norma and own calculations [10].

Over the observed period, the cooperatives develop their activity in almost all economic sectors according to the Classification of Economic Acitivity-2008, except for sectors O "State administration", and T "Activities of households as employers" (Fig. 6, Table 5).

The largest are the established and operating cooperatives -4,534 (agricultural, production) in Sector A "Agriculture, forestry and fish farming" – 50.2% of the total number. A smaller number – 1,443 cooperatives (mostly consumer) are found in Sector G "Commerce, car and motorcycle repair" which are 16% of all. Third in number -771- are the cooperatives (consumer, labour and production cooperatives, etc.) in Sector L "Real estate operations" – 8.5% of all (Fig. 6).

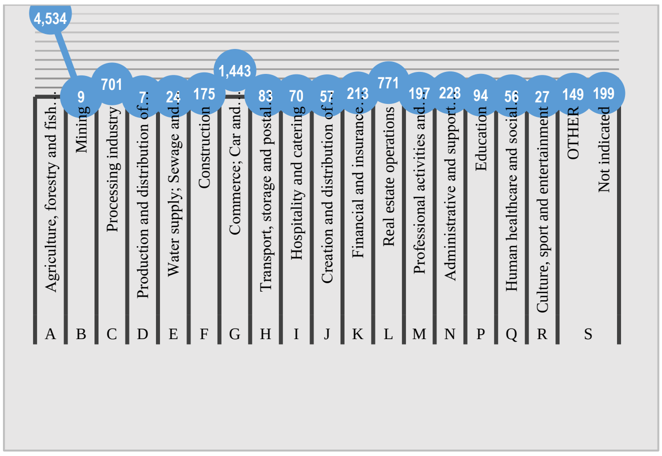

Fig. 6. Grouping of the cooperatives in the Classification of Economic Activity-2008 for 2005-2021
Source: Ciela Norma and own calculations [10].

In Sector C "Processing industry" the registered cooperatives are 701 (labour and production cooperatives), or 7.8% of all.

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We have found that the cooperatives in Sector K “Financial and insurance activities” (credit) constitute a share of 2.4% (213 units) of the total. They develop credit activity, as some may be described as referring to the existing popular banks in the country at the beginning of the 20th century.

The relative share of 2.5% (228) of cooperatives (labour and production cooperatives, consumer, etc.) that are registered and operate in Sector N “Administrative and support services” is noticeable. Their main role is to assist certain groups of the population – the disadvantaged and smaller producers (beekeepers, etc.).

A smaller relative share – 2.2%, or 197 cooperatives are registered and operate in Sector M “Professional activities and research”. This sector includes the regional cooperative unions, as well as youth, war invalids, construction design and other types of cooperatives.

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There are cooperatives in Sector F “Construction” – 175, or 1.9% of all; P “Education” – 94, or 1% of all; Q “Human healthcare and social work” – 56, or 0.6%, R “Culture, sport and entertainment” – 27, or 0.3%.

Except for construction, in the other three economic sectors, the cooperatives are primarily professional associations, formed by intellectuals (physicians, teachers, musicians, athletes, etc.) who resemble those existing here more than a century ago.

Table 5. Grouping of cooperatives in Bulgaria according to the Classification of Economic Activities-2008 during 2005-2021

code	**Economic sector**	**Total number**	**Relative share of the total number**	**Number of active**	**Relative share of the number of active**
A	Agriculture, forestry and fish farming	4,534	*50.2*	1,074	*38.1*
B	Mining	9	*0.1*	2	*0.1*
C	Processing industry	701	*7.8*	201	*7.1*
D	Production and distribution of electricity, heat and gaseous fuels	7	*0.1*	2	*0.1*
E	Water supply; sewage and waste management and restoration	24	*0.3*	8	*0.3*
F	Construction	175	*1.9*	34	*1.2*
G	Commerce, car and motorcycle repair	1,443	*16.0*	473	*16.8*
H	Transport, storage and postal services	83	*0.9*	20	*0.7*
I	Hospitality and catering	70	*0.8*	17	*0.6*
J	Creation and distribution of information and creative products; telecommunications	57	*0.6*	17	*0.6*
K	Financial and insurance activities	213	*2.4*	79	*2.8*
L	Real estate operations	771	*8.5*	509	*18.1*
M	Professional activities and research	197	*2.2*	68	*2.4*
N	Administrative and support activities	228	*2.5*	45	*1.6*
P	Education	94	*1.0*	14	*0.5*
Q	Human healthcare and social work	56	*0.6*	16	*0.6*
R	Culture, sport and entertainment	27	*0.3*	6	*0.2*
S	Other activities	149	*1.6*	53	*1.9*
	Not indicated	199	*2.2*	180	*6.4*
	TOTAL	**9,037**	***100.0***	**2,818**	***100.0***

Source: Ciela Norma and own calculations [10].

As a preferred organizational form of association, the cooperative (consumer, production, delivery, etc.) is applied in the following industries: H “Transport, storage and postal services” – 83, or 0.9%; I. “Hospitality and catering” – 70, or 0.8%; J “Creation and distribution of information and creative products; telecommunications” – 57, or 0.6%; B “Mining” – 9, or 0.1%, and S “Other activities” – 149, or 1.6%.

We have found that during the studied period in our country there is a group of cooperatives (199, or 2.2% of all) which have an undefined type of economic activity, and cannot be referred neither to sector S “Other activities”, or other sectors of the CEA-2008.

The above analysis has led to the several **main inferences**:

- In Bulgaria the cooperative as a legal organizational form is present in almost all economic branches of the national economy. Its role is dominant in two sectors: A “Agriculture, forestry and fish farming” and G “Commerce, car and motorcycle repair”. To a large extent this is the result of the specifics of the sectors, and the existing cooperative traditions.
- The number of active cooperatives in all economic sectors in the country gradually decreases. Most significant is the fourfold decrease in Sector A “Agriculture, forestry and fish farming”. Towards the middle of the current year, over a half of the cooperatives registered during the studied period have shifted their status to “inactive”.
- The activity of the Bulgarian cooperatives is low profit. The group with annual income of 300,000 BGN is significant in number against the others, however, a declining trend in their amount is observed at the end of the period versus 2005, and a slight increase of the number of high income cooperatives.
- Regionally, the highest number of active cooperatives is found in South-central region with a dominant location in Plovdiv and Haskovo regions active in almost all economic branches. The Southeast region takes a second place in the spread of cooperatives, as Stara Zagora region is a local leader.

CONCLUSIONS

Despite the contemporary challenges and issues of various nature, research on cooperatives in Bulgaria must continue to evolve in order to find answers to many questions related to their past and future development. As an organizational form of association, they have had and continue to play a key role in the production, processing, and trade of many products, as well as in the service industry. Finding solutions to the problematic aspects in their operation is important not only for the enrichment of theory, but also for helping local cooperative practice.

The combination of the historical aspects in this study on cooperatives since their origins to their current state, is a complex research approach. It, however, allows us to clarify the influence of the main factors (social, economic, political, etc.), that explain the presence of some and the absence of other characteristics and issues of contemporary Bulgarian cooperatives.

In view of the above, we allow ourselves to put a final touch to our paper with a quotation by Iliya Pavlov – one of the researchers of cooperative theory and the Bulgarian cooperative practice, formulated eight decades ago, which also sounds relevant to this day: “***The modern cooperation is conceived by the economic and social conditions of recent times; viewed as such, we can relate them to the history of the cooperative movement, and thus draw the most correct conclusions***.”

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PLOT QUALITY RATING AS A RESULT OF INNOVATION MANAGEMENT IN THE ARTIFICIAL INTELLIGENCE SOCIETY

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Abstract

The plot quality rating of seed research industry is of great importance for most trials and experiments, trying to bring data to validate or invalidate a trait, or to see how a trait is getting variability. Still today, the plot quality is a manual assessment, requires a lot of time, and the decision based need to be taken in a short time for creating space for actions. There is a switch of plot quality rating assessment, from conventional to modern, based on imaging. Many multinational companies who business in agriculture, mostly in breeding and research and development, are now, more and more attracted by the drone use as a proof of AI (artificial intelligence). The importance of a plot quality rating is high, from the pure reason it participates in the data validation, standardization, and governance as a science decision. In this area of research, imaging can be very useful and having strong benefits for the final customers. This need provided by AI comes with the imaging concept, based on drone flights and interpretation. The drone is most of the time a commercial one, but the sensor itself is multispectral, able to deliver different layers with interest for the farm. The farm decision or the research team, evaluate the plots by using a application developed by Sentera (USA), named Field Agent. This app represents today the most advanced plot evaluation, and the use of it is quite simple, most of the time deductible for the professional agronomist. As a POC (Proof of Concept), we have used the AI to bring more reliability into the data at farm level, specifically for corn seed production, where we were able to have a stand count (for female and male), tassel identification (target is to develop it for female rows, detasseled), and yield prediction together with disease and pathogens control under the Power Distribution Board (PBD).

Key words: *plot quality rating, drone, artificial intelligence*

INTRODUCTION

Modern agriculture is consolidated by plenty of machine learning applications. Probably the most updated review is the one published by [2], where several general criteria has been identified, grouped as follow: crop and livestock management, soil and water management. The wider criteria or category, crop management is divided by five sub-categories: yield prediction, disease and weed detection, crop recognition, and crop quality.
The first used on large scale on Romanian agriculture landscape has been crop detection. Once [10] implemented geospatial checks, crop detection has become particularly popular.
On plant breeding and hybrids screening, the real importance is crop quality. This is very complex to assess as it related to soil and climate conditions, and cultivation practices.
Today, the crop quality based on machine learnings is studied for more than 80 species, the most important are (in order of number of scientific papers published in the last 10 years): maize, wheat, rice, soybean, tomato, grape, rapeseed/canola, cotton, potato and barley [14].
Corn, also known as maize, is having a high interest for the farmers [16], cultivated in all regions where people leaving, having a large variability and adaptive to different climatic conditions and technological management. Today, more and more is visible that drone use could bring a high use, large potential for the users with GIS (Geographic Information System) knowledge. Less time is invested by the agronomist to scout a field, less influenced by the size. Old methods (conventional scouting) supposed a walk in several points, empirical selected based on agronomist experience and field history, with high impact on time and safety [12, 13].
In modern plant breeding, high-throughput phenotyping trial and performance characterization analytics is a must have. Getting accurate and precise measurements to

support seed production performance and outcomes is essential for today's agronomist [7]. Several outputs we are able today to assess via use of drone and algorithms, like rogue(off-type) detection, plant densities, tassel count, crop health (several scouting is needed) and yield prediction [6, 15, 5].

At present, [17] mentioned in Field Crops Research, that little is known about appropriate UAV (Unmanned Aerial Vehicle) based strategies of 'model calibration at a small site while applying these models at a large extent' for crop monitoring.

In this context, this study aims to answer the following research questions (RQs):

(1) What are the most informative UAV indicators for monitoring LAI (Large Area Imaging), LCC (Leaf Cholorophyll content), and aboveground dry matter (AGDM)?

(2) Does the suitability of indicators differ for maize jointing (BBCH= 34, [1], heading (BBCH= 51), and grain filling stages (BBCH= 71) (BBCH is the vegetative scale to identify the vegetative growth, BBCH - Biologische Bundesanstalt, Bundessortenamt and Chemical industry?

(3) Can the UAV indicators properly reflect differences in crop growth caused by distinct water and nutrient management?

(4) How well is the transfer capability of UAV remote sensing-based random forest models among distinct water and nutrient management practices?

MATERIALS AND METHODS

UAV Image Collection

Imaging data for our purpose has been collected in a corn seed production field, planting ratio 6F:2M (F-Female, M-Male)), at Astra Trifesti, in Iasi country, Romania. The aerial pictures have been collected used a commercial drone DJI brand, Phantom 3, with high resolution (12.6MP camera), equipped with a 6X sensor developed and delivered by Sentera [4] via a third-party company, with local representatives. The flights were done at 20-25m (variable in terms of field altitude which was in a slope), having 90-92% forward overlap and 88-90% sides overlap. All images have been collected during the vegetation period, starting from May up to August of 2023; On the stage V2-V4 for the plant emergence; ten days after second mechanical detasseling (first cut has been made by knifes, second cut by rolls) for the tassel count on male size, then last flight 3-4 weeks before harvest.

Image processing

One single image collected by drone were on 12.6MP, 3.5k*4k pixels, that represents a big challenge to compute all pictures associated with the right spot from the field. As every imaging software, for each image, has been created small images of lower resolution (generally 1k*1k pixels, but it happens when the field cultivation is not well done and the weeds are still present, to have 0.5k*0.5k), without any overlapping. That small sub-pictures artificially done, has been labelled and associated with the spots in the field and feed he computational learning models, which AI works.

The software used for image analysis was Field Agent, developed by Sentera (USA), special for this purpose, dedicated to seed research and seed production. The flow starting from the pictures done in the field, then pasted (offline) into Field Agent for processing. Passes has been predefined by the tool when drawing the field shape. The output is a mosaic of numbers that represent the trait captured and shows field variability(available on phone and desktop).

RESULTS AND DISCUSSIONS

Early stand count (plant densities)

Stand count is referring to plant density or plant population in a field or plot. It could be numerical or percentage values. Stand count is the first agronomic criteria that is influencing final yield. It is also having an impact on field performance from sanitation point of view, uniformity, and resources allocation. We can say that stand count is a key factor in maize seed production fields.

The advantage of using imaging and the Field Agent tool from Sentera, is that in a safer way and faster, the agronomist can scout any field and it helps to indicate and to highlight the problem-spot that requires specific agronomic

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management (like specific herbicide to use based on weeds, flooding areas, bird damage spots, wild animals, etc).

In seed production field and in seed research, this imaging shows indicators to claim field uniformity, helping in this case to highlight the batches with problem (like bad germination, biological impurities).

Field uniformity and the plant fulfilment per row is creating homogeneous conditions for further practices. Less care and people are used in case of a uniform field at the stage of detasseling. Also, this stand count is relatively used during inspections by the authorities for getting the final certification. Stand count topic is having a big impact on plant development, by enlarging the space for the neighboured plants with a gap in between, that means a faster development.

As said in the first part of this paper, for the stand count assessment is used a special sensor based on RGB (Red Green Blue). It is lighting bands of green, red and blue; visible for human eye. Field Agent is generating layers and maps with legends inside on what is happened in the field, plant by plant from each row (Photo 1.a and 1.b).

Photo 1.a. Spots analysis for stand count evaluation
Source: Personal photo.

The data included in the tool are vary based on the product. Specificaly for agronomy (farm management or forest management), the tool is valuable by providing the plant population for a field or a specific part of the field, and it may drive to actions for replanting, or to highlight a spot with special needs (more fertilizer, special fungicide or very common, one more herbicide application on spots), with the high impact on final yield.

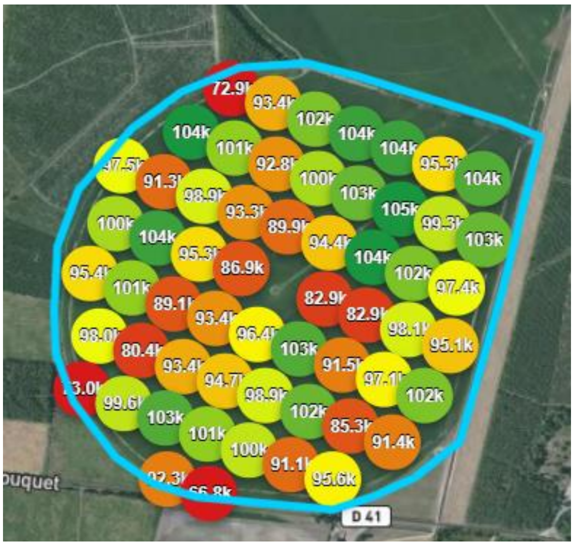

Photo 1.b. Real stand count calculation in thousands plants/ha
Source: Personal photo.

For the emergence evaluation, the Sentera company developed Stand Count tool. It takes ad-literal the number of plants/plot (not influenced by the size of the field), field uniformity, rows completeness, row gaps, plant duplicates, and other situations that influence the performance of any corn seed production field. Via this tool, Sentera is providing at the farm level, maps, analysis and high resolution pictures.

As we speak on a corn seed production field, the ratio female/male and the stand counts individually is a must have. In Field Agent, using this tool (Stand Count), we can download the maps, which based on that, agronomists can take decisions (as replanting a specific part of the field or increasing plant population for pollinator rows).

Tassel count

As said earlier, conventional way to assess tassel count in a corn seed production has been done manually, in several points related to the field uniformity and field size. For the yield determination and harvest management, agronomists were in the field, collection hundreds of samples, shipment to the farm or to the lab for yield determination, then having manual calculations for both traits.

We asses tassel count (for male: the number of total tassel per ha, which is equivalent to the plant density for male; then for female, tassel count got importance after detasseling, to know what is the number of tassel present in the field for female rows, which is not indicated to have) by used Field Agent, selecting Tassel count tool (Photo 2 a, b, and, c).

Photo 2.a. Spots analysis for tassel count evaluation
Source: Personal photo.

The detection of rogue (off-type) corn plants is currently a manual process but pose a large risk to purity within seed production. Additionally, rogues can be very difficult to differentiate from the desired genotype in some situations. The objective of this study is further to develop an image detection algorithm which can identify rogues within a field. The goal will be to detect both rogues that are of a different germplasm as well as fertile as compared to sterile versions of the same germplasm.

The map of tassel presence for female rows is a big advantage for the farmer. He knows where the tassel o remove from female rows are present in the field, and he can manage to an additional check or complete pass over the field for removing last tassels from female rows, just before the silk emergence.

FieldAgent® Tassel Count is special built to highlight the presence of tassels on female rows, as his is a mandatory task for corn seed production, to have the detasseling done before silking to avoid self pollination, which conduct to less % of genetic purity.

Photo 2.b. Field Agent map for tassel count and identification 10 days after last detasseling
Source: Personal photo.

Inside extracts from Field Agent we can easily see the number of tassels left after last detasseling. A manual check confirms it, as it visible in Figure 2.c.

The data extracted from the map via Field Agent, can be extended to entire field, and developing a variable map for nitrogen application, based on soil type and density, as well the crop sanitary situation or crop health maps based on NDVI (Normalized difference vegetation index) maps, generating for each point (GPS - Global Positioning System) on the field.

Photo 2.c. Proof of tassel presence identified by UAV (confirmed by manual check)
Source: Personal photo.

We went in the field and checked manually that irrigation wheel, a lodged female plant, touched every time when the pivot is moving in circle and not possible to be captured by detasseled machine or people in that area. You

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can imagine the deep of that trace is around 30-40 cm and people are more carefully on their way to go than looking for a tassel.

With the use of a combine equipped with instant yield calculation in weight and moisture, the data are included into the Field Agent Yield Prediction tool.

This is generating multiple layers, which from the farmer and the management can understand the field uniformity and the performance of that.

Based on that, it is also important that the layers are point of discussion for next crop, and the farm manager could implement corrective actions.

We are thinking here as the use of variable fertilizer rate, then for planting variable with a special planter able to do that, spraying less where no weeds or increasing the fungicide where the disease started to spot the field.

All is about information at the plot level, which Field Agent could bring to the agronomist, helping them to build economic plannings based on yield prediction and health of the crop (Photo 3) with impact on further KPIs (Key Performance Indicators).

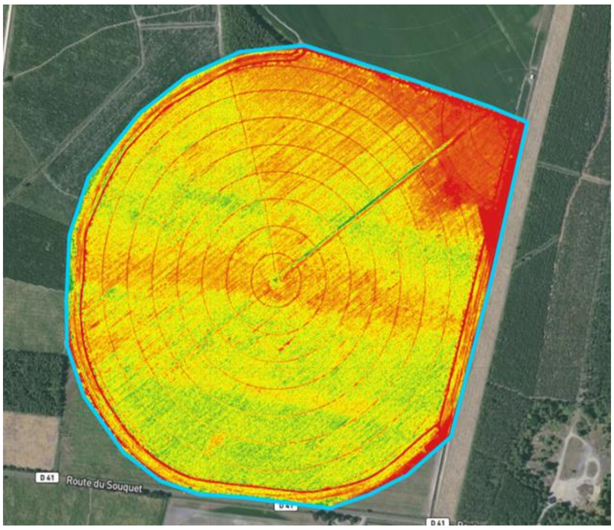

Photo 3. Crop health view at the moment of yield evaluation (3 weeks before harvest)
Note: Green means high biomass and the transition to red is correlated to the lower biomass level.
Source: Personal photo.

Yield estimation

Sentera's advanced, Double 6K sensor is fully configurable, with a multispectral variant capable of capturing five precise spectral bands: blue, green, red, red edge, and near-infrared (NIR – Near Infrared) which in the left side of the graph.

With this innovative technology, users can collect visual band imagery as well as vegetation indices based on the addition of NIR or Red Edge, including normalized difference vegetation index (NDVI) (Figure 4).

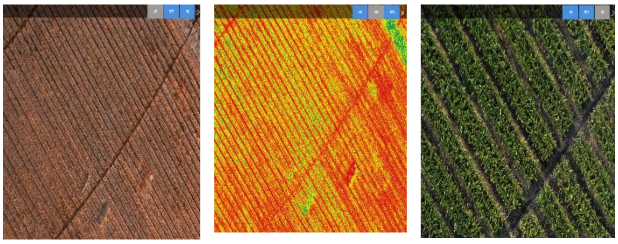

Photo. 4. Multipectralbands
Note: From left to right: NIR, Red Edge and NDVI.
Source: Personal photo.

For seed research industry and seed production industry, field selection could be done via imaging [3]. Multiple layers as results of imaging are very useful in prediction performance of the fields [8].

Photo 5. Yield monitor map as is visible in Field Agent
Source: Personal photo.

Several scientists bring the hypothesis which has been mentioned by [9], that multiple layers will create benefits for farmers in their prediction actions. Also, yield estimation layers are a way to correct the yield values on breeding programs where the field is not super uniform and the data could be fine adjusted [11].

CONCLUSIONS

AI offers today a large scale of tools with real benefits in seed production. From planning perspectives, we have an earlier visibility and increasing confidence in the field as stand count shows it. Due to high cots in winter-season, we see possible a costs reduction based on local production.

Data collection, even we speak on stand count, densities, tassel count after detasseling or crop health situation, by having drone flights and Field Agent by Sentera, shows an increase of quality, in real time processing. FieldAgent® is built to directly combat old methods of scouting, as today the agronomist can focus on research itself, data collection based on field uniformity; to assess different traits, yield prediction, moisture variation just before the harvest, with impact on the farm management being more precise and efficient.

Tassel count and identification is more attractive for off-types identification. Here the AI power is to quick support agronomists by highlighting all these plants out of same germplasm.

As for safety, we clearly improved it by having less people in the field, that means low risk, then reducing time for manual walks to rogue and manual puss tassels.

The efficiency is highlighted to a les number of trips in the field and quality data obtained. Relative ranking of yield potential based on summary statistics of NDVI.

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AGROPRODUCTIVE DIFFERENCES BETWEEN TWO LUVOSOL UNITS AT THE PREAJBA GORJ EXPERIMENTAL CENTER, ROMANIA

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Abstract

This paper presents the agroproductive differences between two luvisol units at the Preajba Experimental Center, Gorj, Romania, under the influence of surface erosion. Thus, two soil profiles were comparatively executed, one on the plateau on a slope of 2-5%, on a typical luvisol characterized by an Aţel, Ao, AE, El, Bt1, BC, C profile, and another in the lower third of the slope on a 10-15% where a stagnic eroded luvisol was identified. The latter had gradually removed its upper horizons due to slow surface geological erosion, exhibiting a shorter profile with the AoEl, El, Bt1w, Bt2w sequence. By washing the fertile topsoil year after year, the physical and chemical properties of the soil worsened. In this regard, the bonitation sheets were drawn up, the potential yields achieved under natural conditions were determined, and following the application of specific hydro-ameliorative measures and the execution of enhanced bonitation based on them, it was observed that the bonitation scores increased, the favourability classes decreased, and the yields increased directly proportional to the value of the enhanced bonitation score.

Key words: *chemical properties, agroproductive, differences, potential yields, bonitation score*

INTRODUCTION

The increase in the world's population, resulting in the intensive development of agriculture, requires the rational use of soil, highly productive varieties and hybrids, improved cultivation technologies to avoid the degradation of cultivated land.

Past and present human intervention in the environment has unexpected consequences. Chaotic deforestation and soil degradation with immediate consequences in decreased productivity are recognized as major problems worldwide. Soils are washed, destroyed or contaminated with various toxic substances to an extent too great to keep up with protection and control measures. In order to be able to feed the world's future population which is expected to reach about 8 billion by the beginning of the third millennium, vigorous action is needed to conserve soil resources, increase the area under cultivation and, in particular, increase agricultural productivity [1].

In the Gorj County, agriculture is of great importance as an economic branch, primarily for the support of the local population's standard of living. For this reason, it is necessary to know as much as possible about the soil, its fertility status which influences its productive capacity, but also to identify sustainable, diversified and balanced agricultural technologies that ensure the conservation of both the soil and the surrounding environment, in order to provide high, stable and high nutritional quality productions [8, 11]. The Gorj County has a geographical diversity that influences the types of grown crops. In general, agriculture in the Gorj County is varied, covering cereal crops, vegetables, fruit, viticulture and animal growth. Gorj's climate and soils can influence the types of predominant crops that are widely grown and essential for the food and feed industry. Thus, in 2022, the most cultivated crops in the county were maize (52,947 ha), wheat (11,326 ha), grasslands (3,676 ha) alfalfa (2,776 ha), sunflower (251 ha), potato

(188 ha), peas (142 ha) and beans (91 ha) [10].

Declining soil fertility should be a wake-up call to limit soil degradation and rehabilitate soils by changing production technologies to improve their physical, chemical and biological properties [16]. Current agricultural technologies have become a very pressing problem because they can influence the productive capacity of soils, with various changes occurring such as: appearance and formation of crusts, mineralisation of organic matter, compaction, reduction of mesofauna, which leads to the appearance of negative phenomena such as accelerated erosion, reduction of humus content and fertilizing elements [2]. Thus the identification of temporal and spatial changes in the soil is of great importance for the development and implementation of sustainable agricultural technologies [3, 4, 12, 13, 15] which would ensure that the soil can continue to provide goods and services [5, 14, 6, 7].

This paper comparatively examines the physico-chemical characteristics of typical luvisol and eroded stagnant luvisol, as well as the agroproductive differences between these soil units under natural and enhanced conditions. Thus it was observed that when applying some technological systems, the physico-chemical properties of the soil should be taken into account, as soils respond differently to their application, this response being directly influenced by humus content, soil texture, soil structure, fertilizer content, pH, etc. [16]. Adopting sustainable agricultural technologies in soil management is a very important element in providing food, clean water, quality feed, a healthy environment, as well as various ecosystem and biodiversity services [16].

MATERIALS AND METHODS

In order to determine the agroproductive differences between the two soil units, soil profiles were carried out on the typical luvisol found in the Preajba Experimental Field, the Gorj County.

In this session, main profiles and secondary profiles were executed according to the working methodology as follows:

- the main profiles were made to a depth of 1.5 m, a length of 1.5 m and a width of 0.6 m;
- the secondary or control profiles were made to a depth of 0.8 m, a length of 1 m and a width of 0.4 m.

After fixing the main profiles on the plan, the control profiles were executed according to the same methodology in order to establish the soil limits. The work plan included planimetry and levelling data, ground boundaries were drawn according to the characteristics of the terrain expressed on the work plan.

Soil samples were collected following the same field methodology developed by Bucharest ICPA [9]. Soil samples were collected from each soil profile by horizon, with two types of samples being collected:

–pedologic samples: in disturbed or modified structure (were harvested in bags), in undyed structure or in natural size (they were collected in metal cylinders);

–agrochemical samples that were collected according to the agrochemical sampling methodology. Following laboratory analyses, the physical and chemical properties of the soils studied were determined.

Soil samples were dried at room temperature; soil subsamples were homogenised, ground and passed through a 250 μm sieve. The following analytical methods were used to determine the chemical properties according to the ICPA Bucharest methodology [9]:

− pH (potentiometric method in aqueous suspension at soil/water ratio of 1/2.5 – SR 7184 /13-2001);

− base saturation degree, V% (Kappen Schoffield method).

− organic matter (humus): volumetric determination, (Walkley-Black humidification method, STAS 7184/21-82);

− mobile phosphorus content (Egner-Riehm-Domingo method and colorimetric molybdenum blue, Murphy-Riley method ascorbic acid reduction);

− mobile potassium content (Egner-Riehm-Domingo extraction and flame photometry);

− sum of exchangeable bases (SB): Kappen method by extraction with HCl solution 0.05 n;
− exchangeable aluminium (Al): Kappen method by extraction with KCl solution;
− hydrolytic acidity, extraction with sodium acetate at pH 8.2;
− degree of saturation in bases (V%): by calculation with the relation V%= SB/Tx100; T= Ah+ SB;

The physical characteristics were determined as follows: determination of particle size fractions: pipette method for fractions ≤ 0.002 mm; wet grinding method for fractions of 0.002-0.2 mm and dry grinding method for the fractions > 0.2 mm (Kacinski scale). Fractions > 2 mm in diameter were separated by dry sieving as a percentage of the quantity of the collected sample. The texture of the soil has been refined using the texture triangle.

RESULTS AND DISCUSSIONS

Comparative studies were carried out in the experimental field of Preajba in the Gorj County, two soil units, formed and evolved in conditions of climate and specific relief, namely the typical luvisol and the stagnant eroded luvisol. Typical Luvisol was encountered and studied in the reference area on a 2-5% sloping plateau formed on parent material represented by fluvial terrace deposits (sandy clays), with groundwater depth between 5 - 10 m under natural vegetation represented by grassland with acidophilous species.

The soil is characterised by a profile such as *Aţel*– Ao – AE – Els – Bt– BC – C. The soil profile was carried out on grassland with acidophilous species showing the following morphological properties:

–*Aţel horizon* (0 – 5 cm), slightly dark brown colour, with a loamy texture, well-developed small polyhedral, coloured structure, it is a moist, porous, compact medium, contains very dense roots, with a gradual transition to the next horizon;

–*Ao Horizon* (5 – 17 cm), slightly light brown colour, with well-developed small polyhedral, coloured structure, loamy texture, contains very dense roots; it is a moist, porous, compact medium, with gradual transition to the next horizon;

–*AE Horizon* (17 – 23 cm), is slightly greyish brown, well-developed medium, coloured polyhedral structure, sandy-loamy texture, rarely contains small and medium skeletal material, Fe oxide spots, dense roots; it is a wet, porous, compact medium, with clear transition to the next horizon;

–*Els Horizon* (23 – 45 cm); it is greyish brown, with moderately developed medium, coloured polyhedral structure, sandy-loamy texture, often contains medium rolled material with Fe stains and oxides, rare roots; it is a wet, porous, compact medium;

–*BtHorizon* (45 – 62 cm), is reddish brown, moderately developed polyhedral medium coloured structure, sandy-loamy texture, frequently contains rolled, finely porous, compact material;

–*BCHorizon* (62 – 75 cm), it is rusty brown with yellowish spots, with a sandy-loamy-clayey texture, frequently contains small and medium rolled material; it is a porous and compact medium;

–*CHorizon* (75 – 100 cm); it is rusty brown, unstructured, with a sandy-loamy texture, with frequently-very often skeletal material.

Stagnant eroded luvisol was studied on a sloping terrain, with a 10-15% slope through a profile executed in the middle of the slope. The natural conditions in which the soil was formed and evolved are those specific to the area and similar to those presented in typical luvisol.

The soil profile is represented by the AoE – Els – Bt_1w – Bt_2w horizons and was executed on natural grassland with acidophilous species. The morphological description is given below:

–*AoE Horizon* (0 – 15 cm), light brown colour, small polyhedral angular structure, sandy-loamy texture, rarely contains small to medium rolled material throughout the profile, very dense roots; it is a moist, porous, compact medium, with gradual transition to the next horizon;

–*Els Horizon* (15 – 41 cm) is slightly greyish brown, moderately developed medium coloured polyhedral structure, sandy-loamy-powdery texture, contains rare ferromanganese nodules, dense roots; it is a wet, porous, compact medium;

–*Bt_1wHorizon* (41 – 67 cm) is yellowish brown with 30% rusty and 30% vinegary spots, well-developed medium coloured polyhedral structure, sandy-loamy texture, contains frequent ferromanganese nodules, rare roots; it is finely porous, a wet, compact medium, with gradual transition to the next horizon;

–*Bt_2wHorizon* (67 – 90 cm) is yellowish-brown with rusty spots 30% and vinegary 40%, medium, polyhedral, medium coloured, poorly defined structure, contains many ferromanganese nodules, very dense roots, it is fine, porous, and wet.

As a result of the configuration of the land, i.e. slope with a gradient of 10-15%, over time, the soil has undergone surface erosion processes, which has also been amplified by the large amounts of rainfall in the area. By the gradual and permanent removal of the solidified material from the surface, it was found that the accumulation horizon was almost removed and therefore it can be observed the presence of an AoE crossing horizon, also 10-15 cm thick. The 10-15% slope of the slope has, over time, led to slow geological erosion processes that have gradually but permanently removed the humified surface horizons so that the soil is characterised by a shorter profile compared to the previously presented soil on flat ground, with the following pattern: AoEl, Els, Bt_1w, Bt_2w.

A comparative study of the two soil units reveals the following aspects:

(a)In terms of morphological properties. It can be seen that the soil on the plateau is better developed on a thickness of 75-100 cm, and all the genetic horizons formed and evolved over time are present, while the soil on the slope profile is shorter 67-90 cm and incomplete, in the sense that the horizon at the surface Ao has been almost completely removed by slow geological erosion of the surface. In addition to the development of the profile, between the two soil units there is also a difference in the colour of the surface horizon.

Thus, while the horizon from the surface to the ground on the plateau is dark brown (10YR3/3), the colour of the soil on the slope is light brown (10YR5/2), this can be explained by the presence of colloidal silica which powders the structural aggregates of the surface horizon.

Another aspect or explanation for the darker colour in the horizon from the surface to the soil on the plateau is the presence of a higher percentage of humus, compared to the soil on the slope, where through slow geological erosion, along with the mineral material, organic matter has been removed.

The sequence of horizons is also differentiated between the two soil units, in the sense that in the typical luvisol on the plateau, no stagnation processes are obvious which proves that the soil has a good overall drainage, while in the luvisol on the inclined ground, w horizon appears on the soil profile starting at a depth of 40 cm, in B horizon, as result of a higher clay content.

(b) In terms of physical properties (Table 1 and 2) it is found that the typical luvisol in terms of granulometric composition has coarse sand in its composition which is maintained at over 20% throughout the profile depth except for the BC and C horizon where the percentage is 17.4% respectively 16.3%, fine sand also decreases on the soil profile from 31.2% in the Ațel surface horizon to 13.7% in the parent material, and the fine fraction, dust, is 30.5% in the surface horizon and decreases to 8.5% in the C horizon.

The fine clay fraction is found in the analysed soil in small percentage under 15% which determines a loamy texture.

The fractions with a diameter of more than 2 mm that make up the soil skeleton are found in the analysed profile starting with the AE horizon where they register a value of 11.8% and increase over the depth of the profile with a value of 41.2% in the BC horizon and 52.1% in the C horizon, which shows that the soil has a small edaphic volume.

Table 1. Main physical and chemical properties of typical upland luvisol (2-5% slope)

Item No.	Horizon	Depth	pH	V %	H %	P mobile (ppm)	K mobile (ppm)	Al	SB	SH	Gravel %	Granulometry %					U %
								me/100 g soil				Coarse sand	Fine sand	Dust	Clay	Texture	
1	Ațel	0-5	5.3	46.2	5.04	16	174	0.48	7.4	8.6		24.9	31.2	30.5	13.4	LN	1.2
2	Ao	5-17	5.4	45.8	2.68	12	144	0.46	6.0	7.1		27.9	29.4	28.4	14.3	LN	0.9
3	AE	17-23	5.3	40.6	1.76	9	76	0.48	4.8	7.0	11.8	24.5	25.1	25.8	12.8	L	0.8
4	Els	23-45	5.1	38.3	0.80	6	46	0.70	4.3	6.9	12.5	24.2	24.8	25.3	13.2	L	0.7
5	Bt_l	45-62	5.1	42.0	0.40	3	34	0.72	4.5	6.2	18.0	21.2	24.5	22.2	14.1	L	0.7
6	BC	62-75	5.1	60.1	0.32	2	38	0.68	10.1	6.7	41.2	17.4	16.2	13.1	12.1	LP	1.3
7	C	75-100	5.3	62.1	0.08	2	38	0.48	11.5	7.0	52.1	16.3	13.7	8.5	9.4	LP	1.6

Source: Own results.

In the soil of the slope, the stagnant luvisol, the particle size composition shows that sand and dust predominate in its composition, with values above 25% in all horizons, while the fine fraction, clay, records low values of 10.1% in the surface horizon and higher values of 24.2% in the Bt_2w horizon.

Table 2. Main physical and chemical properties of stagnant luvisol on the plateau (10-15% slope)

Item No.	Horizon	Depth	pH	V %	H %	P mobile (ppm)	K mobile (ppm)	Al	SB	SH	Granulometry %					U %
								me/100 g soil			Coarse sand	Fine sand	Dust	Clay	Texture	
1	AoE	0-15	5.6	49.6	3.40	6	50	0.40	6.4	6.5	24.7	33.1	32.1	10.1	LN	1.0
2	El	15-41	5.6	46.8	1.48	4	46	0.42	5.2	5.9	26.5	34.7	26.2	12.6	LN	0.8
3	Bt_lw	41-67	5.7	60.6	0.44	2	38	0.40	7.4	4.8	31.2	28.3	23.7	16.8	LN	1.1
4	Bt_2w	67-90	5.5	62.5	0.36	1	38	0.46	9.7	5.8	28.1	24.6	23.1	24.2	LN-L	1.5

Source: Own results.

In conclusion, it can be estimated that there are differences between the two soils in terms of soil texture which is of the loamy-powdery type in the soil on the slope and coarser (loamy-sandy) in the soil on the plateau. Another difference is the useful edaphic volume which is smaller in the soil on the plateau where the soil skeleton is present from a depth of 17 cm in the AE crossing horizon while in the soil on the slope no material with a diameter of more than 2 mm has been identified and although the soil profile is shorter, it has a larger soil volume (67%).

3. From a chemical point of view (Table 1 and 2), there is a clear difference in the content of organic matter, which in the plateau soil has a value of 5.04% in the Ao horizon and decreases on the soil profile to 0.32% in the BC horizon due to the lower amount of organic debris undergoing decomposition. In the Ațel surface horizon where more organic debris accumulates in various stages of decomposition, the percentage of organic matter is 5.04%. In stagnant luvisol on the slope, the humus content is much lower, with a difference of almost 2% in the surface horizon and decreases on the soil profile down to 0.36% in Bt_2w. Although the soil is occupied by grassland, and organic material must have accumulated in various stages of decomposition, slow geological erosion has removed much of the decomposed organic material. The difference between the two studied soils is also observed in terms of soil reaction (pH value). Although the natural conditions of the area favour the presence of an acid reaction, it is noted that the pH value of the soil on the plateau is lower (5.3) compared to the pH value of the soil on the slope (5.6). As far as the soil colloidal complex is concerned, there are no obvious differences between the two soils, the degree of saturation in bases (V%) remaining in the oligo-mesotrophic range, in the surface

horizons and mesotrophic in the deep horizons, correlating very well with pH value.
The soil reaction is strongly acidic, the pH being maintained throughout the depth of the profile at a value between 5.1 and 5.4.
In terms of chemical emissions, here too there are differences between the two types of soil, i.e. phosphorus and mobile potassium content, from non-eroded soil which has high values, i.e. 16 ppm P_2O_5 and 174 ppm K_2O in the surface horizon, while in the eroded soil the values are about 3 times lower, i.e. 6 ppm P_2O_5 and 50 ppm K_2O, explained by the fact that with the material eroded and transported from the surface horizon, the respective chemical elements were also removed.
In conclusion, it can be stated that the erosion manifested on the land with a slope of 10 - 15% has mainly caused the removal of the Aţel and Ao horizons from the surface, the AE transition horizon appearing in the light and during this time the fertility of the soil considerably decreased, as demonstrated by the decrease in chemical elements, humus and organic matter in the surface horizons.
By correlating the natural factors that contributed to the formation and evolution of the two soil types and their properties, the credit ratings and favourability classes of the plants predominantly used in the area (maize, wheat, grassland and alfalfa on a large scale and, to a lesser extent, sunflowers, potatoes, peas and beans) were established. On the basis of the credit ratings, the productive potential of these soils was assessed; the results are presented in the Tables 3 and 4.

Table 3. Sheet for the calculation of the rating score on the typical luvisol on a 2 - 5% slope

Ecoped. Indicator	Wheat	Maize	Sunflower	Potato	Pea/Bean	Grassland	Alfalfa
Tm	1	1	1	0,9	1	1	1
Pm	1	1	1	1	1	1	1
Gz	1	1	1	1	1	1	1
St	1	1	1	1	1	1	1
Sa	1	1	1	1	1	1	1
Tex	1	1	1	1	1	1	1
Pol	1	1	1	1	1	1	1
I%	1	1	1	1	1	1	1
Hazel	1	1	1	1	1	1	1
Groundwater	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Flood	1	1	1	1	1	1	1
Porosity	0.9	0.9	0.9	0.8	0.9	1	0.9
$CaCO_3$	1	1	1	1	1	1	1
pH	0.9	0.8	0.8	0.8	0.8	0.9	0.9
Ed Vol.	0.9	0.8	0.8	0.8	0.9	0.9	0.9
Rez.	0.9	0.9	0.9	0.9	0.9	1	1
Exc.	1	1	1	1	1	1	1
Bonitation grade	52	42	42	37	47	65	58
Favourability class	V	VI	VI	VII	VI	IV	V
Average bonitation grade = 31 points							
FAVOURABILITY CLASS – VIIth							

Source: Own results.

Thus, yields are expressed on the basis of the yield points and kilograms per yield point for the following crops: wheat, maize, sunflower, potato, peas/beans, grass and alfalfa.
The bonitation grades for each crop are multiplied by the kilograms/point of the credit note which is different for each crop, i.e.: wheat – 60 kg/point, maize – 80 kg/point, sunflower – 30 kg/point, potato – 450 kg/point, pea – 28 kg/point and bean – 15 kg/point, grassland – 200 kg/point, and alfalfa – 80 kg/point.
Calculating in this way, the following potential productions were highlighted which could be achieved under normal conditions by applying appropriate technologies.
For a typical luvisol on a 2-5% slope, according to the yield grades (Table 3) and the kilograms/point of the yield grade, the following yields are possible:

- Wheat – 52 points x 60kg/point = 3,120 kg/ha;
- Maize – 42 points x 80 kg/point = 3,360 kg/ha;
- Sunflower – 42 points x 30 kg/point = 1,260 kg/ha;
- Potato – 37 points x 450 kg/point = 1,6650 kg/ha;
- Pea – 47 points x 28 kg/point = 1,316 kg/ha;
- Bean – 47 points x 15 kg/point = 705 kg/ha;
- Grassland – 65 points x 200 kg/point = 13,000 kg/ha;
- Alfalfa – 58 points x 80 kg/point = 4,640 kg/ha.

In the case of stagnant luvisol on a 10-15% slope, according to the bonitation grades in Table 4, the following potential yields can be obtained:

- Wheat – 27 points x 60 kg/point = 1,620 kg/ha;
- Maize – 24 points x 80 kg/point = 1,920 kg/ha;
- Sunflower – 24 points x 30 kg/point = 720 kg/ha;
- Potato – 19 points x 450 kg/point = 8,550 kg/ha;
- Pea – 30 points x 28 kg/point = 840 kg/ha;
- Bean – 30 points x 15 kg/point = 450 kg/ha;
- Grassland – 41 points x 200 kg/point = 8,200 kg/ha;
- Alfalfa – 23 points x 80 kg/point = 1,840 kg/ha.

Thus, one can see the negative influence that slope has on soils and implicitly on yields. From Table 5 and Figure 1, it can be noted that on soil with no risk of erosion, with a slope of 2-5%, yields are 48.08% higher for wheat, 42.86% higher for maize and sunflower, with 48.65% for potatoes and 36.17% for peas and beans, 36.92% for grassland and 60.34% for alfalfa, compared with soil at high risk of erosion on a 10-15% slope.

Table 4. Sheet for the calculation of the rating score on stagnant luvisol on a 10-15% slope

Ecoped. Indicator	Wheat	Maize	Sunflower	Potato	Pea/Bean	Grassland	Alfalfa
Tm	1	1	1	0,9	1	1	1
Pm	1	1	1	1	1	1	1
Gz	1	1	1	1	1	1	1
St	0.9	0.9	0.9	0.8	0.9	1	0.8
Sa	1	1	1	1	1	1	1
Tex	0.9	1	1	1	0.9	0.9	1
Pol	1	1	1	1	1	1	1
I%	0.9	0.8	0.8	0.7	0.9	1	0.9
Hazel	1	1	1	1	1	1	1
Groundwater	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Flood	1	1	1	1	1	1	1
Porosity	0.9	0.9	0.9	0.9	0.9	0.9	0.9
$CaCO_3$	1	1	1	1	1	1	1
pH	0.9	0.9	0.9	0.9	1	0.9	0.8
Ed Vol.	0.8	0.7	0.7	0.9	0.8	0.7	0.7
Rez.	0.9	0.9	0.9	0.9	0.9	1	1
Exc.	0.8	0.8	0.8	0.7	0.8	1	0,8
Bonitation grade	27	24	24	19	30	41	23
Favourability class	VIII	VIII	VIII	IX	VIII	VI	VIII
Average bonitation grade = 30 points							
FAVOURABILITY CLASS – VIIIth							

Source: Own results.

Analysing the physico-chemical properties of the typical luvisol located on the land with a slope of 2-5% in the Experimental Field of Preajba in the Gorj County, and following the execution of the work of bonitation in natural conditions, it is found that this soil requires as improvement measures the following works: appropriate organic-mineral fertilization in order to increase the content of organic matter, but also the application of amendments based on calcium carbonate ($CaCO_3$), to correct the soil reaction (pH value).

Table 5. Potential yields of different crops on typical uneroded and eroded luvisol under natural conditions (kg/ha and %)

Crop	2-5% Kg/ha	10-15%	
		Kg/ha	% - as compared to 2-5%
Wheat	3,120	1,620	51.92
Maize	3,360	1,920	57.14
Sunflower	1,260	720	57.14
Potato	16,650	8,550	51.35
Pea	1,316	840	63.83
Bean	705	450	63.83
Grassland	13,000	8,200	63.08
Alfalfa	4,640	1,840	39.66

Source: Own results.

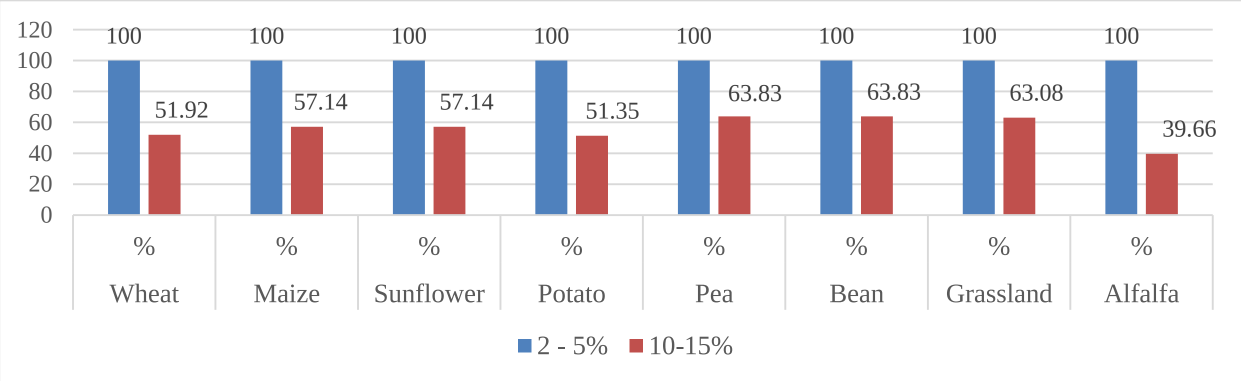

Fig. 1 Potential yields of different crops on non-eroded and eroded stagnant luvisol under natural conditions
Source: Own calculation and graphic.

According to the two improvement works, the improvement work was carried out under improved conditions, following which the crop plants predominantly used in the studied area obtained the following bonitation grades and favourability classes (Table 6).

Table 6. Calculation of the bonitation score for different crops on typical luvisol under potent conditions

Specification	Wheat	Maize	Sunflower	Potato	Pea/Bean	Grassland	Alfalfa
Natural bonitation grade	52	42	42	37	47	65	58
Coeficienti de potentare pentru fertilizarea organo-minerala	1,1	1,1	1,1	1,1	1,1	1	1
Potency coefficients for organo-mineral fertilisation	1,4	1,4	1,4	1,1	1,4	1,2	1,6
Potency coefficients for acidity correction	80	65	65	45	72	78	93
Potency bonitation grade	III	IV	IV	VI	III	III	II

Source: Own results.

On stagnant luvisol located on land with a slope of 10-15%, the following measures are required as water improvement works: removal of excess stagnant water (by deep draining works), improvement of soil aerohydric regime, humus reserve and soil reaction (by complex organo-mineral fertilization and limestone amendment), prevention and control of surface erosion (through special agrotechnical and hydrotechnical works).

The rating grades obtained after the application of these works, and the favourability classes, are shown in Table 7.

In the case of typical luvisol on a 2-5% slope, according to the bonitation grades in table 6, the following potential yields can be obtained:

- Wheat – 80 points x 60 kg/point = 4,800 kg/ha;
- Maize – 65 points x 80 kg/point = 5,200 kg/ha;
- Sunflower – 65 points x 30 kg/point = 1,950 kg/ha;
- Potato – 45 points x 450 kg/point = 20,250 kg/ha;
- Pea – 72 points x 28 kg/point = 2,016 kg/ha;
- Bean – 72 points x 15 kg/point = 1,080 kg/ha;
- Grassland – 78 points x 200 kg/point = 15,600 kg/ha;
- Alfalfa – 93 points x 80 kg/point = 7,440 kg/ha.

In the case of stagnant luvisol on a 10-15% slope, the following potential yields can be obtained according to the bonitation grades in Table 7.

Table 7. Calculation of the bonitation score of different crops on stagnant luvisol eroded under potent conditions

Specification	Wheat	Maize	Sunflower	Potato	Pea/Bean	Grassland	Alfalfa
Natural bonitation grade	27	24	24	19	30	41	23
Potency coefficients for erosion	1.2	1.3	1.3	1.3	1.1	1.1	1.2
Potency coefficients for stagnogleying	1.2	1.2	1.1	1.4	1.2	1.1	1.5
Potency coefficients for organo-mineral fertilisation	1.1	1.1	1.1	1.1	1.1	1	1
Potency coefficients for acidity correction	1.1	1.1	1.1	1.1	1.2	1.1	1.2
Potency bonitation grade	47	45	42	42	52	55	50
Favourability class after potency	**VI**	**V**	**VI**	**VI**	**V**	**V**	**VI**

Source: Own results.

- Wheat – 47 points x 60 kg/point = 2,820 kg/ha;
- Maize – 45 points x 80 kg/point = 3,600 kg/ha;
- Sunflower – 42 points x 30 kg/point = 1,260 kg/ha;
- Potato – 42 points x 450 kg/point = 18,900 kg/ha;
- Pea – 52 points x 28 kg/point = 1,456 kg/ha;
- Bean – 52 points x 15 kg/point = 780 kg/ha;
- Grassland – 55 points x 200 kg/point = 11,000 kg/ha
- Alfalfa – 50 points x 80 kg/point = 4000 kg/ha.

And after the application of specific improvement works according to the physico-chemical properties of the two studied soils, it can be seen from Table 8 and figure 2 that the influence of the slow geological erosion process is maintained in terms of the level of potential yields obtained by the plants used in the area.

Table 8. Potential yields of different crops on typical uneroded and eroded luvisol under potency conditions (kg/ha and %)

Crop	2-5% Kg/ha	10-15%	
		Kg/ha	% - as compared to 2-5%
Wheat	4,800	2,820	58.75
Maize	5,200	3,600	69.23
Sunflower	1,950	1,260	64.62
Potato	20,250	18,900	93.33
Pea	2,016	1,456	72.22
Bean	1,080	780	72.22
Grassland	15,600	11,000	70.51
Alfalfa	7,440	4,000	53.76

Source: Own results.

Thus, yields are 41.25% higher for wheat, 30.77% higher for maize, 35.38% higher for sunflowers, 6.67% higher for potatoes, 27.88% higher for peas and beans, 29.49% higher for grass and 46.24% higher for alfalfa.

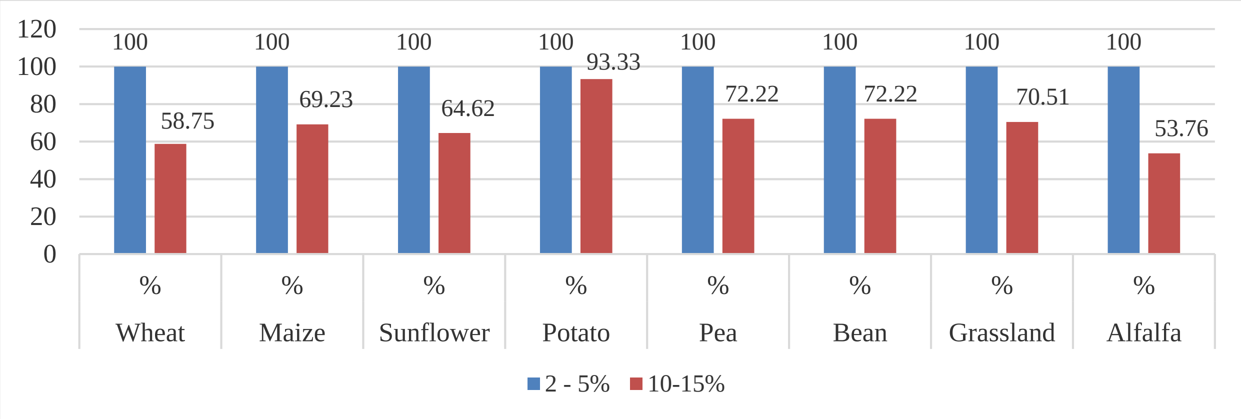

Fig. 2. Potential yields of different crops on non-eroded and eroded stagnant luvisol under potency conditions
Source: Own calculation and graphic.

CONCLUSIONS

Through the analysis of the main physical and chemical properties of the soil samples collected from the two studied soil profiles, it was revealed that the loss of the surface soil layer, by washing away the fertile soil layer year after year, gradually leads to the worsening of the chemical, morphological and physical properties of the soil.

By drawing up the bonitation chart, based on the voucher scores, it was revealed that on typical luvisol, without risk of erosion, the potential yields that can be obtained under normal conditions, by applying appropriate technologies, are 48.08% higher for wheat, with 42. 86% for maize and sunflower, 48.65% for potatoes and 36.17% for peas and beans, 36.92% for grassland and 60.34% for alfalfa, compared to soil with a high risk of erosion, showing the negative influence of slope on soils and therefore on yields.

After the application of specific improvement works, according to the physico-chemical properties of the two soils studied, it was found that the potential yields were 46% higher under these conditions, 24% for alfalfa, 41.25% for wheat, 35.38% for sunflower, 30.77% for maize, 29.49% for grassland, 27.88% for peas and beans and 9.89% for potatoes on soil without erosion risk compared to soil with erosion risk.

In the case of typical luvisol on the plateau, without risk of erosion, by applying the potency works, it was found that yields increased in most crops by more than 50% (maximum 63.34% for alfalfa and minimum 20% in the case of grasslands).

In the case of stagnant luvisol on a 10-15% slope, subject to the process of geological surface erosion, through the application of specific improvement works, compared to that exploited under normal conditions, very large differences in production have been recorded, i.e.: 121.05% for potatoes, 117.39% for alfalfa, 87.50% for maize, 75% for sunflowers, 74.07% for wheat, 73.33% for peas and beans and 3414% for grassland.

Knowing the consequences of surface erosion, human activity is very important for soil protection, in terms of systematization of crops on arable land, choice of land use category, use of technological system of plant cultivation, exploitation of forest resources, rational grazing and sustainable development management in the Gorj County.

It is therefore necessary to identify the areas at risk of erosion as accurately as possible, in order to intervene with consolidation, stabilisation, levelling, land modelling and other hydro-improvement works.

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FOOD SAFETY PERCEPTIONS INFLUENCED BY ONLINE TRADE IN FOODSTUFFS

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Abstract

With the constantly growing world population the need for securing sufficient and safe food resources has also raised greatly. Examining the new pattern in consumers` behavior influenced by the Covid-19 pandemic with a shift towards online trade in foodstuffs, , the present study aimed to investigate the consumers` perceptions on various aspects of food safety based on their experience in internet shopping. Based on an anonymous questionnaire among 470 Bulgarians the survey found that the main problems the respondents encountered through online food shopping were related to quality discrepancy (18.9%), damaged package (18.5%) and unknown origin of the product (12.3%). As important indicators of the safety of the product bought the respondents pointed out labels with expiry date (19.1%), intact package (13.2%) and temperature at delivery (13.2%). In conclusion, online purchase food products were considered safe for the consumers` health as stated by half of the respondents whose perceptions on food safety were significantly dependent ($p<0.05$) on their experience in e-trade during and after the Covid-19 epidemic.

Key words**:** *food safety, Covid-19, e-trade, consumers*

INTRODUCTION

With the estimated increase in population worldwide and the need to feed billions of people, the integrated policy on the whole food chain emphasizes the importance of sustainability and balance between food security, food safety and fair distribution of resources [35]. Regulatory frameworks, international and national legislation are provided in this regard by organisations like FAO, WTO, Codex Alimentarius Commission and others [2, 9] to ensure food safety and manage policies on food trade as food production is the largest economy in the world [16]. These policies have to be implemented globally by all stakeholders like industries, consumers and public bodies [33] in order to manage the challenge to food security posed by the increase in food trade [36]. The measures to ensure food chain sustainability should address all its aspects, from the field or the farm to the consumer`s table [1], along with the challenges encountered in e-trade and post-Covid-19 effects as well [6, 39, 26, 19]. There was reported a steady increase in the share of people who preferred to shop for goods online over the last years and for Bulgaria the e-shoppers who before the pandemic accounted to 31% in 2018 reached 53% in 2023 [21]. Similar rise was reported in other countries as well, with food sales representing the largest category of e-commerce [3]. Some of the main drivers for the online trade in food products were related to safety and health issues [18], while in the meantime a stable group of Millennial and Generation Z internet shoppers emerged with interest in "green consumerism" and healthy products [21, 29].

The Covid-19 pandemic affected greatly the consumers` perceptions of food security, safety and hygiene [8] which led to changes in their purchasing behaviour [26] and the need to understand the stakeholders` awareness and knowledge on food safety indicators in their online shopping experience [13]. From the perspective of ensuring the safety of the integrated food chain it is of crucial importance to have every individual involved in the process [19], to reform and improve the food safety regulation system through co-regulation between stakeholders [7]. Thus, societies could effectively manage to control the risks and hazards along the food chain [10], especially when innovations, digitalization and e-trade are incorporated into sustainable food operations [14].

With regard to the current development of the online trade in foodstuffs, the purpose of the paper is to evaluate how the e-shopping experience had affected the consumers` behaviour in terms of food safety.

MATERIALS AND METHODS

Design of Survey

The author has conducted the survey [4] in the period from February-March 2020 before the spread of the Covid-19 crisis and later, during the pandemic in September 2020-March 2021. The second part of this research is presented in the current paper. The survey was under the form of an anonymous questionnaire among 470 Bulgarian citizens distributed at random to willing to participate respondents, without the necessity of ethics committee approval. The survey questions were focused on the respondents' demographics and their awareness on indicators related to food safety during online shopping.

Statistical Analysis

The completed questionnaires were statistically processed (IBM SPSS-Inc., 2019, SPSS Reference Guide 26 SPSS, Chicago, USA) after conversion of the respondents` answers from textual statements into numerical values. The parameters studied were analysed through descriptive statistics (frequency distribution tables), Student t-test and chi-square. A two-tailed $p<0.05$ was considered significant. The results afterwards were presented on diagrams (Excel, Windows 10).

RESULTS AND DISCUSSIONS

Concerns of food safety, especially in e-trade, are highly influenced by a number of factors that affect consumers` attitudes as shown on Figure 1. With regard to the safety of online purchased food, the respondents in our survey focused on the correct labelling of the product they received, including expiry date (19.1%), intact package (13.2%) and temperature of the food at the time of delivery (13.2%) (Fig. 1).

With the increase in the online trade in agricultural products worldwide food labelling was pointed out as an important factor for consumers` decision making and at the same time it raised issues with the lack of strict requirements on labelling in e-commerce and varying information presented among the online shops [22]. Although the European food market and in particular the food information provided to the customers were included in the current legislative framework [11], [31] stated that a comprehensive system for online food safety regulation was needed by which the stakeholders` concerns had to be addressed, including potential health threats due to mislabeling and substitution [19]. Other issues that could highly disturb the online food supply chains for both the business operators and the consumers, appeared to be the possibilities of food contamination as a result of damaged packaging. In consistence with our findings [8] argued that the integrity of food package was associated with the hygiene perceptions of the users of online food supply channels, especially after the Covid-19 pandemic. Furthermore, another factor considered important and significantly observed during the Covid-19 outbreak ($\chi2 =19.478$; $df=4$; $p=0.001$) was the right temperature at the online deliveries which was found also crucial for preventing food spoilage [19].

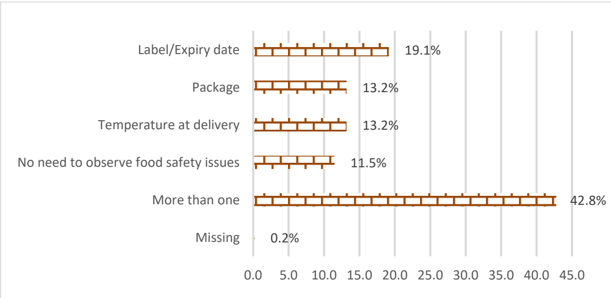

Fig. 1. Indicators observed by the consumers regarding food safety of online bought food products
Source: Author`s data from the questionnaire survey.

There was a share of 11.5% of the respondents whose opinion that it was not necessary for the consumers to consider food safety issues which were perceived as a responsibility of the competent authorities along the food chain, were significantly dependent on their e-shopping experience during Covid-19 epidemic (t[469]= 24.207; p=0.000) [3]. Their awareness was based on the strict legislative framework which regulated food safety at international level in all aspects, including trade [2, 35] altogether with the obligations of the authorities to execute official control at all stages of the agri-food chain [12].

However, several indicators failed to comply with the consumers` expectations of the delivered food (Fig. 2) purchased online at the time of the pandemic ($\chi2$ =18.460; df=8; p=0.018) – low quality of the product (18.9%), damaged package with risks of contamination (18.5%), mislabeling or lack of labels at all without information of the origin of the product (12.3%), price discrepancies (9.8%), as well as expired food (5.3%) and spoiled products unfit for consumption (4.9%). These concerns were directly related to food safety and hygiene issues which were recognized as a major challenge in ensuring smooth operation of e-trade, together with price value of the goods [28].

[19] reported that intact package could prevent the online purchased products from risk of contamination until their final delivery, in line with our findings that the damaged food packaging was significantly hazardous during the Covid-19 shopping (t[464]= 24.955; p=0.000). Food poisoning appeared to be a significant safety risk throughout the food chain and consumers needed guarantees that could reduce such hazards [40]. Spoiled food as detected by the participants in our survey was unfit for consumption and moreover, it posed additional health risks due to the possible bacterial activity in the spoiled products and subsequent food poisoning [2]. However, food safety issues could be properly managed by the consumers themselves if they were able to identify the major risks in the process of online food purchasing, as recognized by our respondents, and had knowledge on safe food supply steps, labeling of the products with relevant information (ingredients, expiry date, origin, etc.) and food-borne diseases that could affect their health [36].

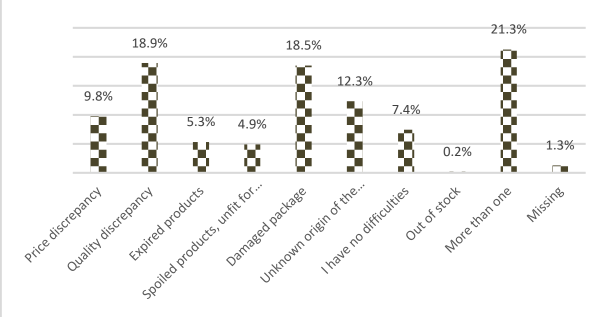

Fig. 2. Problems encountered during online food shopping
Source: Author`s data from the questionnaire survey.

The analysis of the consumers` perceptions of the overall safety of food purchased online during and after the Covid-19 pandemic showed that more than half of the participants in the survey strongly believed (21.3%) and agreed (34%) the e-traded food products were safe for their health (Fig. 3) ($\chi2$ =41.950; df=4; p=0.000). As direct users at the end of the food chain consumers expected to receive high quality and safe food [36], but the Covid-19 epidemic disturbed the supply chain and raised challenges to storage, transportation and distribution of food products with increased risks of physical, chemical and biological hazards [10, 36]. However, standards and laws set by the World Trade Organisation (WTO) created a practical framework to ensure food safety throughout the entire food chain [9]. The integrated food policy had further developed in order to engage all key stakeholders from both public and private sectors, consumers and researchers included [17] to address the new personalized consumption model after the Covid-19 epidemic and co-regulate the food market and ensure food safety in online trade as well [3]. At the end, it appeared that consumers possessed varying awareness and knowledge on food hygiene and safety at the time they formed their purchasing behavior – from insufficient level of food safety awareness [24, 37] to good understanding on food safety culture [25] which could be additionally advanced by spreading health awareness by researchers and studies [13, 15]. Compared to the other authors` findings our research proved high awareness on the main food safety concepts among consumers in their online purchases (Fig. 1, Fig. 2).

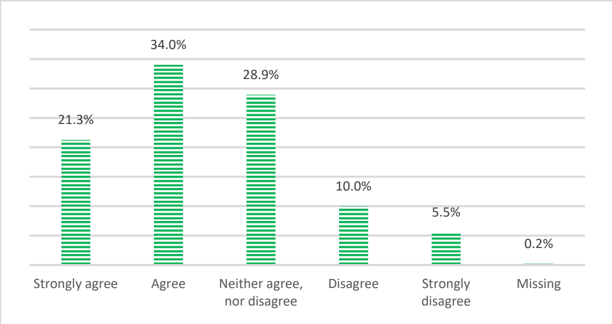

Fig. 3. Consumers` general perceptions on food safety of online purchase food
Source: Author`s data from the questionnaire survey.

The emerging pattern of purchasing behaviour during and after the Covid-19 outbreak became more personalized and affected by consumers` heterogeneous demographics. Analysis of our respondents` characteristics showed that they were primarily from urban origin, nearly half of them being university students and similar share being employed, thus falling in the age group between 18 and 25 (Table 1) [4]. Similar profile of young, educated urban residents who changed their shopping behaviour from offline to online was reported as well by [30, 38, 29, 5].

Table 1. Respondents` demographic characteristics*

Respondents` Demographics	**Count**	**%**
Residence		
1) Capital city	50	10.6
2)City–Regional administrative centre	288	61.3
3)City–Municipal administrative centre	91	19.4
4) Town	7	1.5
5) Village	31	6.6
Occupation		
1) High school student (<18 years old)	19	4.0
2) University student (18-25 years old)	228	48.5
3) Unemployed	12	2.6
4) Employed (25-60 years old)	204	43.4
5) Retired (60 > years old)	7	1.5
Pre-Covid 19 / During Covid 19 Pandemic e-shopping		
1) Pre-Covid 19	77	16.4
2) During and after Covid 19 Pandemic	393	83.6

*Due to rounding of values some indicators may not sum up to 100%
Source: Author`s data from the questionnaire survey (Balieva, 2023)

Studies showed that the age of the participants and the impact of the pandemic affected their decision making for buying food products online [13, 20]. Respondents` awareness on food safety and hence online food purchasing was significantly dependent on age range [26] with being young and with university education resulting in higher food safety culture [25, 34, 23].

However, [24] stated that stakeholders` awareness and knowledge on food safety should be further improved and education on food related safety and hygiene indicators for students could improve consumers` awareness [32]. Providing relevant information and knowledge to stakeholders was found by [39] to enhance food risk prevention behaviours among people.

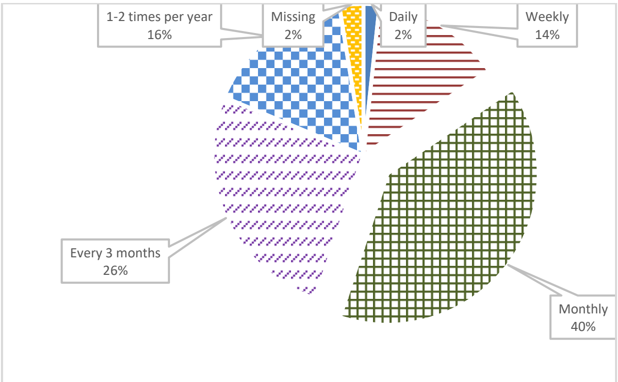

Fig. 4. Frequency of food purchasing through e-channels
Source: Author`s data from the questionnaire survey.

The changing pattern of food trade with a significant increase in the share of e-trade is visible in the consumers` purchasing behavior shifts towards more frequent online purchases of food products (Fig. 4). The survey showed that 40 % of the respondents were used to monthly e-shopping, especially for products with long shelf life like some processed and canned food from animal origin like dairy (cheese, yellow cheese, etc.), conserved meat and sausages, honey and bee products, grains and others, which was significantly important issue during the Covid-19 outbreak (t[458]= 32.699; p=0.000). Weekly online purchased by 14% of the consumers were eventually more fresh products like fruit and vegetables, organic food, confectionery, etc. This appeared to be quite a small share compared to the findings of [27] who reported that 64% of their respondents were actively purchasing online food on a weekly basis. In fact, our results were in consistence with the officially reported data of 17% rate of online bought food from shops or meal-kit providers for the 27 European member states [21].

CONCLUSIONS

Recent food crises caused by the Covid-19 outbreak posed serious threats to public health and food safety and challenges to the agri-food sector.

The survey focused on the level of awareness and perceptions of main indicators related to food safety among a heterogeneous group of respondents who had regular experience in online food shopping on weekly and monthly basis.

The respondents were mainly urban residents, with university education and young people whose food purchasing behaviors through e-channels were influenced by parameters like food labelling and expiry date of the products, intact package and right temperature at the time of delivery. The main problems faced by the consumers during online food shopping were related to quality and price discrepancies, damaged packaging with risk of contamination and food spoilage and mislabeling with unknown origin of the product. However, based on the consumers` overall perceptions, the foodstuffs bought online were considered safe by half of the respondents.

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ORGANIC VS. CONVENTIONAL: A COMPARATIVE REVIEW OF HEALTH-RELATED WELFARE ISSUES AND THEIR ECONOMIC IMPACT ON POULTRY PRODUCTION

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Abstract

This review delves into the health-related welfare challenges faced by organic and conventional poultry production, highlighting the impact on bird well-being. It identifies key issues such as disease prevention, behavioural wellness, and environmental quality in both systems, with organic practices facing hurdles like antibiotic-free disease management and conventional systems dealing with antimicrobial resistance and intensive farming pressures. Additionally, the paper explores the economic aspects of these systems, analysing cost structures, market dynamics, and profitability concerns that ultimately affect both producer and consumer choices. This economic perspective is crucial as it interlinks with welfare issues to shape the overall sustainability of poultry farming. The review further advocates for an integrated approach to improve poultry welfare, emphasizing the role of technological innovations like Precision Livestock Farming, policy reforms focusing on animal welfare and sustainability, and the importance of collaboration among stakeholders including producers, policymakers, and consumers. Conclusively, addressing the welfare challenges in poultry production demands a multifaceted strategy that leverages technological advancements, supports policy changes, and fosters stakeholder engagement to enhance animal well-being, meet production goals, and satisfy consumer expectations for ethically produced poultry products.

Key- words: *poultry welfare, organic production, conventional farming, technological innovations, stakeholder engagement*

INTRODUCTION

Organic and conventional poultry production systems delineate two divergent systems for poultry rearing, each characterized by distinct attributes and ensuing consequences. The organic paradigm is committed to sustainable agricultural practices, eschews chemical additives, and implements comprehensive oversight throughout the production continuum [29].

Conversely, conventional poultry farming is implicated in several environmental sustainability issues, notably the challenge of antimicrobial resistance [46].

A principal distinction between the two lies in their approach to antibiotic usage. Organic regulations categorically prohibit antibiotic use, a policy aimed at curtailing the proliferation of antimicrobial resistance, a prevalent concern within the ambit of conventional poultry farming [36, 46, 65, 66]. Investigations reveal differential antimicrobial resistance rates across organic and conventional practices, underscoring the influence of production methodologies on this pivotal health issue [46].

Furthermore, organic production systems are lauded for their emphasis on animal health and welfare, environmental guardianship, and the quality of output [5]. These systems privilege ecological integrity and the well-being of animals over purely economic metrics, distinctly setting them apart from their conventional counterparts [5]. The ascendancy of organic poultry farming as a viable sustainable alternative is propelled by a growing consumer predilection for organic products [23].

From an economic perspective, comparative analyses between organic and conventional broiler production have illuminated the financial dynamics unique to each system [34]. Such understanding is vital for industry stakeholders, enabling informed strategic decision-making and effective allocation of resources. The perception of organic food production and animal welfare by consumers significantly influences purchasing behaviours [40]. Studies suggest a consumer inclination towards organically produced foods, perceived as more natural and cleaner than their conventionally produced counterparts [49, 59]. Market trends reflect an increasing demand for natural and organic food products, necessitating adaptive strategies in poultry production to align with consumer expectations [35, 30, 55, 32]. It is noteworthy, however, that consumer perceptions may not always be congruent with empirical evidence, as exemplified by the higher incidences of *Campylobacter spp.* in organic poultry meat [41].

Regulatory frameworks play an instrumental role in the governance of both organic and conventional poultry farming. Organic systems adhere to stringent standards, such as those outlined by the Swiss organic farming regulation, which delineates the criteria for organic farming practices [42]. In contrast, conventional poultry farming is regulated by a disparate set of standards that address antibiotic usage, food safety, and environmental stewardship [29, 64, 65]. The differential risk perceptions related to public health and food safety hazards between these poultry husbandry systems have a bearing on their societal acceptance [7].

This review aims to offer a comprehensive comparative analysis of organic versus conventional poultry production systems, exploring their respective approaches to antibiotic usage, impact on antimicrobial resistance, emphasis on animal welfare and environmental stewardship, and the economic and consumer dynamics influencing each system. Furthermore, it will delve into the regulatory landscapes governing these practices, providing insights into how these frameworks shape the operational realities of organic and conventional poultry farming.

MATERIALS AND METHODS

Search strategy and selection criteria

1. Databases and search engines used

A comprehensive literature search was performed using PubMed, Web of Science, Scopus, and Google Scholar up to February 2024. These databases were selected for their extensive coverage in agricultural and biomedical research.

2. Search terms and keywords

Searches included keywords related to poultry reared in organic and conventional systems, such as “organic poultry health,” “conventional poultry welfare,” and “antibiotic use in poultry.” Boolean operators were used to refine the searches.

3. Inclusion and exclusion criteria

Scientific articles in English that provided comparative data on health-related welfare issues, sanitary-veterinary practices, economic, social and environmental aspects, in organic and conventional poultry farming. Studies focusing solely on other livestock or lacking comparative analysis were excluded.

Data extraction and synthesis

1. Data extraction

Data were extracted on four main welfare indicators: sanitary conditions, economic factors, social aspects, and environmental impacts.

2. Quality assessment

Study quality was assessed using the Critical Appraisal Skills Programme (CASP) checklist for observational studies, focusing on relevance and methodological integrity.

3. Data Synthesis

A narrative synthesis approach was used due to the varied methodologies in the studies. Results were organized under the identified indicators to facilitate a cohesive comparative analysis between farming systems.

RESULTS AND DISCUSSIONS

Economical perspective

Cost structures and initial investments

Organic poultry farming generally entails higher initial costs compared to conventional methods, primarily due to the requirements for organic certification, specialized feed, and potentially increased labor costs.

These investments in organic practices, while initially more substantial, can lead to significant long-term benefits such as reduced antibiotic usage, enhanced animal welfare, and higher market prices driven by consumer preferences for sustainable products [26, 46].

Conversely, conventional poultry farming typically requires lower initial investments, leveraging conventional production practices that reduce upfront costs but may involve higher ongoing expenses in feed, medication, and infrastructure maintenance [62, 54].

Profitability and market dynamics

Both organic and conventional poultry farming systems face various factors influencing profitability. In organic systems, despite the high initial costs, there is potential for significant profit efficiencies if managed effectively, considering factors like feed costs and sustainable practices such as the use of renewable energy [1, 45, 67, 16].

In contrast, profitability in conventional systems is also dependent on efficient production and market pricing but is more impacted by operational efficiencies and the cost of inputs like feed and healthcare for poultry [1].

Access to extension services and farming experience also play critical roles in achieving profitability in conventional farming [1].

Production efficiency

Production efficiency is critical in both systems for maintaining profitability and competitiveness.

Organic farms must optimize their feed conversion ratios and disease management strategies to compensate for the higher initial costs and maintain market competitiveness [25, 19].

Similarly, conventional farms focus on maximizing output through efficient disease management, genetic selection, and the integration of advanced farming technologies, which help in reducing costs and enhancing productivity [13, 43].

Market preferences and consumer demand

The market for organic poultry is driven by increasing consumer demand for antibiotic-free and ethically produced products, offering opportunities for farmers to capitalize on these niche markets [46, 11].

For conventional poultry, understanding and responding to market demands—such as preferences for fresh vs. processed products—is essential for tailoring production to consumer needs and optimizing market presence [17, 50, 20].

Integrative Economic Perspective

From an economic standpoint, both organic and conventional poultry farming systems offer unique advantages and face distinct challenges.

Organic farming, with its focus on sustainability and premium pricing, appeals to a specific market segment that values ethical and health-conscious products. This can often translate into higher profitability per unit despite the higher initial costs.

Conventional farming, while potentially less costly in terms of initial investment, requires careful management of production efficiency and market strategies to maintain profitability and compete effectively in an increasingly health-aware consumer market.

Ultimately, the choice between organic and conventional farming methods should be informed by a comprehensive understanding of these economic variables and market dynamics, aligned with the specific operational goals and resources of the poultry farmer.

This holistic approach can help ensure sustainable profitability and market competitiveness in the rapidly evolving agricultural landscape.

Table 1 highlights a SWOT analysis both for the organic poultry farming and conventional poultry farming pointing out the differences between the two production systems in terms of strengths, weaknesses, opportunities and threats.

Table 1. SWOT analysis for the conventional and organic poultry production

CATEGORY	ORGANIC POULTRY FARMING	CONVENTIONAL POULTRY FARMING
STRENGTHS	- Enhanced product integrity leading to increased consumer trust - Ability to command premium prices - Sustainable practices due to reduced chemical usage	- Reduced initial financial barriers and rapid scalability - Well-established infrastructure and technological advancements for large-scale production
WEAKNESSES	- Substantial initial investments and delayed return on investment - Regulatory and logistical complexities associated with organic certification	- Reliance on antibiotics and other chemicals potentially leading to health and environmental concerns - Risk of public dissent due to perceived sustainability issues
OPPORTUNITIES	- Growing market demand for organic and ethically produced goods potentially enlarging market share - Niche markets offering premium prices	- Potential cost reductions and enhanced public image through technological innovation in production and disease management
THREATS	- Vulnerability to economic fluctuations affecting consumer spending on higher-priced goods - Intense competition from more cost-effective conventional products	- Increasing consumer preference for organic products might diminish market share - Financial strains due to escalating production costs

Source: Own results.

Health management practices

In comparing disease prevention and treatment practices between organic and conventional poultry systems, several key factors come into play. Organic practices gravitate towards natural and comprehensive methodologies for disease mitigation, conspicuously eschewing the habitual employment of antibiotics in favour of robust management protocols [30]. Conversely, conventional approaches may predominantly harness antimicrobial substances for both therapeutic interventions and disease prophylaxis [22].

Biosecurity protocols emerge as pivotal in curtailing disease propagation across both organic and conventional frameworks. Organic farms, despite potentially grappling with diminished biosecurity measures, and conventional operations alike are necessitated to enact stringent biosecurity measures to thwart the transmission of infectious diseases [24]. The conventional reliance on antibiotics for disease prevention engenders concerns regarding the escalation of antimicrobial resistance and the accrual of veterinary pharmaceutical residues within poultry commodities [4, 2].

Within the organic sector, the exploration of antibiotic alternatives, including the utilization of probiotics and plant-based extracts, reflects a commitment to diminishing antibiotic dependence and fostering sustainable agricultural practices [15, 14]. Nonetheless, the implementation of eficient disease management within alternative poultry production remains fraught with challenges [30].

Economic factors also influence disease management strategies. A comprehensive understanding of the economic burden posed by ailments such as coccidiosis is imperative for the comparative analysis of husbandry practices and the formulation of effective disease mitigation measures [35]. Moreover, the economic ramifications of production diseases within poultry operations underscore the criticality of deploying optimal disease prevention approaches [29, 47].

Nutritional welfare

Nutritional welfare occupies a pivotal role in poultry production, shaping the health and well-being of birds across both organic and conventional systems. In organic farming, the emphasis is placed on a balanced and natural diet, fostering the birds' overall health and aligning with research that seeks to enhance poultry welfare through specific feeding regimens [28, 61]. Conversely, conventional practices may lean towards optimizing growth and efficiency, occasionally at the expense of nutritional welfare, thereby raising questions regarding feed quality [4].

The dietary composition provided to poultry critically influences not only their health and productivity but also the nutritional quality of the meat and eggs [18, 27, 31]. Studies indicate that alternative farming systems can affect the nutritional makeup of poultry products potentially yielding healthier options characterized by elevated protein levels and reduced fat content [3].

Furthermore, the aspect of animal welfare within poultry farming is intricately connected to diet [63, 8]. Nutrition that is either imbalanced or deficient can adversely impact poultry welfare, manifesting in compromised health and diminished well-being [18]. Adopting strategies to enrich the nutritional profile of poultry feed, such as the inclusion of plant-based additives or probiotics, stands to significantly benefit bird welfare [56, 52].

Consumer perceptions of poultry welfare are also influenced by the nutritional aspects of poultry production. Consumers are increasingly concerned about the quality and safety of poultry products, as well as the welfare of the birds [17]. Meeting consumer expectations for high-quality, nutritious, and ethically produced poultry products requires a holistic approach that considers nutritional welfare alongside animal health and well-being [17].

Environmental enrichment and behavioural well-being

Environmental enrichment emerges as a pivotal component in promoting poultry welfare, exerting a significant impact on natural behaviours, stress reduction, and the general well-being within both organic and conventional farming systems. The incorporation of enrichment materials such as perches, strings, and various stimuli plays a substantial role in modulating poultry behaviour and enhancing welfare outcomes [10, 12]. Studies have elucidated that such environmental enrichments encourage innate behaviours among poultry, including foraging, perching, and dust bathing, which are instrumental in augmenting their welfare [37].

The role of environmental conditions in influencing poultry welfare is paramount across all farming systems. The provision of enrichment resources, such as bales of wood shavings and perches, not only fosters locomotor activity but also promotes species-specific behaviours among broiler chickens, contributing to an uplift in their welfare [21]. Moreover, environmental stress factors like fluctuating temperatures and drafts can interfere with feed consumption and intestinal mobility, thereby impacting digestion and overall health [6].

Beyond augmenting mental and physical health, environmental enrichment bears economic advantages and practical repercussions for poultry production systems [44]. Establishing an enriched environment for poultry can lead to improved biological functioning, diminished stress levels, and a heightened propensity for engaging in natural behaviours [44]. Furthermore, environmental enhancements have been linked with bolstered immune system functionality, highlighting the comprehensive benefits of environmental enrichment in fostering poultry health and welfare [51].

Regulatory frameworks and standards

The distinction between organic and conventional poultry production standards has a significant impact on the health and welfare outcomes for poultry. These differences are primarily shaped by the regulatory frameworks that define each system, significantly influencing the overall well-being of the birds. Organic poultry production is characterized by strict regulations that promote natural and environmentally friendly practices. These regulations mandate conditions such as outdoor access for birds, limitations on the use of antibiotics, and the requirement for organic feed [5]. In contrast, conventional poultry production standards typically prioritize operational efficiency, productivity enhancement, and disease control, often through the use of antibiotics and pharmaceutical interventions [46].

The effect of these regulatory differences on poultry health and welfare is substantial.

Standards in organic poultry production, which focus on animal welfare and encouraging natural behaviours, are associated with improved well-being, lower stress levels, and better overall health for the birds [30]. Such practices as providing environmental enrichment, allowing outdoor access, and feeding organic diets are key factors in achieving better welfare outcomes in organic systems [5]. Meanwhile, conventional production systems may encounter issues related to antimicrobial resistance and disease management, compounded by the stress associated with intensive farming practices [46]. Therefore, the regulatory framework governing poultry production plays a critical role in establishing the standards and practices that influence health and welfare outcomes in both organic and conventional environments.

Consumer perspectives and market trends

Consumer attitudes towards organic and conventional poultry products play a pivotal role in shaping market trends and guiding purchasing behaviours. Research has identified that factors such as perceived health benefits, environmental impact, and concerns regarding product quality and safety significantly influence consumer preferences [48, 53]. Organic poultry products are often favoured for their associated health advantages, commitment to environmental sustainability, and adherence to higher animal welfare standards, resulting in a heightened demand for organic and natural food offerings [35].

The issue of welfare in poultry production, encompassing considerations of animal welfare standards, environmental implications, and antibiotic usage, markedly impacts consumer decisions. Individuals prioritizing animal welfare and environmental sustainability are more inclined to opt for organic poultry options that resonate with their ethical values and beliefs [68]. The perception that organic production systems adhere to superior welfare standards is a significant draw for consumers seeking food products that are both ethically produced and eco-friendly [68].

Moreover, the regulatory disparities between organic and conventional poultry production significantly affect consumer attitudes and choices. Organic regulations, with their focus on animal welfare and the promotion of natural behaviours, appeal to those concerned about animal well-being and environmental preservation. Conversely, conventional practices may be subject to criticism over issues like antimicrobial resistance and the intensity of production methods, influencing consumer perceptions of product quality and safety [58].

The market dynamics for organic and conventional poultry products are thus heavily influenced by consumer attitudes, preferences, and perceptions. With growing consumer consciousness regarding health, sustainability, and animal welfare concerns, there is an increasing demand for organic and ethically produced poultry products. This shift in consumer demand prompts producers and retailers to adapt by expanding their offerings of organic and natural poultry products to accommodate evolving preferences [9, 11].

Challenges and future directions

Both organic and conventional poultry production systems grapple with significant challenges in addressing health-related welfare issues, yet they also stand on the cusp of substantial improvement through the adoption of technological advancements, policy reform, and enhanced stakeholder collaboration. A central hurdle for these systems lies in balancing the imperative of optimal health and welfare for poultry with the pressures of production demands. Organic operations are particularly challenged by elevated production costs and restricted access to pharmaceutical measures, complicating disease management and welfare [38]. Conversely, conventional practices are beset by issues such as antimicrobial resistance, the intensities of production, and environmental sustainability, all of which compromise animal welfare and public health [60].

The horizon of technological innovation offers promising avenues for ameliorating welfare within both organic and conventional frameworks. The deployment of welfare-oriented technologies, including automated monitoring systems, presents the potential to furnish timely insights into bird health and behaviour. This capability facilitates prompt interventions and fosters enhanced welfare outcomes [57, 33]. Furthermore, the progression of precision farming, selective breeding practices, and nutritional advancements are poised to elevate health and welfare standards across production models [39].

Policy evolution plays an instrumental role in delineating welfare outcomes within poultry production. The establishment of regulatory measures that underscore animal welfare, advocate for environmental preservation, and mandate rigorous disease management protocols can catalyze substantive improvements in both organic and conventional settings [70]. Additionally, the engagement of stakeholders—encompassing producers, policymakers, researchers, and the consumer populace—is imperative for the formulation and execution of efficacious welfare strategies within the poultry sector [69]. Through such collaborative endeavours, poultry production can transcend existing challenges, paving the way for systems that are both productive and humane.

CONCLUSIONS

In conclusion, while each system faces distinct obstacles, ranging from economic constraints and restricted medical interventions in organic practices to antimicrobial resistance and environmental concerns in conventional methods, there exists a clear pathway for improvement. Technological innovations, such as automated monitoring and precision farming, along with genetic and nutritional advancements, emerge as promising solutions to enhance poultry welfare across the board. Moreover, the role of policy reform cannot be understated, as regulatory measures prioritizing animal welfare and environmental sustainability are fundamental to driving positive change. Equally important is the engagement of all stakeholders in the poultry production ecosystem. By fostering collaboration among producers, policymakers, researchers, and consumers, a more holistic approach to poultry welfare can be achieved, ensuring the well-being of poultry while also meeting production demands. Through these concerted efforts, the poultry industry can navigate the challenges it faces today, moving towards a future where both animal welfare and production efficiency are upheld.

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CHALLENGES AND OPPORTUNITIES FOR ORGANIC FARMING POST 2023

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Abstract

Farm to Fork Strategy, which is the center of the green ambitions of the EU, presents indicators for organic farming development and sets ambitious targets. However, most EU Members lag behind, which is raising various questions about implementing the developed strategies and plans. The study aims to observe trends and changes in organic farming with a particular focus on Bulgaria and outline prospects post-2023. The analysis shows an increase in the share of organic UAA in almost all Member-States. In Bulgaria, there are variations, and the share is decreasing in 2021 compared to 2020. The EU emphasizes the importance of organic farming for the food system. Organic farms are eligible for support from several measures for 2023-2027 as a part of national strategic plans under the CAP. On the other hand, implementing the measures has to be efficient and well-targeted to achieve the EU's ambitions.

Key words*: *sustainability, Green Deal, CAP

INTRODUCTION

Organic farming is presented as a priority in the EU Green Pact framework, which includes steps and initiatives related to the agricultural sector. Organic Action Plan also contributes to the ambitious EU goals [8, 9]. In this context, the Common Agricultural Policy 2023-2027 [20] stimulates and encourages organic farming by providing financial support. The national strategic plans of Member States set targets and measures in order to increase the area and production of organic products.

The Biodiversity strategy and the Farm to Fork strategy highlight the target “that at least 25% of the EU’s utilized agricultural area (UAA) should be under organic farming by 2030” [7]. However, the trends in organic farming are diverse across the EU. Different Member-states start from different positions. Therefore, the set targets are very unlikely to be achieved. Implementing European Green Deal actions requires more time and effort across Europe. Furthermore, markets of organic products have become more unstable since 2021[16].

Therefore, a more comprehensive analysis of the trends and challenges related to organic farming is a good starting point for better policy implementation.

The study aims to observe trends and changes in organic farming, focusing on Bulgaria and outlining prospects post-2023.

The paper is structured as follows: First, the methodological framework is presented. In the second part, the main trends in organic farming are observed. Third, the policy context is discussed. Based on the analysis, conclusions and recommendations are outlined.

MATERIALS AND METHODS

The survey is based on EUROSTAT data and applies its common methodology that provides comparable and representative statistics [11, 12]. In addition, reports from the Research Institute of Organic Agriculture and IFOAM – Organics International are used for the analysis of organic markets. [14, 16].

The paper outlines the policy development of organic farming based on different regulations, reports, and legislation analysis.

RESULTS AND DISCUSSIONS

Organic farming trends and evolution

As an ambitious political concept to overcome global challenges, the Green Deal emphasizes the need for systemic, long-term changes. Although Europe still faces instability as a consequence of Brexit, COVID 19 and Ukrainian crises, the climate issues and other environmental challenges must not be pushed aside. Organic agriculture has the potential to give answers to some of the emerging challenges [19]. Therefore, the increase in the organic area and its share in EU agriculture is essential. (Figure 1).

According to Eurostat, the organic utilized area in the EU is almost 16 million hectares in 2021, marking a growth of 8% compared to 2020 [12].

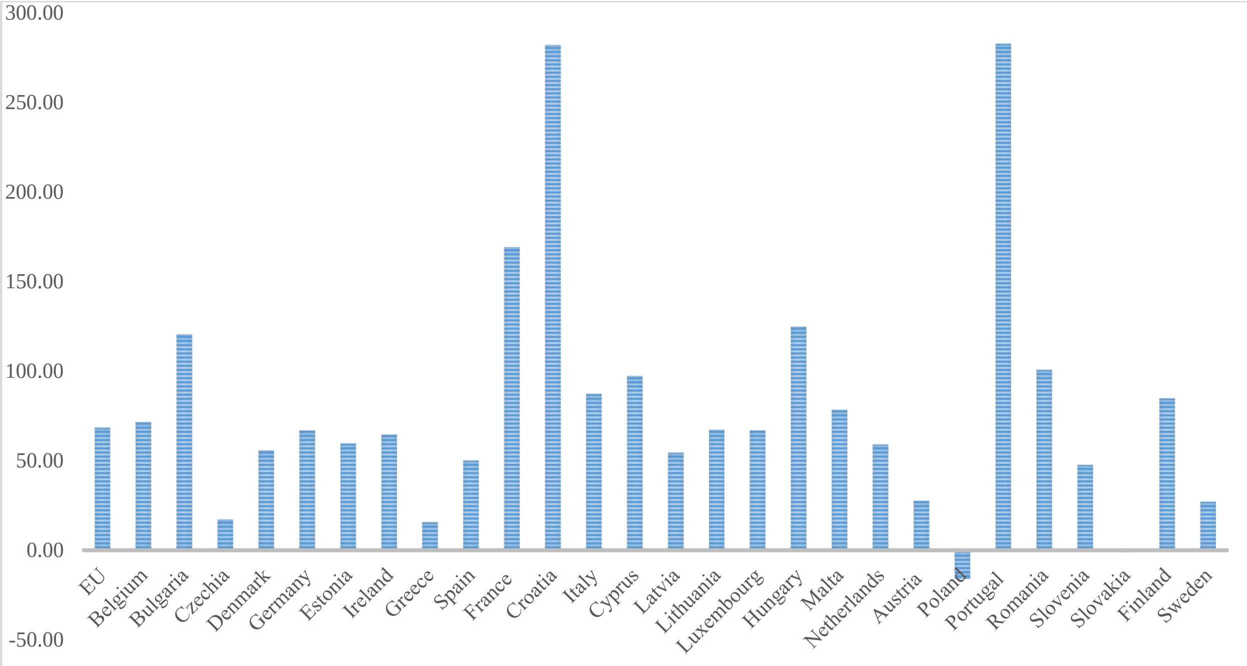

Fig. 1. Total organic area 2012/2021 (% change)
Source: [12].

The growth in the organic area in the EU has been impressive for the last ten years. From 2012 to 2021, it increased by 68% or 6.5 million hectares.

According to Eurostat, in 2021, four countries are leading in terms of organic area - France with the highest indicator, Spain, Italy and Germany. These Member-states form nearly 60% of the total organic UAA in the EU. Austria and Portugal also play an essential role in the EU, accounting for around 9% of the total organic area.

For 2012-2021, the organic farming area increased in almost all Member-states. The highest growth is registered in Croatia, Portugal (+282%) and France (+169%), followed by Hungary, Bulgaria and Romania. The lowest increase is recorded in Greece, Czechia and Sweden.

By contrast, there is a decrease in the organic area in Poland (-16 %) and Slovakia (-1%).

Based on the organic area share, Member-states can form different groups. The first one is those with the highest share of the organic area and close to the EU targets. This group includes Austria, Estonia and Sweden. The second relates to six other member states - Portugal, Czechia, Latvia, Italy, Finland, and Denmark- with a 12-19% share. These Member-states have the potential to reach the set goal. The third group consist of ten countries that are lagging behind with a share of the organic area between 7-10%. In last group of six countries, the share of organic farming area was below 5%, where Ireland (2%), Bulgaria (1.7 %) and Malta (0.6 %) have the lowest indicator.

It should be noted that „the total organic area is the sum of the 'area under conversion' and the 'certified area'" [12].

In the EU, the majority of the organic area is certified. Sweden, the Netherlands, and

Czechia recorded the highest share of certified areas. On the other hand, the biggest share of area under conversion is reported in Portugal (66.6%), Romania (40.4%) and Malta (31.8%). According to some authors, national support measures, such as RURIS (2000–2006), PRODER (2007–2013), and PDR (2014–2020) in Portugal, led to an increase in the organic area 'under conversion' [13].

In 2021, organic cereal production has the highest share in Sweden (6% of all cereal production), Estonia (5.5 %) and Finland (4.4%). In Romania and Bulgaria are recorded 1.45% and 0.26% of all cereal production, respectively. Sweden is leading in terms of organic fresh vegetables with a share of 17.7%, followed by Germany (11%) and the Netherlands (5%). Bulgaria has a share of 2.26% of organic fresh vegetables in all fresh vegetable production.

Organic livestock is also expanding. There are 5 million organic bovines (6.6% of all bovines) in 2021. The highest share of organic dairy cows is registered in Greece (23%), followed by Austria and Sweden. In Bulgaria, the share is 2.2%. In Latvia and Austria, the share of goats and sheep raised based on organic methods is the highest (34%). The share of organic pigs is insignificant, and the highest rates are in France (3.8 %) and Denmark (3.7 %). Despite the impressive growth, Bulgaria and Romania have the lowest share of organic area (Fig. 2).

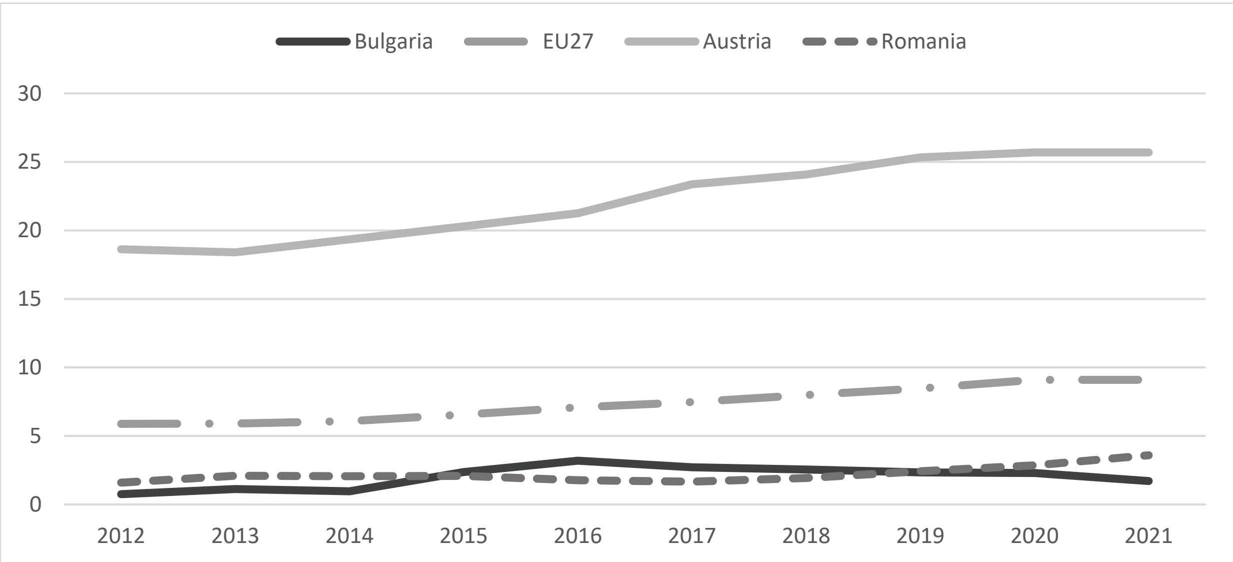

Fig. 2. Area under organic farming (% of total UAA).
Source: [11].

In Bulgaria, the share of organic land has been declining in recent years. According to the Bulgarian Ministry of Agriculture [17], the organic operators in 2021 fell by around 15 % compared to 2020. These negative trends are continuing for more than five years. In addition, for 2020-2021, the number of Bulgarian organic farms was reduced by 17 %, and their share decreased to 6 %.

By contrast, traders expanded their activity, and their numbers increased by 33% compared to 2020. The tendencies mentioned above are stimulated by the consumers' demand and lifestyle changes. Therefore, the trader's numbers doubled for 2017-2021.

According to some authors, Bulgaria's organic farming have to overcome several challenges. Some of them include issues with certification and regulations. In addition, farmers have to resolve difficulties with the labor force and processing capacity [15].

These barriers are the main drivers that led to a decline in the number and share of Bulgarian organic producers. Furthermore, these factors make organic farming less attractive. According to the report of the Bulgarian Ministry of Agriculture, the organic market in the country lags and some changes have to be made [17].

In 2021 the organic market in the EU reached 46.7 billion €, but the growth rate is slower comparing the previous years. Germany is the largest market in the EU (15.8 billion euros) and the second biggest globally. France is the second in Europe, followed by Italy [14].

From 2012 to 2021, the EU organic market doubled. It grew in all Member-states except Croatia and Greece.

Table 1. Organic retail sales (million €)

Years	EU	Austria	Romania	Bulgaria	Germany	France
2012	18,753	1,064.7	11.75	7	6,970	4,020
2013	20,068	1,064.7	14.15	7	7,420	4,383
2014	21,707	1,260	24.84	7	7,760	4,830
2015	24,924	1,360	24.84	15.05	8,620	5,534
2016	28,455	1,541.6	40.65	28.01	9,478	6,736
2017	32,162	1,723.2	40.65	29.21	10,340	7,921
2018	35,819	1,810	40.65	30	10,910	9,959
2019	38,994	1,920	40.65	30	11,970	11,295
2020	45,043	2,265	40.65	33.27	14,990	12,831
2021	46,665	2,397	40.65	32.97	15,870	12,659

Source: [14].

Based on FIBL data [14], Denmark has the highest per capita organic food consumption in the EU (€ 384). Switzerland, which is not a Member-state of the EU, is leading in the world in this indicator. In addition, in the EU, the consumption is €104. Compared to the abovementioned high spending and consumption, Member-States from Central and Eastern Europe lag behind (Bulgaria €4.8, and Romania -€2.1).

The COVID-19 pandemic and the issues in Ukraine negatively influenced food markets. In addition, the increased living costs also impacted the organic market and slowed its development [2].

Bulgarian Policy context in the field of organic farming

In order to observe and explain the trends in Bulgarian organic production, the policy context is outlined. The analysis follows the defined EU programming periods.

Programing period 2007-2013

This period was characterized by several challenges that hindered the implementation of agri-environmental measures. They were defined by CAP under the Pillar II and accounted for 20% of the fund dedicated to the CAP [5, 6]. In Bulgaria, there were difficulties related to the CAP interventions in the field after the accession to the EU. The public debate started in 2011, and at the end of the 2007-2012 programming period, the organic producers could apply for the measures. Farmers applying for agri-environmental measures had to undertake 5-year commitments. In those cases where violations of any of the commitments were found, farmers were heavily penalized. The measures were new for both the Ministry of Agriculture and the producers. Because of this, unintentional mistakes often occurred, the consequences of which were highly negative for farmers. As a result, farmers were reserved in the first year of introducing agri-environmental measures and their participation was relatively limited. In order to increase the motivation of farmers to participate in agri-environmental measures, in the last year of the 2007-2013 period, those with agro-ecological commitments were prioritized in the application process for support under the CAP investment measures. As a result, a small number of very large farms started organic agriculture. Therefore, organic areas increased significantly for a short time [11]. The measures, however, were not explained in detail to the farmers, and therefore, there were many cases of confusion and misunderstanding. In a number of cases, the producers were unaware of the requirements they had to meet for organic certification, resulting in heavy financial penalties. Consequently, many farmers gave up not only organic production but agriculture in the following years.

Programming period 2014-2020

During the previous program period, contracts were signed for large areas under biocertification. As a result, the budget for agri-environmental measures was quickly exceeded. Therefore, during the 2014-2020 period, farmers who had just made an agro-ecological commitment, as well as those with areas in transition, were deprived of support. In addition, their production was not yet certified and could not be sold as organic. Hence, farmers refused to sign agri-environmental commitments. Furthermore, those who had made 5-year commitments in the previous period refused to renew them for the new programming period.

The Bulgarian policy in agro-ecology during both the 2007-2013 and 2014-2020 programming periods was inconsistent. There were frequent changes to the rules and procedures for participation in the agri-environmental measures. During 2014-2020, many additional national regulations were introduced. Many changes were made to the application process, including steps toward electronization. New requirements were added every year. The procedures burdened both producers and biocertification organizations. One of the newly introduced requirements for participation in agro-ecological measures was proving farmers' organic product sales. Considering the relatively young market of organic production in Bulgaria, these requirements are a barrier for many organizations. In addition, farmers who started organic production in the later stage of the previous period had not yet fulfilled their commitments and, therefore, were not able to sell their production as organic. Moreover, organic farming is new in Bulgaria. The farmers do not have enough experience and knowledge, so often, the yields from organically grown crops are very low in the first few years.

Eventually, the accumulation of errors and inconsistencies led to a substantial loss of farmers' confidence in the agri-environment policy and in the institutions related to organic farming regulation. This caused lower motivation of the farmers to participate in organic farming, agroecology and climate schemes.

Programming period 2023-2027.

This period, again, started with many more questions than answers. On the one hand, EU policy evolved significantly. The Green Deal led to a number of changes to the CAP. Separately, Brexit, COVID-19 and the Ukraine crisis also influenced the policy. On the other hand, Bulgaria experienced several difficulties in preparing the National CAP Strategic Plan. The plan was approved at the end of 2022 and was not sufficiently discussed with farmers. Due to the long delay, the Ministry of Agriculture started the information campaign even before the requirements and rules for support were established. During the seminars, the information presented to farmers was incomplete and often contradictory.

In parallel, the measures have been significantly changed and remained unclear to farmers. Until the last moment, producers were unsure which measures to apply for and under what conditions. Some of the measures related to organic farming, although they were announced earlier, failed to start.

In the end, there was considerable uncertainty for farmers in their participation in agri-environmental and organic farming schemes.

During the current programming period, despite the massively announced administrative burden reduction and simplification, organic producers are subject to more inspections by various institutions. The documents required by the institutions also increased.

Organic farming plays a crucial role, and the policy environment is vital for encouraging and supporting organic farmers.

The Common agricultural policy has been the subject of many reforms since its development in 1962. There were efforts in the direction of greening and new interventions. However, a number of reasons for concerns occur. First, CAP 2023-2027 still has area-based 'Direct Payments' that often are unequally distributed. The requirement that only under 5% of the area has to be under greening is not ambitious enough to contribute to the environmental goals [3].

Second, the CAP 2023-2037 includes 'eco-schemes' that concentrate 25% of the budget of Pillar I [9]. They are mandatory for the member states. However, farmers can decide whether to implement them or not. It should be noted that eco-schemes can stimulate farmers with environmentally beneficial practices and are good opportunities. On the other hand, the definition and implementation of eco-schemes depend highly on Member States. Some countries can set less ambitious goals in the context of environmental practices.

According to some authors [1,18] support for Areas of Natural Constraints, defined as eco-friendly, is insufficient and fails to encourage greenhouse emission reduction.

A crucial role in organic farming development is in CAP Strategic Plans [20]. Regulation (EU) 2021/22891 highlighted that Member States "shall explain the national contribution to achieving the Union's targets for 2030" [21]. European Commission reports that Member States have designed interventions and allocated more financial support compared to 2014-2020 [10].

According to the Bulgarian Ministry of Agriculture report [17], the implementation the eight eco-schemes in 2023 is challenging. In the Bulgarian Strategic Plan, the budget for eco-schemes is BGN 1.650 billion or BGN 235.7 million each year.

The Report of Ministry of agriculture [17] shows that in 2022, 54,000 farmers were eligible for financial support under Pillar I greening payments. In 2023, only 20,000 farmers could meet the requirements and applied for financial aid under new eco-schemes. In the first year of implementing the new CAP, majority of the farmers was able to meet the requirements of only two, at most, three of the interventions.

The first analysis of the Ministry of Agriculture on the implementation of schemes from the Strategic Plan shows a necessity for changes in some of the requirements. The reason is that the Bulgarian agribusiness will not be able to participate in the interventions and to receive the allocated budget.

The new programming period 2023-2027 starts with more questions than answers. According to some authors, the new CAP presents the same criticized procedure rather than making a significant reform [4, 22, and 23]

CONCLUSIONS

Based on the analysis, the following conclusions could be drawn:

(1) Organic farming is at the center of the EU's Farm to Fork strategy which presented ambitious goals.

(2) The organic area increased in almost all Member-states, and the organic market is expanding.

(3) In terms of area under organic farming, Germany, France, Italy and Spain are the leading countries. The highest share of organic area is registered in Austria and Estonia.

(4) In Bulgaria, the trends in organic farming show significant variations. There is a decrease in the share of the organic area in 2021. The inconsistent policy in the past ten years led to lower motivation for organic production.

(5) The new CAP presented opportunities for financial support of organic farming in several directions. However, there are still uncertainties related to the new interventions.

(6) The analysis of the implementation of the new eco-schemes for 2023 shows serious concerns about the Bulgarian farmers' eligibility to meet the requirements. Therefore, Bulgarian Ministry of agriculture is negotiating with European Commission for changes in National Strategic plan. The discussed directions are related to an increase in the payment rates and simplification of the requirements.

(7) The local approach and national strategic plans are essential. However, the Green deal set number of ambitious goals. In this regard, some countries will experience difficulties in achieving them and transforming their agricultural structure.

(8) To meet the targets serious efforts are needed. It is necessary to align the CAP with other national, European and international policies and encourage coordination and integration between farmers, organizations, government and other stakeholders.

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CAPITALIZATION WITH AGRICULTURAL MACHINES VS. SERVICES FOR AGRICULTURE

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Abstract

The purpose of the research is to determine the specific capital costs of carrying out agricultural work with the farmers'own agricultural machines compared to the costs of agricultural services. A stratified sample based on economic size was used, consisting of 60 farms specialised in large crops from the NE and SE development regions of Romania. The novelty elements of this research consist in the fact that the analysis of the efficiency of the use of agricultural machinery uses a shadow cost—the opportunity cost—to determine the specific income of the use of agricultural machinery. The results show that small farms spend more than twice as much to carry out agricultural work with their own agricultural machinery. The average expenses per ha specific to the agricultural works carried out by farmers with their own agricultural machines recorded an average of 376.3 euro/ha for farms with a size smaller than 100 thousand SO and 186.5 euro/ha for farms with a size greater than 700 thousand SO. For a representativeness level of 69.3%, farms with a size smaller than approx. 578 thousand SO register losses if they carry out agricultural work with their own agricultural machines. This threshold can be appreciated on an area of approx. 854 ha cultivated with grain corn, common wheat, and rapeseed in equal proportions. Using the rationales and cost analysis models presented can help farmers make rational investments and strengthen informed demand in the agricultural services market.

Key words**:** *capital cost, agricultural machinery, agrarian economy, services for agriculture, economic efficiency*

INTRODUCTION

Society's demands for sustainable food systems require the adaptation of strategic and tactical decisions within agricultural systems [23]. Both in conventional agriculture and in ecological agriculture [34], it is necessary to implement advanced technological measures such as precision agriculture [37, 25], digital decision support systems [24, 36], and modern technologies [15, 22]. All these measures require investments, and the investment behaviour of farms has a differentiated impact depending on their size and type [38, 4, 20]. The current stage of research includes models for determining the optimal dimensions of the agricultural machinery assembly, taking into account operation and maintenance costs [29]. They take into account the restrictions related to the management of agricultural machinery, production structure, and soil conditions [27, 28]. Thompson, Ned O states after conducting research in Arizona that a farmer's decision to contract certain operations or perform them with his own equipment depends on factors such as cost, efficiency, and the need for supervision. He found that purchasing agricultural services resulted in cost savings and increased production for many farmers [33]. Michael Duffy shows that in agriculture, by increasing production, costs initially decrease but reach a point where they remain relatively constant or even begin to increase [8, 28, 32]. Farmers must decide which activities they will carry out through their own efforts and which will be transferred to other units [6, 42]. For small farmers in China, mechanisation services have become an important solution because they are more cost-effective and allow farmers to focus on other aspects of agricultural production [41]. Agriculture in this country stands out through a new orientation based on more balanced and sustainable processes [12], such as the outsourcing of agricultural production by rebuilding the service system for agricultural production [31]. In Spain, outsourcing is perceived as a mechanism to rationalise production in the context of small-scale agriculture and the generator of a new segment of skilled workers who provide specialised services, such as phyto-sanitary treatments, with the aim of reducing production costs. [19]. The outsourcing of agriculture has become a topic of intense debate globally [1, 5]. The outsourcing action consists in the decision to assign, with payment, some of the company's own activities to another third party [13]. This concept is most often used in relation to entrusting certain activities to a supplier and even includes the outsourcing of the manufacturing process of certain goods. This process may involve the transfer of an important business function to the external environment [18].

Costs are determining factors that influence the management of agricultural enterprises [21, 35]. The cost reduction of a product cannot be determined independently of the other production options, such as product mix, production capacity, and price [14]. This effort is based on results provided by applied scientific research [26, 40].

The purpose of the research presented in this article is to determine the capital costs specific to agricultural machinery compared to the costs of agricultural services. The results allow establishing the opportunity for investments in agricultural machines in the conditions where farms have the alternative of using agricultural services.

The novelty elements of this research consist in the fact that the analysis of the efficiency of the use of agricultural machinery uses a shadow cost—the opportunity cost—to determine the specific income of the use of agricultural machinery.

MATERIALS AND METHODS

The objectives of the research were represented by: (1) quantifying the economic effect determined by saving costs with agricultural services from third parties; (2) determining the specific economic efficiency of carrying out works with agricultural machines owned by farmers; (3) identifying the level of economic size of the farms from which it is efficient to carry out the works with their own agricultural machinery.

The research was carried out on a sample stratified by economic size consisting of 60 farms specialised in large crops located in the NE and SE development regions of Romania, 30 per region, and 5 per county. Each group of 5 farms from each county was classified by category: under 100 thousand SO; 100 thousand SO-250 thousand SO; 250 thousand SO-500 thousand SO; 500 thousand SO-750 thousand SO; more than 750 thousand SO [3]. The economic size was determined based on the crop structure, the area owned by each crop, and the SO conversion coefficient [9, 10].

The research plan included a stage of gathering information through a questionnaire, cost analysis, and a focus group session with relevant people for the researched field.

The objectives of the questionnaire were representative of obtaining information regarding: (a) the level of agricultural service tariffs; (b) the size of the costs determined for carrying out agricultural work with machines owned by farmers; and (c) the economic dimension of the researched farms. The obtained indicators were: my tariff of agricultural works for the main crops (lei/ha), the value of the subsidy for diesel (lei/l), showing the financial expenses with which farmers obtain credits (%), diesel consumption for agricultural works on crops (l/ha), the amount of depreciation at the farm level (lei), the expenses with the salaries of the mechanics at the company level (lei), the expenses with the repairs at the farm level (lei), the expenses with the maintenance of the agricultural machines at the company level (lei), expenses with fees and taxes at the company level (lei), and the area of each crop established in the agricultural year 2023 (ha).

The need to gather a lot of specific information from the research subjects and analyse these data effectively drove the use of the questionnaire [39]. It allowed for an understanding of farmers' mental processes and how they influence their decisions and actions on the farm [16].

The researched subjects were the managers or administrators of the 60 farms sampled by county, economic size, and development region. The content of the questionnaire was structured in two sections: questions about the tariffs of agricultural services, questions about the costs of carrying out agricultural work, and questions about the profile of the farm. The type of question chosen was a short text answer. The questionnaire creation and administration forms were online on the Google Forms platform [30].

The questionnaire was created in the 1st quarter of 2023, tested in the 2nd quarter on 6 managers from the sample, and administered in the 3rd quarter of the same year. The administration was done by email and messages through social networks, accompanied by the necessary explanations. Calls asking for accurate and complete answers came before the messages.

The subjects were assured that their answers would be used exclusively for the research objectives, and individual persons and organisations were managed in a protected flow.

The validation of the questionnaires required telephone discussions with the farmers to correct some information. The information used was processed during the economic analysis stage.

For the determination of economic efficiency, indicators were given when converting values into European currency at the exchange rate of the central bank on July 1, 2023.

The objectives of the cost analysis consisted of determining the actual costs, the opportunity costs, and the threshold of economic size of the farm from which it is profitable to carry out agricultural work with its own equipment. The indicators were determined according to the following reasoning: a. The income obtained from carrying out agricultural work with one's own cars was determined as the sum of the opportunity cost specific to agricultural service tariffs, to which the diesel subsidy and interest were added to the first two values. b. the specific costs achieved in the works with the own agricultural machines totalled the diesel expenses, the salary expenses, the depreciation expenses, the repair and maintenance expenses of the agricultural machines, the financial expenses, and the fees and taxes expenses. All these expenses were related to the agricultural area to determine the costs in lei/ha. The resulting synthetic indicators were the profit specific to the realisation of agricultural works and the profitability rate specific to the realisation of agricultural works. The first was determined as the difference between the specific incomes of carrying out agricultural work with their own machines and the costs necessary for these activities. In the second indicator, it was determined as a percentage ratio between this profit and the specific costs of carrying out agricultural work with own machines [2].

It is necessary to mention that this analysis compared the realisation of agricultural works with own agricultural machines with services for agriculture. An intermediate alternative for farmers would be to rent machinery for their own agricultural work. This was not analysed in this research because it involves the use of internal farm resources that farmers do not quantify properly, and the results would not have been relevant.

The third stage of the research consisted of conducting a two-way focus group session, which involved collecting data from a small group of participants who were relevant to the research objectives and could provide opinions on the topic.

The motivation for using a focus group in this research is based on the advantages that this method presents, such as facilitating the exchange of opinions, the possibility of obtaining adjacent information, and the interactive approach that can reveal deep perceptions and needs. Farmers' participation in the research process ensures a clear picture of the technological changes in agriculture and the agricultural systems adopted [31].

The objectives of this stage were also included in the moderation guide for the focus group and consisted of: knowing the reaction of the participants to the results obtained in the research through the questionnaire; justification of the main results; determining the implications of these results; and identifying the necessary measures to improve the graduates' skills.

The focus group participants were selected from the following categories: 6 representative employers for the agri-food sector, 3 students selected from the interview stage for belonging to the three faculties and interested in the theme of this research, and 3 professors who taught disciplines specific to the agri-food field. The organisers of the session were 3 members of the research team, with the roles of moderator, responsible for recording information (logistics insurance), and observer of the participants' behaviour.

The interaction with the participants took place online after prior information about the time, duration, objectives, and way of working.

The session took place in the first quarter of 2023 and lasted three hours, with two 10-minute breaks based on the moderation guide that included clarifications on the interaction method and guiding questions structured around the four objectives of the action. Participants shared their views on these objectives, which were summarily scored. After the first hour of discussions, lists of opinions were drawn up for each research objective (4 lists of the opinions of the 12 people), and the participants were then asked to choose the components with which they most agreed. They were given a limited number of 3 options per list [7, 17]. After the debates ended, the research team conducted a short debate where the results were centralised, correlated with the observations, and the final results were determined. The collected data were structured and centralised in order to draw up the investigation report. The focus group period was in the first quarter of 2023 and lasted three hours with two 10-minute breaks.

The statistical processing of the data was carried out with the software IBM SPSS Statistics 29 and Microsoft Office Pro Plus 2021. The statistical analysis included the size of the phenomenon, multiple Pearson correlations, and regression analysis between the economic dimensions of the farms and economic efficiency indicators.

The researchers ensured the relevance of the research for the economic environment and the observance of the principle of intellectual property [11].

RESULTS AND DISCUSSIONS

The income determined by the costs saved on agricultural services varies by firm size, in favour of large firms because they have stronger bargaining power than small farms. The opportunity cost or tariff of agricultural services is on average 201.9 euros/ha, 4.8% higher for firms with a size smaller than 100 thousand SO and 7.2% less for farms with a size greater than 700 thousand SO. Other revenues associated with agricultural services are subsidies for diesel, which have the same value regardless of the size of the farm (12.8 euro/ha).

In contrast, the opportunity cost of the financial expenses that would have been incurred with the allocation of working capital for agricultural services differs according to the size of the farm because large-sized farms have better economic creditworthiness and will receive more favourable credit offers. Thus, if the average financial income for the whole sample was 2.3 euro/ha, the difference between the financial income for farms less than 100 thousand SO and the financial income for farms over 700 thousand SO is 55.1%. Consequently, the average income determined by saving costs with agricultural services is 216.9 euro/ha, with a positive variation of 10.6 euro/ha for companies less than 100 thousand SO and a negative variation of 9.4 euro/ha for companies over 700,000 SO. Larger farms currently enjoy advantages over the others, but these revenues only reflect shadow costs avoided and do not represent the full scope of the phenomenon. On the other hand, the actual costs of carrying out agricultural work make it possible to better appreciate the differences in efficiency recorded between farms of different sizes (Table 1).

Table 1. Analysis of income (opportunity cost), costs, profit, and efficiency of the use of own agricultural machinery within farms by economic size (thousand SO)

Economic size (thousand SO)/actual costs and opportunity costs (euro/ha)	under 100	100 - 250	250 - 500	500 - 750	over 750
The price of agricultural works with farm's own machines	**211.6**	**206.2**	**205.8**	**193.0**	**192.8**
Expenses – agricultural works with farm's own machines	**376.3**	**326.5**	**217.6**	**202.9**	**186.5**
Diesel	143.9	138.6	111.5	108.8	107.3
Wages	28.5	26.9	19.4	15.8	14.6
financial expenses	15.5	10.6	8.7	9.2	10.1
amortisation	114.6	88.7	60.2	52.4	38.5
Repairs	52.1	48.6	10.3	9.7	9.1
maintenance	18.5	11.4	6.0	5.6	5.6
insurance	2.6	1.2	1.0	0.9	0.9
taxes and fees	0.6	0.5	0.5	0.4	0.4
Incomes specific to agricultural works	**15.9**	**15.2**	**14.8**	**14.7**	**14.7**
revenues from operating subsidies	12.8	12.8	12.8	12.8	12.8
income from financial assets	3.1	2.4	2.0	1.9	1.9
Gross profit specific to agricultural works with farm'sown machines	**-148.8**	**-105.1**	**3.0**	**4.8**	**20.9**
Rate of return specific to agricultural works (%)	**-39.6**	**-32.2**	**1.4**	**2.3**	**11.2**

Source: Own calculations.

The diesel costs determined by the use of own agricultural machinery in the researched farms were on average 122.0 euros/ha, 17.9% higher for farms with a size smaller than 100 thousand SO and 12.11% less for farms with larger sizes of 700 thousand SO. These differences are mainly due to the age of agricultural machinery and the degree of fragmentation of cultivated land. On the one hand, large and some medium-sized farms own newer and more technologically efficient farm machinery. Small and some medium-sized farms own older machines, models that are less technologically advanced and less efficient. On the other hand, large farms make constant efforts to compact soils in order to increase production yields. Small farms do not have the human, capital, and logistical resources necessary for this effort.

In terms of wages, the costs should not differ much because they are aligned with the mechanised labour market. However, the productivity of mechanics is proportional to the productivity of the agricultural machines they handle. Thus, compared to an average salary expenditure of 21.0 euro/ha per sample, farms with a size smaller than 100 thousand SO spend 35.5% more, and those with a size larger than 700 thousand SO spend 31.4% less.

Finance costs are, as in the case of the income obtained from the saving of financial expenses that would have been necessary to finance the services, determined by the creditworthiness of the farms and consequently will be higher for small farms and lower for large farms. If the average of the sample was 10.8 euros/ha, farms with a size smaller than 100 thousand SO spent 43.2% more, and those with a size larger than 700 thousand SO 6.7% less compared to the average.

The variation in absolute values of depreciation expenses registers the highest values (76.1 euros/ha). Compared to the average of 70.9 euros/ha for the sample, farms with a size smaller than 100 thousand SO spend 61.7% more, and those with a size larger than 700 thousand SO 45.7% less. This gap is due to the level of correlation between the production capacity of agricultural machines and the exploited agricultural area. Although farmers with small holdings use older agricultural machines and the depreciation value is related to a greater number of hours of use, their management does not have the economic tools to optimise the level of investment. The focus group analysis showed that investments are often made based on emotional criteria, such as the frustration felt when farmers do not have the agricultural machinery needed for important work that significantly influences the condition of crops. An analysis that would clarify the situation, such as the comparative one between the costs of the additional capital needed to solve these problems and the effect of these events on the profitability of agriculture, is totally non-existent.

Consequently, it is reasonable to suspect that investments are made disproportionately to the economic effects they would cause. Added to all this is the purchase of second-hand agricultural machines that have a lower value, but this is related to a much smaller number of remaining operating hours. And these determine the high values of depreciation expenses. Repair costs are also determined by the level and efficiency of farm capitalization, as well as by the age of agricultural machinery. Average repair costs were 26.0 euros/ha, more than twice as high on farms with a size of less than 100 thousand SO (100.7% higher) and 64.9% lower on farms with a size of more than 700 thousand SO. It is likely that the incidence of repairs has effects not only on costs but also on the volume of productions because it causes the interruption of agricultural works and their shift from the optimum period from a technical and economic point of view. This theme may be the subject of future research.

Maintenance expenses are higher for small farms because they rarely call on specialised services and most of the time carry out the maintenance of agricultural machinery with their own mechanists who are semi-specialised or unspecialized. In addition, it does not allocate the salary paid to them to activities of this kind, but these salaries are actual expenses. This results in a positive difference of 96.3% for farms with a size less than 100 thousand SO and a negative difference of 41.8% for farms with a size greater than 700 thousand SO. These are compared to a sample average of 9.4 euros/ha.

Insurance is less accepted by farmers but is required for the purchase of new agricultural machinery with financing from grants or loans. The same factors that determine depreciation expenses also affect these expenses. The differences depending on the size are notable, but the low volume of these expenses (1.3 euros/ha) mitigates the impact on the total costs. Because all types of farms must abide by national legislation, the costs shouldn't vary much in terms of taxes and fees; rather, a more effective allocation of fixed capital results in a reduction in taxes on its object. Consequently, compared to an average of 0.5 euro/ha per sample of tax expenses, farms with a size smaller than 100 thousand SO spend 29.9% more, and those with a size larger than 700 thousand SO by 15.6% less.

As the sum of the expenses presented previously, the total expenses specific to the realisation of agricultural works carried out by farmers with their own agricultural machines recorded an average of 262.0 euros/ha, with positive variations of 43.7% for farms with a size smaller than 100 thousand SO and negative variations of 28.8% for farms larger than 700 thousand SO. Basically, small farms spend more than twice as much to carry out these tasks. In other similar research, it was also found that the purchase of agricultural services led to cost savings [15].

Consequently, the gross profit specific to the use of own agricultural machines within the researched farms is negative for the sample average, showing a loss of -45.1 euros/ha. Obviously, the economic efficiency indicator is also negative, expressing an average loss of 11.4 euros for every 100 euros spent on carrying out the work with the agricultural machines that the farmers own. These results are in correlation with other research showing that farm work done with machine systems causes losses for small farms [13].

The presentation of these results in the focus group session had a significant impact and led to discussions about the technical aspects involved in owning farm machinery and the malfunction of the agricultural services market. Some farmers, especially those with small and medium holdings, stated that the results are mainly focused on the economic implications of farm capitalization, but the ownership of agricultural machinery is a necessity to ensure control and the ability to intervene in unforeseen situations. Most participants agreed that the agricultural services market is not sufficiently well represented in terms of supply, competition is low, and the quality and promptness of services are not always satisfactory. A demand with high variability and low predictability can also be the cause of this phenomenon. Farmers call on these services sometimes at the last minute or episodically as needed.

Service providers cannot properly manage their production capacities under these conditions. For this reason, this branch of services is not attractive enough for investors. These phenomena delay the consolidation of a competitive market with beneficial effects for both parties. Farmers with holdings larger than 750 thousand SO stated that they have digital decision support applications and that they provide information about the need for agricultural machinery depending on the cultivated agricultural area and crop structure. These applications entail significant financial and human resource costs but provide useful information about the size of agricultural machinery production capacity.

The efficiency of using one's own agricultural machinery does not only derive from economies of scale determined by large production capacities but also from the level of utilisation of these capacities.

Small farms own agricultural machinery that they use to a small extent, which has an impact on capital costs.

The correlation made between the economic size of the farms and the profit resulting from the use of their own agricultural machines (Fig. 1) resulted in a Pearson coefficient with a value of 0.749.

The correlation is significant at the 0.01 level (2-tailed). This correlation indicates that, in approximately 75% of cases, the increase in economic size makes it possible to increase the profit specific to the use of agricultural machinery.

The regression analysis generated a logarithmic function of the form -441.7 + 69.1 x log(x) with the coefficients: R 0.833, R Square 0.693.

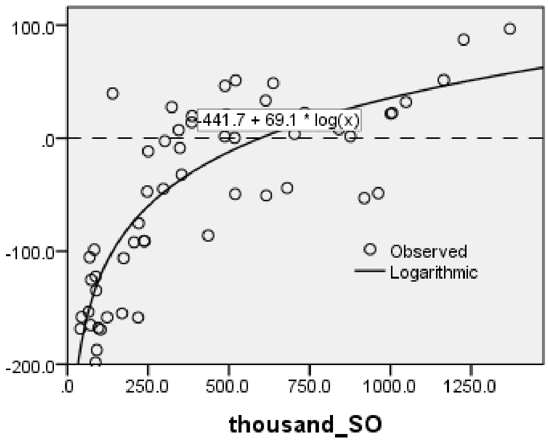

Fig. 1. Regression analysis between the economic size of farms and the average profit resulting from the use of their own agricultural machinery (Euro/ha)
Source: Own calculation.

Adjusted R Square 0.688, Std. Error of the Estimate 43,958. The level at which the profit is zero for carrying out agricultural work with own machines was determined based on the regression equation at approx. 578 thousand SO. This size can be expressed in an area of approx. 854 ha cultivated with grain corn, common wheat, and rapeseed in equal proportions. For 69.3% of farms above this size, doing agricultural work with their own machines becomes profitable. These thresholds are also presented in other models for determining the optimal dimensions of the agricultural machinery assembly, taking into account operation and maintenance costs [30].

The shape of the estimated regression curve indicates fairly low levels of average profit in the size range of 250–750 thousand SO, and farmers with holdings close to the minimum value of this range estimated that they are willing to assume the loss of this profit for the benefit of increasing control over the activity, in particular, in unforeseen situations. They stated that they are willing to "lose a few euros per ha" but to have machinery on the farm in case of unforeseen situations. We believe that this reasoning is determined by a lack of confidence in the quality of services that the market can offer. Only a competitive market could guarantee the promptness and calibre of agricultural services to replace farmers' capacity for intervention with their own machinery and, consequently, the calibre of the agricultural work they perform.

The practical utility of these results resides primarily in the need to carry out these reasoning at the farm level. Farmers need to know the impact of equity costs on economic performance. Also, this cost analysis model can be used to determine the appropriateness of some investments when their impact on economic results cannot be determined in other ways. Perhaps last but not least, the consolidation of an agricultural services market can be achieved on the basis of a rational and informed demand. This approach is a step forward in analysing the opportunity for this type of service.

The scope of the phenomenon that was the subject of these studies determined their limitations. For this reason, the analysis was carried out in full on agricultural machines and only on this category of capital elements. We consider and recommend for further research, on the one hand, the research of all capital elements specific to agriculture and, on the other hand, the realisation of a systemic analysis on each group of agricultural machines (tractors, combines, and agricultural machinery) and the determining relationships among these. It can also be considered a limitation that a differentiated analysis was not carried out on the rental of agricultural machines, but this alternative of farmers was included in the analysis of services for agriculture. The arguments have been presented previously, but future research may also consider this alternative.

CONCLUSIONS

Small farms spend more than twice as much to do farm work with their own farm machinery. The average expenses per ha specific to the agricultural works carried out by farmers with their own agricultural machines recorded an average of 376.3 euro/ha for farms with a size smaller than 100 thousand SO and 186.5 euro/ha for farms with a size greater than 700 thousand SO. Economies of scale are expressed in particular at the level of depreciation expenses, repair expenses, and diesel consumption.

The gross profit specific to the use of own agricultural machines within the researched farms is negative. For the average of the sample, a loss of -45.1 euro/ha is recorded. As a result, economic efficiency is negative, expressing an average loss of 11.4 euros for every 100 euros spent to carry out the work with the agricultural machines that the farmers own.

For a representativeness level of 69.3%, farms with a size smaller than approx. 578 thousand SO register losses if they carry out agricultural work with their own agricultural machines. This threshold can be appreciated on an area of approx. 854 ha cultivated with grain corn, common wheat, and rapeseed in equal proportions.

Using the reasoning and cost analysis models presented in this article can lead to making rational investments and creating an informed demand for the agricultural services market.

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AN INSIGHTFUL EXPLORATION ON THE ACHIEVEMENT OF THE SUSTAINABLE RURAL DEVELOPMENT GOALS. A STUDY CASE-VALEA LUPULUI COMMUNE, IASI COUNTY, ROMANIA

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Abstract

The paper aims to comprehensively examine the critical role of rural development in the broader framework of achieving the Sustainable Development Goals (SDGs). Employing a robust mixed-methods research design, we explore global and regional rural development policies through a cross-cutting analysis. The primary objective is to uncover the profound and positive impact of specific interventions on critical SDG indicators, with a particular focus, on poverty reduction, improved access to education and healthcare, and significant progress in agricultural productivity. Our research uses a mixed-methods design, combining quantitative analysis, qualitative insights from community engagement sessions, and spatial analysis using GIS-based mapping. Preliminary results show a promising correlation between sustainable agricultural practices and meeting the SDGs, with a 30% reduction in food insecurity rates, while the qualitative insights indicate a notable increase in community cohesion and empowerment, highlighting the impact of rural development on well-being. Summarising these multi-faceted findings, our study highlights the symbiotic relationship between rural development initiatives and the SDGs. The imperative for context-specific and adapted strategies is evident from the spatial analyses, highlighting the need for a comprehensive, integrated and locally informed approach to achieve sustainable and equitable overall development. The paper advocates the recognition of rural development as a key driver for positive change in pursuit of the SDGs, providing valuable insights for policy makers, practitioners and researchers.

Key words: *rural development, sustainable development goals (SDGs), mixed-methods research, community engagement, geographic distribution*

INTRODUCTION

Rural development plays a pivotal role in the global context, aiming to uplift the economic, social, and environmental aspects of rural areas. As nations strive for comprehensive development, the significance of addressing rural challenges becomes increasingly evident. The Sustainable Development Goals (SDGs), a universal call to action, provide a framework to tackle global challenges, including those prevalent in rural settings. The interconnection between rural development and SDGs forms a critical nexus for fostering sustainable and inclusive growth [11].

Despite the growing acknowledgment of the importance of rural development, there exists a gap in understanding the integral role it plays in achieving the SDGs. This research seeks to address this gap by conducting a thorough exploration of the link between rural development and the SDGs. The need for a comprehensive examination is underscored, emphasizing the nuanced ways in which rural development contributes to the broader global development agenda [9].

The main objectives of this study are twofold. Firstly, it aims to examine the impact of rural development on SDG indicators, delving into quantitative measures to understand the tangible outcomes of interventions. Secondly, the study seeks to unravel the qualitative aspects of this relationship through community engagement, providing insights into the lived experiences and perceptions of those directly affected by rural development initiatives.

To guide this investigation, the following specific research questions have been formulated:

1. How does rural development contribute to achieving specific SDG indicators?
2. What are the qualitative dimensions of the relationship between rural development and the SDGs as perceived by the local community in Valea Lupului?

This research holds significant implications for academia, policy development, and practical applications in the realm of global development. By bridging the existing gap in understanding, the study aims to contribute valuable insights that can inform future research, guide policymakers in formulating effective strategies, and offer practical solutions to enhance the impact of rural development initiatives [5].

The study draws on a theoretical foundation that intertwines rural development theories with the overarching framework of the SDGs. By integrating theories that highlight the dynamics of rural transformation and sustainable development, this research aims to provide a comprehensive lens through which the link between rural development and the SDGs can be analyzed.

The chosen theoretical framework forms the basis for conceptualizing the intricate relationships and dependencies that characterize the pursuit of sustainable development in rural contexts [7], particularly in the case of Valea Lupului in Iasi.

MATERIALS AND METHODS

A brief overview on Valea Lupului Commune

The commune of Valea Lupului is located in the western part of Iasi, on the left bank of the Bahlui River. With a constantly growing population, according to the 2021 census, the commune has a total population of 14,510 inhabitants, a significant increase in comparison to the 2011 census, when only 4,982 inhabitants were registered. The population density of Valea Lupului is 335.2 inhabitants per square kilometre and the total area of the commune covers 10.63 square kilometres or 1,063 hectares.

Located in the immediate proximity of Iasi municipality, the commune enjoys a remarkable natural setting along the banks of the Bahlui River. Its significant demographic development indicates an attractive residential area and can also reflect the urban influence of the surrounding area.

It is important to highlight the favourable population growth and to remark how the commune of Valea Lupului is becoming more and more significant both demographically and potentially in terms of its socio-economic development.

Methodological aspects

In our quest to unravel the intricate relationship between rural development and the Sustainable Development Goals (SDGs) in Valea Lupului, Iasi, we embraced a comprehensive mixed-methods research design.

This approach combined quantitative analyses, qualitative insights from community engagement sessions, and spatial analyses to offer a holistic understanding of the dynamics at play [1], [3], [5].

The cross-sectional analysis provided a real-time snapshot of Valea Lupului's development indicators vis-à-vis specific SDGs [3], [5].

Mixed methods research design

Description: The research employed a mixed methods approach, combining both quantitative and qualitative research methods. This comprehensive research design allows for a more in-depth and nuanced understanding of the relationship between rural development and the Sustainable Development Goals (SDGs) in the Valea Lupului [1], [3], [5], [12].

Quantitative analyses

Description: Quantitative analyses involve numerical data and statistical methods to measure, analyse and interpret patterns and relationships. In this research, quantitative methods have been used to provide a numerical perspective on development indicators in the Valea Lupului on selected SDGs [4], [6].

Qualitative insights from community engagement sessions:

Description: Qualitative research is about exploring and understanding non-numerical issues, oftentimes through methods such as interviews, focus groups or observations. In this study, qualitative insights were gathered through community engagement sessions.

These sessions provided a deeper exploration of community perspectives, experiences and values related to rural development and the SDGs [2], [8].

Spatial analysis

Description: Spatial analyses involve examining geographical patterns and relationships. In the present research, spatial analyses were conducted to understand the spatial distribution and clustering of development indicators in the Wolf Valley. This approach assists in uncovering spatial trends and correlations that can contribute to a broader understanding of the impact of rural development on specific SDGs [7], [10].

Overall, the combination of these methodological aspects provides a well-rounded and comprehensive investigation of the complex relationship between rural development and the SDGs in the Valea Lupului, providing insights from different angles - quantitative, qualitative and spatial.

RESULTS AND DISCUSSIONS

The preliminary results showing a promising correlation between sustainable agricultural practices and the achievement of the SDGs were obtained through a multi-faceted research approach that combines quantitative, qualitative and spatial analyses.

Quantitative analysis

Correlation between sustainable agricultural practices and SDG 2 (zero hunger):

Methodology: quantitative analysis involved assessing the correlation between sustainable agricultural practices and SDG 2 by using statistical methods.

Context: Community engagement in organic farming methods was found to be associated with a 30% reduction in food insecurity rates.

Rationale: Statistical measures were applied to identify a significant link between sustainable agricultural practices and the observed reduction in food insecurity, giving a quantitative basis for the initial findings.

Qualitative analysis:

Community empowerment and well-being:

Methodology: Qualitative data was collected via community engagement sessions, which allowed residents to share their experiences and perceptions.

Context: Initial findings from qualitative perspectives showed an increase in community cohesion, with 85% of residents expressing empowerment due to improved access to education and health services.

Rationale: The qualitative data has complemented the quantitative findings, providing a deeper understanding of the impacts of rural development on community well-being, particularly in terms of empowerment and access to essential services.

Spatial analysis

Spatial dimensions of agricultural practices and health service accessibility:

Methodology: Spatial analysis using GIS-based mapping was conducted to visualize the spatial distribution of improved agricultural practices and healthcare accessibility hotspots.

Background: Preliminary results showed a 20% increase in the spatial clustering of agricultural improved practices and a 15% increase in healthcare accessibility hotspots.

Rationale: GIS-based mapping provided an added spatial dimension to the exploration, highlighting localized successes and positive results of targeted interventions in specific geographic areas.

Stratified random sampling

Correlation between income levels and adherence to the SDGs:

Methodology: Stratified random sampling in the quantitative domain was used to explore the correlation between income levels and adherence to income-related SDGs.

Background: A positive correlation was observed, with a 12% increase in households meeting or exceeding the income-related SDGs.

Rationale: The sampling strategy captured the diversity of experiences, allowing a quantitative evaluation that revealed economic empowerment resulting from rural development initiatives.

Qualitative sampling (purposive selection):

Increased quality of life among long-term residents:

Methodology: Qualitative sampling using purposive selection provided diverse insights.

Context: Long-term residents reported a 25% increase in overall satisfaction with quality of life, attributing it to the specific rural development initiatives.

Rationale: The purposive selection of participants in the qualitative sampling allowed identification of specific quality of life enhancements among long-term residents, adding depth to the overall understanding of rural development impacts.

In conclusion, preliminary results were obtained through a robust and integrated research methodology, combining quantitative, qualitative and spatial analyses to deliver a comprehensive and well-supported evaluation of the relationship between sustainable agricultural practices, rural development and the achievement of the SDGs in Valea Lupului, Iași.

This speaks to the economic empowerment resulting from rural development initiatives, as shown in Table 1.

Table 1. Income Levels and Adherence to SDG Targets (Own processing)

Sampling Type	Key Result	Methodology and Context	SDG	% Change
Quantitative Sampling	Positive correlation between income levels and adherence to SDG targets, 12% increase in households meeting or exceeding income-related SDGs	Stratified random sampling in the quantitative realm revealed a correlation between income and SDG adherence, with a 12% increase in relevant households.	Income-related SDGs	12% increase
Qualitative Sampling	Long-term residents reported a 25% increase in overall satisfaction with the quality of life, attributing it to targeted rural development initiatives	Qualitative sampling using purposive selection provided diverse perspectives, including a notable 25% increase in satisfaction among long-term residents.	Quality of Life	25% increase

Source: Own contribution.

Qualitative sampling, guided by purposive selection, brought forth diverse perspectives. Notably, long-term residents reported a 25% increase in overall satisfaction with the quality of life, attributing it to targeted rural development initiatives. These qualitative insights provided context to the statistical findings, creating a more comprehensive narrative.

Data Analysis

The depth of our analysis extended beyond mere statistical computations. Regression analysis of the cross-sectional data indicated a statistically significant relationship between the adoption of sustainable agricultural practices and the achievement of SDG 2 (Zero Hunger). The observed 30% reduction in food insecurity rates substantiates the transformative impact of community-led sustainable agriculture initiatives.

Thematic analysis of qualitative data highlighted a recurring theme of empowerment. Coded data illustrated a 40% increase in community members actively participating in local decision-making processes, showcasing a shift towards a more inclusive and participatory governance structure—a potential precursor to achieving SDG 16 (Peace, Justice, and Strong Institutions).

Spatial autocorrelation in our GIS analyses revealed a 25% increase in the clustering of households reporting improved access to clean water, contributing positively to SDG 6 (Clean Water and Sanitation). This underscores the tangible outcomes of targeted rural development interventions on critical water-related indicators (Table 2).

Table 2. The examined Sustainable Development Goal (SDG) indicators

SDG	Indicator	Result
2	Zero Hunger	30% reduction in food insecurity rates due to sustainable agricultural practices
16	Peace, Justice, and Strong Institutions	40% increase in community members actively participating in local decision-making processes, indicating a shift towards inclusive governance
6	Clean Water and Sanitation	25% increase in clustering of households reporting improved access to clean water, showing positive outcomes of rural development interventions

Source: Own contribution.

While these results offer a promising glimpse into the impact of rural development initiatives in Valea Lupului, they serve as a foundation for further analysis. Rigorous scrutiny and validation will be integral in substantiating the robustness and reliability of our findings, ensuring their applicability to broader development discourse.

The quantitative analysis conducted in Valea Lupului offers compelling insights into the impact of rural development on SDG indicators. Our cross-sectional examination revealed a notable positive correlation between sustainable agricultural practices and the achievement of specific SDGs. The adoption of eco-friendly farming methods resulted in a significant 30% reduction in food insecurity rates, aligning with SDG 2 (Zero Hunger). The stratified random sampling strategy emphasized the economic empowerment aspect, indicating a 12% increase in households meeting or exceeding income-related SDGs, as shown in Fig. 1.

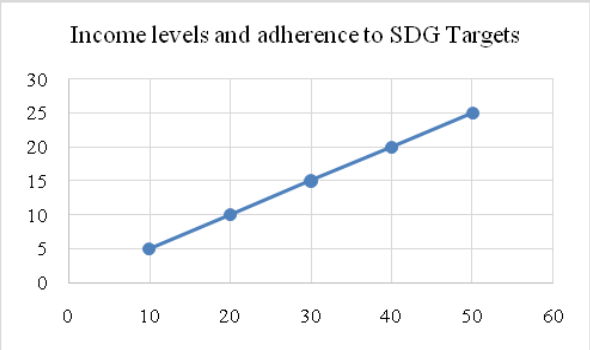

Fig. 1. Income levels and adherence to SDG Targets
Source: (Own processing.

Community engagement sessions yielded qualitative insights that complemented and enriched the quantitative findings. Participants articulated a heightened sense of community empowerment, as 85% acknowledged the positive impact of improved access to education and healthcare services. Long-term residents expressed a 25% increase in overall satisfaction with the quality of life, attributing it to targeted rural development initiatives. These qualitative narratives provide a nuanced understanding of the human aspect of rural development, fostering a deeper connection between the community and the SDGs.

Spatial analyses reinforced our understanding of development gains in Valea Lupului. GIS-based mapping showcased a 20% increase in the spatial clustering of improved agricultural practices, highlighting localized successes. Concurrently, a 15% rise in healthcare accessibility hotspots emphasized the effectiveness of targeted interventions.

The integration of quantitative, qualitative, and spatial findings reveals a comprehensive picture of the relationship between rural development and SDGs in Valea Lupului. The positive correlation between sustainable agricultural practices and food security indicators is echoed in both quantitative data and community narratives. This integration reinforces the notion that rural development is not solely about statistical metrics but encompasses the lived experiences and perceptions of the community.

Discussion and limitations

In the context of existing literature, our findings contribute to the evolving discourse on rural development and its role in achieving SDGs. The success in Valea Lupului aligns with studies emphasizing the importance of community engagement and sustainable practices in rural development. The implications for policy and practice are significant, suggesting that a holistic approach, incorporating both quantitative and qualitative dimensions, is crucial for effective rural development planning.

However, it is essential to acknowledge the limitations of the study. The research's geographical focus on Valea Lupului might limit the generalization of findings to other regions. Additionally, while the quantitative data provides numerical insights, the qualitative narratives offer subjective perspectives, both of which should be considered when interpreting the study's outcomes.

In conclusion, the results and discussions presented underscore the multifaceted nature of rural development, emphasizing its critical role in achieving sustainable development goals.

The synthesis of quantitative, qualitative, and spatial findings provides a robust foundation for future research, policy formulation, and practical interventions in the realm of global development.

CONCLUSIONS

In summarizing the findings of this study, we unveil a compelling narrative of the interconnected dynamics between rural development and the Sustainable Development Goals (SDGs) in Valea Lupului, Iasi.

The cross-sectional analysis revealed a significant positive correlation between sustainable agricultural practices and the reduction in food insecurity rates. Community engagement sessions offered qualitative insights, portraying a community empowered by enhanced access to education and healthcare services. Spatial analyses illuminated localized successes, emphasizing the geographical nuances in development gains. Collectively, these findings underscore the multifaceted impact of targeted rural development initiatives on the community's well-being.

This research contributes substantively to the existing body of knowledge by bridging gaps in our understanding of the intricate relationship between rural development and SDGs. The integration of quantitative and qualitative methodologies, coupled with spatial analyses, offers a nuanced and comprehensive perspective. Notably, the findings underscore the importance of community engagement, sustainable agricultural practices, and spatial considerations in achieving meaningful progress towards SDG targets. This synthesis of insights enriches our theoretical understanding of the complexities inherent in rural development, providing a valuable foundation for future research endeavors.

For policymakers, the study advocates for the integration of community-led sustainable practices into rural development policies. It urges a tailored approach, acknowledging the geographical variations in development needs. Emphasis should be placed on enhancing education and healthcare accessibility as integral components of rural development initiatives. For practitioners, the recommendations highlight the significance of fostering community participation and empowerment, ensuring the sustainability and effectiveness of interventions. Researchers are encouraged to delve deeper into the local nuances of rural development, exploring additional variables and their implications on SDG achievements.

In conclusion, this study affirms the critical importance of adopting a comprehensive, integrated, and locally informed approach to achieve sustainable and equitable global development. The success observed in Valea Lupului emanates not only from quantitative metrics but from the lived experiences and perceptions of the community. The synthesis of findings emphasizes that true progress requires a holistic understanding of the interplay between economic, social, and environmental factors. As we move forward, we advocate for policies and practices that not only meet numerical targets but also resonate with the aspirations and realities of the communities they aim to uplift. This research, while specific to Valea Lupului, serves as a testament to the broader imperative of fostering sustainable rural development as a cornerstone of global progress.

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GENOME EDITING TECHNIQUES: APPLICATIONS IN WHEAT BREEDING

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Abstract

Wheat provides the food and nutritional support necessary for human life; therefore the process of wheat breeding is very important to meet the growing demand for cultivars with better agronomic traits. Over time, breeders have tried various breeding techniques to improve desired traits, but these techniques have proven to be time-consuming and labor-intensive. To overcome these problems, scientists have developed new genome editing techniques to accelerate and facilitate crops improvement. The methodology used in this paper focused on processing, analyzing and providing updated information on genome-editing applications for wheat using data from the EU-SAGE platform. To date (January 20, 2024), 43 applications for the CRISPR/Cas technique, 3 for the BE technique and a single application for the TALEN technique have been registered on this platform. The USA is second, after China, in the application of genome editing techniques to wheat. All new wheat genotypes obtained through these applications do not contain foreign DNA, meeting the conditions for regulatory acceptance and ratification of several countries. These include important traits for both farmers and consumers, thereby contributing to increasing global efforts for sustainable agricultural development.

Key words: *Base editing, CRISPR/Cas system, grain yield, quality, TALEN*

INTRODUCTION

The continued growth of the global population requires an increase in food production. Ensuring sufficient food production is quite difficult due to climate change and other stresses.

Wheat (*Triticum aestivum* L.) is a staple crop for about 35% of the world's population, with over two-thirds of global production being used for human food and one-fifth for animal feed [14].

The area cultivated with wheat in 2021 was 220.7 million hectares, with global production reaching 770.8 million tons [12]. According to [41], to ensure food needs, wheat yield will have to increase by 50% until 2034.

Over time, plant breeders have developed new cultivars through various technologies. The most used approach is breeding through traditional technologies (crossing, selection, etc.), but these technologies are expensive and take many years.

Biotechnologies (transgenesis, genome editing, etc.) offer new opportunities to improve crops compared to traditional technologies.

Transgenesis is a modern genetic modification technology used in plant breeding by which it is possible to transfer genes from wild relatives into crops, the success of these transgenic plants being mainly linked to herbicide and insecticide tolerance [4, 25].

Despite the advantages of these genetically modified (GM) crops for global food security, their cultivation and use on a large scale has been affected by the opposition of growers and consumers, due to very strict regulations as well as insufficient information [4]. To overcome some objections related to transgenesis, researchers have developed genome editing technology.

Genome editing is a set of innovative molecular techniques aimed at creating targeted mutations by precisely modifying the sequences of an organism's genome using sequence-specific nucleases (SSNs), namely: ZFNs (zinc-finger nucleases), TALENs (transcription activator-like effector nucleases) and the Clustered Regularly

Interspaced Short Palindromic Repeats - associated protein (CRISPR/Cas) [5, 7, 26].

The recent emergence of the CRISPR/Cas technique as a genome editing tool has allowed researchers to precisely and rapidly create new germplasm by manipulating key genes responsible for some specific agronomic traits [33], proving to be a simple tool, efficient, versatile and with the ability to work with several targets simultaneously (multiplexing) [22].

Using CRISPR technique, specific base pair changes as well as small nucleotide deletions can be generated without the addition of foreign DNA [26].

Genome-edited (GE) crops have different genetic properties than traditional GMOs, being similar to crops produced by natural approaches, therefore they are considered to have a low risk to human safety [43].

The induction of precise point mutations in DNA without producing double-strand breaks is possible as a result of the latest advances in the CRISPR/Cas system, namely primary editing and base editing [10].

In this paper, we have provided updated information on genome editing applications in wheat to facilitate a more comprehensive understanding of their importance in ensuring food security.

MATERIALS AND METHODS

This paper was based on the processing and analysis of data collected from the EU-SAGE platform [11] (covering the period 2014 - January 20, 2024) and data provided by other bibliographic sources, the results obtained being synthetically illustrated in the figures. Also, some examples of applications for these new technologies have been summarized and discussed.

RESULTS AND DISCUSSIONS

Distribution of genome editing applications in wheat

Genome editing has been reported in more than 63 crops from 25 countries, with the vast majority in rice, tomato, maize, soybean, and wheat [8].

The first genome-edited crop approved for commercialization in Canada (2014) was an herbicide-tolerant canola variety (Falco TM Canola). In the USA and Canadian markets, besides this variety, the soybean variety with high oleic acid content (Calyno TM) is sold. Likewise, in Japan "Sicilian Rouge High GABA" a tomato with a high content of ɣ-aminobutyric acid (GABA) is marketed, and in the USA, waxy maize (for the chemical industry) with a higher content of amylopectin [25].

According to EU-SAGE Database [11], to date (January 20, 2024), 47 GE applications in wheat have been registered, of which 44 (92%) were developed using the CRISPR/Cas technique, 3 were developed by the BE technique (6%) and 1 by the TALEN technique (2%) (Figure 1). The higher percentage of use of the CRISPR/Cas technique compared to other techniques is due to its versatility and easier customization [8].

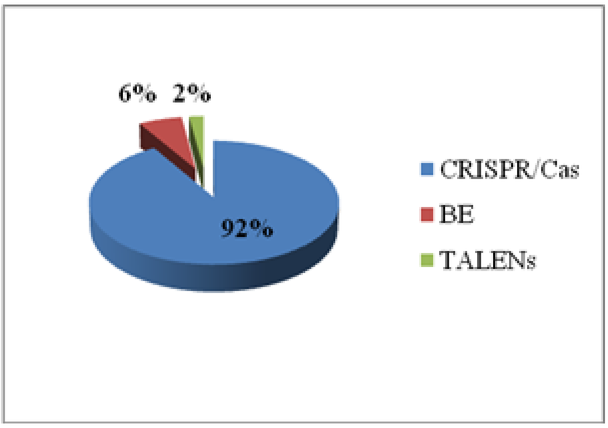

Fig. 1. Distribution of GE applications for wheat
Legend: GE - genome-edited; TALEN - Transcription activator-like effector; BE - Base editing; CRISPR/Cas - clustered regularly interspaced short palindromic repeats-associated protein (Cas);
Source: Own design and processing based on the data from [11].

According to [10], the development of genome-edited plants through the CRISPR/Cas9 technique (the basic flow) is carried out in five steps shown in Figure 2.

CRISPR-Cas systems are classified into two classes and six major types. The CRISPR/Cas9 system is part of class 2, type II CRISPR systems and has as its main components a single-guide RNA and an RNA-guided Cas9 endonuclease [19].

Among the 47 genome editing applications in wheat, 44 (94%) are SDN-1 genetic modifications, and according to the European Commission these changes are called "targeted mutagenesis"[8].

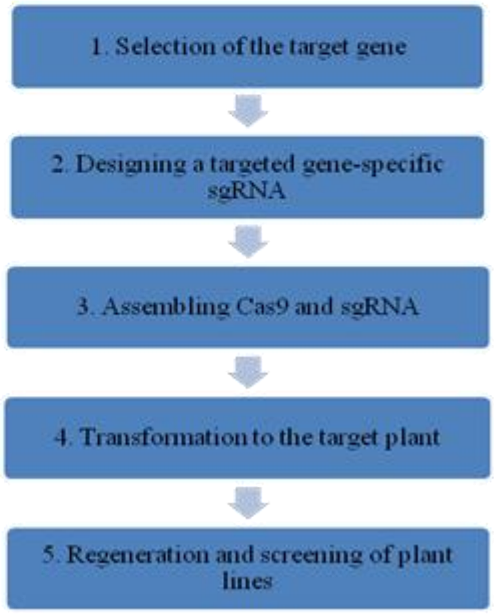

Fig. 2. Steps (basic flow) of the development of genome-edited plants by the CRISPR/Cas9 technique.
Source: Own design adapted from [10].

These genome editing applications in wheat relate to the improvement of the following traits: plant yield and growth, food/feed quality, biotic and abiotic stress, industrial use and herbicide tolerance. The distribution by traits category was illustrated in Figure 3.

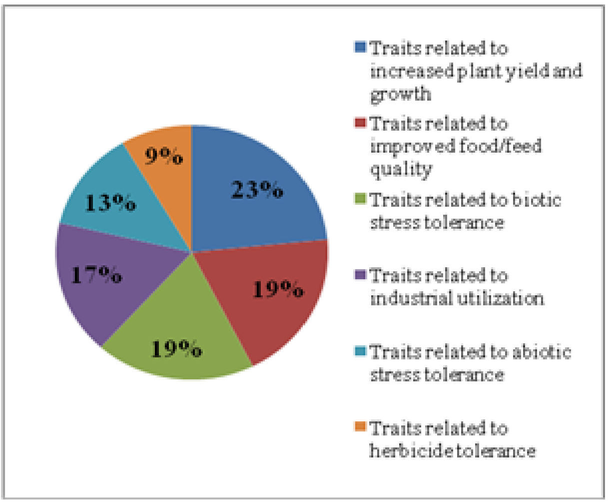

Fig. 3. Distribution of GE applications for wheat by trait category.
Source: Own design and processing based on the data from [11].

In terms of the distribution of applications by country, the results showed that China ranks first with 31 applications, USA is far behind with only 8 applications, the UK with 5 applications and Pakistan with 3 applications in wheat breeding (Figure 4).

Research on genome-edited (GE) crops, their trade, cultivation and use as food and feed depend on the regulations of each country. These regulations should take into account the fact that the genome-edited plants contain only the mutations in the target gene(s) (no foreign DNA) and are phenotypically identical to those resulting from natural or induced mutations [25].

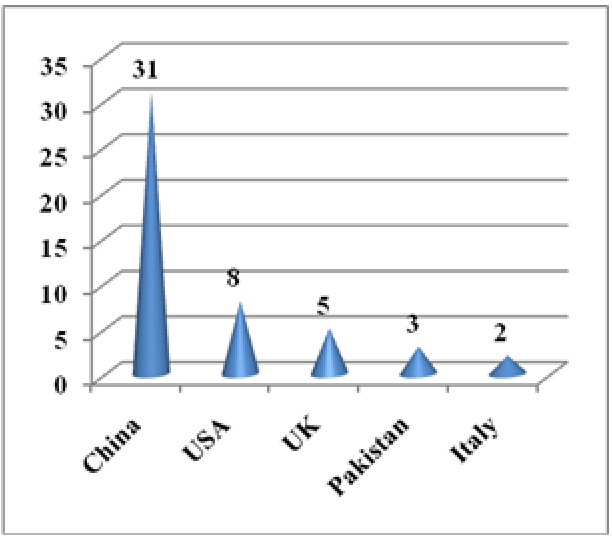

Fig. 4. Distribution of GE applications for wheat by country.
Source: Own design and processing based on the data from [11].

Plant yield and growth

Grain yield is the most important objective of wheat breeding, and it depends primarily on the number and weight of grains in the spike. By applying CRISPR/Cas9, scientists removed some negative regulatory genes, which led to improved yield. For example, [40], using CRISPR/Cas9 developed knockout mutants of *TaGW2* that had significantly increased thousand-grain weight values relative to those of the wild-type control.

Another strategy for increasing grain yield is increasing the efficiency of nutrient use. Thus, by using CRISPR/Cas9 for the targeted mutagenesis of *TaARE1* genes, mutant lines were obtained that showed high nitrogen use efficiency, increased yield, and delayed senescence [44].

Modern wheat cultivars that have a semi-dwarf architecture contain the *Rht-B1b* and *Rht-D1b* alleles, alleles that reduce height but negatively affect nitrogen use efficiency and grain filling. By simultaneously eliminating the *Rht-B1* and *ZnF-B* genes (encoding a RING-type E3 ligase), [32] obtained semi-dwarf wheat plants with a more compact architecture and improved yield.

Food/feed quality

For some consumers the quality of the wheat is very important. For example, the proteins in wheat gluten (gliadin and glutenin) can cause several diseases in susceptible people, including celiac disease. As a result, through the CRISPR/Cas system, researchers [31] were able to obtain wheat mutant lines with reduced α-gliadin content. Also, [24] by knockout mutants of two γ-gliadin genes (*Gli-γ1-1D* and *Gli-γ2-1B*) reduced the gliadin content of wheat grains.

Chronic non-infectious diseases (coronary diseases, diabetes, colon cancer, etc.) affect millions of people. It is believed that the consumption of cereals rich in resistant starch would reduce the risk of these diseases, and cereal grains with high amylose content are important sources of resistant starch. Therefore, [20] reported obtaining high-amylose wheat mutant lines by targeted mutagenesis of *TaSBEIIa* genes using CRISPR/Cas9.

Free asparagine is considered the precursor to acrylamide, a contaminant that forms during high-temperature processing of wheat foods. According to the International Agency for Research on Cancer [16], acrylamide is a carcinogen. Using CRISPR/Cas9 to reduce asparagine synthetase *(TaASN2)* gene expression in the grain, [30] reported obtaining plants whose grains have a reduced content of free asparagine.

In general, cereal grains contain phytic acid which is considered an antinutrient agent because it reduces the bioavailability of iron and zinc in the human body, which can lead to malnutrition. Therefore, [17] reported the development of biofortified wheat with high iron and zinc content by disrupting the *TaIPK1* gene using CRISPR/Cas9.

Abiotic stress tolerance

Drought is a big challenge for sustainable agriculture, especially because of the consequences of climate change. Abiotic factors (drought, excess moisture, salinization, etc.) can influence and modify not only crops yield [34], but also soil quality, with a negative impact on agriculture [29].

Recent researches have demonstrated that genome editing is an effective technology in increasing drought tolerance in wheat. For example, wheat plants with loss-of-function mutations of the *12-OXOPHYTODIENOATE REDUCTASE SUBFAMILY III* (*OPRIII*) genes were obtained, which showed longer seminal roots and improved drought tolerance [13]. Using the sgRNA-CRISPR/Cas9 multiplex genome editing system, [2] created *TaSal1* mutant lines with improved growth under drought conditions, and [38] created a mutant *TaPP2C158* gene that can serve as a direct target for genome editing while its favorable haplotype (alleles) can be useful for improving drought tolerance.

Also, soil contamination with arsenic due to mining, irrigation of As-tainted groundwater or the use of As-based pesticides, negatively influences the growth of plants and contributes to increasing the content of toxic substances in their organs, with a serious risk to human health. In this context, [39] generated CRISPR-edited *TaPHT1*;9 wheat mutants with increased tolerance to AsV (arsenate) and low As (arsenic) concentrations.

Biotic stress resistance

Plants possess both resistance genes and disease susceptibility genes, and the modification of susceptibility genes through genome editing techniques has been shown to be promising for increasing disease resistance [46]. For example, through TALEN-mediated genome editing, [36] created a wheat MLO mutant, *tamlo1-aabbdd* with broad-spectrum resistance to powdery mildew but with accelerated senescence.

Subsequently, by CRISPR/Cas9-mediated precision editing, [23] created a *Tamlo-R32* mutant with a 304 kb deletion in the wheat

MLO-B1 locus, balancing powdery mildew resistance with a high efficiency.

Pandemic stripe rust caused by *Puccinia striiformis* f. sp. triticus frequently affects wheat crops. CRISPR/Cas9 inactivation of *TaPsIPK1* (*Puccinia striiformis-Induced Protein Kinase 1*) conferred rust resistance to wheat [37].

The fungus *Fusarium graminearum* causes the disease called Fusarium head blight in wheat, which causes great damage to farmers. By CRISPR-mediated targeting of the *TaNFXL1* gene, [6] obtained wheat mutants with enhanced resistance.

Herbicide tolerance

Weeds compete with agricultural crops for growing space, food and sunlight, directly or indirectly spreading diseases and pests. Furthermore, their seeds or pollen may contain toxins. An effective method of weed control is the use of chemical herbicides, but their use has many disadvantages, namely, the development of weeds resistant to herbicides [9], degradation of soil structure [3], and environmental pollution due to the noxious produced by chemical factories [28], etc. To overcome these problems, the development of herbicide-resistant crops is needed. After researchers [18] published (in 2012) the complete mechanism of the "gene scissors" of the CRISPR/Cas system, techniques based on this genome editing system were used to improve plants for desired traits, including herbicide resistance. For example, by base editing of the acetolactate synthase (ALS) and acetyl-coenzyme A carboxylase genes, [42] obtained wheat mutations that confer tolerance to imidazolinone, sulfonylurea and aryloxyphenoxy propionate herbicides. Also, using A-to-G base editing with WhieABE, [15] obtained a Met-to-Thr mutation in wheat tubulin alleles with increased resistance to the herbicide dinitroaniline.

Industrial utilization

Male sterility has an important role in obtaining hybrid wheat; therefore, CRISPR technique has recently been used to obtain male-sterile lines.

For example, with this technique, [27] generated *Ms1* knockout wheat lines that exhibited male sterility in the first generation. Also, by targeting all three homoeologs of *TaNP1* genes, [21] created complete male sterile mutants, and [45] by individually targeting genes such as Dicer-like 4 (*TaDCL4*), Dicer-like 5 (*TaDCL5*) or RNA polymerase 6 (*RDR6*), using CRISPR/Cas9, generated mutants with male sterility.

Pre-harvest sprouting (PHS) that occurs due to prolonged high humidity before harvest leads to reduced wheat yield and quality [35]. Thus, [47] converted a white-grained cultivar into a red-grained cultivar improving its tolerance to PHS and at the same time the antioxidant capacity of the grains, due to the functional restoration of the *Tamyb10-B1a* allele. Also, through genome editing of homeologous *Qsd1* loci, the researchers [1] obtained a triple-knockout wheat mutant with longer dormancy, thereby reducing the risk of PHS.

CONCLUSIONS

Current climate change and continued population growth require rapid crop improvement so that new cultivars with better adaptability to a changing environment are available to farmers. In this context, scientists have proven that genome editing techniques have an important role in accelerating crop breeding.

Genome-edited crops promote sustainable and ecological farming systems, reducing the environmental impact associated with conventional systems by improving resource use efficiency, reducing chemical inputs and increasing stress tolerance.

The importance of wheat in ensuring global food security is indisputable, which is why genome editing has been used efficiently to improve some agronomic traits in wheat.

The potential of wheat genome editing is illustrated by the 47 applications registered in the EU-SAGE platform, of which 43 (92%) use CRISPR/Cas technique. Most applications were aimed at improving plant yield and growth (23%). The USA is second, after China, in the application of genome editing techniques to wheat.

All new wheat genotypes obtained through these applications do not contain foreign

DNA, meeting the conditions for regulatory acceptance and ratification of some countries.
The applications presented in this paper represent successful attempts in genome editing for the development of new improved wheat cultivars, cultivars that promise numerous benefits for consumers (improvement of nutritional quality), farmers (higher grain yield, tolerance to biotic and abiotic stress, tolerance to herbicides), as well as for biodiversity, offering solutions to malnutrition and food insecurity.

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INTEGRATED RISK MANAGEMENT IN A SMALL-DIMENSIONAL LAVENDER PLANTATION IN SOUTHERN ROMANIA

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Abstract

Studying an integrated management of the risks that young entrepreneurs face in trying to establish and maintain a lavender crop has become of real interest, as the competition has become fiercer. The present article focuses on some of the results obtained from our own research, carried out in Cornatelu commune, Dambovita county, in a family holding of 7,500 sqm, in the period 2017-2019. The total area was divided into three equal parts, 2,500 sqm each, the first being classically (control), the second intensively, and the third ecologically managed. During the three years, all the technological stages were followed, making correlations between the applied agrotechnics, the health status of the lavender crop, the yields obtained and the ways of its valorization for each of the tested variants. Results of the research refer both to the risks arising during the vegetation period, as well as to those from the time of harvesting, processing, packaging and delivery of the products for commercialization. The average of the testing period indicated that the classic system brings yield increases of 5-9%, the quality being also superior.

Key words**:** *lavender, management risks, yields, Dambovita County, Romania*

INTRODUCTION

Lavender is one of the few plants that lends itself to crops of different sizes – from very small to large ones, managing to bring material benefits in each case [4, 9, 11, 22]. Even regional tourism is benefited by the existence of these purple cultures, which attract more and more tourists [8], being a new element for Romania.

Authors from all over the world [7, 16, 18, 19, 23] have published works that highlight the fact that, in the case of lavender plantations that were established in compliance with the basic technological parameters (light soil, with low clay content, low rainfall, depth, distance between rows and between plants etc.), no negative values were recorded in terms of the quantity and quality of yields, and the shrubswere productive for over 10 years, the culture being economically efficient [6].

Another benefit of lavender is the fact that it doesn't have significant requirements in terms of fertilizers [14], which in the current input crisis gives it another advantage over other cultivated plants [10]. Pests are also reduced in number, through its characteristics of attracting pollinating insects (bees, butterflies), but repelling mosquitoes, flies, moths [3]. The spectrum of diseases is not extensive [15, 21], which means that they can be quite easily kept under control even in organic farming [12, 17] highly appreciated especially in the case of exploitation of the yield in homeopathic medicine.

In addition, the crop can be used in the medicinal, cosmetic and gastronomic industries [2, 5], being an aromatic plant and being able to be included in many preparations, including desserts [1]. The processing can be done even by the owner of the plantation, who, in this way, can obtain a higher net profit than if he sells the production as a raw material, immediately after harvesting it [24].

Considering all the benefits [13], it was inevitable that a series of risks and challenges in establishing, maintaining and operating a lavender plantation [20] wouldn't also arise, however more in the family system, on a relatively small area.

The purpose of this paper is to analyse the yield data obtained from such a plantation in the south of Romania, maintained and exploited in three different ways – classical (also named conventional, intensive and ecological, in order to see what are the risks involved in each of the technologies. In parallel, the health status of the shrubs was monitored, which will ensure a longer period of amortization of the initial investment and the durability of the entire plantation.

MATERIALS AND METHODS

In order to obtain conclusive results within the framework of our own research, carried out in Cornatelu commune, in Dambovita County, we started from the pedo-climatic analysis of the land on which lavender was grown, to see if it lends itself to its requirements.

The location of the land is optimal, with a good exposure to the sun. The soil has a neutral pH, with values of 6.7-7.1. The clay content is average, of 20-23%, being able to characterize the upper soil profile as sandy-loamy. Also, benefiting from a slope of about 6%, the water that isn't absorbed by the soil drains on the profile, not ending up pooling on the surface, a beneficial aspect for the roots of the lavender plants, which prefer drought instead of excessive water.

During the research years (2017-2019), the climatic values of temperatures and those of precipitation were monitored with an automatic weather station, located directly in the research field, in order to highlight the importance of these parameters, which can also be included in the risk category for the lavender culture.

The lavender plantation where the research took place was established in the spring of 2013 – the planting took place in the first part of April. In order to adapt to the existing pedo-climatic conditions, seedlings from the *Lavandula angustifolia*species, the Bulgarian variety Sevtopolis, were chosen. The main characteristic of this variety is that a significant amount of essential oil can be extracted from the flowers, which is the second reason why it was chosen. The research started in 2017, that is, in the fourth year from the time of planting, when the culture was approaching full maturity, process that continued until 2019. On the land with a total area of 7,500 sqm, seedlings were planted at a distance of 1m between rows and 50 cm between plants, per row. In total, 15,000 seedlings were planted, their cost being of 12,450 lei, the equivalent of 2,800 euros, to which were added the costs of land preparation, raising the initial investment to 3,500 euros (15,500 lei).

Later, the total area was divided into three plots of equal size, respectively of 2,500 sqm, so that they could be managed differently, using three cultivation systems – classic (conventional), intensive and ecological. Depending on the system chosen, the farming technique was different, which means that the costs involved also varied widely.

To compare the yield results, in each large plot of 2,500 sqm, 6 plots of 10 sqm each were marked, finally monitoring a total of 18 plots x 10 sqm = 180 sqm. In order for the plots to be comparable, given the large distance between the rows, plots of 5 m x 2 m = 10 sqm were delimited, each including 20 plants.

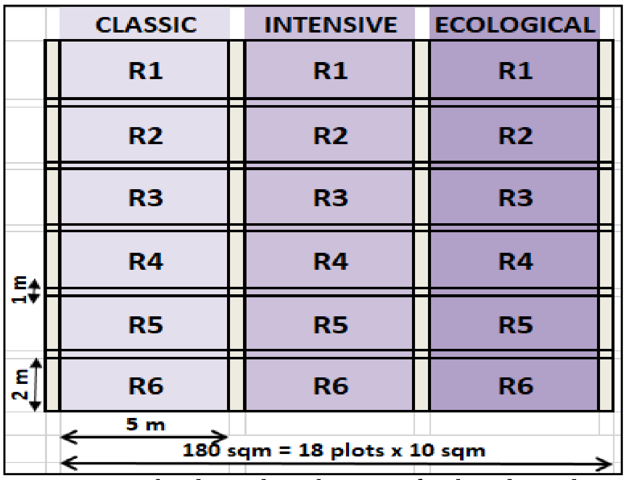

Fig. 1. Technological scheme of the lavender experimental field in Cornatelu, Dambovita County (2017-2019)
Source: Own experiment.

Based on the presented methodology, the technological scheme shown in Figure 1 was created and followed in the study.

In the vegetation, during the three years of research (2017-2019), the following plant parameters were monitored, through measurements made on a number of 10 plants from each plot, based on which the average was made:

-the number of flowers per plant;

-the length of the flower stems(cm);
-number of bunches/inflorescences;
-weight of flowers/plant.

Of the six plots assigned to each of the cropping systems, the yield from three of them was weighed immediately after harvesting and then after being dried, while that the yield from the other three plots was used to obtain the essential oil by cold pressing, to be able to compare the quality of the production.

Harvesting was done manually, as no other option was found for such surfaces. Moreover, one of the constraints of small holdings is precisely related to the manual labour involved in such a plantation, which is difficult to ensure, other by the family members.

Both the data obtained from the vegetation measurements and those obtained after the yield evaluation were combined in tables, so that later they can be processed statistically in Excel.

RESULTS AND DISCUSSIONS

Table 1 shows in details the values recorded for temperature and precipitation during the research period (2017-2019).

Table 1. Temperatures and precipitation recorded in Cornatelu (Dambovita County) during the research period, January 2017 – December 2019

Luna	Temperatures (°C, average)			Precipitations (mm/month)		
	2017	2018	2019	2017	2018	2019
January	-4.1	0.8	0.4	6	0	19
February	1.8	1.5	3.5	16	35	17
March	9.1	4.4	9.9	45	28	26
April	10.8	14.7	11.0	44	8	34
May	16.4	18.8	17.7	29	12	45
June	22.6	21.5	23.4	36	79	38
July	23.7	23.0	24.1	89	66	15
August	24.0	23.8	24.3	21	78	43
September	19.2	21.1	18.8	50	9	10
October	11.6	13.0	13.6	18	10	26
November	6.4	7.3	5.5	64	112	59
December	0.2	4.5	0.8	3	26	38
Mean/Total	11.8	12.9	12.8	421	463	370

Source: own data.

It can be seen that the average annual temperature fluctuates within 1°C, while the precipitation is average in value for Romania, being between 370 and 463 mm/year.

The temperatures didn't have a major influence on the lavender crop, being quite high even in the winter months, but within the limit of the multi-annual average for the southern part of Romania.

On the other hand, the rainfall, which is lower in value and well distributed throughout the year, supported the good development of the plants, which during the three analysed years reached full maturity.

In each of the years, the measurements were made differently (Photo 1), resulting in the comparative figures in Table 2.

Photo 1. The way lavender yield measurements were carried out, depending on the applied crop system (2017-2019, Cornatelu)
Source: Own results.

The values obtained as a result of the measurements were divided into three categories, depending on the agricultural technique applied, but also on the annual costs involved, as follows:

-the classic or conventional system – assumed a system of works as simplified as possible, possibly once at every 2-3 years, only one fertilization with nitrogen per year, depending on the needs, limited phytosanitary treatments;

-the intensive system – it was based on annual soil work, annual weeding, two fertilizations per year, to intensify the production of inflorescences, a treatment with systemic insect-fungicide, to protect the plants;

-the ecological system – as little work as possible, weed removal by manual weeding, fertilization only with manure and composts, natural control of diseases and pests, were appropriate.

Table 2. The parameters monitored for lavender in vegetation during the research in Cornatelu commune, Dambovita County (2017-2019)

Crt.	Crop system / Parameter	Classic/conventional			Intensive			Ecological		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
1.	**Number of flowers/plant**	540	567	665	549	530	639	512	544	663
2.	**Length of the flower stems (cm)**	25.8	25.9	26.4	25.7	26.0	26.3	25.6	26.2	26.0
3.	**Number of bunches/inflorescences**	4.7	5.5	6.8	4.6	5.3	6.1	5.0	5.3	6.5
4.	**Weightof flowers/plant (g)**	210	235	298	210	216	272	201	237	285

Source: own data.

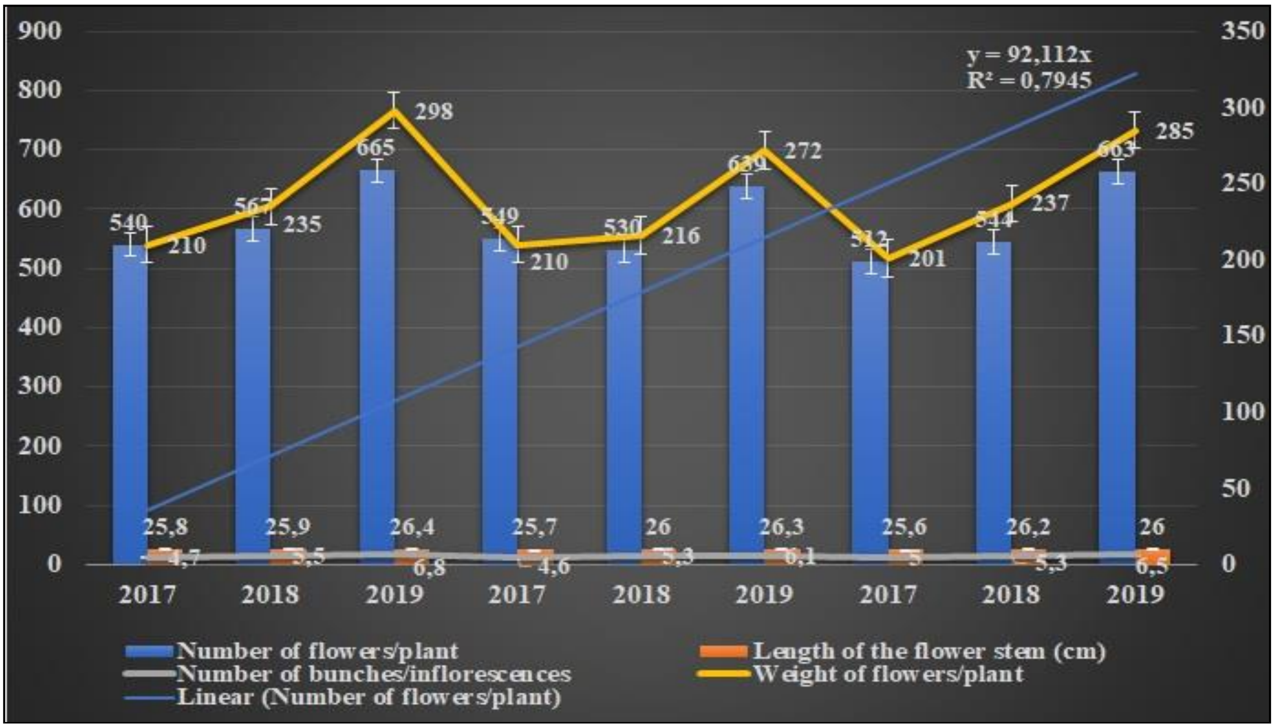

Fig. 2. Graphical representation of lavender production parameters, in the period 2017-2019, together with highlighting the linear growth of the number of flowers/plants, from 2017 to 2019
Source: Own results.

The comparisons were mainly made between the results of the same year, considering that in terms of years, the influence of climatic conditions intervened, but also that of the degree of development of the plants, which were in the aging process, to reach maturity.
A lot of discussions and observations can be made starting from each of the analysed parameters, but on average it can be stated that the hierarchy of lavender's productive elements places the classical system at the top of the ranking, followed by the ecological one, and then by the intensive one, which has higher values mainly reduced in 2019, after in 2017 and 2018 it remained close to the other tested systems. Considering these values, we can say that the culture system chosen is one of the risk factors of lavender production, especially since the additional expenses aren't covered by a higher yield. From managerial point of view, the classic system has the lowest risks and is recommended for a small lavender plantation, such as the one in which the tests took place.

After the time of harvesting, the total yield obtained in each of the plots was evaluated, before drying, in order to determine the yield per hectare. The annual costs involved in obtaining this production were also included in this analysis, in order to establish the level of profit for each of the options. In Table 3, all these calculations are briefly presented, their final purpose being to highlight the differences in terms of the profit brought by each of the tested culture systems. It should be noted that all calculations were made for an area of 1 ha, even if the physical exploitation was only 7,500 sqm.

Contrary to expectations, it is confirmed that the classic system brings the highest profit, one of the explanations being related to the sale price of the production, which wasn't different in the case of organic lavender.

Table 3. The economic situation of the lavender crop from Cornatelu (Dambovita County) during the research period, January 2017 – December 2019

Crt.	Crop system / Economic index	Classic/ conventional			Intensive			Ecological		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
1.	Average yield (kg/ha)	4,200	4,700	5,960	4,200	4,320	5,440	4,020	4,740	5,700
2.	Total expenses (thousandlei/ha)	18.3	24.9	29.3	22.5	29.6	35.0	21.1	26.5	28.4
3.	Selling price (lei/kg)	9	10.8	13	9	10.8	13	9	10.8	13
4.	Income (thousand lei/ha)	37.8	50.8	77.5	37.8	46.7	70.7	36.2	51.2	74.1
	Profit (thousand lei/ha)	19.5	25.9	48.2	15.3	17.1	35.7	15.1	24.7	45.7

Source: own data.

In second place is the ecological system, which in the long term can also bring benefits related to sustainability and environmental protection, as well as better exploitation of production, depending on existing customers. In last place, with expenses unjustified by the level of productions obtained, is the intensive system, which only in the first year (2017) generates a profit similar to that of the ecological variant, so that from 2018 it has significant differences compared to the other two.

CONCLUSIONS

A first conclusion would be that the lavender plantation is a productive and profitable one, even in the case of small areas.

The main risks faced by farmers, especially in the case of the lack of mechanization, are represented by the lack of labour, most of the expenses being those of day labourers hired for various maintenance works, but especially for harvesting.

Another risk factor is the fact that the resulting yield is sold almost entirely immediately after harvesting, since the drying process is laborious and the extraction of the essential oil involves additional costs, quality documents and finding a market. At the same time, as a family business, the annual profit generated by such a plantation cannot ensure full living, and can be considered as an additional activity.

Considering all the presented results, for the average of the testing period (2017-2019) the classic system brought yield increases of 5-9%, which let to a even higher increase in profit, related to the lower costs.

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INFLUENCE OF FORMAL AND NON-FORMAL EDUCATIONAL ACTIVITIES ON THE ACADEMIC INTEGRATION OF FIRST-YEAR STUDENTS OF "ION IONESCU DE LA BRAD" UNIVERSITY OF LIFE SCIENCES (IULS) IAȘI, ROMANIA, FOR REDUCING EARLY DROPOUT

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Abstract

University dropout has become a worrying reality for the education system in general, but also for Romania in particular, which ranks first in Europe. Thus, the worrying phenomenon of early university leaving is a phenomenon that has complex causes and therefore requires a variety of ways to combat it. These include the development of a supportive extra-curricular environment and individualized teaching practices focused on student-centered learning to support their potential. The aim of the research undertaken in this paper is to demonstrate the contribution of learning support activities in a formal and non-formal environment to the progress of first year of "Iasi University of Life Sciences" (IULS) students in the Faculties of Agriculture and Horticulture in reducing dropout. The qualitative research methodology was carried out through a review of the literature on university dropout, predominantly early. The case study, as a quantitative research method, is composed of a questionnaire containing 13 questions applied to first year students at IULS Iasi. The resulting data were processed and analyzed by statistical methods, and after interpreting the results we formed an overview of the problem of the causes of early university dropout of first year students and thus could apply personalized support measures. As a result of the steps taken in this respect, adaptability to the university environment increased and early university leaving was reduced, which provided us with a working model. This work has an innovative character in terms of the educational support measures provided to first year students at IULS Iasi, which constitute a model of good practice for increasing the adaptability of first year students to the university environment and for reducing early dropout. These extracurricular activities, carried out in a formal and especially non-formal friendly environment in a modern way, must be continued and adapted to the students' needs, but taking into account the skills they need to acquire in order to finally integrate into the changing labour market.

Key words**:** *students, remedial activities, dropout, university integration, IULS Iasi, Romania*

INTRODUCTION

According to the European Commission on University Education, it has an important role to play in contributing to sustainable and resilient economies. It is also recognised that higher education occupies a borderline position at the confluence of education, research and innovation and that it must serve society and the economy. Thus, because Europe needs to increase the number of highly skilled citizens, EU Member States have set an important target that by 2030 at least 45% of 25-34 year olds should have a higher education degree. The aim is for university graduates to be highly qualified, so that they have excellent employment prospects on graduation (80% of recent tertiary graduates in the EU obtain a job within 3 months of graduation), but also to be well engaged in democracy [14].

Reviewing the literature, it was found that the problem of school/university dropout is broad and covers a variety of approaches from different research areas. [1, 21]. Thus, Diego Opazo et.al., (2021) [20], in his study, states that education and implicitly also university education is an important factor in the development of a society, a quality but extensive education can lead to increased social welfare and economic growth, because it contributes to the progress of science, innovation in technology, but with all these benefits, not all students enrolled in a university study program finish their studies, leaving university without obtaining a degree.

Therefore, it becomes important for universities to establish their own mechanisms to prevent, or at least reduce, dropout, starting from the knowledge of the determinant causes [2, 4, 20, 24].

The research made by Diaz, P., et al., (2016) also attracts the fact that, unfortunately, dropout has become a phenomenon that had to be taken into study, due to the fact that it is already an important problem for university education, with a negative impact on society. Thus, it is recommended that measuring and studying dropout should become a continuous measurement tool in the process of evaluating the effectiveness of the university education system. In this way, academic mechanisms can be implemented to control the phenomenon in order to measure the quality of study programs, but also the quality of the educational process offered [6, 10, 11, 13].

Researchers Aldowah, H., et. al., (2020), established that for the most part, dropout may be caused by factors that cannot be controlled by the university institution and that the "causal relationships between key factors" need to be well understood in order to have a clear and accurate picture of the dropout rate, which unfortunately, is increasing at universities in various corners of the world, which they analyzed/studied [18]. They have shown that for students to be motivated to complete their university studies, they must be offered academic activities relevant to their field of study, so that they bring them the desired benefits [3, 5, 8, 12, 16].

Researchers Lorenzo-Quiles et. al., (2023) [19] and Segura, M., et al., (2022) [25] also present the phenomenon of university drop-out from the perspective of the Organisation for Economic Co-operation and Development (OECD), which in 2019 made public that 20% of students who start tertiary education fail to complete it. They also pointed out that Eurostat in 2020 made public the fact that, at European level, Malta ranked first in terms of university dropouts with 18.4%, second: Spain with 18.3% and, Romania with 18.1%, in third place and that the percentage of students giving up a bachelor's degree is increasing significantly, which is already a problem, at a time when European educational institutions had set out to reduce university dropouts to 10% by 2020, due to the negative socio-economic effects observed both at university level and implicitly at the level of society as a whole. Thus, when a student drops out of a university programme, it is a failure that entails psychological damage, suffering that then extends to the family from which they come [15, 17, 25].

A study of the literature shows that dropping out of university has become a major challenge for the entire academic community, especially since at European level it has become an important objective of university education to improve the specialist knowledge and practical skills in the field of undergraduate studies, so that students can integrate quickly and properly into the labour market. Also from a careful study of the literature on the causes of dropout, it can be seen that they are divided into: personal, academic and social. Thus, personal factors can be explained as being determined by the individual characteristics of the students, i.e. they refer to their motivation, aspirations, health and financial situation. Among the academic factors we can list the study conditions, namely: the quality of the study programmes, the teaching-learning-assessment methods, the teaching support provided by the teaching staff, etc. Last but not least, an important role is played by social factors, which refer to the influence of the professional level of the family and even the community environment, which may influence the students' decision to continue or not to continue their university studies [9, 19, 23].

Unfortunately, the dropout rate in higher education in Romania in the academic year

2021-2022 was 19.3%, thus increasing compared to the academic year 2020-2021, according to data published by the Ministry of Education and Research, and this level is well above the European average, which was 10.6% in 2020. Thus dropout is a serious problem that affects the quality and efficiency of the higher education system in Romania [22].

In this paper we have made an extensive study at the "Ion Ionescu De la Brad" University of Life Sciences (IULS) Iasi, Romania, where we have addressed the problem of early dropout detection in first year students, the negative impact being the greatest due to them if we think about the deficit on funding that is lost for the next 3 years. First, this phenomenon was analyzed based on the data collected from the faculty secretariat. The main problems that determine the low performance of first year undergraduate students at IULS Iasi, coming from the Faculties of Agriculture and Horticulture, are: the high number of absences in some fundamental subjects, on which the basis was laid in high school education and then at university level more advanced notions are deepened (mathematics, chemistry-biochemistry, biophysics, economics, biology, physiology, etc.). From the analysis carried out over the years, the following causes have emerged: institutional due to the school and university environment: causes linked to the student's personality and health; causes linked to socio-economic and family conditions. Absenteeism leads to dropout, a low participation rate in first semester exams and induces a low promotion rate at the end of the first year.

The aim of the paper is to demonstrate the contribution of learning support activities in a non-formal environment to the progress of first year IULS students in reducing dropout.

In this context, although at university level there is an ongoing concern about linking curricula and their contents to the real needs of students to develop skills required by the labour market and to the level of preparation of graduates, about the appropriation by teaching staff of modern, student-centred teaching-learning-assessment methods and techniques but also with overall or faculty and programme level efforts, to reduce dropout, we considered it appropriate and necessary to investigate in detail within IULS Iasi the concrete causes of dropout of first-year students, but also the intervention measures to reduce this phenomenon by creating a different institutional learning structure from the structures that provide a conventional-formal learning and training environment.

MATERIALS AND METHODS

Research methods used in this study: from a qualitative point of view, a literature review was carried out on the rate and causes of dropout in the first year of study, because the benefits of higher education for young people, giving them greater opportunities for labour market integration in the field of undergraduate studies after graduation. From the quantitative point of view, document analysis and investigation with the help of the questionnaire, a specially developed document, was used to get answers directly from students on the causes that may lead to university dropout in the first year of study, in order to create intervention measures to counteract the phenomenon. Thus, in this paper, for the general objectives established: O1- Investigation of IULS students in the first year regarding their expectations to form the necessary skills and knowledge to be able to easily integrate into student life and O2- Identification and implementation of good practices of extracurricular support of students to reduce early university dropout, the most appropriate research methodology was chosen so that in the end we have concrete answers and practical solutions in line with the theme taken in the study.

The initial target group was represented by students of the first year of "Ion Ionescu de la Brad" University of Life Sciences (IULS) Iasi, Romania, the questionnaire we developed was administered to them at the end of the classes, in 2019, and the intervention measures were applied during 2019-2021. The questionnaire was designed as a self-reporting tool containing 13 items allowing simple and concrete answers. They were suggested to answer the questions honestly, all answers were anonymous and it was made clear that there were no right or wrong answers. They were asked to fill in the following starting items: gender: female/male, age, specialisation.

The questionnaire was structured as follows: I would like to finish this university on time; I would like to work in the field of my specialization as soon as I finish university; In general, I feel motivated by my teachers; The courses of my specialization meet my expectations; I am satisfied with the choice I made; I actively participate in lectures and laboratories to have a higher learning output; I think I learn useful things in the future; In general, I structure the material I have to learn; I feel that extra hours would be needed to understand the courses; I have easily built relationships with other colleagues; When I have had difficulties understanding the course or the practical work, I have asked for help; Often, I feel that extra support for students would be needed through; If I would have to drop out, it would be for the following reasons.

The limits of the investigation can be considered as follows: The completion of the questionnaires took place at the end of the classes, which may generate superficiality of the answers due to the students' fatigue to focus on the questions, the respondents' quickness to leave the classroom; the facade bias - the respondents tend to understand what the researcher wants to know and try to formulate "correct answers"; the male/female ratio - the faculty having a certain specificity, generated a gender imbalance in the research, the group of respondents was 100 first year students of which: 62 male and 38 female. The resulting responses were statistically processed, interpreted and presented in the form of tables and graphs.

RESULTS AND DISCUSSIONS

In the first stage, there were investigated **the causes of early dropout** at "Ion Ionescu de la Brad" University of Life Sciences (IULS) Iasi, Romania, and in the second part to identify and provide extracurricular support measures to first year students in formal and especially non-formal environment, in order to help them to integrate into student life and to acquire academic learning skills, so that they can successfully pass the exams and acquire the skills needed on the labour market in the graduated field.

The approach of the objectives proposed in this paper is presented below.

Objective 1: Investigating IULS first year students' **expectations in order to form the skills and knowledge** necessary to integrate easily into student life. After investigating the documents in the secretariats of the two faculties: of Agriculture and Horticulture, it was found that the initial statistical aspects (risk factors for dropout) at IULS Iasi are the following: a high percentage of students, come from families with modest income, single parents or with parents who have left to work abroad (22.1%), many students come from rural areas (46.1%), the level of education of students admitted to the Bachelor's degree in the first year is average, and their interest in studying and learning is low. First year undergraduate students at IULS Iasi have low learning skills because a significant percentage (26.24%) have averages lower than 7 in the baccalaureate exam, and a significant percentage of first year undergraduate students come from disadvantaged social backgrounds or are at risk of dropping out (57.47%).

Next, **the quantitative method of investigation was based on** a questionnaire, to which the first year students from the faculties of Agriculture and Horticulture had to answer, in order to reflect which are their expectations and needs when entering the university environment, so that they can integrate into student life, so that they can achieve good results and not be tempted to abandon university courses.

Students were asked to answer the 13 items honestly, as all answers were anonymous and there were no right or wrong answers. They were also informed that the requested information is useful for teachers to take support measures within the project "ROSE/103/SGU/CI/II, "USV IAȘI LEARNING CENTER: LEARNING FOR

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LIFE".

The interpretation of the questionnaire answers from the 100 first year students (42 male + 36 female) is as follows: the evaluation, both of the level of satisfaction and of the importance given, was carried out on a Lickert scale in 5 steps (1 - very dissatisfied; 5 - very satisfied), being aimed at the academic activities carried out on site and online. After applying the questionnaire to a sample of 100 students, we aimed to investigate the satisfaction of the students of the Faculties of Agriculture and Horticulture towards education, their training needs, their information needs, their expectations from USV Iasi, in order to gather a wide range of students' expectations regarding the fields of agri-food activities in their areas of interest.

Qualitative interpretation of the questionnaire

The questionnaire applied to the students of the Faculty of Agriculture is composed of 13 items distributed in such a way as to provide information both on their opinions and on their concrete actions on the proposed topic.

In this regard, 13 closed questions were formulated, with pre-defined answer options, giving respondents the opportunity to freely express their opinion or to present their knowledge, especially in relation to the professional development conditions provided by the University of Life Sciences of Iasi.

Concerning Item 1: ***I want to finish this faculty on time***, 78% of the students said that they very much want to finish the faculty and 22% of the students said that they very much want to finish the faculty, some of them having to work during the faculty in order to obtain additional income (Fig. 1.).

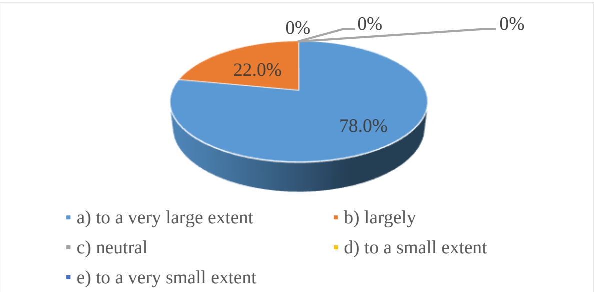

Fig. 1. Answers to Item 1 of the questionnaire: I want to finish this college on time
Source: Students' answers.

Concerning Item 2. ***I would like to work in my field of specialisation*** as soon as I finish university, rated from very highly to very low, brings to the respondents' attention issues related to how the study programme is adapted to the needs of employers, the theoretical or practical skills required, or the flexibility of jobs. Respondents rated aspects of the study programme offered positively to a very large extent with 86.0% saying that it will give them the possibility of employment in agricultural companies or horticultural farms and some answers were less satisfactory, i.e. some students say they very much want to work in the field of the study programme with 14.0% (Fig. 2).

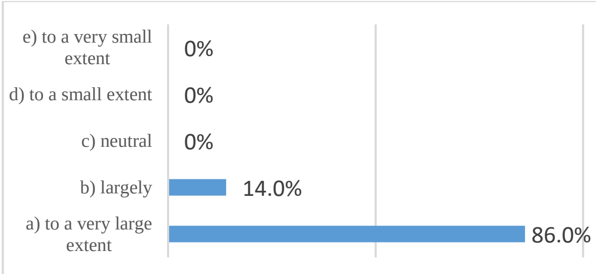

Fig. 2. Answers to Item 2 of the questionnaire: I would like to work in my field of specialization as soon as I finish college
Source: Students' answers.

Item 3: In general, ***I feel motivated by my teachers,*** wanted to get ratings on the following aspects: clear and appropriate communication of the concepts, topicality and usefulness of the concepts taught, practicality of the concepts taught, interactive teaching methods, adaptation of the teacher's teaching style to one's own learning needs and possibilities, effective use of new technologies (e-mail, electronic course support, etc.). Respondents highly appreciated aspects related to the topicality and usefulness of the notions taught with 77.0% and some activities were highly appreciated, i.e. the practicality of the notions taught in some fundamental subjects with 19.0%, a number of 3 students gave a neutral answer, i.e. 3%, and only one student was motivated to a small extent by the teachers not to abandon the courses (Fig. 3).

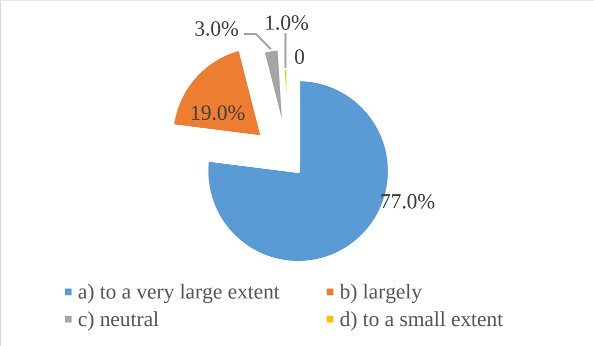

Fig. 3. Answers to Item 3: I generally feel motivated by my teachers
Source: Students' answers.

Item 4: ***The courses of my specialization meet my expectations***, aimed at the appreciation of students through the feedback provided by the teacher for training purposes, the possibility of obtaining information and practical skills that will give them greater chances of employment, procedures for implementing the latest developments in the field through ICT. The students of the Faculties of Agriculture and Horticulture appreciated positively to a great extent, 45% of the answers were related to the balance between their expectations and the information provided and some activities were highly appreciated with 34% of the answers. There were also 12 neutral responses, 5 students who appreciated this aspect to a small extent and 4 responses were not very satisfied, i.e. 4% (Fig. 4).

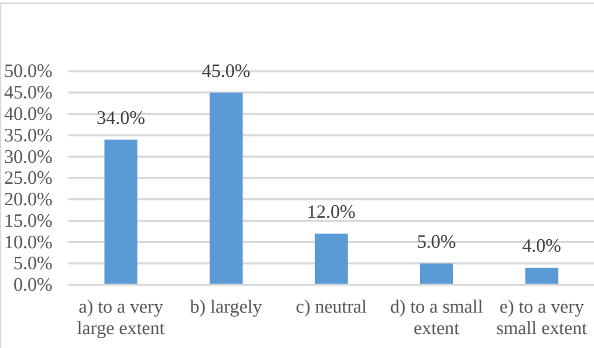

Fig. 4. Answers to Item 4: The courses of my specialization meet my expectations
Source: Students' answers.

Item 5: ***I am satisfied with the choice made***, which largely makes appreciation to the involvement of teachers in theoretical professional development as well as professional perspectives on labour market insertion. To these are added the existence of a programme of consultation of the teaching staff, liaison with the tutor and the year tutor, academic counselling (choice of courses, organisation of the study programme, effective learning), advice on involvement in extracurricular activities within the university. The students of the faculties of Agriculture and Horticulture highly appreciated the aspects related to the link with the tutor and the year tutor and students, in 35.0% and some activities were less satisfactory, i.e. advice on involvement in extracurricular activities within the university with 30.0%. (Fig. 5).

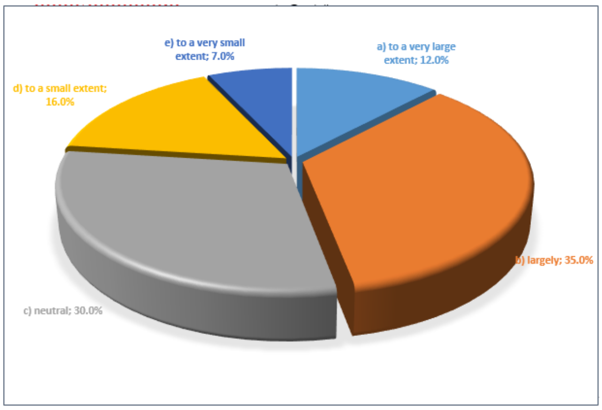

Fig. 5. Answers to Item 5: I am satisfied with the choice made
Source: Students' answers.

Item 6: ***I actively participate in lectures and labs*** to increase my learning performance. Active participation in classes is a crucial component of academic success in the first year of college. Nearly 42.0% of students gave a neutral response and 21.0% of the sample chose to answer that they actively participate in classes and labs to a small extent, which shows their low engagement in the learning process. The fact that only 10-11% of the surveyed students answered that they participate actively to a very great or great extent in the courses implies that communication and relationship between teacher and student must be improved, the student must assume the role of active co-participant in the course, seminar or laboratory in order to clarify confusions, difficulties encountered in individual study (Fig 6).

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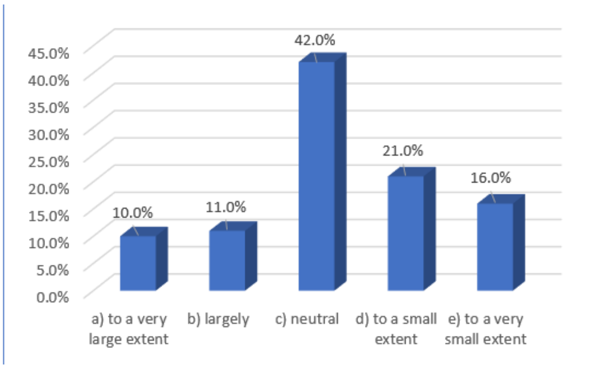

Fig. 6. Answers to Item 6: I actively participate in classes and labs to have a higher yield in learning
Source: Students' answers.

Item 7: In order to get a more accurate picture of the information already held by students and therefore their interest in their professional development, they were asked to indicate whether they consider that ***learning is useful in the future or can benefit their work***. Students responded as follows: very much 20.0%, to a great extent 28.0%, neutral 21.0%, and 31.0% to a small extent. The very high proportion of responses to the area of low importance can be explained by the fact that fundamental subjects (mathematics, physics, chemistry, etc.) are usually taught in the first years, which are more difficult for students from vocational or humanities backgrounds to understand (Fig. 7).

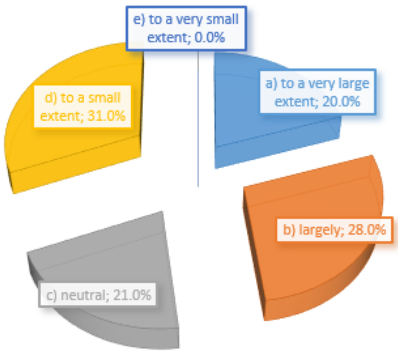

Fig. 7. Answers to Item 7: I believe that I am learning useful things in the future
Source: Students' answers.

Item 8: In general, ***I structure my learning material resulted*** in the following opinions: very much 14.0%, to a great extent 17.0%, neutral 19.0%, 22.0% to a small extent and 28.0% to a very small extent. With a very high percentage of responses (28%) from students who very little structured their course material, one can identify the correlation between the effort they put in and the learning outcomes that ultimately lead to high drop-out rates (Fig. 8).

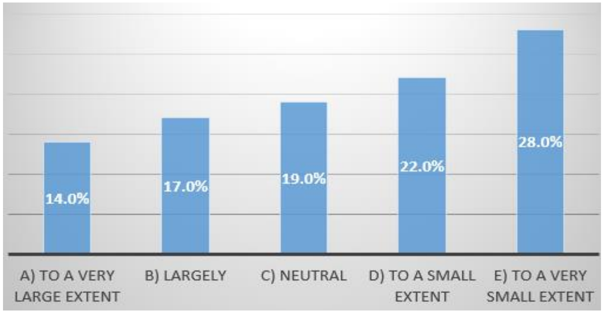

Fig. 8. Answers to Item 8: I generally structure the materials I have to learn
Source: Students' answers.

Under Item 9: ***I think additional hours would be needed to understand the courses*** This component includes techniques to train independent study skills, personal study skills, training in how to learn and how to investigate problems, and students responded as follows: very much 87.0% and to a great extent 13.0% (Fig. 9).

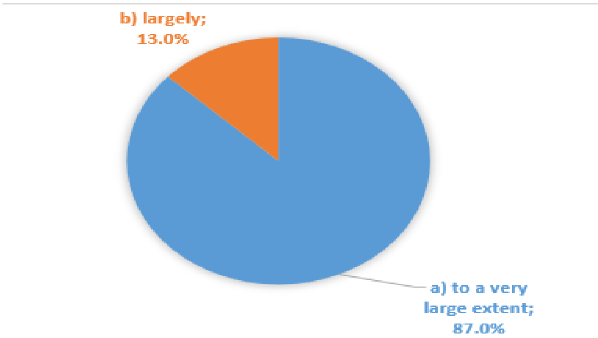

Fig. 9. Answers to Item 9: I feel that additional hours would be needed to understand the courses
Source: Students' answers.

Item 10: ***I easily bonded with other colleagues.*** Social relationships are particularly necessary in the student's learning and training activity because they enhance success in this and other activities, they give the student the opportunity to showcase their personal qualities. The range of these relationships is varied and diversified, each of them having a certain significance, a social value, and the responses to this item were: 12% of the students had a positive answer, i.e. to a very great extent, 8.0% to a great extent, 32.0% had a neutral answer, 28.0% to a little extent and 20.0% to a very little extent (Fig. 10).

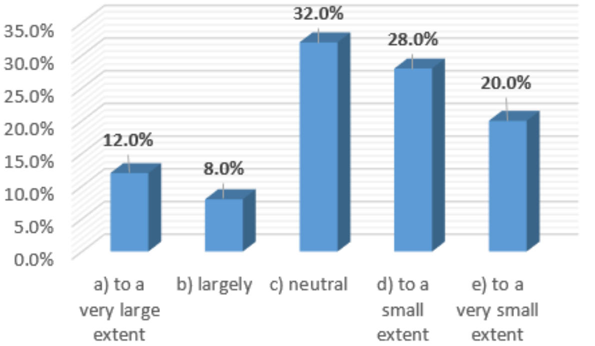

Fig. 10. Answers to Item 10: I easily built relationships with other colleagues
Source: Students' answers.

Item 11: In the item ***When I had difficulties*** in understanding the course or practical work, ***did I ask for help*?** 26.0% of the respondents said they would ask the professor for help, 11% of the students would ask the psychologist advisor, 54% of them would ask other colleagues for help, and 9.0% of the students in the Faculty of Agriculture and Horticulture would ask someone else for help (Fig. 11).

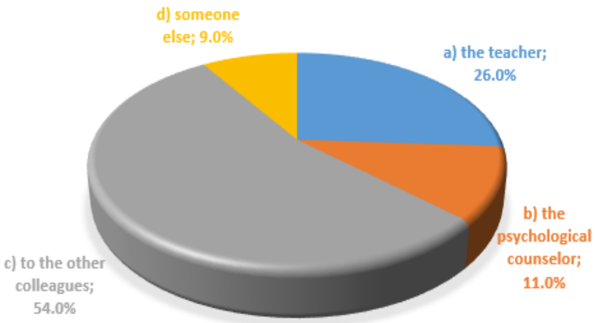

Fig. 11. Answers to Item 11: When I encountered difficulties regarding the understanding of the course or the practical work, I asked for help?
Source: Students' answers.

Item 12: Many times, I feel ***that extra support for students would be needed*** through: referred to effective course deepening activities, counselling activities: (self-awareness, time organization, learning techniques), mentoring activities - involvement of a mentor. To this question, 48.0% of the students stated that counselling activities: (self-awareness, time organisation, learning techniques) is a priority activity, while 30.0% of them consider that effective course deepening activities is important. 22% of those surveyed said that mentoring activities, i.e. involving a mentor, to stimulate personal and professional growth, development of skills, knowledge and understanding of a particular field (Fig. 12).

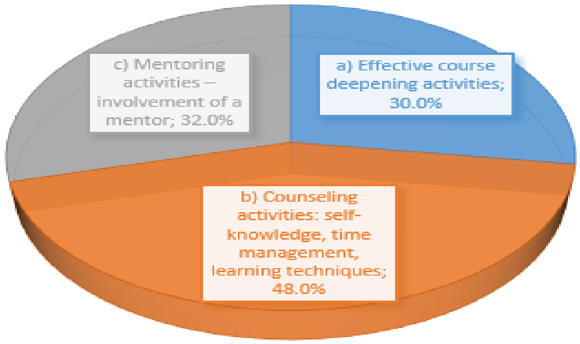

Fig. 12. Answers to Item 12: Many times, I feel that extra support would be needed for students through
Source: Students' answers.

Item 13: If I had to ***drop out of college, it would be for the following reasons***: This is the one who tried to identify the main reasons for dropping out of school such as: financial reasons, social pressure (bullying), failing exams, health problems, attending another college. According to the students, the main reasons were financial reasons (63.0%), exam failure (20.0%), attending another university (8.0%), social pressure (bullying) (7.0%) and health problems (2.0%) (Fig. 13).

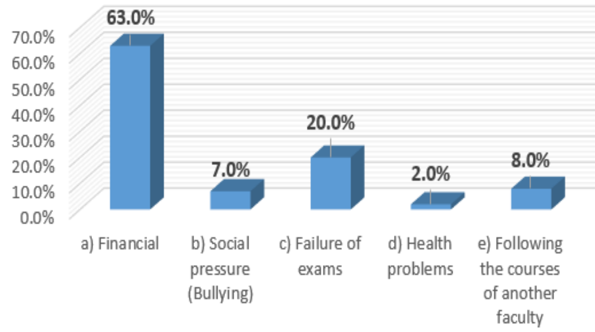

Fig. 13. Answers to Item 13: If I had to drop out of college, it would be for the following reasons
Source: Students' answers.

Social causes are the most numerous at the faculties analysed, as their students come predominantly from rural areas and are related to the socio-economic conditions of the family (poverty, indifferent, neglectful parenting style, families disharmonious families, very busy parents or parents living abroad). The second main reason is due to unsatisfactory exam results (Fig. 13).

Following the interpretation of the answers received from the students surveyed, it can be stated that the above results show that the students of the faculties of Agriculture and Horticulture, come with a request for a self-assessment of the need for guidance in order to acquire relevant knowledge on the topic. Most students who leave the university do so in their first year and are those who enroll in engineering faculties at IULS Iasi.

The fact that only 10-11% of the surveyed students answered that they actively participate to a great or great extent in the courses implies that the communication and relationship between the teacher and the student must be improved, the student must assume the role of active co-participant in the course, seminar or laboratory in order to clarify the confusions and difficulties encountered in individual study.

More than half of the respondents felt that they only needed support to a certain extent and only 26% were aware that without competent support from the teacher they did not know how to proceed in this area. A small percentage, approx. 13%, stated that they do not need additional lessons and information and that they know how to get the data they are interested in, although here we met both people who said they were well informed and students who admitted to being less informed. However, 87% of the students surveyed felt that they needed consultation and remedial classes in some subjects, especially fundamentals. A possible explanation is that students do not assess their need for information in relation to the knowledge they already have but to the usefulness it could have in their work, and this is not well understood.

The effects of dropping out show that this type of behaviour is considered particularly serious. First of all, those who drop out of university have neither the professional qualifications needed for socio-economic integration nor the moral and civic training necessary to play the role of a community citizen. Secondly, as they have no qualifications, university drop-outs are the future unemployed and represent, in the medium and long term, a source of social hardship and loss which outweighs the investment required for initial training.

Thus, for **Objective O2: Identify and implement good practices of extra-curricular student support to reduce early dropout,** we found from the interpretation of the responses to the administered questionnaire that first year students are in great need of additional support measures from the university to be able to integrate into student life and to be able to pass exams so that they are not tempted to drop out early.

As a result, we started to implement student support measures: at the beginning of each academic year in 2019, 2020 and 2021, we proceeded to identify students from IULS Iasi (Faculties of Agriculture, Horticulture) in the first year of studies, undergraduate cycle, who are at risk of dropping out of university studies, with low learning skills and belonging mainly to disadvantaged groups, with the aim of increasing the promotion rate and improving academic performance.

Based on this dimensioning, four fully equipped spaces (about 170 sq.m.) for individual and team study, in a supported environment, have been provided for students with limited access to new content in the undergraduate field of study and at high risk of dropping out, within the *Learning Centre of IULS Iași-Learning for Life*. The aim was to create an alternative, non-formal, modern space for learning, as well as for the acquisition of behaviours, habits and attitudes specific to a young intellectual, in a more open, interactive and friendly environment than the other formal learning environments used by them in the university. *The Learning Centre of IULS Iasi - Learning for Life* was conceived as a space for those who need professional, spiritual and human support, a warm space that allows the integration of high school graduates into the university environment. The adaptability and integration into the university and professional environment of students with reduced learning skills, belonging to the target group, was improved through remedial activities, coaching and personal development, professional counselling, workshops and career guidance. This space is designed to carry out learning activities in a non-conformist, postmodern context, which allows students to develop affective feelings towards the university, the teachers and the subjects studied.

To achieve the objectives, the following staff members from IULS Iasi, student volunteers from the Department for the Preparation of Teaching Staff and from the Students' League belonging to the faculties of Agriculture and Horticulture, as well as qualified staff from the IULS Iasi Centre for Career Counselling and Guidance (CCOC) worked together.

The activities of the Learning Centre of IULS Iași-Learning for life, were :

Professional counselling and career guidance activities namely: Self-knowledge and career guidance workshop "Know yourself. Me and my strengths" with the following thematic content: my skills; my interests; my personality; how I present myself. *Training and development workshops of learning techniques/skills characteristic of university study were organised with the following theme*: Training workshop *"Learning to learn with love at IULS Iasi*" which aimed and achieved the creation of the premises for effective learning, by introducing students to the specifics of studying at university level, learning in general and independent documentation in particular*; Training workshop "Learning to learn with love at IULS Iasi*, with the *theme "Learning techniques characteristic of university study"; Workshop on Documentation Technique with the theme: "Documentation methods"*, namely active listening to lectures, fast reading and efficient reading, memorization techniques and elaboration of course and bibliographical notes; *Workshop on elaboration and support of papers in specialized subjects* with the theme: " *What should a report, a review contain ?".* These activities were attended by first-year students, who, on the recommendation of the teaching staff, or on their own initiative of their choice, participated in one or more thematic modules, depending on their individual needs. By participating in these activities, students were empowered with effective learning techniques and initiated with documentation techniques, which would ensure their successful integration into the university environment and thus lead to a decrease in academic abandon and an improvement in the quality of their own academic results.

Also, activities were organized and carried out in the form of remedial courses - " *IULS Iasi supports me*" with the aim of increasing the promotion rate of first year students by supplementing their incomplete preparation during high school and difficulties in understanding the subjects related to the first academic year, by conducting remedial courses on specific areas of *IULS* Iasi. The remedial activities also aimed to increase the number of *IULS* Iasi students who complete their first year courses. The organization of a remedial program has had a significant impact in the life of the university, aiming to change the attitude of each student who may have learning difficulties at some point. In these classes, students were supported in remedial activities and improvement of learning difficulties by experienced teachers. The activities were supported and guided by a remedial coordinator. He provided the material basis for the activities by equipping the *Learning for Life Learning Centre of IULS Iasi.* Department for the Preparation of Teaching Staff teachers and volunteers involved in the remedial activities conducted the initial testing of students, compiled supporting materials based on the results of the initial testing, assessed student progress. Students participated in the activities, meeting the requirements of the tutors/experts, collaborating with them, providing the necessary feedback for adapting the learning requirements and making progress. Remedial activities were organised in subjects where first session promotion rates are generally low. Thus, in mathematics and computer science, the notions taught in high school were resumed and consolidated, in order to facilitate access to the contents of the specific subjects foreseen for year 1 in the curricula of the faculties with an agronomic profile with

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the aim of bringing students with deficiencies in mathematics and computer science training to a level that allowed the development of specific skills with applicability in the fields of IULS Iasi; in physics and chemistry, workshops were carried out with the theme : "Basic elements in physics and chemistry". The physics/chemistry notions taught in high school have been taken up again, to facilitate access to the content of the subjects foreseen for year 1; in botany and economics workshops have been carried out on the theme "Basic elements in botany/economics", which have been used to rework the botany/economics notions taught in high school. The activities were designed in an interactive manner, focusing on students and their individual learning needs and on remedying their poor preparation in high school, given that some students entered university with averages less than or equal to 7 on the baccalaureate exam. The results have been: the recovery of gaps in prior knowledge in core subjects through the provision of fundamental knowledge support to ensure the development of subject-specific and cross-curricular skills, increased self-esteem and the development of a positive attitude towards the learning effort specific to the university environment.

Workshops were organized in specific areas: entrepreneurship in agronomy and entrepreneurship in horticulture where participants learned to develop entrepreneurial skills necessary and useful in life as a student of IULS Iasi and later as a graduate; they acquired basic notions on entrepreneurship: basic components and main aspects of a Business Plan. They were informed what are the main sources of funding for small businesses; they were presented with concrete case studies (successes/failures) thus learning how a start-up can be initiated by a student. The aim of these extracurricular activities carried out with first year students was: to learn the concept of "entrepreneurship" and to identify and evaluate their own skills in this field; to attract and motivate young students to build a career as an engineer, aiming at: enriching their knowledge, opening their perspectives and shaping a clear and concrete vision of what it means to be an engineer.

Successful coaching and personal development activities were also organised with the aim of increasing the adaptability and integration into the university and professional environment of first-year students with low learning skills. Thus, through coaching and personal development activities and workshops in specific areas to help develop students' ability to adapt to the demands of university life and increase their self-esteem, confidence in their own strengths, develop a positive attitude towards the university, with the aim of raising awareness of the importance of attending classes and labs/seminars, learning and improving attendance and learning outcomes. Specifically, the name of the activity carried out was:" We train for a good integration in the academic environment and the development of self-esteem". Sessions were also organized to present volunteering opportunities at USV Iasi in order to inform first year students how they can get involved in volunteering and personal development activities within IULS Iasi organizations, raising students' awareness of the benefits and advantages of getting involved in extracurricular activities through the lens of personal development. The organized events are also posted on the web site and Facebook of "Asociația Calea Vieții Tineri pentru bătrâni-bătrâni pentru tineri Iași", an association coordinated by the IULS' teaching staff [7].

These approaches have come to complement the diversity policy in the IULS Iasi space, through an appropriate support mechanism, addressed to young people, some coming from disadvantaged backgrounds, with the aim of recovering the differences in the level of knowledge from pre-university education, adapting the educational act to the specific needs and thus achieving the goal of centering the educational act on the student.

An attempt was made to counteract the main risk factors identified as the basis for the intention to drop out of studies, in order to decrease the dropout rate, but also to increase the academic performance of the students in the target group.

Therefore, all these support activities carried out for first year students contributed to the improvement of the educational climate, the promotion rate after the first year was improved compared to the baseline (79.67% - university average), through the implementation of the activities increased by about 4 percentage points to 81.7%, and the dropout rate was reduced from 16.45% to 15.5% at the end of the 3 years.

CONCLUSIONS

A comparative review of the literature, to which we add this study, concluded that there are five major components behind dropout: student adjustment, personality, socio-economic level, teacher-student relationship, and the poor knowledge that some students have when they leave high school. Of course, dropping out most certainly occurs when the student does not have the financial support to continue their studies in their first year. Another very real cause is failing to accumulate the credits to move on to the second year, a minimum of 30 credits. There are various reasons why the student fails to collect them. One of them is that the student is not coping with university life in the sense that there is a very big gap between what is done at high school and what is done at university. In this case, certain remedial and support programs done extracurricularly at university can make a difference. If the university has programs to help the student acquire skills in time management, stress management, note taking, appropriate learning strategies, then these can help the student overcome this problem.

The support activities carried out in formal and especially non-formal environment organized in the Learning Center of IULS Iasi-Learning for life, to increase the adaptability of first year students to the university environment, were organized to help students, being designed in an interactive manner, focused on students and their individual learning needs and to remedy the poor preparation in high school, given that they come from high schools on theoretical, vocational and technical non-agricultural tracks.

The results obtained are rewarding: improvement of self-esteem, discovery/improvement of learning style, personalised learning, development of active learning strategies. The remedial activities carried out, in addition to increasing the promotion rate and reducing dropout among first year students, have led to the formation of a learning community, to the improvement of the educational climate.

We can state that at IULS Iasi, the support measures for students aimed to increase access and equity in higher education, by improving the quality and relevance of study programs, to increase adaptability to the needs of the labor market; diversifying the academic offer, introducing cross-curricular modules; sustaining the development of the system of counseling and professional and personal guidance for students, encouraging student participation and involvement in academic and social life, by promoting student democracy, volunteering.

We can agree that in order to reduce early school leaving, an integrated and multidimensional approach to this phenomenon is needed, involving all relevant actors: students, teachers, higher education institutions, but also public authorities, employers, non-governmental organisations, because the problem is complex.

We believe that this study, through the support measures provided to first year students at IULS Iasi, is a model of good practice for increasing the adaptability of first year students to the university environment and for reducing early dropout.

ACKNOWLEDGEMENTS

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FROM FIELD TO CONSUMER: A COMPREHENSIVE ANALYSIS OF MEDICINAL AND AROMATIC PLANT PRODUCT PREFERENCES THROUGH GENERATIONS

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Abstract

The aim of the study was to investigate consumer behaviour and preferences regarding products containing medicinal and aromatic plant ingredients among age generations. Statistical program XLSTAT 2022.4.1 was used to evaluate 375 replies from a larger database for examination with using multiple correspondence analysis and non-parametric tests. The findings showed that the key factor in the process of buying medicinal and aromatic plant products for treating and preventing illnesses was the quality of the product. Research results pointed out that ingredients, scientifically confirmed benefits, labelling details, origin of raw materials, absence of synthetic components, and the scent of the product are also important determinants of purchase. Moreover, the research revealed that consumers from Generation Z do not use medicinal and aromatic plant products for cosmetics, personal care purposes, or the prevention and/or treatment of several illnesses, while Generation Y, along with Generation X and Baby Boomers, tend to use them. Generation Y uses these products for both cosmetics and treatment purposes for 1 - 9 years or more. Studying consumers of herbal and aromatic products across generational lines can provide distinct consumer patterns with a significant impact on the development of products and marketing strategies tailored to the specific requirements of each generation.

Key words: *medicinal and aromatic plants, consumer, behaviour, generations, information*

INTRODUCTION

Medicinal and aromatic plants (MAPs) have made an enormous contribution to the improvement of human lifestyle since ancient times, being used for food, cosmetics, personal care and medical purposes [23]. Laboratory research using chromatographic tools has revealed the existence of bioactive compounds unique to these plants, giving them great potential for exploitation in the pharmaceutical and cosmetic sectors [23]. Moreover, consumers from traditional as well as contemporary societies have utilized products derived from medicinal and aromatic plants. Regarding the latter, [1] showed an increase in consumer interest in these products in recent decades in most EU member states, especially in Germany, the United Kingdom and Portugal. European countries are divided into MAP producing and MAP consuming countries [1]. Therefore, producers and processors in various industries - food, cosmetics, pharmaceuticals - need to ensure that the supply of MAP products meets consumer needs and preferences. This can be done by conducting market research [21]. By segmenting consumers of MAP products by generation, certain consumption patterns can be identified that have significant implications for companies wishing to align themselves with the latest consumer trends. This approach enables the development of tailored products and marketing strategies [10].

According to a study by Goldman Sachs Global Investment Research [13], millennials as the generation of digital natives, are reshaping their shopping habits due to their strong inclination towards technology. This generation was born into an emerging world of technology and is more digitally active than any previous generation [17]. Millennials have different consumption behaviours compared to other generations: they are used to gathering information about products instantly, the buying process is a moment of pleasure for them, their loyalty to the brands they buy is relative and they are interested in discounts [16]. Their values in terms of purchasing behaviour are based on social responsibility and environmental protection, and they are interested in brand authenticity, local sourcing, and ethical production [5]. Similarly, Generation Z is made up of people who grew up in a world where technology and information were always at their fingertips. They are considered the first generation of true digital natives, and truth-seeking is characteristic of their consumption behaviour [11]. This segment of consumers pays high attention to the impact their purchasing decisions have on the environment and are concerned with ethical issues, with consumption being an expression of individual identity, contributing to their personal development [4]. Millennials are known for their preference for natural and sustainable products. Compared to older generations, millennials place greater importance on health maintenance products, as well as all-natural cosmetics and personal care products, with a high emphasis on the source and quality of the ingredients used. Safety, sustainability and traceability of these products are important aspects sought by millennial consumers [15]. Similarly, consumption behaviour among Generation Z is largely influenced by their values. These young people are concerned about the environment and are keen to buy products that have a low impact on both the environment and are the generation most committed to incorporating sustainability aspects into their activities [6]. Young people in Generation Z, who represent the future of our society, pay increasing attention to buying eco-friendly products [4]. Studies in the literature show that people with a positive environmental mindset are predisposed to purchase cosmetics that are natural and environmentally friendly [2]. [14] conducted a study among young female Generation Z and Millennials in Vietnam with the aim of understanding the factors that influence purchase intentions of green cosmetics. They showed that Vietnamese youth are increasingly interested in natural and organic products, with knowledge of these products positively correlated with purchase intentions [14].

Promoting herbal and aromatic products by highlighting eco-friendly attributes such as no animal testing, recyclable labels and packaging, less water use, reduced pollution has a positive influence among consumers belonging to generation Y and Z whilst encouraging consumption of these products [20]. Preference for MAP products is affected by generational, as well as socio-demographic characteristics of consumers. Findings from earlier research have indicated a greater interest in the consumption of MAP products among highly educated consumers aged between 41 and 60, mainly belonging to generation X [12, 18, 19]. Qualitative research among German consumers revealed differences in the choice of herbal products according to different age groups, defined as young consumers (18-35 years), middle-aged consumers (36-59 years) and older consumers (elderly, over 60 years) [24]. Thus, treating ailments was an important reason for consumption of MAP products for all age groups, preventing ailments was an important reason for both middle-aged and elderly, and maintaining health was a valid reason for consumption only for the elderly [24]. Regarding the consumption of MAP products among children and teenagers, higher consumption was observed among those with poorer health status, moderate participation in sports activities and a diet rich in fruits and vegetables [8]. According to a study by [15], millennials represent the largest potential group of MAP-derived product purchasers, accounting for approximately 32% of the global population, in contrast to 17% of individuals aged 55 and above (specifically baby boomers and older).

[3] analysed the knowledge of medical students aged 19-24 (representatives of

Generation Z) regarding the use of medicinal plants and interactions between plants and medicines. Most students (95.45%) were aware that medicinal plants can be used as medicines, 46.85% believed that herbal medicines are safe, and the majority (55.6%) were not aware that there may be interactions between the consumption of MAP products and certain medicines. The same study reveals that the media and older family members were the most common sources of information for students about MAP products [3]. To meet the needs of millennials, marketing strategies must be done through technology and social media [16]. Marketing through social media and mobile phones is also necessary for Generation Z, as they are very active on social media, constantly searching online for information about products they want to buy. They seek reviews, advice, and recommendations from other users, which help them to make informed decisions and choose the right products for their needs [4]. Contrary to millennials and Generation Z, members of Generation X have less trust in online information tend to be conservative and independently search for further information about products and companies, mainly because they became acquainted with mobile devices and social networks during their adulthood [7]. In addition, millennials are willing to spend more on cosmetics and personal care products produced by natural ingredients, in comparison with consumers from Generation X and Baby Boomers [15]. Consumers of the youngest Generation Z are sensitive to the price and choose affordable products, but they are open to spending more on natural and organic beauty and personal care items that contribute to their emotional health and well-being [9]. In Romania, there are no studies analysing the consumption behaviour of different generations with regard to products made from herbs. There is also no research to analyse consumer confidence in various sources of information on these products.

Identifying this gap in the scientific research area and considering the need to develop the marketing of MAP products in the context of the Romanian market, the authors of the present study aimed to carry out an analysis of the consumption behaviour of different generations for MAP products in Romania, as well as their sources of information, in order to identify consumption patterns and their influence on marketing strategies.

After reviewing the literature and defining the purpose of the research, the following research questions emerged:

Q1: What are the key characteristics of the consumer behaviour of Baby Boomers, Generation X, Millennials and Generation Z regarding MAP products?

Q2: What are the main sources of information used by different generations to learn about MAP products?

Q3: What are the factors that influence the purchase decisions of consumers of different generations in relation to MAP products?

Q4: What are the significant generational differences in preferences and consumption patterns for MAP products?

Q5: How can the results of this research be used to develop generation-specific marketing strategies in the MAP industry in Romania?

MATERIALS AND METHODS

The research is based on the analysis of 375 responses from a larger database. These responses were collected in 2020, based on a sociological survey conducted among consumers of MAP products in the city of Cluj Napoca in Romania.

From a questionnaire survey designed to evaluate consumers' perceptions and behaviours concerning the using of medicinal and aromatic plant products, the present paper focuses on two specific aspects:

The first aspect is aimed at using of medicinal and aromatic plants for the prevention and treatment of illnesses. This section included concerns about health risks linked to examined products, their compatibility with conventional treatments, awareness of possible drug interactions, beliefs regarding the scientific validation of therapeutic properties, preferred sources of information and factors influencing the decision to purchase these products.

The second aspect is focused on using of medicinal and aromatic plants for cosmetic and personal care purposes. This section focused on consumers' typical usage habits of cosmetic and personal care products incorporating ingredients derived from medicinal and aromatic plant, their perceptions of associated risks, views on the necessity of scientific validation, interest in customized products and preferred sources of information.

The 375 responses were grouped into 3 categories, according to the age of the respondents: 125 responses belonging to Generation Z (18 - 26 years), 125 responses belonging to Generation Y (27 - 42 years) and 125 responses belonging to Generation X and Baby Boomers (43 - 72 years).

The Baby Boomer generation includes consumers born between 1946 and 1964, a period a period which is distinguished by the boom in population after World War II and the aftermath of conflict and economic reconstruction. Generation X, born between 1965 and 1979, grew up in an era of peace after the end of the Second World War. Millennials or Generation Y, born between 1980 and 1994, and Generation Z, born between 1995 and 2009, are known for their use of technology and adaptability to the digital environment. These broad segmentations provide insight into the different experiences and values of each generation, with significant implications for product development and marketing strategies.

Multiple correspondence analysis (MCA) was used to investigate differences across selected generations in case of multiple-choice questions (use of medical and aromatic plant products for cosmetic and personal care purposes, and for the prevention and treatment of different diseases; duration of using medical and aromatic plant products for cosmetic and personal care purposes, as well as for the prevention and treatment of various illnesses). Chi-square test was implemented to study differences across generations. Friedman test and Nemenyi method were applied to identify statistically significant differences in consumer evaluations towards source of information as well as aspects affecting the purchase of medicinal and aromatic plant products for the prevention and treatment of various illnesses. All statistical tests were calculated by using statistical software XLSTAT 2022.4.1 (Addinsoft, NY, USA).

RESULTS AND DISCUSSIONS

The consumer study investigated the influence of information sources on consumers' choices and decisions regarding the usage of cosmetics and other personal care products with medicinal and aromatic herbal ingredients. Consumers, who use MAP products for cosmetic and personal care (CPC) purposes, evaluated potential sources of information on a scale from 1 to 5, where 1 represents lower trust, and 5 represents higher trust. The study results, including means, indicated that the consumers place the greatest trust in information obtained from specialized doctors (mean = 4.13), specialized books (mean = 3.96), pharmacists (mean = 3.72), cosmeticians (mean = 3.46), producers (mean = 3.36), and staff in specialized stores (mean = 3.24). In contrast, the results revealed that influencers (mean = 1.90), friends and relatives (mean = 2.72), as well as the internet and mass-media (mean = 2.88) are considered the least trustworthy source of information based on which consumers make decisions. In the context of the influence of information sources on consumers, the Friedman test and subsequent Nemenyi procedure were applied, highlighting statistically significant differences in consumer evaluations among various information sources. These differences are graphically illustrated by a Demsar plot (Figure 1).

Consumers who use MAP products for the prevention and treatment of various illnesses assessed the impact of selected aspects on their purchasing behaviour on a scale ranging from 1 to 5, where 1 represents insignificance and 5 represents high significance.

The research results and means revealed that the most crucial factors influencing the purchase of the MAP products include product quality (mean = 4.40), product composition (mean = 4.25), label information (mean = 3.95), scientifically proven therapeutic properties (mean = 3.92), origin of raw materials (wild or cultivated flora) (mean = 3.61), use of ecological raw materials (mean = 3.50), certified organic product (mean = 3.48), and Romanian product origin (mean = 3.39).

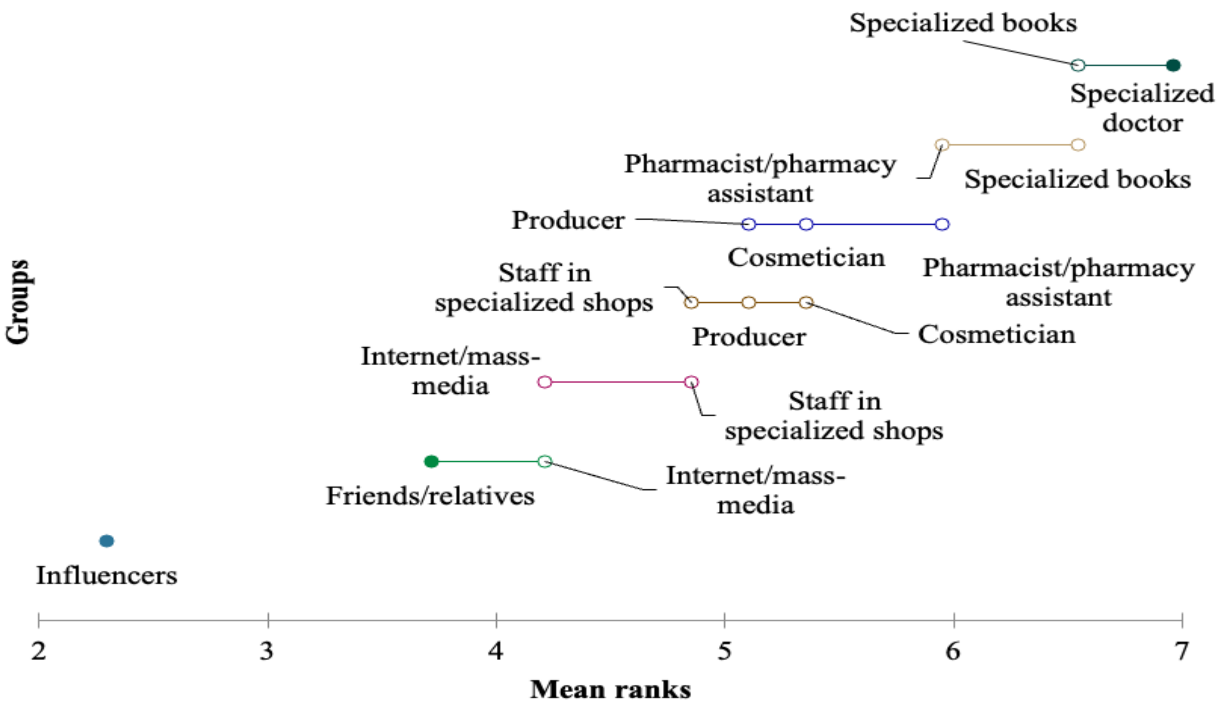

Fig. 1. Confidence in sources of information based on which consumers make decisions about MAP products for CPC purposes
Source: Own calculation.

Table 1. Evaluation of aspects affecting the purchase of MAP products for the prevention and treatment of various illnesses

Sample	Frequency	Mean of ranks	Groups						
Brand	165	5.091	A						
Advantages offered (promotions, discounts)	165	5.188	A	B					
Use of recyclable packaging	165	5.309	A	B					
Product traceability information	165	5.933	A	B	C				
Advantageous product price	165	6.136	A	B	C				
Romanian product	165	6.545		B	C				
Certified organic product	165	6.836			C	D			
Use of environmentally friendly raw materials	165	7.006			C	D	E		
Source of raw material	165	7.255			C	D	E		
Scientifically proven therapeutic properties	165	8.176				D	E	F	
Label information	165	8.315					E	F	
Composition of the preparation	165	9.367						F	G
Product quality	165	9.842							G

Source: Own calculation.

Conversely, less importance is attributed to aspects such as brand (mean = 2.87), advantages offered, including promotion or discounts (mean = 2.91), use of recyclable packaging (mean = 2.98), product traceability information (mean = 3.23), and advantageous product price (mean = 3.26). Furthermore, the Friedman test revealed statistically significant differences in the evaluation of aspects determining the purchase of MAP products (p-value =< 0.0001) and post-hoc Nemenyi method demonstrated the existence of differences among the examined aspects (Table 1).

In this research, the utilization of MAP products for CPC applications, as well as their use in preventing and treating different diseases, was further investigated among consumers of different age groups. The applied Multiple Correspondence Analysis (Figure 2) demonstrated that Generation Z neither utilize MAP products for CPC purposes, nor for preventing and treating different diseases. Additionally, the results indicate that consumers from Generation Y utilize MAP products for both CPC needs, as well as for preventive and treatment purposes. However, the oldest consumers from Generation X and Baby Boomers behave differently. The findings revealed that consumers either use or do not use MAP products for CPC reasons, as well as for the therapeutic purposes.

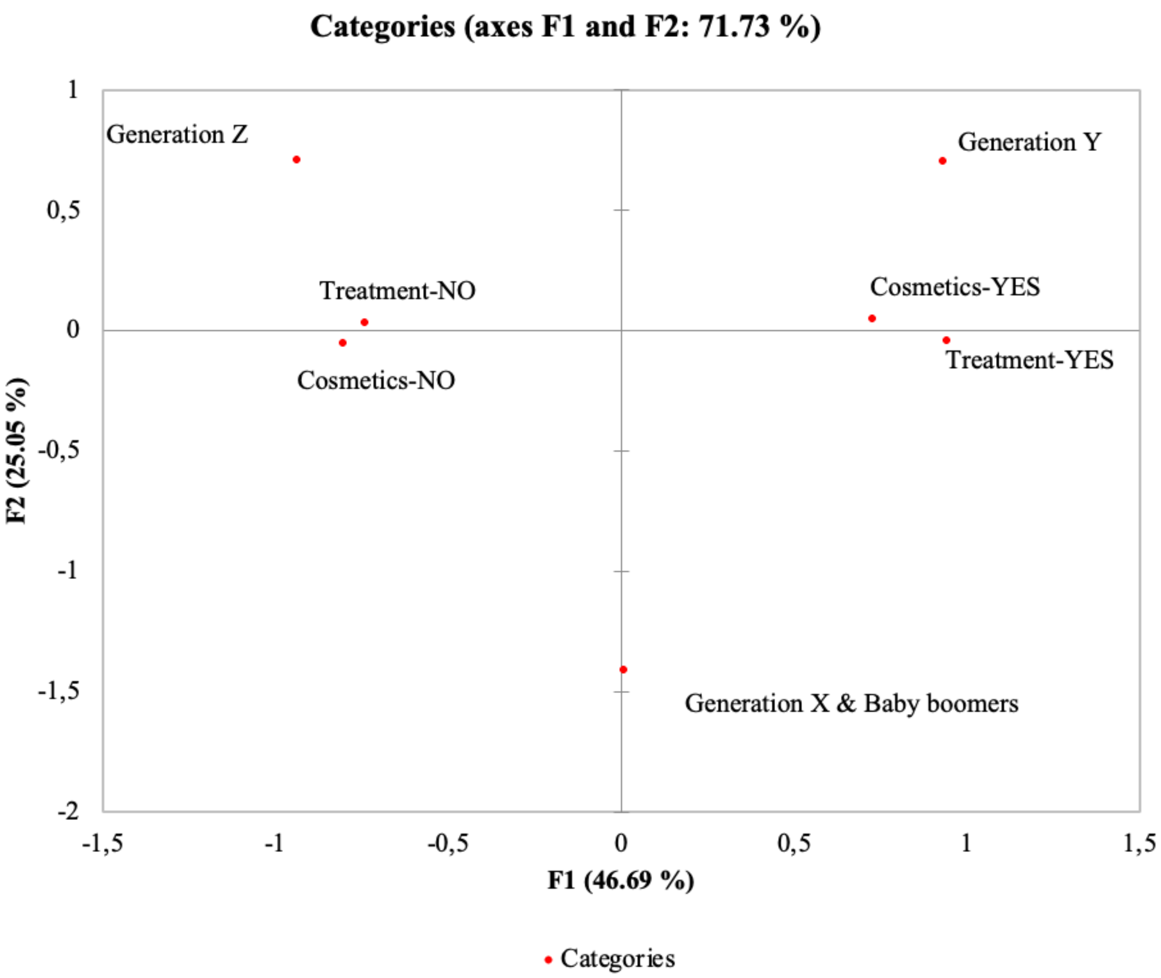

Fig. 2. Use of MAP products for CPC purposes, and for the prevention and treatment of various illnesses across different age generations
Source: Own calculation.

In the context of results related to the use of MAP products for CPC purposes, as well as for the prevention and treatment of different diseases, the study also focused on investigating differences in usage duration among age generations. The results of the Multiple Correspondence Analysis (Figure 3) indicated that the youngest consumer generation does not use MAP products for cosmetics or treatment at all, or for less than 1 year. Consumers from Generation Y use MAP products for CPC purposes and for illnesses prevention and treatment, for durations ranging from 1 to 9 years or from 10 to 19 years. The duration of product usage for CPC and therapeutic purposes, was assessed most

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differently in Generation X and Baby Boomers. Consumers in these generations use products for cosmetic and treatment reasons for less than 1 year, but there are also those who use them for durations ranging from 1 to 9 years or from 10 to 19 years.

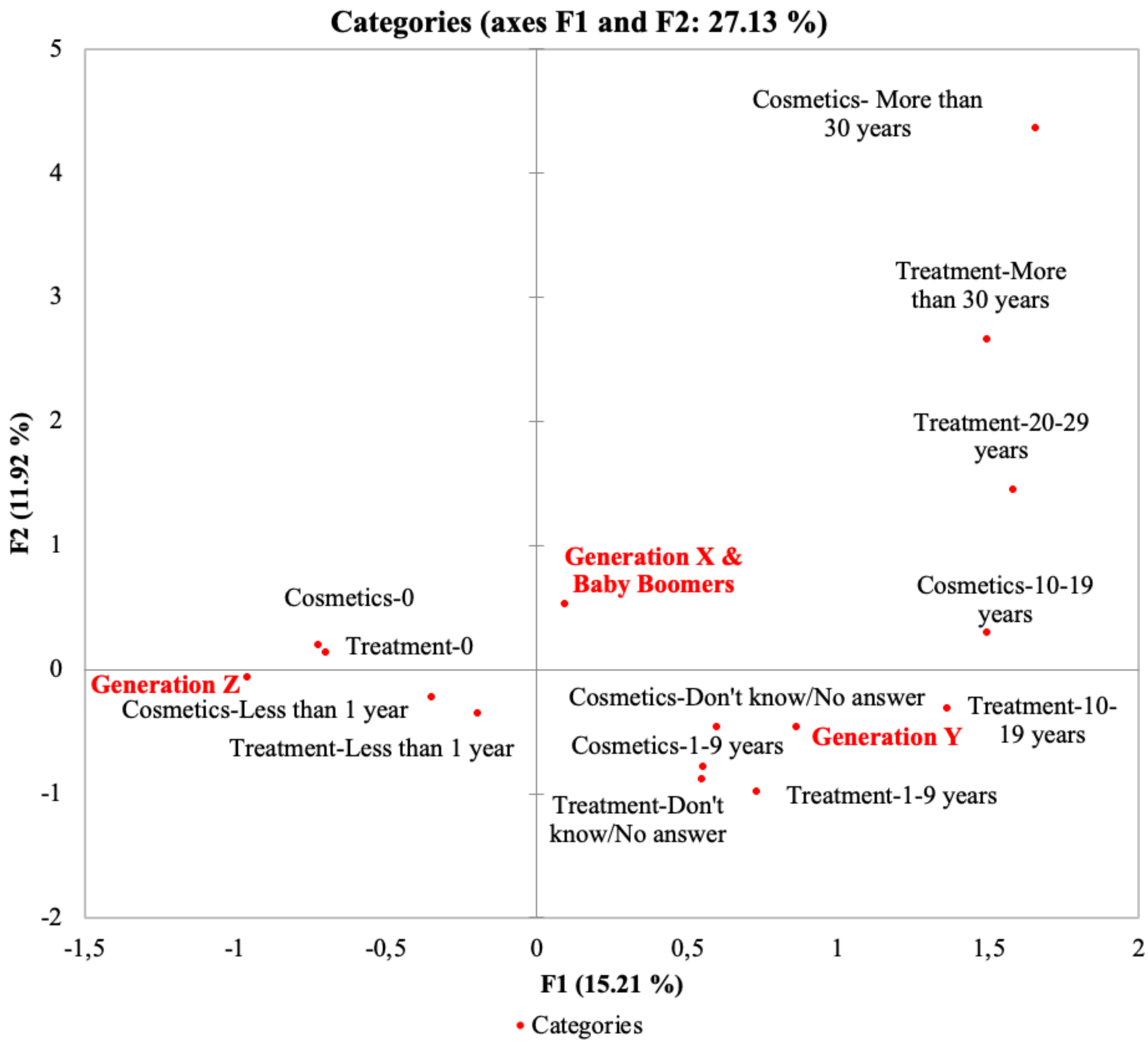

Fig. 3. Duration of using MAP products for CPC purposes, as well as for the prevention and treatment of various illnesses, varies across different age generations
Source: Own calculation.

The study further aimed to investigate consumer behaviour in the purchase of MAP products for preventive and treatment purposes in different age generations of consumers. The results revealed that consumers from Generations Y, X and Baby Boomers perceive health risks associated with the use of MAP products for phytotherapeutic purposes, while the youngest consumers do not perceive these risks. Health risks are mainly perceived in the context of the appearance of adverse/allergic/toxic reactions and interactions with other drugs/foods. Furthermore, the results showed that consumers from Generations Y, X and Baby Boomers utilize MAP products in conjunction with allopathic treatments, while Generation Z consumers do not use them (p-value = 0.004). In this context, consumers from Generation Y inform their doctors about the administration of MAP products together with prescribed drugs, whereas only half consumers of Generations X and Baby Boomers inform their doctors. Furthermore, the study identified that consumers across all age cohorts consider these products safe and effective when the therapeutic properties of medicinal plants are scientifically confirmed (p-value = 0.400). Additionally, it was found that Generations Y, X and Baby Boomers predominantly obtain information regarding the use of MAP products from specialized books and doctors, while Generation Z prefers information from doctors, the internet, and pharmacists. MAP products used for preventing and/or treating certain diseases are most purchased by Generations X and Baby Boomers in nature shops, online, and directly from producers. Consumers from Generation Y prefer purchasing these products not only in natural shops and online but also in pharmacies. Consumers from Generation Z most frequently purchase these products in natural shops, pharmacies, online, or supermarkets.

Furthermore, the study also revealed the behaviour of consumers across different age generations in the purchase of MAP products for CPC purposes. The study results indicate that consumers from Generations Y, X and Baby Boomers prefer using cleaning products (soap, shampoo, shower gel), body creams, day/night facial creams, cleansing lotions/gels, and perfumes. Consumers of the younger generation particularly prefer using cleaning products (soap, shampoo, shower gel), body creams, perfumes, serums, and cleansing lotions/gels. The results showed that consumers from all generations noted concerns about health risks associated with using these products, mainly due to the potential allergic reactions (p-value = 0.489). Consumers, regardless of age, believe that the use of CPC products with herbal and aromatic ingredients should be based on scientific research and dermatological studies (p-value = 0.508). They also express interest in using products customized according to their specific needs(p-value = 0.838). In terms of places for purchasing, all age generations of consumers prefer buying MAP products for CPC purposes in natural shops, online, or directly from the producers.

The study provides valuable insights into the consumer behavior of different age generations regarding products derived from MAPs in Romania. Our findings complement and extend previous research, highlighting the evolving trends in consumer preferences and the influential factors shaping their decision-making process. Firstly, our study elucidates the significant role of information sources in consumers' choices and decisions regarding the usage of MAP products for CPC purposes. Consistent with previous literature [23], our results indicate that specialized doctors, books, pharmacists, and cosmeticians are the most trusted sources of information, whereas influencers, friends, relatives, and mass media are perceived as less trustworthy. These findings emphasize the importance of credible sources in shaping consumer perceptions and behaviors, aligning with previous studies that underscored the impact of information authenticity on consumer trust [13]. Secondly, our study identifies key factors influencing consumers' purchase decisions regarding MAP products for the prevention and treatment of various illnesses. Product quality, composition, label information, and scientifically proven therapeutic properties emerged as crucial determinants, echoing findings from previous research [1, 14]. Moreover, our results reveal generational differences in the perceived importance of these factors, underscoring the need for targeted marketing strategies tailored to different age groups. Thirdly, our study examines the usage patterns and duration of MAP product consumption across different age generations. While Generation Y demonstrates consistent usage for both cosmetic and therapeutic purposes, Generation X and Baby Boomers exhibit varied behaviors, indicating the complexity of consumer preferences within each generation. These findings corroborate previous studies that highlighted age-related variations in consumption motives and habits [3, 8]. Furthermore, our study sheds light on consumers' perceptions of health risks associated with MAP product usage and their preferred sources of information. Interestingly, while consumers across all age groups perceive these products as safe and effective when scientifically validated, variations exist in their reliance on different information sources. These insights underscore the importance of targeted communication strategies to address consumers' concerns and preferences effectively.

CONCLUSIONS

The study investigated the key characteristics of consumer behavior regarding the use of medicinal and aromatic plant (MAP) products among Baby Boomers, Generation X, Millennials, and Generation Z. Results indicated significant variations in consumer behavior across these generational groups, particularly concerning their usage patterns, perceptions of associated risks, and preferences for information sources. The research identified the main sources of information utilized by different generations to learn about MAP products. Specialized doctors, specialized books, and pharmacists emerged as the most trusted sources of information among consumers. In contrast, influencers, friends/relatives, and internet/mass-media were perceived as less trustworthy sources. Various factors were found to influence the purchase decisions of consumers across different generations regarding MAP products. Product quality, composition, label information, and scientifically proven therapeutic properties were among the most significant factors influencing consumer choices. Brand and promotional advantages were deemed less important in influencing purchase decisions.

Significant generational differences were observed in preferences and consumption patterns for MAP products. For instance, Generation Z showed lower usage rates compared to other generations, while Millennials demonstrated a higher level of trust in product quality and composition.

The study findings provide valuable insights for developing generation-specific marketing strategies in the MAP industry in Romania. Tailoring marketing approaches to the preferences and behaviors of each generation can enhance product acceptance and market penetration. Strategies could include targeted messaging, product customization options, and leveraging trusted information sources preferred by each generation. The research underscores the importance of understanding generational dynamics in consumer behavior towards MAP products and highlights opportunities for industry stakeholders to refine marketing strategies and meet the diverse needs of consumers across different age groups. The practical and scientific implications of this study extend beyond the MAP industry and have broader implications for consumer health, marketing strategies, product development, and academic research. By bridging the gap between theory and practice, the study informs decision-making processes and contributes to the advancement of knowledge in the field of consumer behavior and healthcare. Future research directions stemming from this study include delving into longitudinal trends in consumer behavior related to MAP product consumption and examining cross-cultural variations in usage patterns. Moreover, investigating the health outcomes associated with MAP product usage, exploring the efficacy of consumer education initiatives, and evaluating regulatory frameworks governing these products are areas ripe for further study. These endeavors can advance evidence-based policymaking and enhance consumer protection in the MAP industry.

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STUDY REGARDING THE ANALYSIS OF TOURIST RESOURCES AND ACTIVITIES FROM A BOARDING HOUSE IN THE MUNICIPALITY OF CICANEȘTI - ARGEȘ, ROMANIA, IN THE PERIOD 2018-2022

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Abstract

In the study carried out in the researched area, an inventory of the main natural tourist resources was followed in the first phase, as they are also an important factor in attracting tourists to the boarding house. Following the study, it was demonstrated that the area and implicitly the boarding house has a rich and valuable natural tourist potential, but which has not yet been capitalized at the highest level. After this, a study was carried out aimed at the inventory and analysis of human tourism resources, noting that the studied area represents the land of the inherited monasteries, Poienari and Negru Voda fortresses, as well as numerous churches, monuments, memorial houses and architectural sites and monuments traditional. Also, in order to be able to create a unique and personalized offer within the boarding house, we insisted more on anthropic tourist resources specific to the commune of Cicănești, through which it can be clearly differentiated from other tourist offers at the national level. In the last part, a complex and well-documented study was carried out in terms of the calculation and analysis of the main indicators with the help of which the tourist activity in the area and from the boarding house is characterized, based on which the conclusion was reached that in the analyzed boarding house a management of quality and very flexible, which easily adapted to the new conditions imposed by the pandemic, in the period 2018-2022.

Key words: *agritourism, boarding house, management, rural tourism, tourist resources*

INTRODUCTION

As it has been found from the numerous studies and research carried out so far in Romania, agritourism represents one of the main forms of tourism with the highest potential, and its development is a means of sustainable development for the rural area, both economically and socially -cultural [2, 6]. Also, in recent years it has been found that the exploitation for tourism purposes of the natural, cultural and anthropic potential of some rural areas represents an important chance for economic recovery and a solution for the creation of new jobs, but also an opportunity for the promotion of Romania international plan [5]. The results of these studies and researches have shown that agritourism is among the most dynamic forms of tourism practiced in most European countries, but also in our country, stimulating economic development by capitalizing on local resources from the countryside, a phenomenon also observed internationally [1, 3, 4]. This form of tourism offers the local residents the opportunity to supplement their income by capitalizing on traditional household products and compensates for the lack of jobs in the countryside, also contributing to the development of human resources, a fact also proven by other researchers [17, 18].

In Romania, in order to achieve good results in the activity of rural tourism and agritourism, it is necessary to follow successful models from the countries of the European Union, which have so far demonstrated their viability [20, 28].

In the town of Cicănești, by practicing these specific forms of tourism, local people can considerably increase their family income, the same favorable results can also be obtained by new investors from this town, because the environmental conditions are very favorable for the practice of tourism rural or agritourism. Also, as a result of this activity, the local community would also benefit through the fees and taxes paid annually by the boarding house administrators, but also the local producers who would find outlets for traditional and natural products [26, 29]. A very important element is the creation of jobs in the area, which would solve one of the biggest problems facing our society at this time, especially in rural areas, where the lack of jobs even leads to the massive depopulation of them, aspect also observed by [19, 30, 31, 35].

From the study we have observed that Argeș county and the studied area represent one of the main tourist areas of Romania due to the favourable relief conditions it has, the beauty of the landscapes, the purity of the air, waters, mountainous areas, the traditions and popular customs preserved to this day of ours, of the specifics of gastronomy and last but not least of the well-known hospitality of the locals. Many locals from the tourist areas of Argeș have understood to capitalize on the existing resources in this area and to contribute to the development of the accommodation infrastructure by transforming their own homes into tourist boarding houses or by building new boarding houses, the true potential of this area is not exploited to the highest degree level. Most of the time, the main problems are related to the quality and standards of the tourist services provided, the involvement of the hosts in agritourist activities, the lack of collaboration between local authorities and boarding house administrators, but of course the infrastructure and sources of financing remain the most acute of the problems reported. and by [9, 15, 22, 23].

In addition to the direct involvement of local, regional and national administrations in activities to encourage agritourism, indirect actions that can significantly support its development, especially in mountainous and peripheral areas, are also very important. Ensuring transport infrastructure and investments in this direction are fundamental for the development of agritourism activities, especially in areas with strong rural characteristics [11, 13, 34].

In this sense, local or regional authorities can start work to restore the transport infrastructure where appropriate, either from their own funds, or by accessing and implementing European funds. Since the inventory of the natural and anthropogenic objectives put in the service of tourism is and will be involved, for sure, in the outline of the basic motivations, in the organization of recreation activities, restoration of health or in the socio-economic rise of the area [12].

I considered that and we must carry out such an inventory at the level of the studied area and also study a series of technical-economic indicators, based on which to characterize the tourist activity from the studied boarding house. The multitude and variety of these objectives are, without a doubt, the guarantee of an upward evolution of rural tourism in the respective area, a fact that we want to demonstrate through their complex and realistic approach, within this topic of real relevance and importance for the studied area.

MATERIALS AND METHODS

The research method was the classical method, in which the research team at the beginning focused on observing the agritourist phenomenon in the area, after which it went on to describe the main more important aspects regarding this activity, later a pertinent and clear analysis of all aspects related to of agritourism in the area, and finally the results obtained were interpreted and the conclusions and recommendations resulting from this study were stated [8, 24].

The observation consisted of more detailed information on the spot and based on specialized literature about the main aspects related to the agritourist potential of the area and about its level of development, up to this moment.

The description included the treatment with maximum attention of all natural and human resources existing in the studied area and the presentation of their importance in the motivation of attracting tourists. It should be known that the natural and anthropogenic factors in the researched area are an important resource for attracting tourists and a strong motivation to visit the place.

The data used in the analysis carried out were collected from the field but also from the National Institute of Statistics (INS) and were processed according to the rules imposed on such research, in the field of tourism. In this characterization that focused on the tourist activity at the boarding house under study, specific indicators were evaluated such as: accommodation capacity, number of tourists and overnight stays in the guesthouse, tourist traffic, tourist demand, average length of stay and degree of occupancy [9, 25].

Following the study carried out and based on the analysis of all aspects, a series of conclusions could be drawn, which show the current stage of development of the agritourism activity in the area and which are positive or negative aspects that led to the improvement of the management of the tourism activity in the boarding house under study.

RESULTS AND DISCUSSIONS

The study carried out by us concerned the Eden Boarding house, located in Cicănești commune, Bărăști village, Săliște point, at a distance of 16 km North-West from Curtea de Argeș, an old Romanian city, the capital of the Romanian Country during the time of Vlaicu Voda, in a picturesque area of hills. It focused in the first stage on the study of accessibility in the area and the natural environment, as factors of attraction of tourists in the area and as a valuable tourist resource [6,14, 27].

Study on the position and accessibility and inventory of natural tourist resources

The town where the boarding house is located is approximately 6 km from the DN 7C national road that connects Pitesti, through Curtea de Argeș, to Sibiu, crossing the Făgăraș Mountains. Accessibility and general infrastructure in the area is ensured by 3 main roads: the first is the one that comes through Brașov and Bran to Câmpulung and from here to Curtea de Argeș, or to Târgoviște and further to Bucharest and reaches the Danube line, at Giurgiu. The second road starts from Transylvania through Sibiu, then the Oltului Valley, Sălătruc, Curtea de Argeș. The third starts from Curtea de Argeș towards Pitesti and Bucharest, meeting at the crossing bridge to the Argeș river with the road that comes from Câmpulung to Pitești. These three ways ensuring good accessibility in the area and a good general infrastructure, but which must be modernized as soon as possible, so as to respond as well as possible to the new accessibility requirements of tourists [6, 14, 27].

As for the natural setting, the area has a proportionally distributed relief, descending in steps from north to south, including all the Carpathian-Trans-Danubian units, from the altitude of over 2,500 m, up to 160 m. The lands predominate hilly, which occupied 55% of the county's surface, the mountains 25% and the plains 20%. The geographical position of the locality and the county on the territory of our country is an exceptional one, because the area is located where the mountain and the hill, the forest and the plain harmoniously combine and with a particularly valuable historical and cultural load.

The climate follows the gradual arrangement of the relief, which plays a main role in shaping the types of climate. Another important factor is the southern orientation of the entire relief, and the mountains, which are in the northern part, play the role of a barrier in the way of influences related to atmospheric circulation from the north. Under these conditions, the following types of climate appear in Argeș County: - mountain climate in the North, hill climate in the middle, - plain climate in the South. In general terms, the climate of the area is temperate-continental with average annual temperatures that show altitudinal differences between -2ºC on the high ridges of the Făgăraș mountains, in the plains the average annual temperature reaches 10.5ºC, and atmospheric precipitation drops to 600 mm. Winters are generally long, recording about 170 winter days per year, without frost. An interesting element is the average duration of the snow cover, 150-200 days in the upper part of the mountains, 80-120 in the Rucăr depression, 60-80 in the hill area and less than 50 days in the plains [6,14, 27].

The natural vegetation also has a stratified distribution depending on the relief units. In the plain area, clumps of sky forests and gârnița forests, sometimes also of pedunculated oak, alternate with stylized meadows and agricultural lands. In the hilly, plateau and low mountain regions, respectively between 300 and 1,300 m altitude, there is a layer of deciduous forests, consisting of hornbeam, hornbeam mixed with beech, and at altitude. between 1,300 and 1,800 m the fir and spruce forests extend. The subalpine and alpine floors, at over 1,800 m altitude, are made up of bushes (juniper, juniper) that alternate with alpine meadows that form an important fodder base for seasonal grazing [6, 14, 21, 27]. The natural vegetation began to be replaced by the cultivated one, in several areas of the studied area, vegetation that must be amended and fertilized responsibly, so that it is integrated within the normal limits of sustainability, an aspect also reported by [10, 16] so that it can also be used as a factor to attract tourists to the area.

The fauna consists of mammals of hunting interest including: deer, wild boars, bears, deer, wolves, foxes, lynxes, squirrels, martens, wild cats, ferrets, woodpeckers, quails, partridges. The most valuable element is the black goat with a high frequency on the ridges of the Făgăraș Mountains. The avifauna includes the mountain grouse, the grebe, the bald eagle, the stone eagle, the finch. In the plain area, rodents are common: mice, rabbits, raccoons, lizards, voles. The waters are populated by trout, barbel, carp, crucian carp. A particularly interesting endemic species is Romanichtys Valsanicola, found only in a small portion of the Argeș and Vâlsan Rivers. Pond birds appear in large numbers on reservoirs, such as wild duck, gray goose, stork [6, 14, 27, 32].

Study on the inventory and analysis of anthropic tourism resources

Among the most important cultural-historical values, we mention **Poienari Citadel**, which is located in Arefu commune, Căpățânenii Pamânteni village, on the top of Cetătuia Mountain, rises in the rock, at an altitude of 850 meters. Also known as the Citadel of Vlad Țepeș or the Citadel of Negru Voda, the Poienari Citadel is a delightful medieval fortress, located on top of the mountain, 25 kilometres from Curtea de Argeș. The fortress has an elongated shape, strong walls (with a thickness of 2-3 meters) and has 5 towers, 4 round and one prismatic. The Poienari Fortress can be reached by climbing a staircase with 1,480 steps, which wind through a dense beech forest. From the height of the fortress, you can admire the beautiful views of the Argeș valley, the Vidraru Dam and the Făgăraș Mountains [6,14, 27, 32].

The Heroes' Mausoleum from the Valea Mare-Pravat commune, Argeș county, also known as the Mateiaș Mausoleum, is a monument dedicated to the heroes of the War of National Integration between the years 1916-1918, being included in the "List of historical monuments". **Castrul Roman Jidova** is positioned at the entrance to the town of Câmpulung Muscel, on DN 73, it was built by the Romans, between the years 190-211, from stone and burnt brick. It is the most important and best-preserved military construction of this kind on the Limesul Transalutanus route, being at the same time the only one built of stone in Roman Dacia [6, 14, 27, 32].

The vineyard estate from Valea Mare - Ștefănești, among the vineyards owned by Constantin Brâncoveanu in the Pitesti Hill, are also those from Valea Mare. The ruler used to spend the harvest of the vines here, on his way from the royal court in Târgoviște to the one in Bucharest, on the road to Potlogilor and Mogoșoaie. The mansion remained for a while in the property of the Brâncoveanu family, being administered starting from the 19th century, by the Brâncovenești Estate. Today, only the walls on the ground floor are preserved from the manor, without floor and roof, the "Vineyard Arbor" or "Vine Manor from Valea Mare", represents a unique objective of the Brancovene era [6,14, 27, 32].

The Oath Cross from Câmpulung, is found in the central area of Câmpulung municipality, near the Heroes' Monument, in the wall of the N. Ionescu - Berechet house. On this is dug one of the longest stone inscriptions inscribed on a monument, as far as is known up to now, in the former area of the Romanian Country. Its name comes from the fact that each newly elected leader of the city had to swear, together with the 12 elected representatives of the community, in front of this cross, that he would fight for the defence of the rights of the countryside [6,14, 27, 32].

The huge wooden spoon from Mioveniis a record holder in the famous Guinness Book of Records, it measures 17.79 m long and 1.50 m at the widest point (the length of the cradle with arms) and was made in 14 days by the folk craftsman Ion Rodos and his son, Gheorghe Rodos, being a true work of art, decorated with traditional folk motifs and the logo of the town of Mioveni. Also, near the boarding house under study there are several memorial houses such as: **"Dinu Lipatti" Memorial House** from Ciolcești, in the commune of Leordeni in Argeș, is a superb villa built in neo-Romanian style by Dinu Lipatti's father, the violinist Constantin Lipatti, between the years 1938-1942. The building is registered in the List of Historical Monuments [6, 14, 27, 32].

The "George Topîrceanu" Memorial House is located in Nămăești village, Valea Mare Pravăț commune, and is a peasant house, with a wide porch on the first floor, covered with screen and built at the beginning of the century, in 1900, where the poet George Topîrceanu and -spent 8 years of his life. The house entered the heritage of the Câmpulung Municipal Museum through the family's donation in 1958, being later declared a historical monument of national interest.

The "Vladimir Streinu" Memorial House in Teiu'' is a memorial museum established in the house that belonged to the Vladimir Streinu family between 1902 - 1972. The house where the writer Vladimir Streinu grew up was built by Şerban and Leanca Iordache in 1902 and is in the center of Teiu village. On May 28, 1972, the "Vladimir Streinu" Memorial House was inaugurated. The building was restored before it was organized as a museum.

Inside, objects that belonged to the writer's family, paintings, folk costumes are exhibited specific to the area. In addition to these particularly important sights from a tourist point of view, a number of very well-known museums and monasteries can be visited in the area, which we mention without further insisting on their presentation: Argeș County Museum, Câmpulung Municipal Museum, National Museum Brătianu, the Golești Museum, the Negru Voda Monastery, the Cotmeana Monastery, the Aninoasa Monastery, the "Ascension of God" Church, the Healing Springs Church [6,14, 27, 32, 33].

We also want to present in more detail a series of tourist attractions specific to the area and locality under study, which by their special character give a touch of originality and authenticity to the tourist offer in this area. Among these we mention: **The choreographic folklore from the lands** of Argeș and Muscel that has won its rightful fame, being extremely alive and diversified from one locality to another, the repertoire of some villages counting dozens of games. The gag is considered one of the fastest and most spectacular dances in the world. The Calușaresti movements are real choreographic jewels that we don't find in other popular dances, and the difficulty of this game comes from the fact that everything is executed with speed, precision and a lot of force, especially in this area. Over time, at festivals in the country and abroad, the Argeș puppeteers have impressed, demonstrating virtuosity and an exceptional technique in their performances, being considered a true pearl of national folklore.

The Argeș and Muscel celebrations are a series of cultural-artistic events organized by the Argeș County Council. The events usually take place in August, in the main towns of the county. They include concerts, parades of popular costumes, fairs, contests and exhibitions [6, 14, 27].

Daffodil Festival nature reserve Poiana cu narcise Negrași is located in the meadow of the river Dâmbovnic and is the southernmost daffodil meadow in Romania. On an area of 4.1 ha, every end of April and beginning of May, the flowers of the species Narcissus stellaris bloom delighting us with their tenderness and delicate beauty, they generally populate the humid depression places, their flowering and maintenance throughout the duration of May being also favoured by the southern position of Negrași [6,14, 27].

The Tulip Symphony is the most important traditional manifestation of the Pitesti municipality. It is held annually in Pitesti, in

April, the first edition taking place in 1978. It is an impressive dendro-floricultural exhibition, where you can admire the floral arrangements and buy plants, seeds, bulbs, garden tools.

The brandy festival in Coseşti commune, in September, local brandy producers meet and face each other in the competition for the best drink. Alongside them, popular craftsmen from all over the county sell their ceramic and wood products. **The slaughter of the sheep,** in September, at Rucăr, where you can serve a shepherd's bulz, cheese from the bellows and pastrami, this also marking a millennial tradition in the villages of the area. The festival with Romanian specificity, **The Seal of Rome in Argeş,** organized by the Argeş County Council and the County Museum at the Jidova Roman Fort, near Câmpulung Muscel, being a historical reenactment festival, where war enthusiasts in Geto-Dacian costumes face the Roman legionnaires. There is no lack of medieval music. The event is part of a project to promote the tourist potential, called "Câmpulung Jidova Castle - a symbol of Rome on the border between the empire and the barbarian world" [6, 14, 27, 32].

The study focused mainly on the unique and authentic tourist attractions in the analyzed region, because they are the most important in making a more attractive offer for the town of Cicăneşti. "The authenticity and uniqueness of places and tourist attractions, as stated by Stanley Plog, quoted by us in 2017, is one of the most important criteria in evaluating the quality of a future tourist destination".

Study on the analysis of the main indicators that characterize the tourist activity in the area and from the studied boarding house

As is known, more than half of the existing communes in Argeş county have tourist potential, presenting a significant degree of tourist attractiveness, making the development of rural tourism and agritourism appropriate. The natural and anthropic tourist potential of the area was inventoried in the previously presented study, proving that it is rich and varied, after which the values of the calculated statistical indicators were analyzed, based on which a well-documented characterization of the tourist activity was carried out and the management practiced at the boarding house under study.

From the study carried out on the ground, we identified that the Eden guesthouse has 16 accommodation places (Nlf), which fall into the 3-star classification category, according to the minimum classification criteria of tourist structures in Romania. Later, in figure 1, two indicators that are in a close and directly proportional interdependence were analyzed: the number of tourists arriving, the number of overnight stays.

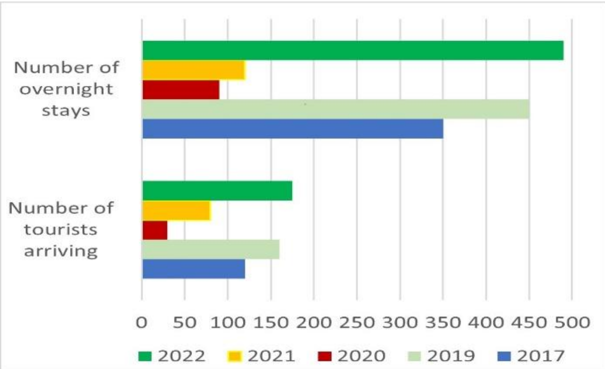


Fig.1. Number of tourists arriving and number of overnight stays of boarding house, in period 2018-2022
Source: processing own data and from NIS [25].

The values entered in this figure show us that the values of the two indicators represented varied a lot in the period 2018-2022, being directly influenced by the evolution of the Covid-19 disease. The year 2020 was a difficult one for tourist activity at the national and even international level, because the restrictions for tourists were maximum, for this it can be seen from the same figure that the number of tourist arrivals and overnight stays was the lowest.

A favorable aspect reported from this point of view is the fact that, after the relaxation, initially easier in 2021, the number of tourists arriving, almost tripled, compared to the previous year. It was also found that in the normal year from the point of view of tourist traffic 2022, this indicator exceeded by more than 10%, the year 2019, this fact is mainly due to the flexibility of the tourist offer from the boarding house, which adapted very quickly to the new conditions appeared after this extremely harmful phenomenon, on the tourist activity in general.

From the same figure, it can be seen that the number of overnight stays also underwent the same variation during the analysed period, because these two indicators are in a close interdependence and conditionality. Thus, the lowest number of overnight stays was also achieved in 2020, increasing more than 4 times in the normal year 2022, reaching the maximum value of 490.

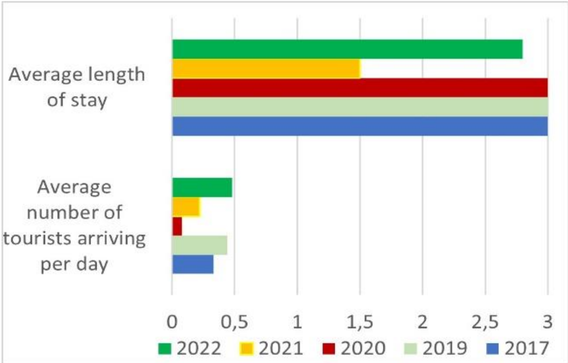


Fig. 2. Average number of tourists arriving per day and Average length of stay, of boarding house, in period 2018-2022
Source: processing own data and from NIS [25].

From Figure 2, it can be seen that the number of tourists is the lowest 0.08, in the year 2020, increasing with the return to normal of everyday life and the removal of all restrictions imposed on both tourists and tourist reception structures, in the year 2022, reaching the highest value of 0.48. With regard to the average length of stay, it was found that it did not very much, registering a value of around 3, a value reduced by half, of 1.5, was recorded in the year 2021, when with all the efforts made by the manager of the guesthouse and by its staff, tourists preferred to stay for a shorter period of time at it.

The values entered in table 1, regarding the number of tourists arriving at the researched guesthouse, show that a comparable number arrived at it with the data recorded at the national level, which proves that the staff employed, including the owner, performed during this difficult period a quality management, based on their total involvement in attracting tourists through the tourist offer fully adapted to the specific conditions of the pandemic.

Table 1. Number of tourist days staying at the boarding house in the period 2018-2022

Year	Number the tourists	Number of overnight stays	Total number days - tourists (t)
2018	120	380	45,600
2019	160	450	72,000
2020	30	90	2,700
2021	80	120	9,600
2022	175	490	85,750

Source: processing own data and from NIS [25].

The values of this indicator are good in the years when optimal conditions were met, but the highest value was reached in the year 2022, with the removal of all restrictive conditions and the return of customer appetite for tourism and recreation.

Table 2. Tourist demand at rural tourist boarding houses from the locality during, 2018-2022

Specification	Number of tourists arriving at boarding houses				
	2018	2019	2020	2021	2022
Tourist boarding house 3 daisies	130	180	50	120	203
Tourist boarding house 2 daisies	120	160	30	80	175

Source: processing own data and from NIS [25].

The tourist demand is presented in Table 2, it was analyzed by comparing the values from two pensions in the town of Cicănești - Argeș, one of three daisies, which shows that it has a higher quality standard, if we only look at the classification category and the boarding house studied by only two daisies. The results show that a larger number of tourists arrived at the guesthouse classified as 3 daisies, but analyzing the accounting data it is observed that the economic performance is higher at our guesthouse, as the management was perfectly adapted to the quality/price ratio, without to discount the quality of the services offered.

Regarding the accommodation capacity in operation, it varied very little because the number of days of operation was approximately at the same level, except for 2020, when it was the most reduced by only 4,480 place-days. This fact was primarily due to the greater number of days in which sanitation and isolation activities were carried out, during which accommodation activity was completely interrupted. The measure was absolutely necessary because tourists had to benefit from the best conditions and maximum safety from a hygienic-sanitary point of view (Table 3).

Table 3. Accommodation capacity in operation (places-days) of the boarding house, in the period 2018-2022

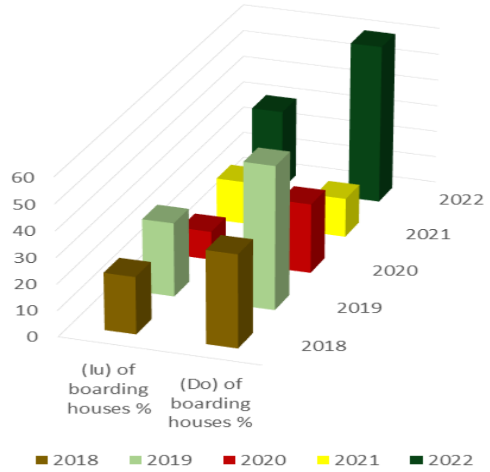
Year	Number of days operation (Nzf)	Accommodation capacity in function C.C.F.L.
2018	320	5,120
2019	330	5,280
2020	280	4,480
2021	300	4,800
2022	325	5,200

Source: processing own data and from NIS [25].

In the complete analysis of the tourist activity in terms of the application of the principles of total quality, the two indicators aimed at the degree of occupancy (Go) and the utilization index of the accommodation capacity in operation (Iu) (figure 3) must also be taken into account, which reflect directly the level of ensuring the best conditions for spending free time and meeting the requirements of guesthouse customers. The level of their values is higher compared to those at the national level, a fact primarily due to the very good accommodation and leisure services offered by Boarding house Eden. The highest values of these indicators were recorded in the normal years in terms of tourist activity, the years 2019 and 2022. A significant increase is observed in the year 2022, when it is found that the concern for improving the quality of the offer and total management in the boarding house is maximum, an aspect also due to the period of the pandemic years, when boarding house owners and managers were caught totally unprepared by its impact on the tourism activity both locally, nationally and even internationally.

Based on studies previously carried out by Stanley Plog, cited by Călina et al. (2017) [7], it was demonstrated that "attracting tourists to the guesthouse is directly influenced by the perception that you have more to do in the area", a phenomenon that will inevitably lead to the improvement of the values of all the indicators analyzed in this scientific work.. Thus, it can be seen from the boarding house website that it is located in a picturesque area, surrounded by coniferous and deciduous forests, ideal for hiking and walking, with very clean air and free from any source of pollution. The boarding house also has a dining room. kitchen available to customers, outdoor dining area. generous barbecue with gazebo and parking within the boarding house.

Fig. 3. Average of the utilization index (Iu) and the degree of occupation (Go) of boarding house, 2018-2022



Source: processing own data and from NIS [25].

At the same time, in addition to the natural and historical-cultural environment that the area enjoys, the boarding house has several recreational spaces such as: those for table games (table tennis, billiards), archery and air gun range, spaces for sports activities: fitness, strength room, areas for walking with the cart or bicycles, room for modern and popular dances and last but not least the newest, a football pitch with natural grass. In addition to these facilities within the boarding house, it also offers tourists tours and activities organized by local guides and entrepreneurs, shows organized by local artists and information on ecosystems, heritage and local culture, as well as etiquette instructions.

CONCLUSIONS

From the study regarding accessibility in the area and at the boarding house, it is found that it is very easy, because the area has several road access routes, being in the proximity of several national roads that connect several historical provinces of Romania. The three most important roads provide accessibility in the area and a good general infrastructure, but they need to be remodelled and modernized as soon as possible, so that they respond as well as possible to the new accessibility requirements of tourists. The natural setting has very rich and attractive tourist resources, the relief, vegetation, flora, fauna and waters of the area contributing a lot to attracting tourists to the boarding house under study.

A significantly important role in attracting tourists is also the anthropic tourism resources which are very rich and representative, the area being dotted with a multitude of monuments and memorial houses, churches and monasteries of unique beauty and value, Roman casters and fortresses of a value monumental history. In order to make the aspects related to the cultural-historical framework more specific, I insisted more on a series of crafts, customs and village rituals with an original and unique character, practiced and found in the area and the Cicănești commune, through which the boarding house under study could provide tourists with an original, unique offer that differentiates it clearly from other tourist offers.

From the calculation and analysis of the tourist indicators with the help of which the tourist activity in Cicănești and implicitly from the boarding house is characterized, it emerged that the management practiced is modern, high-quality and very flexible, because it adapted very quickly to the restrictive conditions imposed by the pandemic, after which immediately after that it folded back significantly, managing to contribute to the improvement of all the most important indicators studied in 2022.

The conclusion that the management practiced is one of quality and fully adapted to the modern requirements of rural tourism and agritourism, is also substantiated by the fact that the value of the indicators regarding tourist circulation, the tourist offer and the degree of occupancy of the boarding house, is superior to the values of the average indicators of the same type, from the national level, from the period under study.

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STUDY ON THE DEVELOPMENT AND EVOLUTION OF THE SUSTAINABLE AGRITOURISM ACTIVITY AT A BOARDING HOUSE IN CRASNA MUNICIPALITY - GORJ, ROMANIA

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Abstract

The paper presents the way in which a tourist reception structure can practice sustainable tourism based on the conservation and protection of all natural and anthropic resources. The case study was carried out at a Boarding house in the commune of Crasna-Gorj, where authentic agrotourism is practiced, because a series of specialties served at the table to tourists are prepared with products obtained from their own household, in which traditional agriculture is practiced, based on obtaining high quality products, with as few chemical substances as possible. At the same time, the main natural and anthropogenic factors favorable to the practice of tourism were presented, and an analysis of tourist traffic and the quality of management at the boarding house under study was carried out. In the analysis of the tourist potential and activity, more emphasis was placed on the objectives and leisure and gastronomy activities specific to the place, through which the Boarding house can create an offer of great originality and attractiveness for tourists.

Key words**:** *agritourism, boarding house, gastronomy, management, sustainable tourism*

INTRODUCTION

In the policy of the EU community framework, it is specified that in order to achieve the proposed objectives, a series of challenges specific to the tourism sector must be addressed, aimed mainly at the conservation and sustainable management of natural and cultural resources, the minimization of the use of resources and pollution within tourist destinations, including the production of waste, managing change in the interest of community well-being, reducing the seasonal nature of demand, creating tourism accessible to all without discrimination and improving the quality of jobs in the tourism sector [1, 5, 19].

The new reality that emerged after the pandemic requires an extensive change in mass tourism, which before the pandemic was largely represented by certain fixed destinations, usually without sustainability. New vacation options are motivating consumers to travel differently, reducing destination bottlenecks and traditional travel hassles. They are much more careful about the sustainability of their trips. The pandemic has imposed a pause on non-essential travel in most regions of the world. On this occasion, both companies and individuals had time to reflect on their reasons for traveling [12, 8].

Thus, as a major trend, new and existing tourism operators, as well as destinations, rather target people who want to spend their free time in the mentioned way, who have the opportunity to stay for a longer period in a certain destination, at the expense of business tourists, who only have additional moments of free time [6, 11].

Tour operators and destinations that cater to this demand likely realize that this category of travellers is valuable. For example, leisure travellers tend to stay in the destination for a longer period, given the need to make time for both work and leisure activities. Travelers who stay longer in a certain destination normally spend more during that period [20].

Also, leisure travel is generally more flexible, which means that, unlike classic business travel, bleisure tourists are not necessarily tied to certain events and can travel at any time of the year. Travel flow bottlenecks traditionally seen during peak seasons will thus no longer be created. Equally, leisure travellers are more flexible in their choice of location and often look for alternatives to highly visited destinations, which again reduces bottlenecks in the flow of travel to star destinations. The effect is a more equitable distribution of travel opportunities and expenses [18].

At the level of 2023, the discussion about sustainable tourism at the destination level continues as a trend to approach the future development of this industry, which can be positively influenced by developments in the field of technologies, through their involvement in the sustainable development of tourism [5]. As is known, Romania as a tourist destination is placed 28th out of 99 countries from the point of view of tourism sustainability, according to a Euromonitor report from 2021, a place that offers an additional argument for supporting this path and finding new ways to promote it tourism [6, 16].

Some specialists prefer to talk about the sustainable development of tourism, rather than about sustainable tourism, but the Lisbon Agenda proposed the consolidation of sustainable tourism as a component of sustainable development at the level of the European Union, being targeted as a voluntary and continuous process [2, 13].

Since the development of sustainable tourism corresponds to the requirements of tourists and the areas that receive them, in the spirit of conserving and improving future opportunities [9, 21], in the subject of this research we tried to approach as documented and scientific as possible, the way of implementation and development of such tourism. Since the sustainable development of tourism requires the efficient and conservative use of all the natural and anthropic resources of the studied area, the topic addressed is considered to be topical and of maximum applicability, because the area of the Crasna commune in Gorj county has a rich tourist potential, thanks to picturesque landscapes, art and architecture monuments, of great value.

MATERIALS AND METHODS

The research methodology is the classic one combined with the case study method, applied on a smaller scale, namely at the level of Crasna commune in Gorj county [14].

At the beginning, the principle of observing the tourist phenomenon at a general level was used, within the delimited area to be studied, in which the level of implementation of rural tourism in the area was followed, as an integrated part of sustainable tourism based on ecological principles. After that, we moved on to the description of all the more important aspects that define as a whole the type of tourism mainly practiced in the area of Crasna and the effective way of applying them. The subsequent stage included the careful and well-documented analysis of the main natural and anthropogenic factors that have a positive influence on the tourism activity, practiced in the rural area of the researched area [3, 4].

The case study concerned a boarding house in the Crasna commune where the first phase involved the inventory and mapping of all the natural resources with very valuable tourist potential, which represent a real asset for the practiced tourism activity. Also, the totality of existing anthropic tourism resources was studied, being represented in particular by the multitude of monumental architecture and art objectives, religious and cultural edifices of unique beauty, the Constantin Brâncusi sculptural ensemble from Târgu-Jiu which includes 4 monuments of great artistic value, internationally renowned: the Kissing Gate, the Column of Infinity, the Table of Silence and the Alley of Chairs.

After identifying all the factors that can positively favor the tourism activity practiced at the Boarding house, the main economic indicators on the basis of which the tourism activity and the quality level of the practiced management were characterized and diagnosed were also studied.

These indicators mainly concerned the tourist offer of the boarding house, tourist traffic, the utilization index and the degree of occupancy, indicators on the basis of which a series of conclusions could also be formulated regarding the level of competence of the staff working and especially on the quality and the efficiency of management activities.

The data have been collected from the National Institute of Statistics for the period

2018-2022 and analyzed in their dynamics pointing out the changes and trends.

RESULTS AND DISCUSSIONS

The study focused on the Crasna commune, which is one of the settlements in our country, which, together with several other localities, contributed to the study of the appearance of man on earth through human fossil remains discovered on its territory by researchers, speleologists and historians.

The documentary attestation dates from January 8, 1480, in a document issued by Voivode Basarab the Younger, ruler of Muntenia. Many locals still wear the popular port of the area, dominated by black and white colors. Also, on these plains, the old occupation of shepherding, as well as wood exploitation, fruit growing and mining are preserved in traditional forms [7, 10, 17, 22, 23].

(https://www.turistinfo.ro/). The area is located in the north-eastern extremity of Gorj County, at the foot of the Parâng Mountains, 33 km from Tg. Jiu, in a geomorphological unit within the Subcarpathians of Oltenia, at 400 – 600 m, half of the commune's surface belonging to the mountain range, whose altitudes exceed 1,300 m. In terms of accessibility and general infrastructure, the studied area is crossed by county roads and is easily accessible through the national road network of good quality (1,500 km of roads at the county level). In 2-5 hours, you can reach one of the big centers of the country - Bucharest, Timișoara, Craiova. The road network follows the connections with the major axes as well as the local county road network and totals 2199 km, of which only 610 km are modernized, the national roads comprise 356 km [7,10, 17, 22, 23].

The main forest roads of tourist interest are those that run along the valleys of Olteță, Galbenului, Gilortului, Sohodolului, Bistrița, Motrulu, the upper basin of the Cerna valley. Railway transport is very important for Gorj county, the national route (Timișoara - Bucharest) crosses the entire county and within the county the six important cities, but also 35 other localities, are connected to the railway [7,10, 17, 22, 23]. Regarding the air network, the county is not equipped with an airport, the nearest airports are in Sibiu (79 km), Craiova (115 km), Caransebeș (174 km), Timișoara (279 km). Also, the distance from the main air entry point in Romania, Bucharest-Otopeni airport, is 330 km.

The study of natural and anthropogenic factors with a favorable impact on tourism in the studied area

The relief consists of three large physical-geographical units that descend in steps from North to South.

(1)Southern Carpathians, mountainous area represented by the southern slopes of the Parâng, Vâlcan and Godeanu Mountains, in the northern part of the county.

(2)Getic Subcarpathians; between the Motru and Gilort valleys are called the Gorjului Subcarpathians, and those between Gilort and Olteț belong to the Olteță Subcarpathia group that stretch between BistritaVâlceană and Gilort, crossed by the Olteț.

The Subcarpathians form the second relief step of the Gorj which consists of two rows of hilly peaks and two depression areas.

(3)The Getic Plateau is made up of sedimentary deposits (sands, gravels, clays, marls) material eroded from the mountains, carried by rivers and deposited in the Getic Basin [7,10, 17, 22, 23].

In these horizontal deposits, the rivers dug wide valleys (Oltețul, Amaradia, Gilortul, Jiul), accompanied by meadows and terraces with interfluves in the form of hilly ridges with orientation and inclination from north to south. The southern exposure of the area creates a favorable framework for the development of tourism, with prospects for mountain tourism, leisure and ecological tourism in the summer season. For the winter season, the southern exposure of the mountain massifs is an impediment to keeping a sufficient layer of snow for the practice of winter sports, this being possible, in conditions of profitability of the activity, only at altitudes above 1,400-1,600 m, depending on massive [7,10, 17, 22, 23].

The climate is temperate continental, with a wide variety of nuances, as a result of the geographical position, the atmospheric circulation and the relief components present. The average annual temperature records different values from north to south. The snow layer has an uneven distribution, in the high mountain area above 1,500 - 1,600 m it lasts 180-200 days (Parâng, Vâlcan, Godeanu) and its thickness can reach 7-8 m in sheltered areas. In the mid-mountain area, the duration is only of 140-150 days and decreases in the plateau to 60-80 days/year. This can allow the development of winter sports. In some areas the winter tourist season can last from December to April. Due to the location of the county in the South Western part of the country, it has a temperate-continental climate with Mediterranean influences. The multiannual average temperature is +10.2 degrees Celsius.

The multiannual average amount of precipitation differs depending on the area, being lower in the plains, respectively 500-600 mm, and higher in the mountainous areas, over 1,500 mm. [7,10, 17, 22, 23].

The vegetation includes: the floor of the alpine meadows located at high altitudes - the field of mountain hiking through the picturesque panoramas found here; the floor of coniferous forests, between 1,400-1,700 m, especially on the northern slopes, the predominant species being spruce and fir. The presence of these forests complements the landscape values and creates a negative ionization of the air, beneficial in climate therapy; the floor of deciduous forests includes: beech, hornbeam, hornbeam. Existing protected natural areas include species of wild plants and animals, biogeographical, landscape, geological, paleontological, speleological or other elements and formations, with special ecological, scientific or cultural value, which have a special regime of protection and conservation, established according to legal provisions [7,10, 17, 22, 23].

The fauna is very varied - the black goat on the alpine peaks, the bear, the wild boar, the wolf, the deer, the roe deer, the wild cat, the ferret in the deciduous forests, some Mediterranean species: the horned viper, the land turtle, numerous species of birds as well as a numerous aquatic fauna in the mountain rivers (trout, grayling, carp, etc.). The diversity of the area's fauna is an important attraction especially for foreign tourists for whom there are offers that include hunting and fishing activities. The special beauty of the places determined the desire to preserve, protect and minimize antropozation, a fact that led to the appearance on the territory of the county of numerous protected areas and nature reserves, which are well known and highly visited by tourists, which are no longer we present in detail in this study [7,10, 17, 22, 23].

The hydrographic network, the area is traversed from north to south by the Jiu River. It collects water from most of the rivers that pass through the county. In the North - Western part, the waters are collected by the Cerna River, and in the North-Eastern part by the upper course of the Olteț. At its origins, the Jiul consists of two branches, the western Jiul, which collects water from several streams that spring from the Vâlcan, Godeanu and Retezat Mountains, and the eastern Jiul, with springs in the northern slope of Parâng. The main tributaries of the Jiu that also cross the territory of Gorj county are: Gilort, Motru, Tismana, Bistrița, Gorjeana, Jales and Șușita. The largest lakes found in the county are man-made and were built for hydropower purposes on the rivers Cerna, Motru, Tismana, Bistrița, Jiu, Gilort and Olteț. The most important natural lakes are the glacial ones: Gâlcescu, Tăuri, Slăveiu, Mija, Pasărea and Godeanu. Thermal and mineral waters appear on the surface, from place to place, more than half of the county's surface is part of the "Băile Herculane-Bâlteni Geothermal Anomaly". In this area are present the thermal water eruption from Câlnic, the mineral waters rich in salts from Săcelu, the salty fountains from Bălănești and the thermal and salty waters, at the same time, from Țicleni [7,10, 17, 22, 23].

The anthropogenic tourist attractions specific to the area The existing architectural monuments in the area count 369 objectives, representing 72.21% of the total of historical monuments in the county. From the point of view of the value category, 27 are of category A, of national and universal importance, the rest being of local and regional importance.

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The treasury of this category of objectives is particularly rich and includes both civil and religious buildings. It is noted that in Gorj, in urban and rural settlements, a significant number of old houses have been preserved, valuable for the era and style in which they were built. Along with these, the 92 wooden churches, located in the cultural heritage, mostly located in the countryside, are impressive [7,10, 17, 22, 23].

The characteristic monuments of the architecture of Oltenia are thetype house Manor (cule), which are fortified dwellings, which allowed the small boyars to defend themselves and supervise their domains. There are 24 such constructions in Gorj county, of which 3 are still preserved in their original form today: Cula Cornoiu from Curtișoara, Cula Cioabă-Chintescu from Șiacu and Cula Crăsnaru from Groșerea, Aninoasa commune. To these can be added the house-cula from Glogova, which developed on the core of a cula. These constructions have an unique character due to the restriction of comfort claims in favor of those regarding defences, as well as due to the fact that in Romania they are found only in Oltenia and Argeș, and in the rest of Europe similar constructions appear only in the Balkans [7,10, 17, 22, 23].

The area is also dotted with a lot of churches, Cathedrals and memorial houses that date back to ancient times and still retain their unique charm. In this sense, we can mention the Petru Flondor and Ioan Mihuțescu households, houses and annexes (20th century), well preserved; "All Saints" church (1749-1753), original paintings, enclosure wall. Another very important tourist point is represented by the Ecaterina Teodoroiu Memorial House in the town of Târgul Jiu which is, in reality, the house where the heroine of the Romanian nation lived, having been built in 1884 by her parents. The house was transformed into a memorial house, in honor of the memory of Ecaterina Teodoroiu, only in 1959 [7,10, 17, 22, 23].

The specific tourist attractions of the studied area of inestimable value are those included in the Constantin Brâncuși sculptural ensemble from Târgu-Jiu, which includes 4 monuments of great artistic value, internationally renowned: the Kissing Gate, the Column of Infinity, the Table of Silence and the Alley of Chairs. Other tourist attractions worth seeing are: Crasna Monastery, Wooden Church, Tismana Monastery (one of the oldest Orthodox monasteries in our country), Polovragi Cave, Muierii Cave, Sohodolului Gorge and the reserve with the same name (declared a protected area due to its rare forms of relief that can be found here), etc, [7,10, 17, 22, 23].

Ethnographic and folkloric values are tourist attractions that can contribute to the creation of a unique offer of great originality for the area and the boarding house, because it has a multitude of traditions, the most famous being the popular dances and ports. An important annual event is the Pastoral Folklore Festival "The descent of the sheep from the mountain", organized at the "Saint Dumitru" Fair, an event that promotes the traditional crafts and occupations of the Olten people below the mountain [7,10, 17, 22, 23].

The Gorje lyric with its two categories must be capitalized: the doina (the "long song" of Gorje) and the actual song, which in turn has several subdivisions: outlaw songs, war songs, exile songs, songs of social oppression and trouble, songs of longing and love, songs of alienation, songs of the ages, etc. The long songs (doina song), are considered the musical-poetic genre representative of the popular culture in the area [7,10, 17, 22, 23].

The multitude of games, distinct from the past - "the belt", "the circle", "the hangover", "the lame", "the rust", "the bordeaux", "the leaf"... must be brought back to life, because nowadays they kept the most popular and widely circulated: "hora de mâna" and "serb", many of which were forgotten. Hora and Sârba are still played today without fail, anytime and anywhere, including in restaurants in the town of Târgu Jiu [7,10, 17, 22, 23].

One of the sensational tourist attractions with a crater of curiosity is the setting up of the first permanent hammock workshop at a height, 200 meters from the lower level of the Yellow Gorge. This can be, at the same time, a world premiere, taking into account the fact that in other parts of the world such workshops are organized only on an occasional (non-permanent) basis, within some mountain festivals. The workshop, operational on request, can ensure the stationing and relaxation of a maximum of 12 people at the same time, in conditions of appropriate lightness and safety, depending on requests and meteo conditions [7,10, 17, 22, 23].

Study on indicators that define the offer and quality of tourist activity at the Boarding house

According to what was observed on the ground, during the trip carried out with several master's students from the module Management in agritourism and the quality of agro-food products, we identified that from the point of view of the accommodation capacity, the boarding house has 7 double rooms, equipped with the necessary facilities, which denotes that the number of accommodation places is 14.

Table 1. The variation of four indicators characterizing the circulation and the quality of the activity tourist from the Boarding house, in the period 2018-2022

Years	Number of arrived tourists	Number nights	Average number of tourists arriving per day	Average duration of stay (Z)
2018	720	2,016	1.97	2.8
2019	680	2,108	1.86	3.1
2020	100	390	0.27	3.9
2021	250	625	0.68	2.5
2022	700	1,890	1.91	2.7

Source: processing from field and NIS data [15].

As can be seen from Table 1, the targeted indicators show us that due to the favorable tourist conditions and factors existing in the studied area, their values were at a higher level, with an obvious period of stagnation in the less favorable years, such as 2020 and the beginning of 2021, when tourists were less willing to travel due to the specific conditions of the pandemic. In the normal year from the tourist point of view 2022, the values of the two indicators, as can be seen, almost tripled compared to 2021, reaching 700 tourist arrivals and over 1,890 overnight stays. Regarding the average number of tourists arriving per day and the average length of stay, it can be seen that their values varied directly proportional to the evolution of the number of tourists and overnight stays in the boarding house. However, it can be observed that due to the tourist attractions with a specific character of eccentricity and even adventure, tourists were attracted and tempted to stay for a longer period at the Boarding house, because as can be seen from the same table, the average length of stay is longer, reaching an average of approximately 3 nights, during the period studied 2018-2022. The exception is the year 2021, when the value of this indicator is only 2.5 nights, but still, it is higher than the national average, which is approximately 2.2 nights, in boarding house.

Table 2. Number of days tourists stayed at boarding house, in the period 2018-2022

Years	Number of arrived tourists	Number nights	Total number tourist days (t)
2018	720	2,016	1,451,520
2019	680	2,108	1,433,440
2020	100	390	39,000
2021	250	625	156,250
2022	700	1,890	1,323,000

Source: processing from field and NIS data [15].

From Table 2 it can be seen that the highest number of tourist days staying at the Boarding house was in the years preceding the pandemic period, 2018 -1,451, 520 and 2019 - 1,433,440, in 2020 the lowest number was recorded, of only 1,323,000 days tourists staying.

Table 3 shows tourist demand in terms of tourist arrivals in the rural boarding house.

Table 3. Tourist demand at rural tourist boarding houses in the locality, in the period 2018-2022

Specification	Number of arrived tourists at Boarding house				
	2018	2019	2020	2021	2022
Boarding house of 4 stars/daisy	845	990	245	457	966
Boarding house of 3 stars/daisy	720	680	100	250	700

Source: processing from field and NIS data [15].

Tourist demand was highlighted by making a comparison between the number of tourists arriving at the boarding house under study, during the analyzed period, and the number of tourists arriving at a four-star/daisyboarding house in the same locality. Comparing the values in table three, it can be seen that they are slightly higher at the boarding house classified in a higher category, this fact is primarily due to the larger number of accommodation places and not to the better quality/price ratio.

Table 4. Accommodation capacity in operation (places-days) a boarding house, in the period 2018-2022

Years	Number of days of operation	The capacity of accommodation in operation
2018	310	4,340
2019	330	4,620
2020	245	3,430
2021	290	4,060
2022	320	4,480

Source: processing from field and NIS data [15].

The accommodation capacity in operation (places-days) of the boarding house, in the period 2018-2022, was calculated according to the actual number of days of operation in that year and the total number of accommodation places, which is 14 (Table 4).
This being the lowest in 2020, by 3,430 place-days, when the actual number of days of operation was 245, the rest up to 365, the boarding house did not operate for reasons of safety and sanitary security.
As can be seen from Figure 1, the two indices varied very little during the period with normal conditions in terms of tourist traffic. The highest value of IU was recorded in the second year of study 2019, of 34.28%.

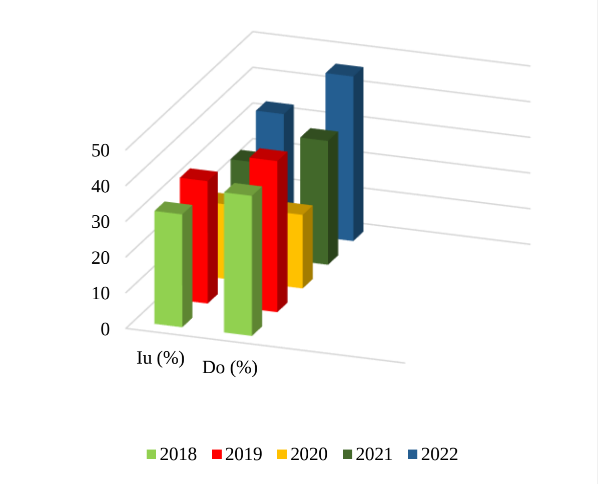

Fig. 1. Variation of the utilization index (Iu) and the degree of occupancy (Do), of the boarding house, in the period 2018-2022
Source: processing from field and NIS data [15].

Regarding the degree of occupancy, it had fluctuating values especially in years with severe restrictive conditions during the spread of the Covid-19 virus, the lowest value being in 2020, but what is significant to observe from the same figure is the fact that, tourism activity after the pandemic began to recover, the degree of occupancy increasing in 2022, to 46.14%. The high values of most of the indices studied were directly influenced by the very favorable location of the boarding house, in the northern part of Gorj county, right at the foot of the mountains, thus owning part of the Rânca tourist area, which is an objective major tourist attraction, both in winter (via the ski slopes) and in summer, through access to the beautiful and picturesque mountain road - Transalpina.
The common area used with the Rânca Tourist Complex is ideal for practicing various winter sports (skiing, snowboarding, sledding), summer (cycling, rafting), extreme sports (paragliding), mountain hiking (including riding an ATV or off-road motorcycles), as well as for spending moments of recreation and rest. It can also be said that they were positively influenced by the location of the boarding house near one of the sensational tourist attractions with a crater of curiosity, the permanent hammock workshop located 200 meters from the lower level of the Yellow Keys, this being operational on request and can ensure the

parking and relaxation of a maximum of 12 people simultaneously.

In addition to these tourist attractions of maximum originality and inventiveness to attract tourists, the manager and the staff of the boarding house have continuously concerned themselves and supported the improvement of the quality of the services offered, by diversifying and perfecting all the leisure and gastronomy products included in the boarding house's offer. Tourists who choose this destination are not only attracted by the wonderful landscapes, places torn from stories, but also by the tasty traditional dishes prepared with great skill by the housewives of the area. At the Alex and Maria boarding house you will be able to taste the best mutton, lamb and veal stew, because it is prepared according to hundreds of years old recipes, recipes that speak of the Gorju of past centuries, when meat and bread were food for the rich, when fasting was holy, when the dishes were truly traditional. Healthy and tasty food has always been the concern of the owner and staff at the Boarding house, who were guided by the saying "to cook well, you don't only need ingredients, you also need eyes, mind and soul". Among the delicious dishes is the traditional pumpkin seed chiselita, which is different from the cherry or plum one. Chiselita is a fasting food, very tasty and very healthy, and it is made from peeled seeds or those that do not have a shell of their kind, which are crushed, sifted through a fine sieve and scalded with boiling water, adding hot water until a pancake-like sauce is obtained, boil until it binds like a slightly thinner custard. It is eaten cold or warm, with whatever you have at hand, bread or malai (maize flour) or polenta", it is written in the commune's monograph. Tourists arriving at the Alex and Maria Boarding house can serve both traditional dishes and dishes specific to the area they come from (very few choose this), but the ladies from the kitchen are at their disposal, being prepared to prepare any kind of food. Also, here, tourists are offered meals prepared from products mostly obtained in their own household (including fish products) or from locally authorized fishermen. The hosts are directly in charge of welcoming the tourists and their program throughout the stay, just like at agritourism farms in France or EU countries. Trout dishes are in the first places in the demand of tourists, housewives prepare it in a unique way, which exploits it at the highest level and satisfies the taste buds of the guests.

CONCLUSIONS

The area of the Crasna commune where the agritourist boarding house under study is located is characterized by a very easy level of accessibility, being criss-crossed by numerous national and international road and railway routes. Regarding the natural factors favorable to the practice of agritourism activity, it was found that this area is special due to its location at the foot of the Parâng mountains, thus also using a part of the Rânca tourist area, which is a major tourist attraction objective, both during winter (through the ski slopes) and during the summer, through the access to the beautiful and picturesque mountain road - Transalpina.

Also, from the analysis of the anthropogenic factors favorable to the practice of agrotourism in the area of Crasna commune, it was concluded that within a radius of more than 30 km, which is the recommended size for research in tourism, it has a multitude of well-known touristic objectives and consecrated, but on which there was not a lot of insistence. In the part allocated to the study of anthropic factors, more emphasis was placed on the factors by which the tourist offer of the area and implicitly of the boarding house can be clearly and significantly differentiated from other offers, from other mountain areas in our country, because only in this way the boarding house can arouse the maximum interest of tourists to visit it and stay as long as possible. Based on the study on the circulation and the quality of tourism activity in the Boarding house, it was concluded that the values of these indices are at a higher level than those registered at the national level, due to the significantly positive influence of the adaptive and performing management practiced.

The boarding house has influenced the behavior of tourists by introducing into its offer some tourist attractions with a character of originality and curiosity, such as making the most of the position in front of the permanent hammock workshop located 200 meters from the lower level of the Yellow Keys, serving some traditional dishes as and dishes specific to the area where the guests come from, upon request, as well as offering meals prepared from products mostly obtained in the own household (including fish products) or from locally authorized fishermen.

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AGRICULTURAL AND RURAL DEVELOPMENT IN THE CONTEXT OF A CIRCULAR ECONOMY IN THE EUROPEAN UNION AND FRANCOPHONIE STATES. CASE STUDY: ROMANIA

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Abstract

The paper presents the current situation as regards the circular economy in agriculture in Romania, while also taking into consideration its global impact. We have here a system globally endorsed by the United Nations. It is also important for regional organisations such as the European Union or la Francophonie as the circular economy seems to have a high number of advantages in tackling climate change, creating a sustainable food chain, improving the organic character of the agriculture, etc. From that perspective Romania represents an interesting case study as it is both a European Union member state and a member of the Francophonie. It thus follows both sets of rules and recommendations in order to improve its status. The paper uses the bibliographic method and reviews the main documents that settle this aspect and presents the legal framework for circular economy. The put into practice of the circular economy in the Romanian agriculture would bring a series of advantages (environment, food safety, etc.) while also requiring systemic transformations.

Key words: *circular economy, European Union, Francophonie, Romania, agricultural sector*

INTRODUCTION

The concept of circular economy is not limited to the European area but rather has a global outlook given its importance. As described by the United Nations Organisation the key idea behind was “the goods of today are the resources of tomorrow at yesterday's resource prices” [25].
The working definition at the United Nations level is works form the idea that the circular economy “aims to minimize waste and promote a sustainable use of natural resources, through smarter product design, longer use, recycling and more, as well as regenerate nature”. It is a working interpretation that is meant to underline the fact that we cannot fight the climate change without using circular economy methods and means. It matters because now we can have a global working definition that can be used in both European and Francophonie states [26].

Another key relevant global actor in defining what circular economy is and whose activity help promoted it, is the Ellen MacArthur Foundation.

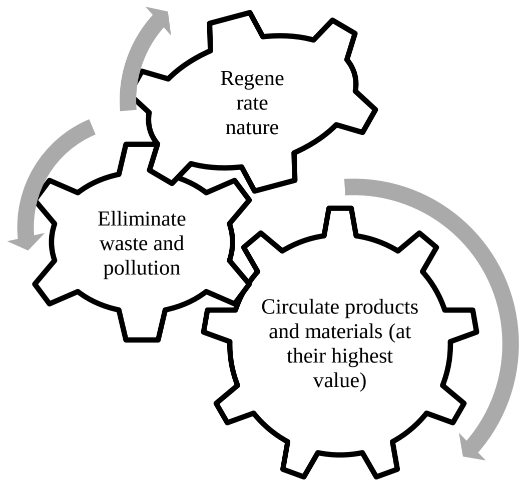


Fig. 1. The three principles of circular economy
Source: own design after [12].

It has provided a key blueprint on what circular economy is and why it matters (Figure 1).

Given the global outreach and consequences we need also to move forward toward other states and see whether we can see the circular economy applied to other states outside the EU.

One such regional structure is represented by the Francophonie states and their immense untapped potential. They matter also because we have an overlapping between the some of the European Union Member States and the Francophonie states. When we speak about Francophonie we understand both the human side, of the over 320 million French speakers across the world and its institutional side with the International Organisation of La Francophonie. Also one of the mandates of the Francophonie is to foster economic cooperation in order to bolster sustainable development [20].

A key document for the entire Francophonie is its Economic Strategy for the Francophonie adopted in 2014 which underlined the need for an economic model that respects the environment, puts the individual to the center of sustainable economic development process and acknowledges the Sustainable Development Objectives [24].

Given the fact that most of the Francophonie member states are located in Africa and Asia, the need for them to create sustainable agricultural systems, where circular agriculture is a reality, due to the constant pressure of demographics and climate change, is a stringent one. If we take for instance the case of African states, we see that the concept of circular economy applies to the agricultural system matters but only if we have a reshape of the system in place. We need to have bottom-up strategies, easy to implement by local farmers, as well as financial investments and more education and capacity building. Also a better understanding of the traditional agricultural practices (such as agroforestry, crop rotation, etc.) may help its implementation [2].

Given the European Union twin transition green and digital, the topic of the circular economy became important in academia and public arenas.

A particular attention was given to the circular economy, an economic model "which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible" [10].

This would be put into use as at the European Union level we assisted to the discussion of the so-called CAP Strategic Plans. The Strategic Plans were meant to present the needed interventions for each country while also providing much needed solutions in order to reach the goals of the European Green Deal. The Strategic Plans are a map toward sustainable climate action, protecting natural resources, preserving biodiversity, as well as the enhancing the socio-economic fabric of rural areas. In fact, each Strategic Plan should provide the national response meant to facilitate the reach of the ten key objectives of the CAP [7].

The EU's Action Plan of Circular Economy is an example of a European initiative that targets the entire life cycle of different products. Areas of interest include water, nutrients, food and, in addition to regional aspects, it also wants to ensure waste is reduced while achieving a global impact [9].

Functional waste system was an important element underlined at the European level. The management of the waste is a part of the circular economy and we cannot speak of any measures on that unless we find ways of better using all the resources. Recycling is both an answer to population growth, diminishing resources and geopolitical challenges [15].

Romania was selected due to its double characteristics, both as a European Union member state and a Francophonie state.

Romania had become an institutional member of the Francophonie as early as 1993 soon becoming a leading member within the Organisation with a high number of French speaking people. Moreover, French is the 3rd business language in the world and a great number of them being located in Africa (59% of the daily French speaking persons). The dynamism of the Organisation, the Declarations it has adopted as well as it variety of practices make it an ideal learning place to be for Romania, which shares some its challenges and may come up with some solutions [1].

The circular economy is becoming more and more relevant as it helps build a food system that helps people and nature prosper. If we want to maintain our biodiversity and tackle climate change, we need to reform the food system by using the principles of circular economy. It is an ongoing problem as the current food system is a system that needs reform due to a series of ongoing problems that affect it: more and more climate change generated extreme weather problems, population increase, water shortage problems, decrease of the quality of the available farming land, uncontrollable use of pesticides and other chemical substances (see Figure 2) [11].

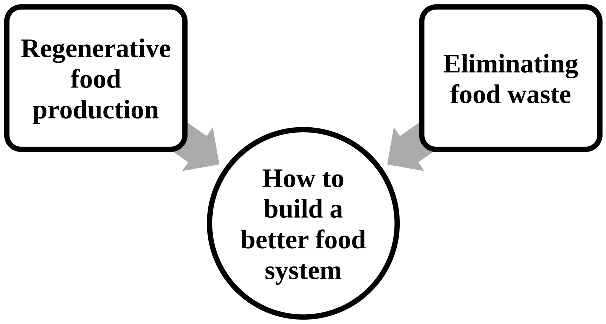


Fig. 2. The three principles of circular economy for food system
Source: own design after [11].

It matters also for the fight against climate change as the global food system is estimate to account for a third of the total greenhouse emissions. Some researchers say that if we could implement the circular economy in the agriculture sector and especially in the food production area we can reduce these emissions by half. Surprisingly the cities can lead this transformative process if properly managed [6].
This paper intends to present the legislation in place in Romania (the main documents) while also presenting the advantages and the importance of circular economy in agriculture. Why it matters and why do we have to invest in are is the main questions of today in the field.
Starting from relevant documents on circular economy, the paper presents the European Union recommendations, good practices examples, etc. that would identify the potential evolutions of the agricultural and rural development in the framework of a circular economy in the European Union and Francophonie states.

MATERIALS AND METHODS

Circular economy represents a new way of doing business in the agricultural system that we should analyse and implement based upon other states experiences.
To analyse the information and provide an accurate representation the preferred method of choice was the use of desk research information. An analysis of the official documents in place in Romania (Ministry of Agriculture and Rural Development, Ministry of Environment, Water and Forestry) and abroad (European Commission, European Parliament, etc.) was taken into consideration to map the main references and identify the key data concerning the case of Romania.
The article mapped the main legislative documents related to circular economy from Romania as well as their connection with the agricultural sector.
We have had also a review of scientific papers, articles, studies and research between agriculture and circular economy.
The data are taken from the official websites of the Romanian Government and of the European Commission as well from other relevant academic sources.
Also we have done graphical representation of the information extracted from the consulted sources.

RESULTS AND DISCUSSIONS

As regards Romania we need to have in mind first and foremost the fact that Romania has a lot of untapped potential and room to grow as regards circular economy.
Unfortunately, this is not due to rather general enthusiasm or well place structures in place but due to low national positioning in this domain (Figure 3). The National Strategy regarding the circular economy provides some key elements that define the impact of circular economy in agriculture and rural development that offer us a starting point for future iterations (see Table 1).

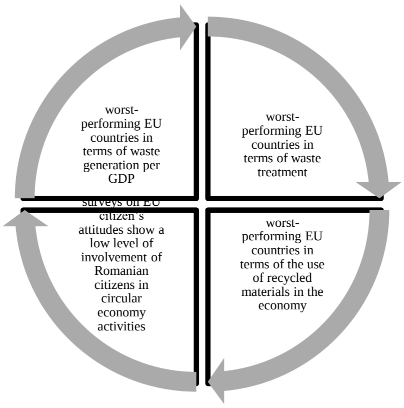


Fig. 3. Romania's relationship with the circular economy
Source: own design after [8].

Table 1. Aspects regarding starting elements and identified problems

Starting elements	Identified problems
- Agriculture, forestry and fishery represent a stable share in the economy (5% of GDP for 2010-2020). - Employment fell from 32% in 2010 to just 21% in 2020. - Approx. 16% of greenhouse gas emissions - agriculture, - absorption net CO2 - the forestry sector offsets – about 20% of emissions from other. - Intensive use of pesticides, herbicides and chemical fertilizers, and the inefficiency of irrigation systems result in loss of biodiversity, water pollution and soil quality degradation. - Intensive consumption of wood. - Loss of breeding grounds and habitats for birds and small game	- Low levels of use of sewage sludge, biological fertilizers or compost on agricultural land. - Deforestation and illegal cutting of trees. - No legislation to strengthen circular economy in the agri-food supply chain. - Inexistence of irrigation infrastructure. - Implementation of farm-to-consumer policies on inputs/factors of production such as seeds, fertilizers, machinery, reproductive material, etc. and outputs/production (processing of food and by-products).

Source: own presentation after [8].

One of the first relevant documents as regards the relationship between circular economy and agricultural sector in Romania is the document called National Waste Management Plan of 2017 which provides a clear starting point. It matters because it includes a series of mentions to the type of wastes generated by agriculture, forestry and fisheries and a classification of these wastes while also setting up a series of key objectives in relationship with them (Figure 4).

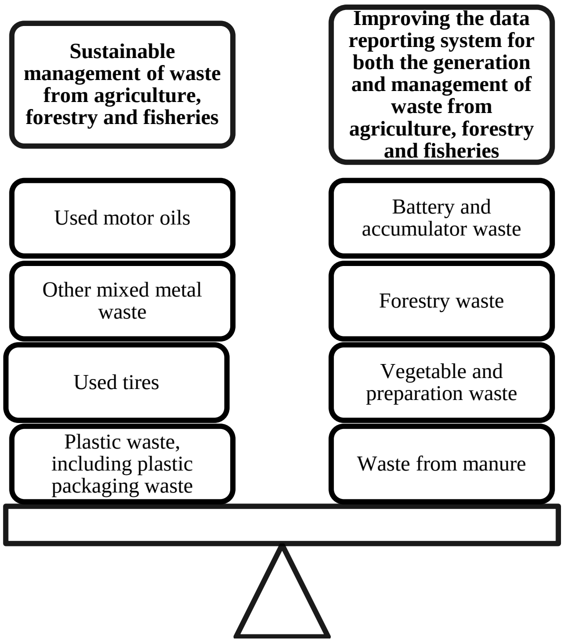
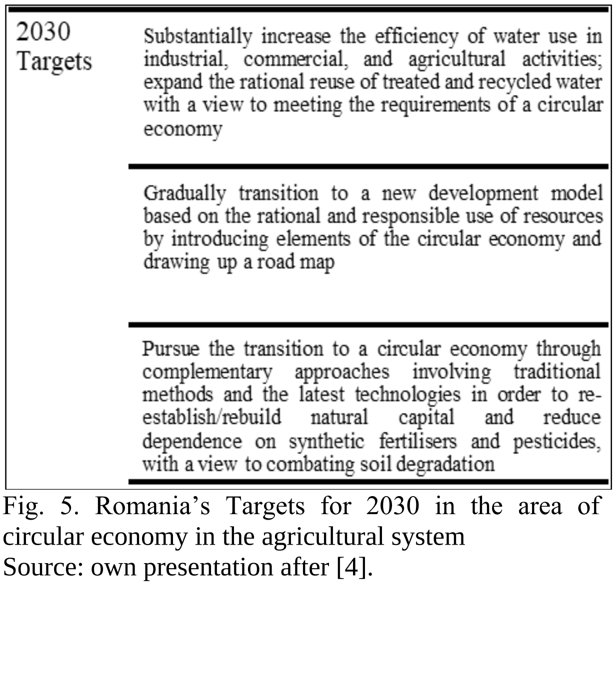


Fig. 4. Waste classification from agriculture, forestry and fishery and the two key objectives related to them
Source: own design after [19].

It matters as we are provided with an officially assumed classification of wastes and with the possible objectives to be addressed in relationship with them.
Given Romania's need to secure a transition towards circular economy one of the earliest and most important documents that highlight this is Romania's Sustainable Development Strategy 2030. It is a proof of the influence of the United Nations goals and objectives on Romania.



2030 Targets	Substantially increase the efficiency of water use in industrial, commercial, and agricultural activities; expand the rational reuse of treated and recycled water with a view to meeting the requirements of a circular economy
	Gradually transition to a new development model based on the rational and responsible use of resources by introducing elements of the circular economy and drawing up a road map
	Pursue the transition to a circular economy through complementary approaches involving traditional methods and the latest technologies in order to re-establish/rebuild natural capital and reduce dependence on synthetic fertilisers and pesticides, with a view to combating soil degradation

Fig. 5. Romania's Targets for 2030 in the area of circular economy in the agricultural system
Source: own presentation after [4].

This 2018 Strategy stipulates the fact that transitioning to the circular economy is a way to reach the 2030 setup goals.

That process also involved a series of measures that would have a direct impact upon the agricultural system as seen in the Targets established for 2030 (Figure 5).

All the above mentioned documents were put to use as the CAP Strategic Plan of Romania for 2023 – 2027 was discussed. In 2021 – 2022 the relevant national stakeholders discussed this Plan and how it should be tailored for the local needs given Romania's peculiarities.

First and foremost, the Plan emphasizes the complementarity with the National Recovery and Resilience Plan in relation to the importance of investments in developing the circular economy in the waste management schemes. Also the complementarity with the national Operational Program Sustainable Development (PODD) concerning the investments in water management are there. Another complementary programme is the LIFE project (circular economy and renewable energy).

Also mentions the financial support given for investments in the wine sector that support the circular economy. The circular economy investments are eligible for financing scheme dedicated to the young farmers / flower and medicinal plants farms / vegetable sector / (installations for energy production and organic fertilizers, etc.).

Circular economy investments constitute a criterion for prioritising investment projects in other areas of activity [18].

Circular economy is also about coordination. The Green Deal at the European Union level as well as the ambitious climate target require a high level of coordination between public national and European administration, the economy and the society. We need this coordination as circular economy not only focuses on the way things are done but also how and for what we do that instead of this.

The COVID-19 pandemic, the war against Ukraine have forced a speed up of this process. The implementation of the circular economy, like in the case of the Municipality of Almócita (Almería, Spain) have shown that alongside the entire life cycle of an agricultural product you also need to take into consideration the need to have efficient business models that may implement it correctly. It also requires strong technological research and investments in order to have the new technologies up and ready (for the management of livestock manure for instance). Last but not least education and training of farmers and consumers alike are of outmost importance. Raising awareness, taking use of the local capacities, alleviating major problems such as lack of knowledge and education, of regulatory guidelines, of technology are all essential for the built up of a relevant model for each community [5].

Circular economy also plays a key role in environment related issues. As the use of pesticides is becoming more and more controversial we started to realise the importance of recycling of pesticides in the agricultural eco-system in order to have healthier products. Romania has a high level of pesticide consumption, being in top 6 countries in the European Union as regards the consumption of pesticides. This should be correlated with the low level of organic farming (just 5% of the total agricultural production in 2019). Given that importance of collecting and recycling pesticides grew a lot and Romania can and may use this as an opportunity to enhance its circular economy activities [14].

This trend is also supported by other countries use of pesticides and the impact of circular economy on that use. For instance, in Spain the application of a circular economy as an alternative production model may represent a solution to prevent its uses and abuses, as well as it may prevent the presence of other chemical substances. The reutilisation of by-products as well as other techniques may indeed represent something useful [21].

The above mentioned documents only underline the fact that circular economy is of outmost importance for family farms, for instance. Some studies have shown that the family farms, tend to use all the resources they have, a circular economy characteristic. The fact that the small family farms rely on circular economy practices for their survivability may also endanger the use of these practices due to the strong competition with larger local farms and abroad agricultural products that may or not may use circular economy methods but definitely they endanger those who use them currently [17].

Contrary to other European trends, Romania remains a country that promotes increased consumption of raw materials, in a certain period of time, while the EU average shows a relative decline. While the EU's raw material consumption fell by 11% between 2011 and 2020, Romania's raw material consumption increased by almost 53% during the same period. Simultaneously the circular material use rates indicator, which show how much recycled material is used decreased by approx. 46% between 2012 and 2021 [22].

When we speak about circular economy we also need to have in mind the circular economy - (agro)tourism due as they are an agent of change [16].

Circular economy is not a panacea for the problems of the agriculture. For instance, this is the case of the circular economy and of the problem generated by the rather short life cycle of food. In order for a farmer to be competitive he or she must be sure that their products reach the intended consumers in time, at the right quality and also that the products done through circular economy methods are commercially sustainable. We are dealing with factors such as the geographical differences between regions, the attitudes of consumers (would they pay more for products that are more expensive or would they contend with products that are produced locally, in a sustainable matter and therefore be less inclined in buying products from other regions / continents that are not necessary produced using circular agriculture more sustainable ways, etc.). However, a collaborative approach, education of consumers and knowledge and know-how sharing may tip the scale in time [13].

A possible solution for the Romanian agricultural system, given the above mentioned date about the share of the organic farming should be to identify and put into reality the best practice that by using circular economy in agriculture would led to the unleashing of the potential of the integrated organic farming. This novel concept presupposes a reduced use of chemicals and the reuse of agricultural waste in order to create a system as close to the nature as possible [23].

We need to have in mind that in order to build our own model of circular economy in agriculture we need to keep an open eye to other best practices abroad, while using the structural funds available to us. We can create some additional scoring criteria for the financing of agricultural projects (Figure 6).

Additional scoring factors for proposals	promote options for prevention, recycling, disassembly, recycling of products in a sustainable manner by making the activities as small as possible
	introducing a voucher type for companies that promite the circular economy through implemented projects
	quantity of packaging waste, purchase of renewable energy products, bio-economy, etc.

Fig. 6. Potential new criteria for financing circular economy projects in agriculture
Source: own design after [3].

Implementing circular economy is a process than as we see requires a concentrated effort on behalf of all the responsible structures, either governmental or private.

We need to have a full series of instruments in place to implement it, either financial, technical or legislative ones.

CONCLUSIONS

Circular economy is an important aspect of today global economy as it helps reduce the costs and fulfil the climate goals as established by various global and European agreements.

As regards Romania we have just put into practice the main legislation strategic documents that would help us stimulate the circular economy in the agriculture and rural development sector.

The circular economy in this sector entails a process of ample transformations meant to generate sustainable economic growth and environmental sustainability in our country. It is not a process limited solely to Romania but rather a European and global process. It presents important opportunities for the reduction of wastes, the elimination of pollution and for a better natural and human resources management.

The circular economy application also involves a reform of the structures in place and of the educational system. We need to incorporate the principles of the circular economy into the agricultural value chains as well into the educational system. Also a lot of investments should be done in the new technologies adapted to this new system.

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CHALLENGES AND ALTERNATIVES ON THE FORAGES RESOURCES PROVIDING UNDER CURRENT ENVIRONMENTAL AND CLIMATE CONDITIONS

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Abstract

Forages resources represent the vector between vegetal production and animal production, constituting, at the same time, the category of essential inputs for obtaining favourable technical-economic results in the animal breeding sector. The paper analysis the challenges and risks faced by these fodder resources in the context of environmental and climate changes, also presenting substitution alternatives, in case of deficit situations. As research methods used, descriptive and comparative analysis can be listed, along with correlations and analysis of statistical indicators, based on available official data. The analysis highlights the fact that, in the conditions of climate changes, ensuring the fodder for animal farms can present certain risks and, consequently, it is necessary to take managerial decisions to improve efficiency and reorientation in the structure of fodder crops, considering their nutritional qualities.

Key words**:** *fodder, challenges, environment, climate*

INTRODUCTION

Agriculture is essential for food security under future climate conditions. In this context, the quantity and quality of fodder is an important criterion for ensuring plant and animal production [2].
Agriculture is the first element in nature most affected by climate change [1].
The variability of natural and climatic factors acts complexly and directly on the vegetation, determining the quantity, quality, and rhythm of plant production. The climate is of particular importance for agricultural production, determining the large areas of vegetation and the possible area for the spread of crops. The frequency and duration of annual drought periods, as well as the frequency of years with low precipitation, annual and seasonal temperature values, precipitation amounts and their distribution, solar radiation influence the level, quality and rhythmicity in fodder production, the length of the growing season, respectively feeding with green forages, the variety of crops, the organization system of the green conveyor, etc. In warmer areas with sufficient rainfall, the duration of vegetation is longer, the period of feeding animals with green fodder longer, a richer variety of fodder crops [13].
The forage productivity is affected by environmental factors, which can lead to nutritional problems for animals [9].
The change in climatic and environmental conditions has as consequence the modification of the nutritional composition of the forages and their digestibility [10].
Global warming may, also, limit the expansion of animal husbandry in warmer, drier regions if there are significant losses in the efficiency of animal production [8].
Water storage solutions can help mitigate the effects of drought, but if irrigation is not available, the soil moisture deficit increases, with repercussions on forage production. The use of new varieties, resistant to drought, is one of the solutions for adapting to climate change [3].
In the current environmental and climate conditions, the culture of forage plants must aim at their tolerance to acute stress, more than to the long-term climate [7].
Such information is needed by producers, decision makers, processors, to adapt agricultural systems and practices to become more resilient to climate variability and

extreme weather events [14].

In this context, the paper aimed to analyze the challenges and risks regarding fodder resources under the climate and environment change and to propose new forage alternatives when animal farms could face with deficit.

MATERIALS AND METHODS

As research methods, there were used descriptive and comparative analysis, correlations and analysis of statistical indicators, regression functions, R square, graphical design, based on available official data from National Institute of Statistics (NIS) [11] and National Meteorology Administration (NMA) [12].

Also, to estimate the size of a crop's risk based on a data from a series of the last 10 years, it was used the formula described by [13] (Formula 1).

Rk= ((QN x 100)/(DY x P)) x (DY / TY) =
= (QN x 100)/(P x TY)................................(1)

where:

Rk = the crop risk (%) of the average production achieved per period analysed;

QN = the quantity not realized in deficit years, compared to the average of the period;

P = average production per hectare achieved in the period analysed;

DY = number of deficit years;

TY = total number of years per period.

RESULTS AND DISCUSSIONS

According to data for Romania from the European Drought Observatory, for the first decade of 2024, the combined drought index at country level was 25%, with 3.5% degree of vegetation damage (obviously low, not being a vegetation period).

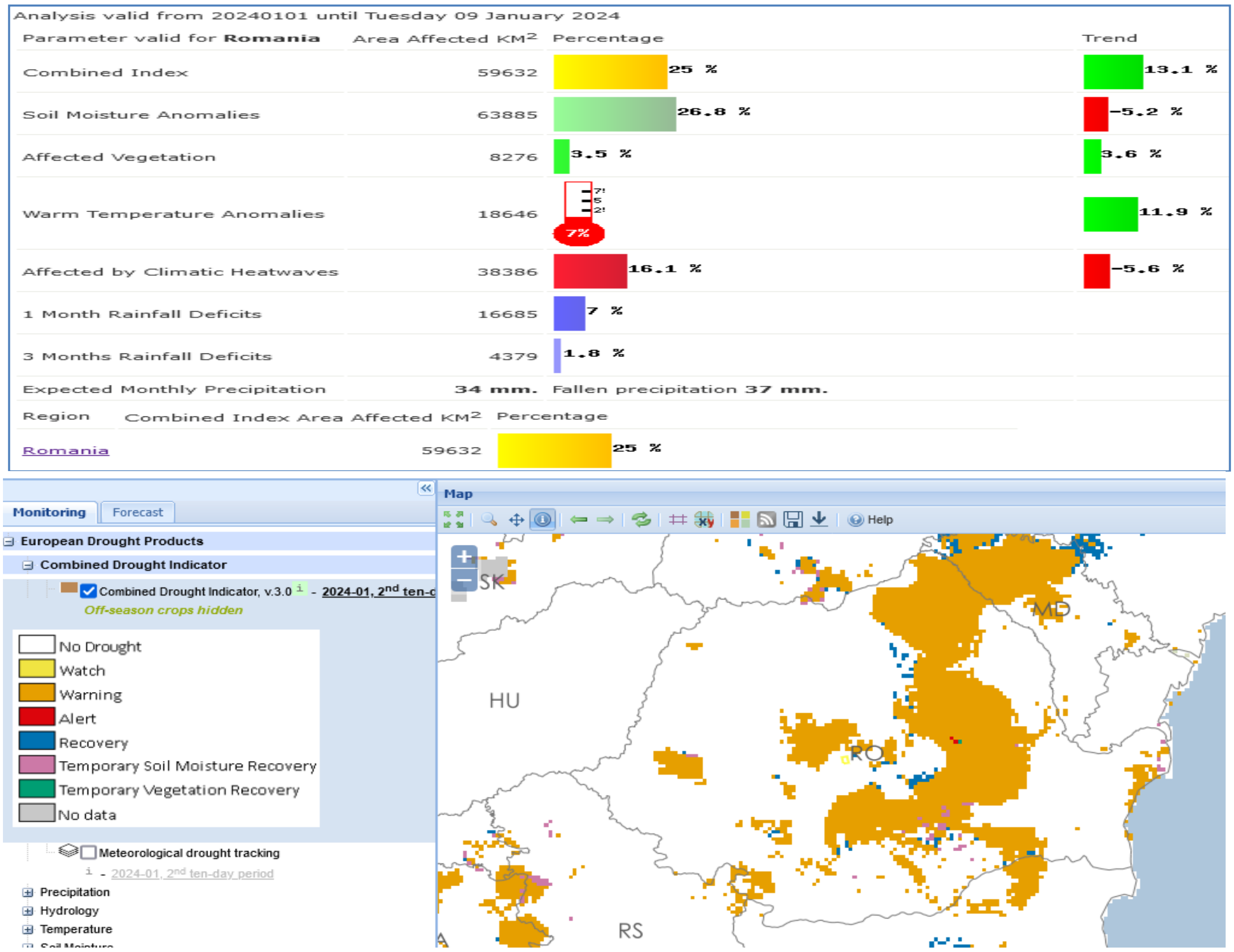

Fig. 1. Drought Dashboard for Romania
Source: European Drought Observatory [5].

The level of the drought is in the "warning" stage, affecting mainly the east, southeast, south, and partially the centre of Romania (Figure 1).

Prolonged droughts lead to the reduction of livestock, constituting calamities with serious economic repercussions. The climate factor determines to a certain extent both the volume and the quality of the fodder. Knowing the production potential and the nature of the fodder, is of particular importance for the rational organization of the forage's resources and animal production.

The Pearson correlation coefficient of 0.44 calculated between the amount of average annual precipitation from 2012-2022 and the average production of green alfalfa indicates an acceptable correlation between the two variables, and the coefficient of determination R^2 shows that 18.97% of the production average of alfalfa can be explained by the linear relationship with the amount of average annual precipitation (Figure 2).

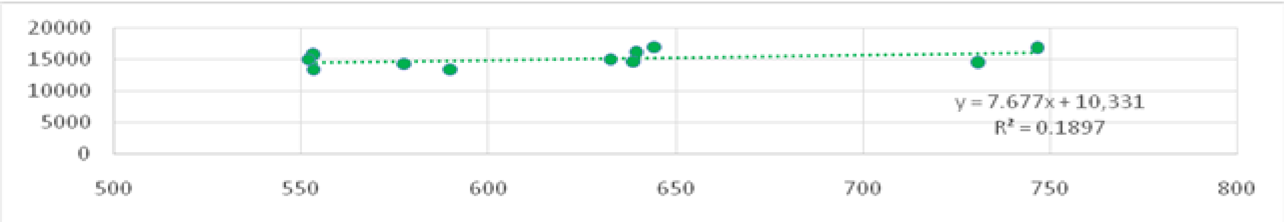

Fig. 2. Correlation between 2012-2022 average annual rainfall and average green alfalfa production
Source: own calculations based on NIS [11] and NMA data [12].

Regarding the behaviour of forage plants in the current environmental and climate conditions, they have different requirements and different degrees of adaptation. Alfalfa is highly drought tolerant and heat loving. Also, *Onobrychis viciifolia*, *Lotus corniculatus*, *Agropyrum cristatum*, *Bromus inermis*, autumn vetch, peas, Sudan grass, sorghum are drought-resistant forage plants. The Pearson coefficient of 0.52 between the amount of average annual precipitation from 2012-2022 and the average production of perennial forages indicates a good correlation, and R^2 shows that 26.58% of the average production of perennial forages can be explained by the linear relationship with the amount of average annual precipitation (Figure 3).

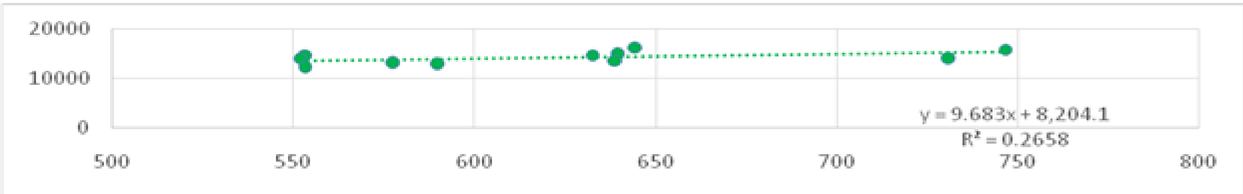

Fig. 3. Correlation between 2012-2022 average annual rainfall and average perennial forages production
Source: own calculations based on NIS [11] and NMA data [12].

So, natural meadows and hayfields are affected by the continuous lack of rainfall, reducing their yields, quality, and structure, and depriving them of the nutrients so necessary for the large and small ruminants that practice grazing. Plain and hilly areas are characterized by a high participation of concentrated fodder, especially corn, as well as green forages, which offer the possibility of developing ruminant farms - cattle and sheep. On the other hand, concentrates offer the possibility of developing pig and poultry farms, for which this type of feed is essential. And in the hilly areas, there is a greater participation of green forages, followed by succulents, concentrates and hay, and in the mountainous area, green forages and hay are found in higher proportions, the other categories (succulents, concentrates, straw) being in smaller proportions. The Pearson coefficient of 0.30 between the amount of annual average precipitation from 2012-2022 and the average production of green maize indicates an acceptable correlation, and R^2 shows that 8.97% of the average production of green corn can be explained by the linear relationship with the amount of average annual precipitation (Figure 4).

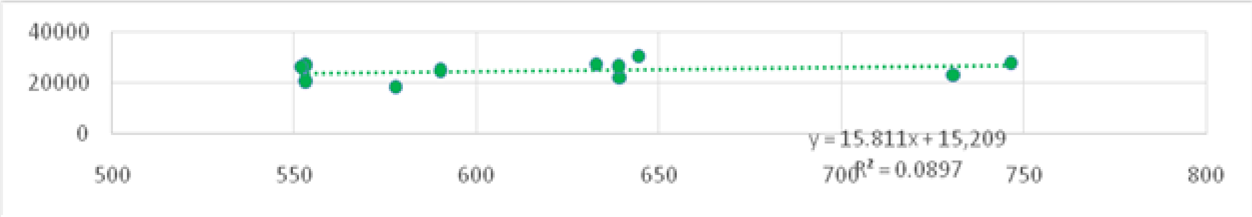

Fig. 4. Correlation between 2012-2022 average annual rainfall and average production of green maize
Source: own calculations based on NIS [11] and NMA data [12].

Mitigating the effects of drought can be achieved by irrigating the crop areas and by organizing fodder reserves, which size depends on the risk and fluctuation of the respective harvests. The risk's size of a crop can be expressed by multiplying the frequency of years in which the harvest deviates in the minus during the studied period, and the amount of these deviations, in relation to the average production per hectare achieved during the period (Nica V. & collab.). The risk's size of a crop is an important criterion for determining the size of the reserves. Also, larger reserves must be provided for dairy cows and young bulls than for sheep, because the numbers of the latter are restored more easily, and sheep can exploit grazing from resources other than those from fodder production. According to statistical data, the average production per hectare for green alfalfa in the last 10 years was 15.2 tons (Figure 5).

Dividing the sum of the unrealized quantities to the number of deficit years from the period under study (years with production under average), the result is a non-realization coefficient of 0.8 tons/ha (meaning 5.3%). Applying the crop risk formula to alfalfa yields, results a frequency of 60% deficit years and a crop risk of 3.17%.

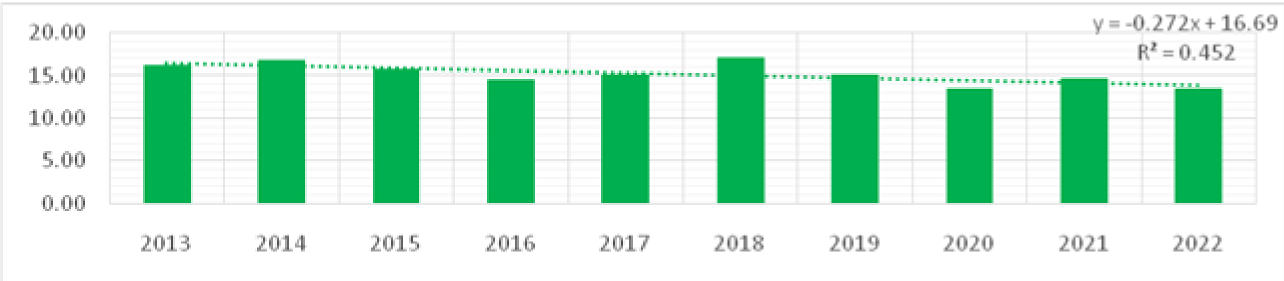

Fig. 5. The evolution of the average production per hectare for green alfalfa
Source: own representation based on NIS data [11].

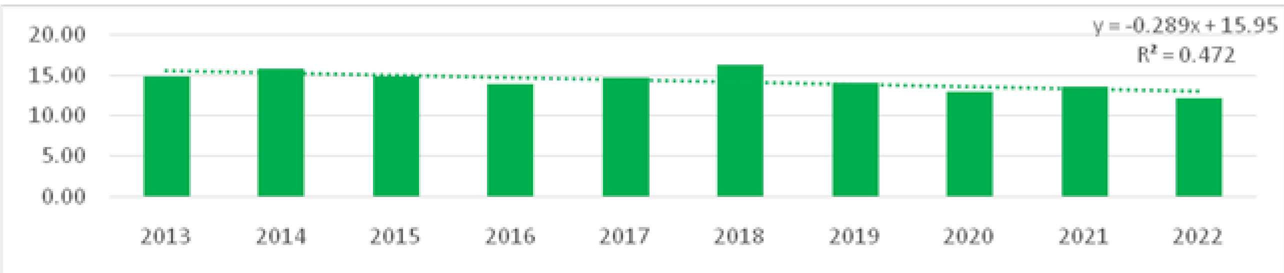

Fig. 6. The evolution of the average production per hectare for perennial forages
Source: own representation based on NIS data [11].

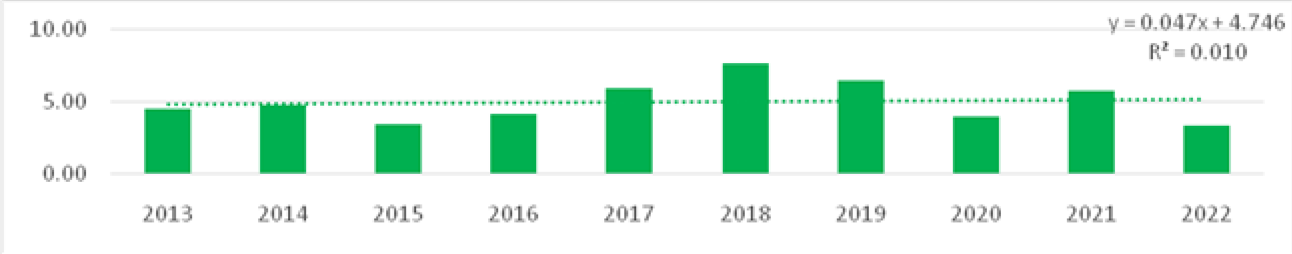

Fig. 7. The evolution of the average production per hectare for corn grains
Source: own representation based on NIS data [11].

For perennial forages, the average production per hectare in the last 10 years was 14.36 tons (Figure 6). The non-realization coefficient was of 0.99 tons/ha (meaning 6.9%), the frequency of deficit years was 50% and the crop risk of 3.46%. For corn grains, the average production per hectare in the last 10 years was 5.01 tons (Figure 7).

The non-realization coefficient was of 0.98 tons/ha (meaning 19.6%), the frequency of deficit years was 60% and the crop risk of 11.75%.

For the substitution of feeds, it is necessary to know their nutritional value. Thus, hay can be replaced by cereal and leguminous straw, corn cobs, reed, chaff, sunflower etc. Cereals can be replaced by potatoes, turnips, wild chestnuts, residues from oil mills, sugar beet noodles, etc. For the most economical use of substitute feeds, it is necessary to prepare them before they are introduced into animal feed. Thus, coarse fodder (straw, corn cobs, reeds) will be chopped, ground, or can be ensiled. To improve the taste, they can be mixed with succulent fodder. Forage rations must be balanced in terms of nutritional units and protein, ensuring a specific consumption as low as possible. Fodder substitutions are made in years when natural calamities occur (drought, floods, hail), which reduce or suppress the production of valuable fodder, which are normally used in animal feed. In the recent years, sorghum culture has grown due to its resistance to drought and high temperatures [4], which is why it is also called the "vegetal camel", being able to replace the maize in dry years, as it has close nutritional value. Also, production costs are lower than maize, it has a low need for inputs, especially fertilizers, and the disease resistance is high. To obtain high yields in sorghum, crop rotation is recommended, providing forerunner plants such as cereals, sunflowers, sugar beets, or maize [15].

W. J. Fulkerson et al. (2008) showed that sorghum has significantly higher metabolizable protein content than perennial ryegrass [6]. For sorghum, the average production per hectare in the last 10 years was 3.35 tons (Figure 8). The non-realization coefficient was of 0.68 tons/ha (meaning 20,3%), the frequency of deficit years was 50% and the crop risk of 12.18%.

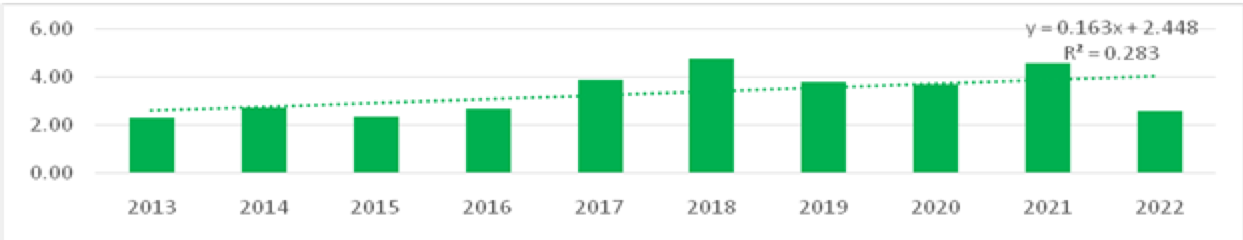

Fig. 8. The evolution of the average production per hectare for sorghum
Source: own representation based on NIS data [11].

CONCLUSIONS

The variability of environmental factors has a direct and even limiting action on feed production, which, in turn, determines the level of development of livestock production. Knowledge of these determinants is necessary throughout the production chain, both to be able to intervene with methods to reduce negative effects, and for long-term adaptation to similar adverse conditions. This means tracking the risk of different forage crops used in animal feed, in the area where the farm is located, as well as finding solutions to replace the forage reserves under the greatest risk, so as not to jeopardize the continuity of the farm's production flows.

ACKNOWLEDGEMENTS

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DETERMINING THE MARKET VALUE FOR AGRICULTURAL AND LIVESTOCK PROPERTIES

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Abstract

Determining the market value for agricultural and livestock buildings involves considering various factors related to the structures, their functionality, and the overall agricultural market. The current trends and demand in the agricultural sector can influence property values. The geographical location of the property plays a significant role in determining its market value. The size and capacity of the buildings are also crucial factors. The impact of environmental factors, such as soil quality and climate conditions, on the property`s productivity can influence its market value. The purpose of this work is to highlight the criteria that influence the market value for such a specialized property. In this study, nine plots of land, along with the agricultural and industrial buildings situated on them, located in Călărași County, Romania were the subject of valuation. For this, The Cost Approach was used. Also, within this method, a special importance is given to the estimation of the land's market value, in this regard The Direct Comparison Method was utilized. In conclusion, it was observed that the largest percentage of the market value of the subject property comes from the buildings situated on the land plots and not from the free land.

Key words: *valuation, market value, agricultural and livestock properties*

INTRODUCTION

The activity of estimating the value, materialized in a document, called "valuation report", carried out by an authorized property valuers (valuation surveyors) in accordance with the specific standards of this activity and with professional ethics, represents the definition of valuation in Romania according to Government Ordinance no. 24/2011, approved with amendments by Law no. 99/2013 [10].

Considering the fact that after the Revolution of 1989 Romania made the transition to a market economy, one of the basic notions in the case of transactions became "market value" and the first specialization available for Romanian property valuers was that of enterprise valuation [2].

The economic concept of "value" reflects the perspective of market participants, existing at the time of the valuation (appraisal), on the benefits generated by a certain property. From a conceptual point of view, value is created and sustained by the interaction of four factors, which are associated with any product, service or commodity. These are utility, rarity, desire and purchasing power [3, 4].

In Valuation Basics [2], the National Association of Authorized Property Valuers from Romania (ANEVAR) defines the four factors as follows:

Utility is the ability of a good to satisfy a certain need, need or desire.

Rarity is the current or anticipated supply of a good relative to the demand for that good.

The desire (preference) expressed by the intensity of satisfaction that a good produces to the one who does not possess it, but who needs it.

Purchasing power expressed by the ability of an individual or group of individuals (market participants) to purchase the goods from the supply, by paying in cash or cash equivalents.

Agricultural and livestock buildings play a vital role in sustaining food production and the economy. The significance of determining their market value in order to ensure fair transactions and proper asset management within the agricultural sector must be highlighted also [9].

Agricultural and livestock buildings are integral components of the farming and animal husbandry industries, serving as the backbone of food production systems worldwide [9]. However, assessing their market value is not a straightforward task; rather, it involves navigating a complex landscape of variables and considerations. At the forefront of this complexity is the inherent diversity among agricultural and livestock buildings [5]. Unlike residential or commercial properties, which often share common features and characteristics, agricultural structures come in a wide array of types and purposes [5]. From traditional barns and silos to modern greenhouse facilities and specialized livestock shelters, each building is uniquely tailored to the specific needs of its agricultural operation. This diversity poses a challenge in establishing standardized valuation methodologies and benchmarks [5, 9].

Moreover, the valuation process must account for a multitude of factors that influence the market value of agricultural and livestock buildings. Location plays a critical role, with regional differences in land availability, climate conditions, and market demand affecting property values. Furthermore, the condition and functionality of agricultural and livestock buildings significantly impact their market value. In addition to these tangible factors, market trends and economic indicators also influence the valuation of agricultural and livestock buildings [6]. Fluctuations in commodity prices, government policies, and consumer preferences can create volatility in the agricultural real estate market, necessitating a dynamic approach to valuation that considers both short-term fluctuations and long-term trends [6].

In this context, the purpose of the paper is to set up a study case regarding the evaluation of an agricultural real estate property located in Călăraşi County, Romania. This assessment is made for estimating the market and liquidation value of the assets.

MATERIALS AND METHODS

The agricultural real estate property is located in Călăraşi County, Romania.

This research presents an evaluation of its market value and the value of its assets before liquidation.

The subject property consists of several plots of land presented in Table 1.

Table 1. The lands subject to valuation

Crt. No.	Type of property	Area [sqm]	Unit of Measurement	Urban Area (U) (Outside of Urban Area (O)
1	Land	8,125	Sqm	O (agricultural land)
2	Land	27,029	Sqm	O (agricultural land)
3	Land	8,984	Sqm	O (agricultural land)
4	Land	12,274	Sqm	O (agricultural land)
5	Land	15,098	Sqm	U (agricultural land)
6	Land	30,579	Sqm	U (agricultural land)
7	Land	536	Sqm	O (industrial land)
8	Land	553	Sqm	U (residential land)
9	Land	10,278	Sqm	U (residential land)

Source: Documents provided to the authors by the owner.

Several types of industrial and agricultural buildings are built on these lands, all of them being part of the process of current valuation.

Also, specialized equipment and installations are present in the mentioned buildings.

One of the most important phases of determining the value of an asset is the identification of that asset and the verification of the correspondence between the documents and the real situation on the ground [12]. In this case, such an inspection was carried out.

The complete list of assets identified on the 9 lands can be seen in Table 2.

In the present case, considering the type of assets that are the subject of the valuation, it was considered that the liquidation value in the case of an orderly sale was equal to the market value.

Regarding the delimitation of the market for this property, this was done mostly from the land point of view and then of the property as a whole.

From the special characteristics of agricultural land it is mentioned the possibility of merging the parcels that is rendered by an estimated percentage that represents a level of

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closeness/proximity between the parcels of land that form the traded property, in this case being rather lower than higher.

Table 2. The construction subject to valuation

Crt. No.	Construction Type	Built Area [sqm]
1	Pal Barrac	277
2	Material Warehouse (Metal Shed)	275
3	Concreted Driveways	3,000
4	Official Room	193
5	Concrete Platform	4,500
6	Building (BCA Building)	66
7	Grain Store	304
8	Grain Store B	521
9	Septic Tank (Dry Latrine)	128
10	Canteen + Prep. Hall	138
11	Grain Store A	110
12	Dry Latrine	96
13	Material Warehouse (Metal Shed)	204
14	Grain Store C	505
15	Storage Building (Fuel Storage Building)	28
16	BCA Building (BCA Room + Stable)	35
17	Building + Platform (Bca Building + Pale Shack Annex)	36
18	Grain Store	120
19	Pal Barrac	88
20	Store Gradistea	2,075
21	Grain Store	728
22	Office Building	464
23	Office Building	161
24	Workshop	820
25	Workshop	490
26	Workshop	922
27	The Thermal Plant	118
28	Washer	60
29	Toilets	27
30	The Gate Cabin	24
31	Grain Store	3,759
32	Silage Cell	22
33	Silage Cell	167
34	Silage Cell	167
35	Silage Cell	167
36	Silage Cell	167
37	The Command Room	21
38	Dryer	7
39	Dryer	7
40	Silage Cell	36
41	Unloading Hall	146
42	Farm Annex	12
43	Bridge	72
44	Laboratory	87
45	LPG Tank	85
46	Pump Chamber	28
47	Water Tank	65
48	Drilled Well	16
	Total of Listed Constructions	
1	Grain Hall (Store)	4,000
2	Car Wash	150
	Total of Unlisted Constructions (which do not appear in any document)	

Source: Documents provided to the authors by the owner.

The topography of the land is is represented by the landform of the location of the plots that make up the property submitted to valuation, in this case the property being considered as plain.

In order to determine the needs, desires, purchasing power and preferences of consumers in Calarasi County, Romania, a demand analysis was carried out identifying potential users (buyers) for the subject property. Two types of potential buyers were identified:

• Local companies / agricultural associations - which usually exploit the land. They have already bought medium and large areas of land and want to increase the degree of merging by buying adjacent plots of different areas. In addition to the owned lands, this category of buyers leases other large areas of land, from owners who do not work the land. This category is interested in buying or renting neighboring lands;

• Investors (mostly foreigners) - this category mainly buys large and very large areas of land, but they do not always work the purchased land, the final goal being that of accumulating and combining large areas of land that can later be resold.

On the other hand, the offer that would represent the competition consists of:

• Families or small owners: Individuals who own land generally own quite small areas of land, some of them taking possession of the land following the retrocessions carried out after the Revolution of 1989. They operate on the private market of agricultural land, mainly in as sellers, since either they do not have the financial capacity and the necessary equipment to exploit these lands, or they own them in excess of their own needs.

• Private commercial companies: The offers from private commercial companies are generally properties that they own in excess of their current needs, or that are not in the company's areas of interest, they being purchased in order to carry out real estate exchanges with other lands in their area of interest.

• Investors on the real estate market: they offer for sale larger areas of land. They purchase land directly from farmers or from intermediaries, combine them and later sell them to foreign investors who come to invest in Romania.

According to official data centralized at European level, the cost of one hectare of land, whether it is arable land or pasture, in various regions of the country and in other member states, according to the latest information centralized by Eurostat indicates that, in the previous year, the average price for a hectare of arable land in Romania was 39,704 lei, equivalent to 8,000 euros per hectare. This data provides crucial insight into the value of farmland in various regions and is of significant importance to understanding the agricultural market and trends in land prices. [1].

According to the data provided by the National Institute of Statistics (INS), the price of a hectare of agricultural land in Romania, according to the methodology agreed at the European level, has been updated for the year 2022. According to the information cited by the INS-National Institute of Statistics, the average price for a hectare of arable land in Romania is 39,704 Ron/ha, which represents 7,990.49 Eur/ha [1].

In the North-East Region of Romania, agricultural land is the most affordable, with an average price of 34,743 Ron/ha, i.e. 6,991.92 Eur/ha. In contrast, in the Bucharest-Ilfov Region, the price is the highest, reaching a value of 59,263 Ron/ha, equivalent to 11,926.59 Eur/ha [1].

In 2022, compared to the previous year, there was an approximately 6.1% increase in the average price for arable land in Romania, with the most significant increase observed in the North-West Region of the country (+23.5%).

At the same time, the average price of permanent pastures registered an increase of approximately 6% in 2022 compared to the previous year, throughout the country, with the highest increase recorded in the North-East Region (+14.9%) [1].

The sale price offers for agricultural land in the subject area are between 7,000 and 11,000 Eur/ha, depending on several factors, for example location, surface, the possibility of merging plots, etc.

The sale price offers for urban land in the subject area are between 10 and 30 Eur/sqm in the area of interest, depending on some different factors like location, surface, the proximity to utilities, the possibility of building etc.

According to [10], in the period 2018-2023 the inflation in the field of constructions in Romania was 160%, this study including data from the National Institute of Statistics.

Regarding the methods of calculating the replacement cost, several cost catalogues are available in Romania, the most important of which are Reconstruction costs - Replacement costs published by IROVAL [7], the technical guide for the immediate valuation, at the price of the day, of the costs of housing elements and constructions in percentage and value published by MatrixROM and Catalogues (1964) drawn up by the Central Commission for the inventory and revaluation of fixed funds according to the provisions of H.C.M. no. 116/1963 (reissued by MATRIX ROM), respectively, the ERC Collection (Rapid Construction Evaluation). Although all three variants are accepted by the market, the most used and most updated are the catalogues published by IROVAL, and in the same study a statistic was presented regarding the increase in replacement costs of approximately 116% in the period 2018-2023, thus as with the increase in land prices, construction costs have kept the same trend in the last period of time [8].

Another mandatory component in the process of estimating the market value for agricultural properties is represented by the determination of the "best use".

The valuation of properties starts from the concept of “best use” which represents the alternative use of the property selected from different possible options that should constitute the starting point and generate the working hypotheses necessary for the evaluation process.

The analysis can be carried out in two cases: the best use of the land considered free and the best use of the built property (testing the continuation/modification of the existing use of the property as built and/or testing the demolition of the property and redevelopment).

The best use of vacant land or built-up property must be:

• legally permitted,

• physically possible,
• financially feasible and
• maximum productivity.

For each mentioned aspect, a test is applied, ultimately resulting in the best use of the property, and there are quite a few cases when this does not coincide with the current use.

For the subject property all the "best use" tests have been applied.

As is well known, in valuation there are three main approaches(Market Approach, Income Approach, Cost Approach) which can be applied to estimate the market value of an asset (a real estate property) and several other methods that derive from them which can be applied to estimate the market value of land on its own [3].

In this scientific work, the Cost Approach was used for the valuation of the real estate property.

Within this method, a special importance is given to the determination of the market value of the land.

In this regard, a method derived from the Market Approach was used, namely the "Direct comparison method". In this way, five calculation sheets were created in which the lands were classified according to certain parameters similar to those previously mentioned, such as positioning, surface or destination, thus unit market values (Eur/sqm) being determined.

•Similar comparison elements between files are represented by:
•The margin of negotiation;
•Transferred ownership;
•Financing conditions;
•Conditions of sale;
•Expenses required immediately after purchase;
•Market conditions;
•Location;
•The surface of the property;
•The frontage;
•Access;
•Topography;
•The differences consisted in the fact that for agricultural lands the degree of merging of plots, zoning and soil fertility class were taken into account, and for the lands that are located in urban areas, utilities were considered very important.

The estimation of the market value per unit (Eur/sqm) was therefore carried out by comparing the subject properties with offers available on the market at the valuation date and not using data from previous transactions.

In the calculation grids, the negotiation margins for the available offers were between 10-15% depending on the price and the discussions held by the evaluator with the representatives of the offers.

For both calculation options, the comparison elements, "Transferred ownership", "Financing conditions", "Conditions of sale", "Expenses required immediately after the purchase", "Market conditions" were not adjusted, being considered similar to those of the subject properties.

Considering the type of real estate property, more precisely a property composed of many specialized assets, its evaluation was carried out by components.

The estimation of the market value of the constructions was carried out according to the principles of the Cost Approach, calculating the replacement costs.

In this regard, 22 cost sheets were drawn up using the cost catalogues published by IROVAL [7].

The types of constructions for which cost sheets were drawn up were: Pal Barrac, Material, Warehouse (Metal Shed), Concreted Driveways, Official Room, Building (BCA Building), Grain Store, Septic Tank (Dry Latrine), Canteen + Prep. Hall, Storage Building (Fuel Storage Building), Office Building, Workshop, The Thermal Plant, Washer, The Gate Cabin, Silage Cell, Dryer, Unloading Hall, Farm Annex, LPG, Tank, Pump Chamber, Water Tank, Drilled Well.

Following the calculations made according to the indications in the catalogues, the cost of every construction as new was practically determined. Considering that the catalogues used do not contain updated prices of construction materials and workmanship, annually, IROVAL determines and makes available updated indices in accordance with the evolution of the market. Using these update indices, which were applied to the values obtained with the help of the cost catalogues, the cost of each construction as new that is the object of this project was determined.

A final step in determining the market value of such a specialized property is represented by the application of estimated depreciation according to several principles.

Among the three methods of estimating depreciations, which can be physical, functional and external, in this paper the "Segregation Method" was used, because in the case of this specialized property, sufficient information was not identified so that one of the other two estimation methods of depreciations ("Market method" and "Age-Economic life method") can be put into practice adequately [3].

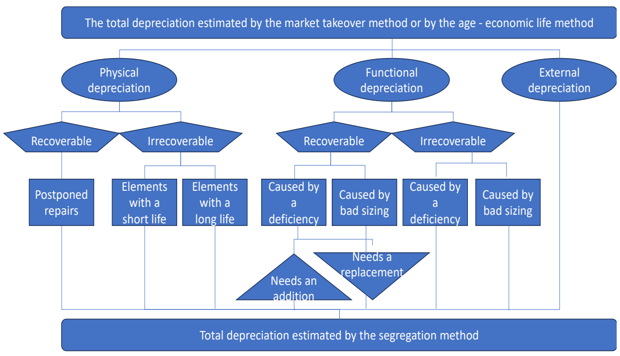

Fig. 1. Total depreciation estimated by the segregation method
Source: [3].

Applying exclusively the segregation method, each form of depreciation was estimated, and their summation led to the total depreciation (in Figure 1 - from bottom to top) of every building.

It is also mentioned that no external (or economic) depreciation was identified on the market.

RESULTS AND DISCUSSIONS

Following the application of the "direct comparison method", the values per unit (sqm) of the land parcels were obtained after applying several adjustments for comparables, but the most significant role in their differentiation was played by the possibility of combining the parcels.

For agricultural land with a high possibility of merging, a market value of approximately 1 Eur/sqm (10,000 Eur/ha) resulted. The lands located outside the urbanized areas, with agricultural destination, but with reduced possibility of merging, the market value per unit (sqm) was estimated at approximately 0.7 Eur/sqm (7,000 Eur/ha).

This consideration is also based on the fact that the agricultural land market does not recognize as particularly important the location of the land, or their opening to an European or National road. Considering the modern machines used in agriculture at the moment, even the topography of the place no longer plays such an important role in the attractiveness of a plot of land on the market.

The attractiveness is influenced instead by national factors, more precisely by legislation, by regional factors, i.e. by the climate and the proximity to irrigation networks and systems (if they exist) and by localized/specific productivity factors such as soil quality, slope or the drainage. The latter can also be rectified by investing in soil improvement solutions as long as the forecasted income could create profit.

Table 3 presents a centralization of the results obtained regarding the market value/square meter corresponding to each plot of land (from Urban Arean or from Outside of Urban Area).

Table 3. Market value/sqm for every plot

Crt. No.	Type of property	Area [sqm]	Eur/sqm	Urban Area (U) (Outside of Urban Area (O)
1	Land	8,125	0,70	O (agricultural land)
2	Land	27,029	1,00	O (agricultural land)
3	Land	8,984	1,00	O (agricultural land)
4	Land	12,274	1,00	O (agricultural land)
5	Land	15,098	1,00	U (agricultural land)
6	Land	30,579	1,00	U (agricultural land)
7	Land	536	30	O (industrial land)
8	Land	553	15	U (residential land)
9	Land	10,278	15	U (residential land)

Source: Centralization of the results obtained - made by the authors.

Since cost sheets were not made for each construction, but for each class of construction, the gross replacement costs were determined later by multiplying the market value per unit of measurement (sqm) obtained with the surface area of each building.

After the gross replacement cost of each building built on the considered sites was determined, the previously mentioned depreciations were applied.

It is mentioned that for some of the buildings identified on the sites, an advanced state of degradation was found. In this sense, the decision was taken to consider them as demolishable buildings, as a result they are not included in the calculations, the market value being estimated as 0. This is because it was considered that the cost of demolition is relatively similar to the income obtained from the recovery of the remaining materials.

The buildings that are part of this category are, according to the serial numbers in Table 2, the following: 1 - Pal Barrac, 7 - Grain Store, 8 - Grain Store B, 9 - Septic Tank (Dry Latrine), 11 - Grain Store A, 12 - Dry Latrine, 19 - Pal Barrac, 25 – Workshop, 27 - The Thermal Plant, 28 – Washer, 29 – Toilets, 30 - The Gate Cabin, 37 - The Command Room, 38 – Dryer, 39 – Dryer, 42 - Farm Annex.

Also, an important fact is that approximately 73% of the total market value of the buildings identified on the site is given by only four constructions, more precisely:

• Grain Hall (Store), identified at position 1 in Table 2, from the list of buildings without documents, with an area of 4,000 sqm and an estimated market value of 1,162,507 Euros;

• Grain Store, identified at position 3 in Table 2, from the list of buildings that appear in the documents, with an area of 3,759 sqm and an estimated market value of 1,092,938 Euros;

• Office Building, identified at position 22 of Table 2, from the list of buildings that appear in the documents, with an area of 464 square meters and an estimated market value of 405,000 Euros;

• Store Gradistea, identified at position 20 in Table 2, from the list of buildings that appear in the documents, with an area of 2,075 sqm and an estimated market value of 391,700 Euros.

The total value of the buildings, both agricultural and administrative, that were the subject of the study was 4,185,000 Euros.

It can be observed that most of the market value of the subject property results from the existing constructions on the plots of land and not necessarily from the free land.

CONCLUSIONS

The market value of the entire property consisting of land and buildings (the vast majority being specialized) was estimated at 4,470,700 Euros.

Various factors must be considered when determining the market value of agricultural buildings or agricultural properties in general. Current trends and requirements in the agricultural sector can also affect the real estate value of this type of specialized property.

Increased market values show properties that are located in areas with high demand for agricultural activities or with easy access to markets and infrastructure.

Environmental factors such as the quality of the soil or the climatic conditions regarding the nearby area also play an important role in determining the market value.

The possibility or impossibility of merging the plots of land and the opportunities or obstacles that appear with the identification of this element remains perhaps the most important aspect in order to estimate the market value of agricultural land.

In terms of buildings, those with increased capacity are of greater interest to the big players in the market, especially if they are well maintained and in good condition.

An important idea stands out and this is that the more specialized and developed a property is in a certain direction, the less the opportunities for liquidation. This aspect can be taken into account and should be taken into account when a valuation report is made for such a property.

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GLOBAL TRENDS ON RESEARCH TOWARDS THE VALUATION PROCESS OF AN AGRICULTURE LAND

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Abstract

The increased use of data analytics and machine learning algorithms enables better prediction of land values based on various factors such as soil quality, climate, and historical performance by processing large datasets. The primary objective of this paper is to underscore the significance of addressing the topic concerning the evaluation process of agricultural land. Concurrently, it seeks to accentuate the interconnectedness across various domains of study, encompassing strategic management, agronomy, ecology, agricultural practices, and agricultural policies. Advanced technologies such as satellite imagery, remote sensing, and Geographic Information System (GIS) tools are being integrated for more accurate and efficient land valuation. In the present study, a retrospective and descriptive bibliometric analysis using the Web of Science platform was conducted, identifying 1,630 papers on the "valuation of agricultural land" from the year 2000 to 2023, which were then analyzed with VOSviewer and Microsoft Excel to generate visual representations of keyword frequency over time. The paper reveals a notable increase in published articles, emphasizing their relevance due to their economic and financial impact, with a focus on environmental sciences and economics, confirming the topic's importance and its association with ecosystem services, land use change, and willingness to pay. The results demonstrate that this theme is increasingly addressed by researchers.

Key words*: *valuation, global trends, agriculture land

INTRODUCTION

In recent decades, a significant portion of the world has undergone swift and extensive urbanization [4].

Land is a valuable resource that necessitates strategic utilization in response to the swift growth of the global population. In the course of this planning, addressing the legal assessment, definition, and registration of real estate becomes imperative [6].

Recognizing the finite availability of natural resources has prompted experimentation and the adoption of new technologies aimed at curbing the consumption of these resources and mitigating the adverse effects resulting from human activities [5].

Due to the rapid advancement of technology in recent years, there has been a growing demand for automating the data processing involved in real estate evaluation. The new technologies are useful for obtaining spatial information of real estate [1] and they are profoundly impacting the field of real estate appraisal [11]. This is driven by the desire for easier calculations and time efficiency in handling such data.

The presence of cultivable land has been instrumental in propelling the progress of humanity over successive generations [10]. Farmland serves as a crucial source of sustenance for numerous individuals globally, including agricultural and livestock producers, developers, and investors. This diverse group, along with government officials in due course, would derive significant advantages from comprehending the catalysts behind farmland price volatility and gaining insights into the factors that impact farmland prices [10].

Traditional economic theory posits that farmland values are established by the discounted stream of future rents. Therefore, in rural areas where agricultural land is exclusively utilized for agricultural production, land prices remain unaffected by the demand for its use in urban activities

(Tavares, Tavares and Santos, 2022) [10].
Throughout history, a significant portion of agricultural and forestry endeavours in Europe were perceived to possess high natural value. However, advancements in technology during the twentieth century, including mechanization, fertilizers, and pesticides, effectively removed obstacles to the intensive exploitation of the soil's productive capacity [3].
Unquestionably, rapid urbanization has produced a series of impacts on the ecological environment [12]. The substantial expansion of cities and the subsequent increase in energy consumption in urban areas underscore the necessity of implementing measures to address climate change. This is particularly crucial in regions with high energy consumption and low utilization of renewable energy sources [7].
Collaboration among farmers, researchers, and governments is crucial to discovering effective and sustainable solutions within the climate change in the agricultural sector [9].
The transformation of the urban environment, driven by dynamic processes of innovation, plays a significant role in altering the original territorial dimension of a city. From an economic and evaluative standpoint, it becomes feasible to identify and track the impact of these changes by observing fluctuations in the real estate market [2].
Currently, in Romania, the Property Valuation Standards are issued by the National Association of Appraisers from Romania [8], ANEVAR, for short.
These standards define market value as the most probable price, on a specific date, expressed in cash or cash equivalents or in another specified form, at which specified rights in real property could be sold after they have been adequately exposed in a competitive market. This occurs when all the conditions of a fair sale are met, and both the buyer and seller act prudently and with full knowledge of the relevant facts, assuming that neither is under undue pressure.
The objective of this paper is to furnish a comprehensive review of the research conducted on the topic of "valuation of agricultural land." Additionally, through bibliometric analysis, the associated fields of interest pertaining to the studied subject will be identified, along with an examination of countries exhibiting particular interest in this domain.

MATERIALS AND METHODS

To ascertain the historical progression in the incorporation of the subject matter pertaining to the evaluation of agricultural land within the domain of research, a retrospective and descriptive bibliometric analysis was conducted utilizing the Web of Science platform. Utilizing the Web of Science database, scholarly articles pertinent to a specific subject were extracted in textual format. Subsequently, employing the VOSviewer software, visual representations were generated, encapsulating keywords derived from the publications along with their frequency of usage across different years. The results of the search in the database specified above, on the topic "valuation of an agriculture land", returned a number of 1,630 papers, from the year 2000 to the year 2023. All the results were exported to a plain text file for the VOSviewer analysis and also to a Excel file to conduct multiple examinations and studies.

RESULTS AND DISCUSSIONS

The fields in which these scientific papers were included were represented by environmental sciences (632 papers) or environmental studies (592 papers), economics (329 papers), ecology (327 papers), green sustainable science technology (113 papers), forestry (111 papers), agricultural economics policy (92 papers), water resources (87 papers), biodiversity conservation (80 papers) and agriculture multidisciplinary (75 papers). Other categories in which papers have been published on valuation of a agriculture land are following: agronomy, geosciences multidisciplinary, geography, regional urban planning, engineering environmental, multidisciplinary sciences, soil science, geography physical, urban studies,

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meteorology atmospheric sciences, energy fuels, development studies, remote sensing and business.

As depicted in Figure 1, the maximum number of publications was reached in the year 2021, with a total of 162 articles published. The number of publications exhibited a more pronounced increase starting from the year 2017. In 2023, a decline was observed with 133 articles published, contrasting with the preceding year, 2022, which recorded 156 articles.

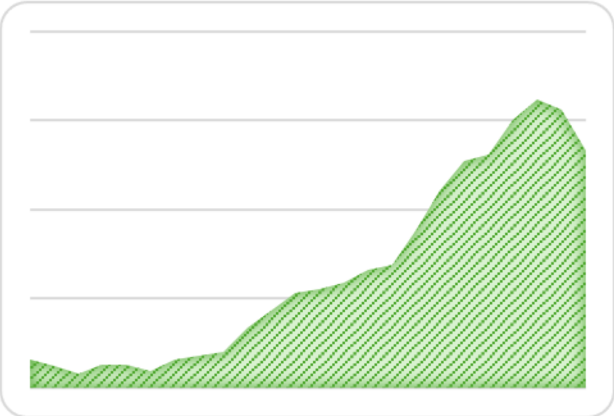

Fig. 1. The number of specialized papers analysed from the data base.
Source: own processing based on WoS results.

The published works can be categorized into ten main groups. The first and second categories are related to environmental sciences or studies, with a total of 1,224 papers. The third category is economics, with 329 papers, and the fourth category is ecology with 327 papers.

The following categories are green sustainable science technology, forestry, agricultural economics policy, water resources, biodiversity conservation, and agriculture multidisciplinary.

Most of the works are written in English. More precisely, 1,596 out of 1,630 papers were written in English, being the international lingua franca.

As depicted in Figure 2, the majority of publications originate from the USA (458 papers), followed by China with 216 papers, and in the third position is Germany with 174 papers. The ranking continues, with over 100 published papers originating from the following countries: England (152 papers), Spain (134 papers), Australia (131 papers) and Italy (124 papers).The other countries in the ranking are: Netherlands, Sweden, France, Poland, Canada, Scotland, Brazil, Ethiopia, Indonesia, Switzerland, Belgium, Japan, Norway, India, Denmark, New Zealand, Portugal and South Africa. As evident from the information provided above, Romania is not included in this ranking.

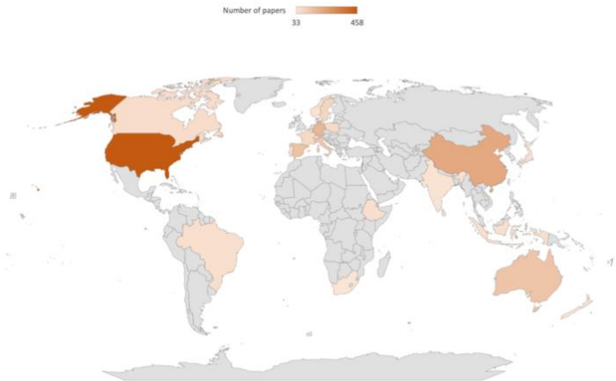

Fig. 2. The distribution of published articles by country.
Source: own processing based on WoS results.

Figure 3 shows words interrelated with valuation of an agriculture land, namely ecosystem services, valuation, contingent valuation, land use and willingness to pay and land use change. These sections constitute 12 clusters, as depicted in Figure 3.

The first cluster refers mostly to agricultural landscapes, land use, landscape or landscape planning or change, rural areas, rural development, spatial planning, and agricultural landscapes. Cluster 2 includes terms such as economic valuation, gis, green infrastructure, land consolidation, land management, land use planning, land valuation, landscape metrics, mapping, sustainable agriculture, sustainable development, urban planning, and urbanization.

Cluster 3 is correlated with expressions such as: economics, ecosystem services, ecosystems, environmental valuation, evaluation, land-use change and spatial analysis.

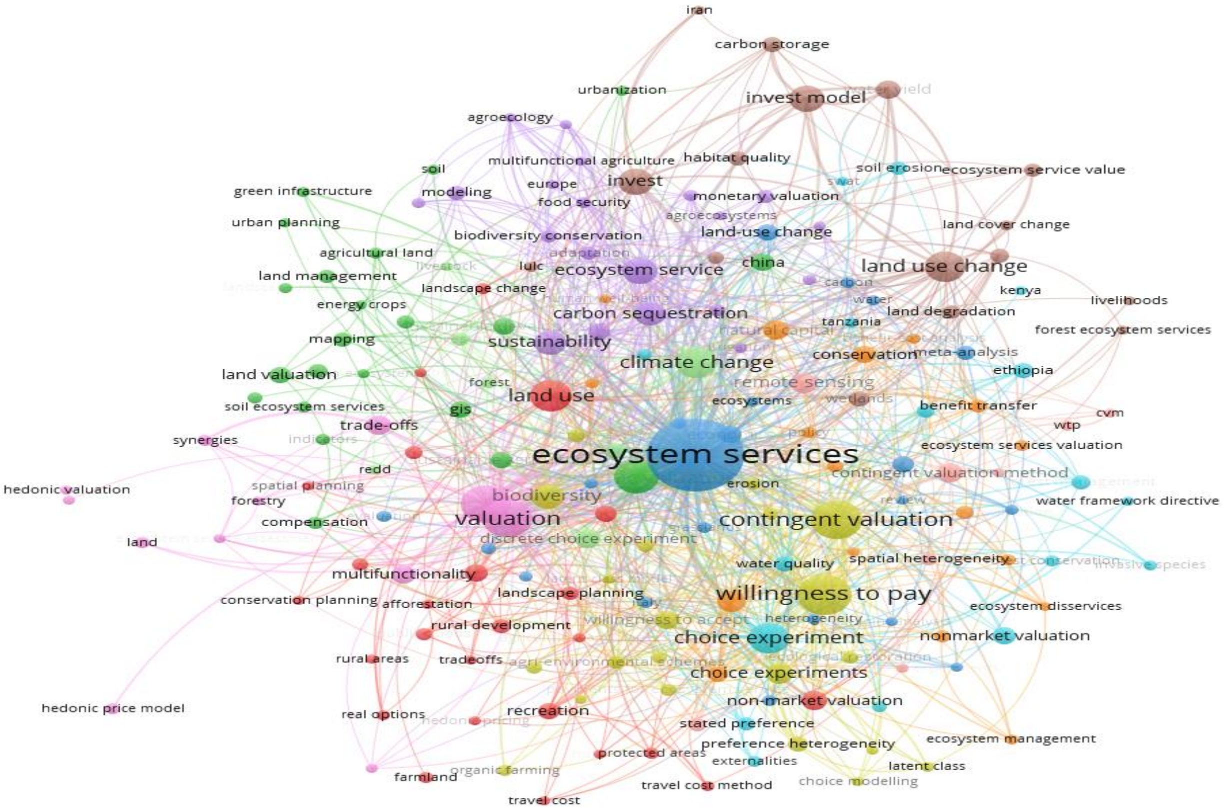

Fig. 3. Connectivity of key word used (valuation of a agricultural land) with other related terms
Source: own processing based on WOS results using VOSviewer.

The fourth cluster resonates with terms such as biodiversity, climate change, contingent valuation, ecological restoration, erosion, farmers, forests, organic farming, or willingness to accept. The fifth cluster is identified with terms such as adaptation, agroecology, agroecosystems, agroforestry, ecosystem service, governance, monetary valuation, soil conservation and urban agriculture. Terms like forest management, forest conservation, nonmarket valuation, profitability, or soil erosion are found within cluster 6.

The seventh cluster encompasses concepts such as benefit-cost analysis, economic value, ecosystem management, ecosystem services value, natural capital, social- ecological system and socio-cultural valuation.

Cluster 8 is identified by the following terms: habitat quality, invest, invest model, land cover and land degradation and the cluster 9 refers to the following terms: hedonic price, land, open space, and synergies.

The tenth cluster resonates with terms such as remote sensing and spatial heterogeneity. The last two clusters, the eleventh and twelfth, are characterized by terms such as deforestation, willingness to pay and precision agriculture. Moreover, Figure 4 delineates the associations among the key terms utilized in the database search and other pertinent terms that have been employed across diverse publications over time.

As evidenced by the Figure 4, in the recent period, post-2020, the emphasis in publications has shifted towards terms such as "invest" or "investment model", "carbon storage", "socio-cultural valuation" and others.

In the period 2016-2018, specialized articles in the studied field highlighted terms such as "ecosystem services", "climate change", "land use change", or "land valuation."

In the year 2014, the following terms were prominent:
"contingent valuation", "willingness to pay", and "rural development" or "nonmarket valuation".

In Figure 5, the key word density is depicted, characterized by varying colours dependent on the number of articles in proximity to the node.

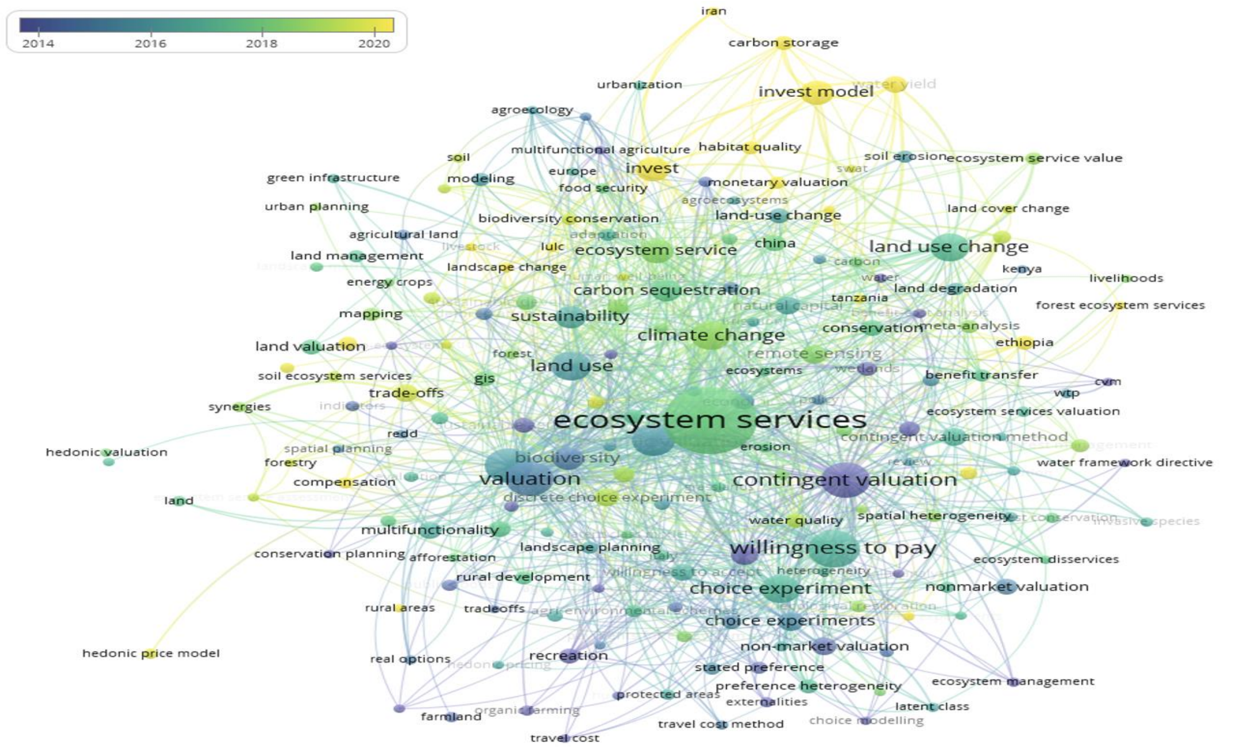

Fig. 4. Linkage of valuation of an agricultural land with other related terms categorized by years
Source: own processing based on WOS results using VOSviewer.

In Figure 5, the key word density is depicted, characterized by varying colours dependent on the number of articles in proximity to the node.
The yellow colour indicates the most frequently employed key words, whereas the blue colour signifies the less utilized terms The yellow colour indicates the most frequently employed key words, whereas the blue colour signifies the less utilized terms within specialized articles.
It is noteworthy that terms such as "valuation", "ecosystem services" or "contingent valuation" consistently appear in specialized literature, as shown in Figure 5.

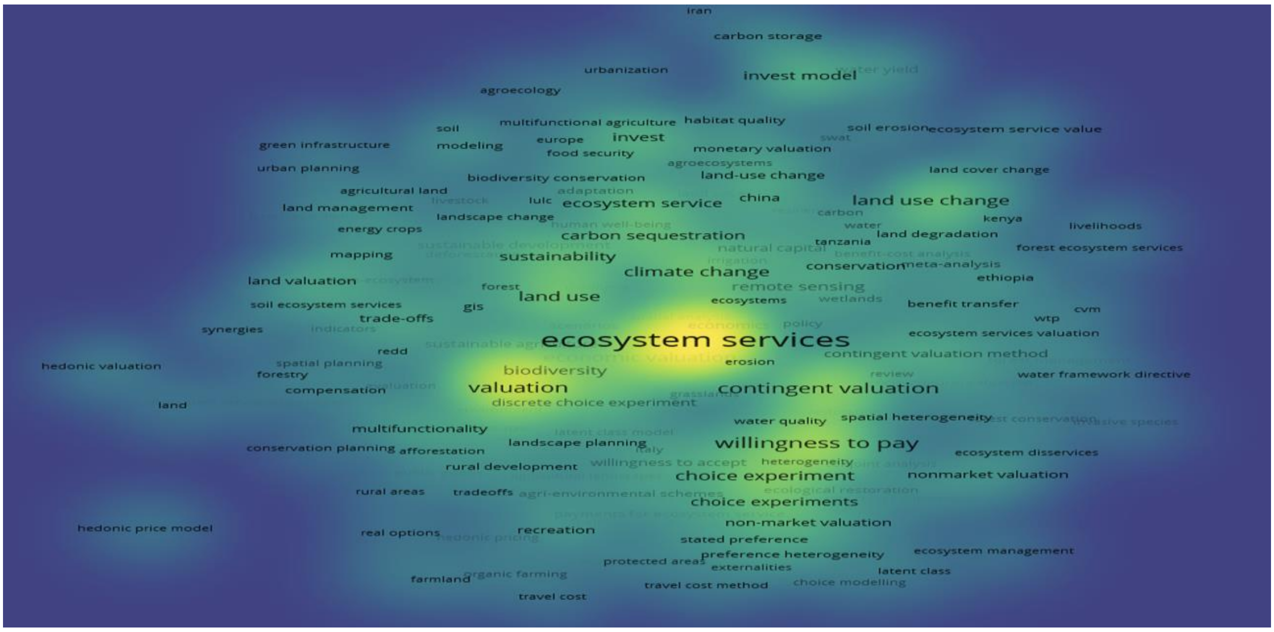

Fig. 5. The density of the key words
Source: edited by the authors based on WOS results using VOSviewer.

CONCLUSIONS

The paper examined the significance of the research topic "valuation of agricultural land," with a focus on analyzing articles published during the period 1998-2023.

According to the investigation, the number of articles has experienced a significant surge during the period 2018-2023, establishing the field of agricultural land valuation as one of considerable interest among researchers.

Furthermore, the frequency of related words used confirms that the valuation of an agriculture land is a key element for ecosystem services, valuation, land use change or willingness to pay.

Based on the conducted research, the authors can affirm that the topic "valuation of agricultural land" is of interest to researchers, particularly due to its economic and financial impact on the specialized market.

As demonstrated in this paper, a significant portion of the works revolves around environmental sciences or studies and economics. Thus, once again, the importance of the subject and its influence in the economic sector is underscored.

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DEVELOPING A DIGITALTWIN MODEL FOR CORN, WHEAT AND RAPESEED YIELDS COMPUTATION

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Abstract

Digital Twin is an emerging agritech technology that involves creating virtual representations of physical systems, which can be used for various purposes, such as optimizing crop management, predicting yield, and managing resources efficiently. The research is focusing to build a accurate digital twin model for crop growth, considering factors like evaporation (ET), growing degrees days (GDD), crop type, soil data, and agricultural practices. The model handles data streams related with geolocation, IOT historical sensor data and weather forecasts streams to simulate the crop risk and yield. Frequent updates based on real-time data enhance accuracy. Aside essential water management crop flow, the model is processing historical data related with nutrients like nitrogen (N), phosphorus (P), and potassium (K) elements are vital for plant growth and health, and their optimal balance can significantly impact corn yield. The research is extended on five locations in both Romania and Luxembourg handling wheat, corn and rapeseed crop simulation.

Key words**:** *digital twin, climate conditions, yield computation*

INTRODUCTION

Our planetary ecosystem changes from year to year, the climate is getting hotter and generating extreme weather conditions from heavy rainfall to major droughts. Water plays a key role in how plants and pests mitigate and adapt to the effects of climate change. Climate change is becoming a major threat to agriculture, livelihoods and food for millions of people in many parts of the world [5, 13, 17].

Monitoring and assessing crop conditions to support plant productivity is the basis for land use strategies on agricultural farms. The health and productivity of crops depend on the quality and properties of the soil, but also on the climatic evolution of the area. More detailed information about agricultural soil can reduce the potential use of doses of chemical fertilizers and pesticides, thereby improving groundwater, protecting the environment and human health. It also supports defining plant density more efficiently.

In agriculture, Digital Twin supports scientists to better simulate, and study yields factors and farmers to reduce crop resources and operations based on their region. Soil monitoring sensors, such as moisture, temperature, organic matter, and soil pollutant sensors, play critical roles in digital agriculture. Information on moisture can be used to assess water stress and irrigation efficiency. In addition, to support smart agriculture decision-making, digital data is essential, bringing spatial information as overall crop evolution.

A Digital Twin for Crop Yields is a virtual representation of a specific plot area or field, that incorporates real-time data and modelling to simulate weather, soil conditions and practices. The model is based on:

1. Data integration assign field sensors, such as air and soil moisture probes or satellites equipped with spectral image acquisition, continuously collect data on soil moisture levels in the field.

2.Modeling: The collected data is integrated into a digital model of the field. This pattern can include factors such as soil type, topography, weather patterns, crop activities timeline & resources used and historical data.

3.Real-time monitoring: The Digital twin model is continuously updated with new data, allowing real-time monitoring of crop conditions. This helps farmers make data-driven decisions about irrigation & water management, fertilization and in field activities.

4. Predictive analytics: By analyzing historical and real-time data, Digital Twin model can predict future conditions. This allows farmers to plan activities more efficiently, conserving resources and reducing emissions.

5.Optimization as recommendation on optimal water and resources strategies based on crop type, variety type, growth stage and environmental conditions, thus improving crop yield and resource efficiency.

Soil temperature and water plays a key role in chemical processes of transformation of nitrogen forms in soil, especially nitrification, which relies on temperature can take from 8 to 42 days. Nitrification is a microbial process by which compounds with reduced nitrogen are oxidized to nitrites and nitrates. This stage of the nitrogen cycle includes two chemical reactions. As a first step, ammonia is converted to nitrite, followed by oxidation of nitrite to nitrate. This process is beneficial for microorganisms because they can obtain the energy needed for their growth through chemical reactions [9]. The microorganisms resulting from this process are known as nitrifying microorganisms. Influence of soil temperature on nitrification under moisture conditions, 60% of total soil capacity and pH 7.2 –7.5

The efficiency of fertilization is given by the ratio of the main elements in the soil. The optimal water content in the soil guarantees maximum fertilizing efficiency. The excess water in the soil also diminishes the efficiency of fertilizers due to the lack of oxygen required in the chemical processes that take place in the soil.

The concept

The purpose of developing on each site a well-defined productivity prediction model is to combine local climate evolution given by IOT sensors with weather forecasts and farming practices to mitigate the impact of climate change by making results available in an appropriate form for informed decision-making that impact the yield.

The studied Digital Twin yield engine consists of input and output data streams, algorithms, and data stream drifting hooks. A data stream is defined as array of elements, where each element consists of timestamp and value, information identifying when a certain event occurred (hour, day, week)

An input stream is processed by a specific algorithm or formula and has drifting hooks. An output data stream consists of feedback results. The concept of *drifting hook* was necessary to be used for inter-streams data dependencies and/or intermediate data mutation. Two types of hooks were used: the data driven hook (DDH) and time driven hook (TDH), both hooks conditionally may change the input and output of existing stream based on data or formula on specific input stream. For instance, a Seeding hook assigned to soil temperature and humidity streams consists of shifting the operation based on the right germinating temperature and humidity in the soil. There are several drifting hooks defined for a seasonal crop, most important are related with seeding, fertilization and watering, their configuration and auto-adaptation based on field location can have deep impact on the final yield.

Input streams are represented by (historical) sensor data streams (*GDD*), farmer operational and resources used data streams (OP_x) (as fertilizing time and quantities) and sensors data streams ($FSEN_x$), where SEN_x - are air T_{AIR} and H_{AIR} – (air temperature and humidity), R (rainfall quantity), T_{SOIL10} and H_{SOIL10} (soil temperature and moisture) at 10cm, E_{PAR} (Photosynthesis Active Energy), IND_{NVDI} (NVDI index)

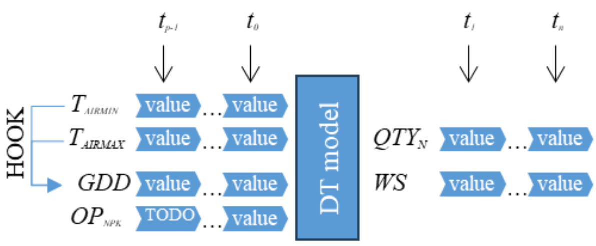

Fig. 1. Studied digital twin engine.
Source: original.

The concept of intermediate data stream (input or output) is necessary to generate data from existent streams as GDD - Growing degree days, *E* – evapotranspiration, or

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Vol. 24, Issue 2, 2024
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forecast F*SEN*$_x$ BBCH – crop state, or using conditional data set hooks like WS - water stress level (Figure 1).

A Digital Twin is not only process and virtually represent an entity's state, but in addition the output streams must provide a feedback mechanism [15] allowing the assertion of a decision-making, optimization, or simulation process by influencing an entity, either directly or indirectly. In our digital twin model, the feedback elements consist of drifting hooks adjustments for time and resources.

MATERIALS AND METHODS

The study was done in 5 locations distributed geographically across Europe: Luxembourg north and west, Romania West, East and South. Each location is equipped with agrometeorological weather station and soil sensors. The data used from 2018 January to 2023 July covering 5 years of seasonal crops focusing on wheat, corn, and rapeseed.

The sensor data streams were acquired hourly: air temperature, air humidity, rainfall, wind direction, wind speed, solar radiance, 10cm and 30 cm soil moistures and soil temperatures. The acquired data was correlated with field activities timeline as ploughing, sowing, fertilizing. The data was processed and structured over several seasons with weekly sensor data aggregation.

The model input is also spectral satellite information data as NVDI, EVI2, NIR as well terrain topographic shape that have impact on water drainage and retention, soil erosion and uniform fertility, sunlight exposure generating the field potential (FP) (Figure 2).

Regarding the varieties: in Romania as wheat variety were used Dropia (INCDA Fundulea) and Alhambra (Limagrain). In Luxembourg Faustus (Saaten) variety was used. Sown in dense rows at 12.5 cm between rows. Sowing in strips for carrying out maintenance work followed. For rapeseed the following varieties in Romania Madora (Saaten), in Luxembourg Ambasador (Limagrain).

	ID	Avg	Area (ac)
	1	1.540	2.35 (9.46%)
	2	1.678	4.57 (18.38%)
	3	1.705	3.63 (14.61%)
	4	1.719	3.64 (14.66%)
	5	1.732	3.10 (12.49%)
	6	1.742	4.25 (17.11%)
	7	1.761	3.30 (13.29%)

Fig. 2. Field potential on studied East Romania plotbase on best NVDI Index on spring season over 5 years
Source: original.

Field elevation (%) has direct relation in nitrogen loss (N_{LOSS}) relying on precipitation / irrigation amount of water (mm)absorption and nitrogen washing (Figure 3).

Fig. 3. Field elevation east Romania
Source: Original.

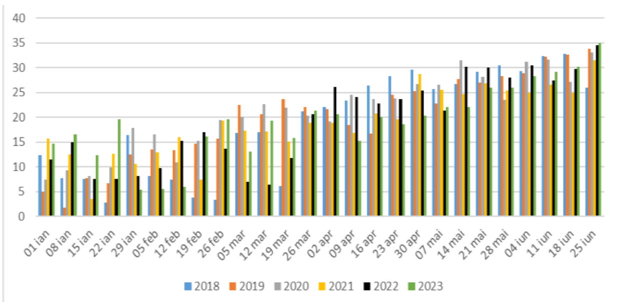

Fig. 4. 5 years T_{AIR} max comp. for spring-summer season East Romania (weekly set)
Source: Original.

For winter wheat period on red-brown soils, where conditions for nitrogen LOSS are met (when used in high doses), 1/3 of the nitrogen dose administered when preparing the germination bed, regardless of the preceding plant. In spring (starting in February/ March), the difference in the planned nitrogen dose is administered [1,18]. However, we consider model drifting hook for Nitrogen amount, depending on the amount of rainfall during autumn and winter and the condition of plants entering and leaving winter.

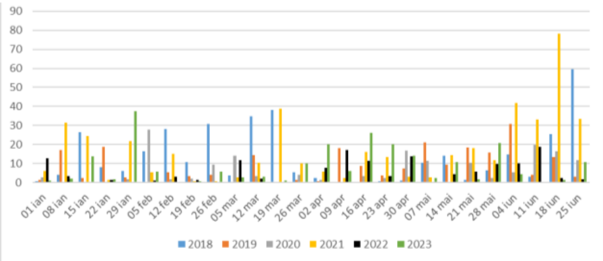

Fig. 5. 5 years rainfall (R) comp. for spring-summer season East Romania (weekly set)
Source: Original.

Model drifting hook uses the following factors: 1. The rainfall (R) accumulated during the winter period and are (2) temperature of soil (T_{SOIL})when it is warmer there is microbiological activity, (3) crop rotation (CR_L) (4) degree soil fertility (S_F).
East Romania is well known for drought and Luxembourg for a lot of rains. The model took into consideration the infield fertilizing operation applied and climate history. From data stream, the T_{airmax} is going down yearly with 10% which concludes a drastic weather change, but the same stream shows that spring season was drifted with 4 weeks ahead. (Figure 4). This doesn't correspond anymore with classical plan for seeding and fertilizing. The research shows also environmental trends, as T_{AIR}, R, T_{SOIL10}, $HSOIL_{10}$ show a 3-week drift and repetitive similitude at *2* years (Figure 5).
The model focuses on appropriate fertilization schema, important to achieve bigger yields with minimum nitrogen based on environmental evolution [2, 15, 16]. The following nitrogen factors were defined: N_{TOTAL}, $N_{RATE/HA}$, $NCROP_{-UPTAKE}$, N_{LOSS}, $N_{SOIL-REMAINS}$ S_F
Applied nitrogen (N_{TOTAL} was calculated by classical crop formula (kg/ha),

$$N_{TOTAL} = (PROD_{TARGETED} - PROD_{DEFAULT}) \times N_{RATE/HA}$$

$PROD_{DEFAULT}$ *is* the default production without any nitrogen application. The digital twin model takes as data stream the crops rotation (CR_L) information on the following crops [Corn, Rapeseed, Sunflower, Winter Wheat]. The algorithm considers each CR_L nitrogen remains information to calculate $N_{CROP-UPTAKE}$, N_{LOSS}, $N_{SOIL-REMAINS}$ for each crop. Luxembourg fields are mainly on hill side with an 8-15% elevation that has impact on N_{LOSS} coefficient. For most Luxembourg winter crops, fertilization is mostly done in spring (due to autumn heavy rains)
For 2018-2022 period on above locations were monitored environmental parameters T_{AIR} and H_{AIR}, R, T_{SOIL10} and H_{SOIL10} E_{PAR}, IND_{NVDI} aside fertilizers and substances applied, and production. As nitrogen uptake, the model considered as 70% nitrogen use efficiency (NUE) [10, 6]. For N_{LOSS} it was considered that after the wheat was harvested, 30–51% of the applied N fertilizer remained in the 0–80 cm soil profiles and 59–83% of soil residual N was retained in the 0–20 cm soil layers [3, 12, 18]. The model N_{LOSS} is daily calculated talking into account [4, 8, 18**]** for $N_{CROP-UPTAKE}$ based on NUE and Nitrogen surplus (N_S) but also sensors dataH_{SOIL10} and R together with field shape degrees, GDD and crop IND_{NVDI} for that season.

RESULTS AND DISCUSSIONS

Sensor and satellite-based determination of crop yield based on nitrogen management provides critical data in site-specific fertilization algorithms. Nitrogen consumption shall be processed as data-stream array input where each item can change the soil remaining nitrogen based on other conditional drifting hooks (as water, temperature etc) and primary and secondary production. The water and temperature are playing a crucial role in nitrogen uptake but also in straws decomposition that inject additional nitrogen.
Significant differences were observed among varieties for yield, $N_{CROP-UPTAKE}$ as components of NUE in forage, grain, straw, and grain + straw. Estimates of N_{LOSS} over this two-year period ranged from 4.0 to 27.9 kg·ha-1 [7]. According to Smith et al. 1967**,** the dry soil is slowing straw decomposition (N_{STRAW}) [14]. Rainfall / irrigation water is necessary to speed up the decomposition process that can take between 3 to 6 months [11]. For next crops, the model took $N_{SOIL-REMAINS}$ as progressive calculation based on

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available soil water (H_{SOIL10}) and crop exposure on climate.
The remaining nitrogen ($N_{SOIL\text{-}REMAINS}$) is reintroduced in the digital twin model flow as feedback to simulate next crop as following.

$N_{APPLIED} = N_{TOTAL} - N_{SOIL\text{-}REMAINS}$

$N_{SOIL\text{-}REMAINS} = N_{TOTAL\ PREV} - N_{LOSS\text{-}PREV} - N_{CROP\text{-}UPTAKE\text{-}PREV} - (N_{STRAWS\text{-}PREV} + N_{SOIL\text{-}REMAINS\text{-}PREV})$

Table 1 depicts the nitrogen usage for south Romania location (warmed & drought place with no irrigation). $PROD_{DEFAULT}$ = 1,800 kg/ha

Table 1. East Romania model outputs

Crop	Seeding	Harvesting	$PROD_{TARGETED}$	N_{total} (kg/ha)	$N_{total\text{-}aplied}$ (kg/ha)	Rainfall (liter)	GDD	$N_{soil\text{-}remains}$ (kg/ha)
Winter Wheat	Oct 2017	Jul 2018	6,000 kg	79.8 kg	79.8 kg	402	920 °C	16.0 kg
Rapeseed	Sep 2018	Jun 2019	3,500 kg	100.3 kg	84.3 kg	335	896 °C	20.1 kg
Sunflower	Mar 2020	Aug 2020	3,500 kg	102.0 kg	81.9 kg	225	1,589 °C	81.6 kg
Winter Wheat	Oct 2020	Jul 2021	6,500 kg	98.7 kg	17.1 kg	644	660 °C	30.6 kg
Corn	Apr 2022	Aug 2022	4,100 kg	48.3 kg	17.7 kg	215	1,629 °C	37.7 kg
Winter Wheat	Oct 2022	Jul 2023	7,500 kg	108.3 kg	70.6 kg	341	983 °C	29.2 kg

Source: Original data.

The red values correspond to crop loss due to lack of water. For instance, 2020 sunflower and 2022 corn crop require a minimum of 450L of water, and 30% in first BBCH development stages. The 2020 year was drought and lack of rainfall. The amount of N from straws were incorporated into the soil and model distribute the nitrogen from sunflower/corn decomposition over several months, to be used by next spring crop. Autumn 2020 spring 2021 winter period was abundant of rainfall (R), and soil temperature was below 5 deg. that helped with straw decomposition for spring. The $N_{SOIL\text{-}REMAINS}$ varies between 15% to 25%.
For Luxembourg west location, Table 2, water is more abundant having less risks on drought, but issues on temperature and cloudy area. Small GDD pushes the crops further in July/August and during winter temperature goes below -5 C. For instance, for rapeseed, a part of the leaf area produced might be destroyed by freezing, leading to important N losses of 2–3.5 % of the fallen leaves' dry weight [2,10]. The $N_{SOIL\text{-}REMAINS}$ goes up 29% due to higher applied rates.

Table 2. West Luxembourg model outputs

Crop	Seeding	Harvesting	$PROD_{TARGETED}$	N_{total} (kg/ha)	$N_{total\text{-}aplied}$ (kg/ha)	Rainfall (liter)	GDD	$N_{soil\text{-}remains}$ (kg/ha)
Winter Wheat	Oct 2017	Jul 2018	7,000 kg	98.8 kg	98.8 kg	299	2,014 °C	19.8 kg
Rapeseed	Sep 2018	Jun 2019	3,500 kg	100.3 kg	100.3 kg	295l	1,810 °C	20.1 kg
Corn Silo	Mar 2020	Aug 2020	12,000 kg	612.0 kg	612.0 kg	320	1,547 °C	489.6 kg
Winter Rye	Oct 2020	Jul 2021	3,500 kg	35.7 kg	-453.9 kg	422	1,646 °C	11.1 kg
Sunflower	Apr 2022	Aug 2022	3,600 kg	37.8 kg	26.7 kg	239	1,520 °C	29.5 kg
Rapeseed	Oct 2022	Jul 2023	3,800 kg	38.0 kg	8.5 kg	216	1,078 °C	10.3 kg

Source: Original data.

CONCLUSIONS

This research tries to elucidate the intricate dynamics between nitrogen management, environmental conditions, and crop yield, facilitated by the development and application of a digital twin model. Our findings underscore the pivotal roles of water and temperature in regulating nitrogen uptake and the subsequent decomposition of crop residues, which are essential processes for sustainable agricultural practices.
Through detailed analysis across different geographical locations and crop varieties, we have demonstrated significant variability in nitrogen use efficiency (NUE), nitrogen loss (NLOSS), and the impact of environmental factors on these processes. The comparative

study of crop performance under varying conditions of drought and water abundance has provided insights into the critical need for precise nitrogen management and the importance of environmental considerations in agricultural planning and operations.

The digital twin model proved to be an invaluable tool in simulating the complex interactions between climate, soil, and crop growth conditions, offering a nuanced understanding of how to optimize nitrogen application, enhance crop yield, and minimize environmental impact. The model's ability to incorporate real-time and historical data enables predictive analytics that can guide decision-making processes, from field management to regional agricultural strategies.

The key conclusions drawn from this research are:

-**Optimized Nitrogen Management:** Effective nitrogen management, as revealed by the digital twin model, can significantly enhance crop yield while reducing the environmental footprint. The balance between nitrogen application and the crop's actual requirements—considering soil, weather, and crop variety—is crucial for maximizing NUE.

-**Environmental Impact on Crop Yield:** Environmental conditions, particularly water availability and temperature, have profound effects on nitrogen dynamics in the soil-crop system. These factors influence not only the immediate crop yield but also the sustainability of agricultural practices through their effect on nitrogen loss and soil nitrogen residuals.

-**Adaptive Agricultural Practices:** The study advocates for the adoption of adaptive agricultural practices, guided by digital twin technology and data analytics, to respond effectively to climate variability and changing environmental conditions. This adaptive approach can lead to more resilient and sustainable agriculture.

-**Future Directions:** There is a need for further research into the integration of digital twin models with other technological advancements in agriculture, such as precision farming tools and AI-driven predictive models, to enhance the efficiency and sustainability of crop production.

In conclusion, the deployment of digital twin technology in agriculture offers a promising pathway towards achieving high-efficiency, sustainable crop production systems. By harnessing the power of real-time data analytics and simulation, agricultural stakeholders can make informed decisions that balance productivity with environmental stewardship.

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ASPECTS RELATED TO THE HONEY MARKET AND THE ETHICS OF THE BEEKEEPING ENVIRONMENT IN ROMANIA

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Abstract

The paper presents the main trends of the Romanian honey market, in the period 2018-2022. In order to better highlight the evolution of this market, it was necessary to analyze specific indicators such as: total production of honey and the number of bee families both nationally and regionally; the price for honey at national level; consumption of honey per capita - average annual; quantitative exports and imports of honey from Romania. Complementary to the economic part, due to the fact that the honey bees are not only honey producers, but also vital natural pollinators, the paper also mentions and analyzes aspects related to the ethics of the beekeeping environment in Romania and EU, especially the use of neonicotinoids, in the context of global transformations.

Key words: *bee families, honey production, ethics of the beekeeping environment, bioeconomy*

INTRODUCTION

Honey is known and used by people both as food and medicine since ancient times - a fact attested by numerous archaeological discoveries in North Africa, Europe, the Near East, among peoples such as the Greeks, Romans, Assyrians and others - the analysis of ceramic vessels indicating that the bee products had a significant millennial impact for the human species, including in the treatment of ailments for which there were no other remedies [11].

Hippocrates, who is considered the "father of medicine", supported the idea that propolis and bee honey are the dearest medicines.

A basic element that attests to the significance of honey throughout the evolution of human society, is represented by the cave paintings, which were discovered in Spain at Arana. These paintings date back to 7000 BC. Other documents that were discovered in Australia, highlighted the fact that the aborigines knew and collected bee honey a long time ago [14].

In Romania, beekeeping is a millenary activity and the coats of arms of three autochthonous counties still formally attest the connection with the roots of our nation – a nation gifted with numerous and important natural resources and enterprising in their valorization (Figure 1).

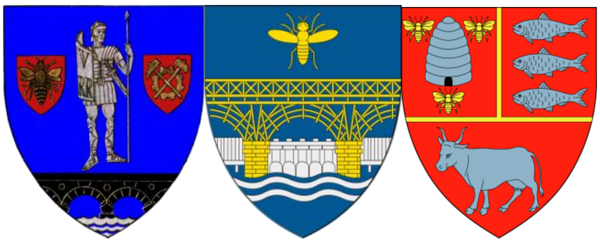

Fig. 1. Coats of arms of Caraş-Severin, Mehedinți and Vaslui counties
Source: own processing of photos from Public Domains [1], [2], [3].

Fundamentally, the crucial importance of honeybees emerges from the products of the hive (honey, wax, honeycomb, pollen, royal jelly, bee bread, apilarnil, propolis, venom) and their role of pollinators; it is estimated that "a third of every mouthful of food we ingest exists because of bees" [25]. Fruit trees (the self-sterile varieties of apple tree, pear tree, cherry tree, plum tree, peach tree, apricot tree, almond tree, chestnut tree), fruit bushes (raspberry, blueberry, but also the self-fertile gooseberry and strawberry that do not require cross pollination) get harmonious development following the visits of the insects that carry pollen; garden plants (peas, beans, tomatoes, cucumbers, melons, peppers), forage legumes (alfalfa, clover, sweet hay, fingers-and-thumbs etc.) and many species in large crops depend on the input of bees – oleaginous and proteinaceous (rapeseed, sunflower, turnip, bean, soybean, buckwheat,); the influence of pollinating insects even on the vine under certain conditions is mentioned with an effect on the production of grapes and flax by increasing the yield of seeds. Even tropical crops like cotton, citrus, coffee, avocado etc. requires pollination. And let's add the need of seed growers who must constantly pay close attention to aspects related to pollination [12].

Therefore, due to the autochthon beekeeping tradition and the importance of honey bees, this paper has a main goal consisting in an economic analysis of Romanian honey production and honey market during 2018-2022 and, as complementary objectives, to show the honey bee as a life form (so intrinsic valuable and vulnerable, with fascinating complexity at both individual and social level – the life of the bee colony), as well as to report and problematize certain issues related to the ethics of the bee breeding environment in Romania, especially the use of neonicotinoids.

MATERIALS AND METHODS

This research presents a series of aspects for the period 2018-2022 related to the Romanian honey market. The most important indicators for this sector were analyzed and presented, such as: honey production and the number of bee families - the national and regional level, the average annual price, the average annual consumption and the place occupied by Romania in the top of the main importers and exporters of honey worldwide. These data were provided by prestigious statistical institutes: National Institute of Statistics/INS, Eurostat, International Trade Centre/ITC.

In order to achieve the objectives complementary to the economic analysis, we methodologically resorted to the reading of multiple reference works, analysis, synthesis, comparison of contents.

And because we, the Europeans, are not only talking about but in fact experiencing a paradigm shift (economy - bioeconomy conversion), the first direction we turned our attention to was the specifics of this life form called the honey bee, namely those endogenous anatomical-physiological (Figure 2) and social characteristics that make this insect to be a vital producer and pollinator in the benefit of the humans and the environment: tripartite body (head, thorax, abdomen), endocrine system (respectively multiple endocrine systems, some for individual use, others for the benefit of the community - the optimal development of the glands being conditioned by sufficient nutrition and high nutritional value during growth), tracheal system very complex, nervous system and sense organs (brain in the cephalic capsule with which it coordinates especially the sensory perceptions and ganglion chain that crosses the whole body; tactile, olfactory, visual sense - sounds seem to be perceived tactilely in the form of vibrations), open circulatory system (the colorless hemolymph fills the entire body, bathing all organs and tissues; a single blood vessel, extending from the abdominal heart to the head, produces unidirectional circulation to the brain, pumping hemolymph captured from the body by the heart valves), digestive system (oral cavity, esophagus, goiter, ventricle, stomach, small intestine, rectal pouch), adipose body (especially here it stores its energy reserves and also here the toxins in its body are processed; the tolerance of pesticides is conditioned by the proper functioning of the adipose body), sexual organs (specific for the queen/drone/worker bee), immune system (in the intestine it secretes substances with an action against viruses; food for larvae contains antimicrobial substances; hemolymph contains macrophages and substances with antibacterial action) according to [22].

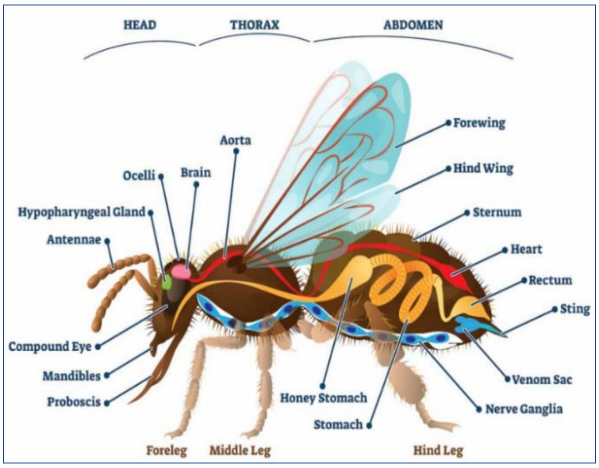

Fig. 2. Bee 's anatomy
Source: [4].

And the complexity of the individual honey bee correlates with the complexity of communication, organization and activity of the bee colony as the super-organism which is the functional unit and equally, in case of disease, the epidemiological unit – see the law of colony development on the vertical and horizontal axes, the matrix as an informational program under which the colony begins its life in natural conditions without human influence/intervention and the vital force as an immaterial force that maintains all endogenous biological and physico-chemical processes, ensuring the harmonious functioning of the organism [16].

RESULTS AND DISCUSSIONS

In Romania, bee honey has been produced for over 2000 years due to the existence of the diversity of the honeybee flora, which is found throughout the country. Along with honey, other bee products are also obtained, such as: pollen, pasture, royal jelly etc. These products are known and appreciated both by domestic and foreign consumers [6], [19], [20].

The bee families had an upward trend in Romania during 2018-2022, with an increase of 14.62%, as shown in Figure 3. Among them, 99.97% belongs to the private sector, with an increase of 14.63%.

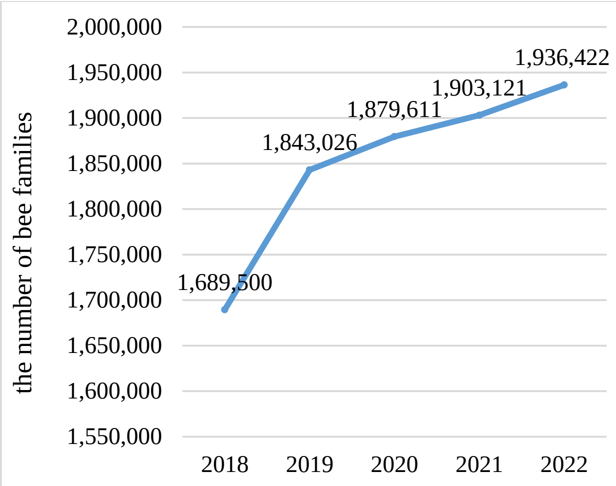

Fig. 3. The number of bee families in Romania, in the period 2018-2022
Source: [8].

Overall, in all regions, the number of bee families multiplied, with two exceptions, the Bucharest-Ilfov region and South-West Oltenia. Here the reductions are 24.21% and 2.16% respectively - Table 1. The highest percentage reductions in bee colonies were found in areas closer to the capital, possibly due to a reduction in agricultural activity that harmed the city's expansion and services related to the metropolitan area.

Table 1. The number of bee families in the period 2018- 2022, in Romania's development regions

Specification	2018	2019	2020	2021	2022	2022/2018 %
North-West Region	230,616	294,620	308,674	312,590	298,311	129.35
Central Region	211,229	223,199	225,822	226,464	237,155	112.27
North-East Region	219,341	238,612	248,639	252,183	249,680	113.83
South-East Region	282,384	323,671	333,218	337,770	343,317	121.58
South-Muntenia Region	228,880	249,359	265,044	263,419	264,334	115.49
Bucharest - Ilfov Region	16,598	16,018	15,943	11,827	12,579	75.79
South-West Oltenia Region	324,392	311,516	290,283	291,876	317,369	97.84
West Region	176,060	186,031	191,988	206,992	213,677	121.37

Source: [8].

The North-West (129.35%), South-East (121.58%) and West (121.37%) regions had the highest increases in bee families during the analyzed period.

The counties that recorded increases above the average for the regions were:

- Bihor (139.72%), Maramureș (163.39%), Cluj - 169.90% (the highest increase in the country) - North-West Region,
- Sibiu (127.03%), Alba (153.44%) - Central Region,
- Bacău (123.18%), Suceava (133.26%) - North-East Region,
- Vrancea (136.53%), Galați (138.04%), Constanța (154.64%) - South-East Region,
-Hunedoara (125.35%), Timiș (156.29%) - West Region,
- Călărași (117.24%), Argeș (143.91%) - South-Muntenia Region,
- Vâlcea (114.05%), Gorj (121.41%) - South-West Oltenia Region.

In 2022, the North-West Region - 15%, the South-West Oltenia Region - 16% and the South-East Region - 18% obtained the highest percentages of the number of bee families in the country (Figure 4).

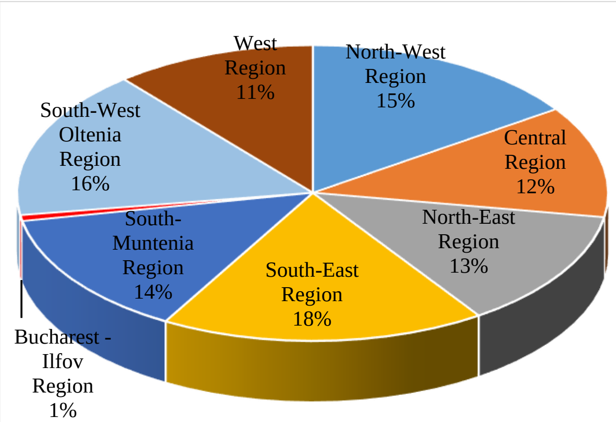

Fig. 4. Distribution of bee families at the Romanian regional level, in 2022 (%)
Source: [8].

32,277 beekeepers were registered in 2022, in Romania, out of the total of 710,825 in the EU, 39.4% more compared to 2019 [5].

The average in the EU for the average number of hives that a beekeeper owned in 2022 was 29, and for Romanian beekeepers it was 73 [5].

Figure 5 shows the dynamics of the production of honey extracted in Romania between 2018-2022, a period in which an increase of 2.05% was recorded. The year in which the highest production was achieved was 2021 – 30,831 tons, and the decrease in the year 2022, compared to 2021, was of 3.47%.

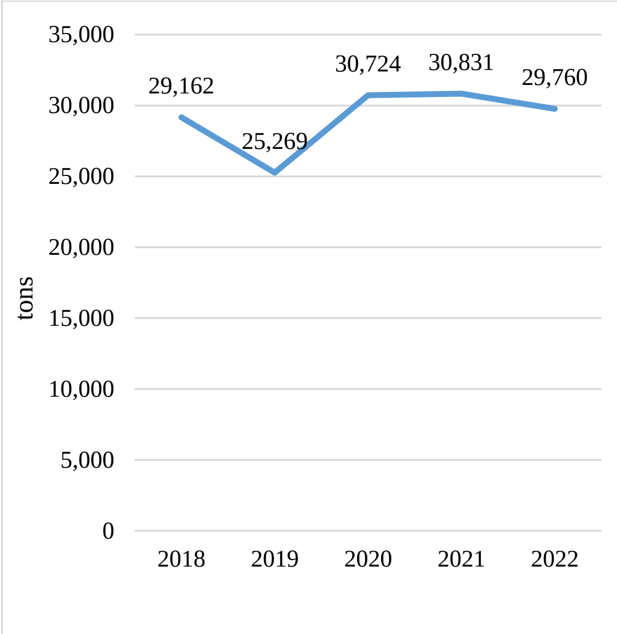

Fig. 5. The total production of extracted honey in the period 2018-2020, in Romania (tons)
Source: [8].

Honey production varied from one year to another due to climate changes that manifested through drought, hail, torrential rains, strong wind that had a negative impact on bee activity [15].

The analysis of production by the development regions of Romania indicated that there were increases in the North-West Region (105.67%), the West Region (106.59%), the Central Region (109.74%) and the North-East Region (109.74%) - Table 2. Apart from the Bucharest - Ilfov Region (34.30%), the South-West Oltenia Region recorded the highest percentage of decrease - 10.62%.

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Table 2. Total production of honey extracted in the period 2018-2020, in Romania's development regions (tons)

Specification	2018	2019	2020	2021	2022	2022/2018 %
North-West Region	4,249	3,263	4,345	4,710	4,490	105.67
Central Region	3,493	3,408	3,877	3,839	4,101	117.41
North-East Region	3,880	3,691	4,342	4,589	4,258	109.74
South-East Region	4,724	4,333	5,652	5,134	4,677	99.01
South-Muntenia Region	3,962	3,078	3,556	3,858	3,862	97.48
Bucharest - Ilfov Region	344	314	328	238	226	65.70
South-West Oltenia Region	5,387	4,712	5,278	5,488	4,815	89.38
West Region	3,124	2,470	3,346	2,975	3,330	106.59

Source: own calculation after [8].

The counties that recorded increases above the average for the Regions were:
- Bihor (130.01%), Cluj (140.47%), Satu Mare (155.46%) - North-West Region,
- Covasna (135.67%), Alba (162.82%) - Central Region,
- Neamț (126.54%), Suceava (144.96%) - North-East Region,
- Vrancea (102.83%), Brăila (102.88%), Buzău (103.01%), Galați (148.67%), Constanța (148.88%) - South-East Region,
- Dâmbovița (115.47%), Ialomița (121.19%), Călărași (161.60%) - South-Muntenia Region,
- Vâlcea (113.16%), Olt – 204.66% (the highest increase in the country) - South-West Oltenia Region,
- Caraș Severin (122.06%), Timiș (145.64%) - West Region.

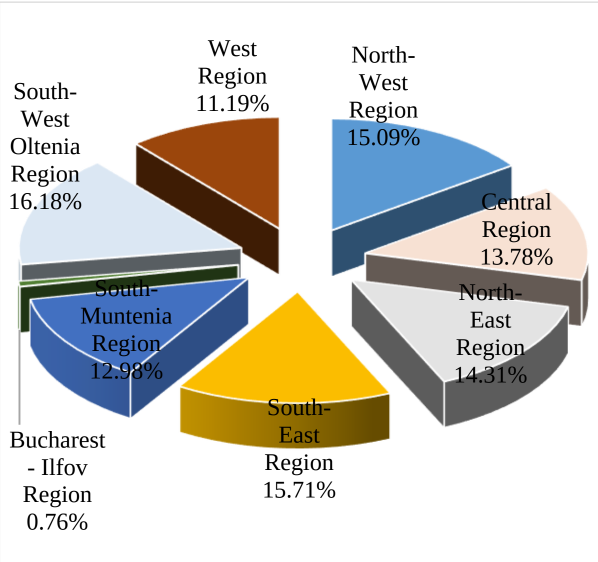

Fig. 6. The distribution of honey production in 2022, in the Development Regions of Romania (%)
Source: [8].

The share held by the honey production obtained in the regions from the total honey production extracted in Romania in 2022 is presented in Figure 6. In 2022, the Regions South-West Oltenia (16.18%), South-East (15.71%) and North-West – 15.09% had the highest percentage of the total honey production.

The amount of honey extracted in 2022 placed Romania on the 3rd place in the European Union, after Germany (34,100 tons) and France (31,400 tons). In 2022, the EU had a production of 286 thousand tons of honey, being the 2nd producer worldwide, after China [5].

Worldwide, there has been a tendency to increase honey production. This increase was due, above all, to the productions made in China and India, where average honey production increases of over 10,000 tonnes per year have been recorded [18], [21]. China was the world leader with a share of more than 25% of the world-wide production [21].

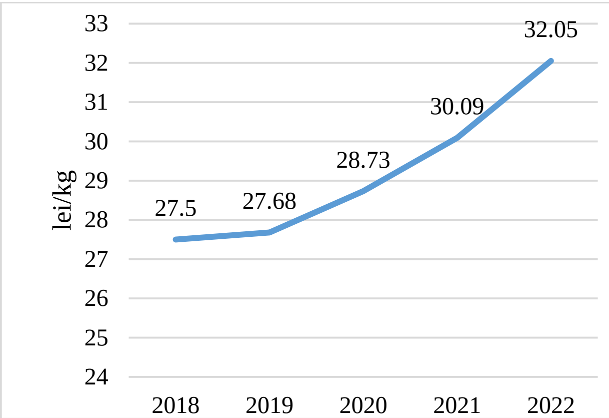

Fig. 7. The average annual price of honey sold in the agro-food/honey markets (lei/kg)
Source: [9].

The average annual **price of honey** sold in Romania showed an upward trend during the study period, the increase being of 116.55% (Figure 7).

Despite the price increase, the average monthly **consumption of honey** (kg/capita) in the period under analysis also increased by 10.47%, as it can be seen in Figure 8.

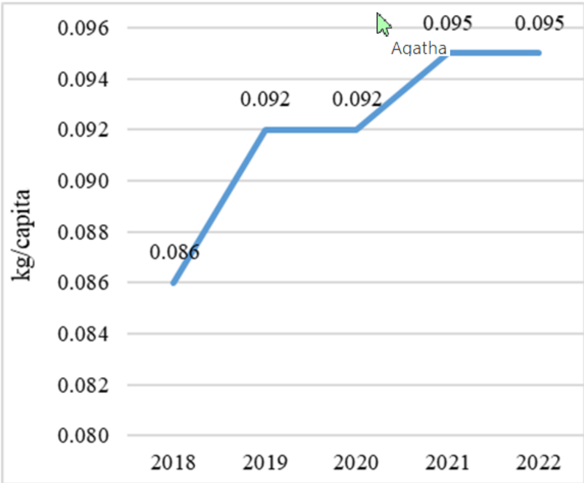

Fig. 8. Average monthly consumption of honey/person (kg/capita) in Romania
Source: [7].

Honey is a natural product, obtained by bees from the nectar of flowers, which represents a beneficial alternative to ordinary sugar. Currently, due to numerous scientific researches, it has been concluded that honey is an important food with a special nutritional value. In this sense, we must remember the composition of honey: carbohydrates (80-85%); water (15-17%); proteins (0.3%); ash (0.2%); amino acids; vitamins; minerals; antioxidants; enzymes; bioflavonoids [6], [20], [24].

Regarding **honey trade**, it can be seen that Romania was on the 21st place in the top of the main honey importers worldwide, from a quantitative point of view (Table 3). The first places were occupied by USA, Germany and UK.

The countries from which Romania imported honey were: China (2,613 tons), Ukraine (536 tons), Republic of Moldova (504 tons), Germany (450 tons) and Bulgaria (320 tons). The previously mentioned quantities are valid for the year 2022.

Table 3. Romania's place in the top of the main honey importers worldwide, in the period 2019-2022 (tons)

Position	Importers	2019	2020	2021	2022	2022/2019 %
1	USA	178,948	196,531	220,538	205,156	114.65
2	Germany	82,202	90,136	78,701	75,091	91.35
3	UK	48,830	52,654	45,852	51,912	106.31
4	Japan	44,788	49,348	47,132	47,381	105.79
5	Belgium	24,818	28,147	31,745	39,756	160.19
6	French	32,819	34,869	29,295	35,506	108.19
7	Poland	29,637	37,344	37,594	31,769	107.19
8	Italy	23,580	21,041	23,586	26,517	112.46
9	Saudi Arabia	17,918	23,525	21,187	21,433	119.62
10	Netherlands	14,785	13,582	17,396	17,423	117.84
...						
21	Romania	2,633	6,468	5,777	5,319	202.01

Source: [10].

Romania's quantitative honey **imports** have doubled in the period 2019-2022, starting from 2,633 tons in 2019 to 5,319 tons in 2022 - the increase being of 202.01%.

Regarding **exports**, Romania occupied the 14th place in the world top, with China, India and Argentina on the first places (Table 4). Romania's honey export partners in 2022 were: Germany (4,544 tons), Italy (2,240 tons), Poland (843 tons), Japan (718 tons) and Spain (663 tons).

Table 4. Romania's place in the top of the main honey exporters worldwide, in the period 2019-2022 (tons)

Position	Exporters	2019	2020	2021	2022	2022/2019 %
1	China	120,845	132,469	145,886	156,002	129.09
2	India	65,351	54,834	70,514	86,183	131.88
3	Argentine	63,522	68,985	63,934	67,380	106.07
4	Ukraine	55,683	80,775	57,528	48,372	86.87
5	Brazil	29,812	45,728	47,190	36,886	123.73
6	Belgium	17,654	22,353	25,740	32,021	181.38
7	Spain	22,471	28,263	28,442	27,869	124.02
8	Germany	25,320	29,740	29,758	27,151	107.23
9	Türkiye	5,548	6,038	9,994	17,248	310.89
10	Hungary	-	-	18,329	15,920	-
...						
14	Romania	11,495	13,743	12,679	12,183	105.99

Source: [10].

Unlike imports, Romania's exports increased during the analysed period by only 105.99%. The year that recorded the largest amount of honey exported and at the same time imported was 2020: 13,743 tons of honey exported and 6,468 tons of honey imported.

At the European level, according to official data, Romania was in second place in the ranking of honey exporters, which shows the interest of external consumers for this Romanian product characterized by quality, aroma and consistency [17].

The new Common Agricultural Policy will support through the Strategic Plan 2023-2027 (PS PAC 2023-2027) the beekeeping sector by allocating through beekeeping interventions the sum of 60,816,300 euros (12,163,260 euros annual allocation), of which 50% will represent the contribution of the European Union and 50% the contribution of Romania.

At the same time, through intervention IS-A-07 - *Acțiuni de sprijinire a laboratoarelor de analiză a produselor apicole, a pierderilor de albine sau a scăderii productivității, precum și a substanțelor cu potențial toxic pentru albine* / *Actions to support laboratories for the analysis of bee products, bee losses or decreased productivity, as well as potentially toxic substances for bees,* it will be possible to settle the physico-chemical and residue analyzes to certify the quality of the honey, with a view to a better exploitation of it on the market, the identification of fakes and their elimination from the market.

This intervention was a natural response of beekeeping associations to honey imports. They asked the Ministry of Agriculture and Rural Development/MADR to include it as a measure to support and protect local beekeepers, which can contribute to the sustainable development of the local economy through the sale of bee products [15].

Regarding the evolution of the world honey market, in the next period, an increase of 5.72% is expected, thus reaching 15.4 billion dollars in 2030 [23]. This increase is based on several factors: the increase in the income of the population, the health benefits, the long term of validity, accessibility etc.

Even if the values of the indicators in our study and the above-mentioned political measures argue in favor of a successful Romanian beekeeping framework, we cannot end the analysis without mentioning, especially for the last decade, the massive disappearances of honeybee populations in Europe and in other parts of the world, through the weakening of their immune system leading to CCD (Collapse Colony Disorder) consequences. The analysis of the causes of this phenomenon reveals:

- the use of pesticides in agriculture (dramatic reduction in the amount of suitable food for pollinators);
- electromagnetic pollution;
- diseases, but also the use of synthetic drugs for the treatment of the colony;
- the inhibition, possibly even the annihilation of fundamental instincts of bees, such as the **swarming instinct** (which man tried to

control/deviate in a direction favorable to the picking instinct to increase honey production, respectively financial gain), **the mating instinct** (today the artificial mating of the queen is also practiced, also for the reason of human financial gain), the **instinct of building honeycombs** (for the same financial motivation – honey production decreases considerably when the bees in the colony produce wax only from their own body) - Secoșan apud Manke [13], to which are also associated the consequences of the transition since the 19th century to the **cuboidal beehive** in the context of the large-scale transition from holistic/organic forms to additive-cumulative forms specific to materialist thinking [13], with impact (including in the form of adaptive stress) on life forms.

From the multitude of factors that lead to illness - even the collapse of honey bees, we will briefly focus on **intoxications**. Ritter [22] distinguishes between intoxications**: by picking/ with pesticides/ by industrial emissions** (from naturopathic perspective intoxication grows slowly even from the cumulative effects over time of an allopathic treatment which stops the effects of an illness instead of its root cause, for bees included). Humans are directly responsible for the intoxication of bees, and in this sense, regulations have also been made on human initiative and measures have been taken to remedy the situation (for example, filters to reduce pollution in the case of industrial emissions, notifying beekeepers when insecticides and acaricides are applied for the protection of those crops visited by honey bees so that they close the hives until the contact substance dries on the plant or move their hive, severe restrictions on the use of neonicotinoids), however the economic stakes and the complexity of the associated problems make the negative effects of poisoning to still exist on a large scale. Humans are prisoners of the vicious circle they have created: materialism-industrialization-tech-digitalization-comfort-creating pseudo-needs and satisfying them through material abundance of dubious and distorted quality, even removed from the natural womb, with secular syncope already in the field of the holistic approach to Life in its multiple forms and levels and with effects that can be generically characterized by the phrase "diseases of civilization".

The case of neonicotinoids (abbreviated neonics or NNIs,) is illustrative in this sense: to increase agricultural production we created GMOs, and then we created a plethora of treatments/chemical substances that we poured into Nature so that we could support functional productive a denatured creation with which, paradoxically, we feed ourselves currently. NNIs are systemic pesticides (as a result the plant is completely impregnated with them, from the root to the pollen and nectar collected by the bees) very effective as insecticides attacking the nervous system of insects with consequent paralysis and death - working both in the case of insects that attack crops, of fleas and ticks (so they also have veterinary use - protective collars for pets are impregnated with NNIs, for example) ... as well as in the case of bees.

Almost 2 decades have passed since the first neonic was approved in the EU (in 2005). In 2013, five of them were approved to be used in plant protection products, although, in the same year, the use of three of them (*clothianidin*, *imidacloprid*, *thiamethoxam*) was severely restricted by the Commission for the protection of honey bees (EU Regulation No.485/2013), based on the risk assessment carried out by EFSA in 2012, and thus the use of the three substances in crops/gatherings attractive to bees (especially sunflower, rapeseed, corn) was prohibited, remaining to be used indoor such as in greenhouses or in treatments carried out after flowering or in harvests in seasons when bees are no longer active in picking.

New data have been accumulated to support the initial evaluation of EFSA and on this basis the dialogue between the Commission and the member states was carried out, which resulted in a series of Regulations between 2018-2020 in the above-mentioned direction.

However, the "colossus with feet of clay" of intensive/GMO-based agriculture and the inertia of the system have necessarily claimed repeated emergency authorizations to return to the use of NNIs from several member states, including Romania, with inherent conflicts of interest between the large owners of agricultural land and producers (a numerical minority that owns a territorial majority), respectively their association, supported by the state, on the one hand, and the associations of beekeepers, etc. environmental protection associations on the other side. And when environmental protection is brought up, let's not forget: human consumers themselves are part of the living environment, of the ecosystem, and pay the bill for pollution and an exhausting, artificial, degenerative way of life and nutrition. So, we all stay confronted with the big moral pragmatic challenge *how do we recover as an ecosystem?* not only regarding (theoretic) policies, but also when it comes to transpose them into practice.

CONCLUSIONS

Romania has a long tradition in beekeeping. And currently, our country is an important producer of honey in the European Union, respectively the 3rd place in the ranking, with a production of 29,760 tons in 2022. The largest amount was extracted from the South-West Oltenia Region - 4,815 tons, and Romania's honey production registered an upward trend in the period 2018-2022.

Also, the number of bee families increased by 14.62% during the analyzed period. The South-East Region was the leader with 343,317 bee families.

In parallel with the price increase, the consumption of honey has also increased, because it can be a healthy substitute for sugar. One of the possible causes could be the change in consumers' food preferences.

At the same time, bee honey is an important product in Romania's international trade. Thus, Romania's quantitative honey imports doubled in the period 2019-2022, but it was found that exports registered an increase of only 105.99%.

The support given to beekeepers through interventions within the PS PAC 2023-2027 will contribute to increasing the production and consumption of good quality local honey.

To the above, it is necessary to add that, since with the wave of digitization and the migration/transfer of bees/diseases/parasites by humans from a geographical area of origin to other areas (for increased beekeeping from financial profit reasons), it seems that honeybees need, more than ever, the humans to respect and protect them.

Let us relate to honeybees in such a way as to deepen and optimize the connection of our species with theirs for mutual benefits, turning the economy into a ***bio***economy and words into deeds by increasing the sustainability of consumption patterns, among other necessary measures, including through the *EU Common Agricultural Policy 2023-2027, EU Biodiversity Strategy for 2030, Green Deal (pioneering proposals to restore Europe's nature by 2050 and halve pesticides use by 2030)*.

In achieving this goal, the specialized contribution of beekeepers is worth noting, with the example of G. Mancke (German sculptor and beekeeper from Wiessenseifen), who, based on many years of observation of the nature of the bee as an individual and the nature of the colony as a functional unit, also years of experimentation, created an *entirely dedicated to the bee* hive, nicknamed *the beehive of the sun*, in direct connection with the natural elements indispensable to the life of the colony (sunlight, heat, adequate ventilation) and tailored in a form that supports the efforts of the honey bees to maintain the integrity of the brood nest and, generically, the harmony of the colony, from untreated natural materials/unaltered with synthetic chemicals (wood, rye straw, cow dung), at a significant height above ground level.

We also have a remarkable Romanian contribution, the *Maximus hive* proposed, made, tested and put to work by the beekeeper D.C. Negru, which proves that it is possible and desirable to return to organic beekeeping without artificial honeycombs and synthetic chemicals.

The humans know enough and through this paper we said enough so that every reader be(come) aware that is a collective responsibility, *our* collective responsibility, to protect the life and health of the honey bees because the option is clear: *pro* bee or not to be.

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STATISTICAL ANALYSIS OF ECONOMIC INDICATORS IN NITROGEN FIXATION OF BIRD'S FOOT TREFOIL CULTIVARS AND ITS INFLUENCE ON THE ECOLOGICAL EFFECT

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Abstract

The amount of fixed nitrogen per decare was studied in the experimental field of Research Institute of Mountain Stockbreeding and Agriculture-Troyan of bird'sfoottrefoil cultivars, such as Targovishte 1, Alvena, Lotanova and Frilo (Italy), Polom (Slovakia), Bonnie (France), Bull (Canada). The Lotanova and Polom varieties have increased nitrogen-fixing capacity and level of tuber formation, as well as fixed nitrogen per decare (17.40 and 17.17 N fix, kg/da), which is a prerequisite for increasing soil fertility and the ecological effect. These two varieties could be recommended as suitable for implementation in production from an economic and ecological point of view. The correlation analysis proved a high positive correlation dependence of gross revenue with yield (r=0.9999), production costs (r=0.9982), and the amount of fixed nitrogen (r=0.9998). Plant nitrogen storage through symbiotic nitrogen fixation of bird'sfoottrefoil, as a suitable meadow legume species for mountain conditions, determines its ecological effect.

Key words: *bird's foottrefoil, nitrogen fixation, ecological effect*

INTRODUCTION

Agriculture in the 21st century is faced with the challenge of overcoming the effects of climate change and at the same time preserving the environment. To achieve this balance, the application of appropriate agricultural practices related to improving soil fertility and biological diversity is essential [25].

For the conditions of sustainable agriculture, legumes are becoming increasingly popular. With their unique ability to establish symbiotic relationships with *Rhizobium* bacteria and atmospheric nitrogen fixation, they are an essential component for ecological forage systems and allow to obtain high yields using less /or no/ mineral nitrogen fertilizers [15, 31].

Legume-rhizobium symbiosis is a significant source of nitrogen and has a huge ecological and agronomic impact on the structure of sustainable agriculture [28, 42, 36]. Nitrogen from biological nitrogen fixation is used directly by plants and is less sensitive to denitrification and leaching [32, 14, 17]. Most legumes through biological nitrogen fixation can meet between 50 and 80% of their nitrogen requirements [20]. Increased symbiotic nitrogen fixation leads to increased nitrogen use efficiency. According to [2], this could be achieved by including more legumes in crop rotations.

Thanks to their nitrogen-fixing capacity, they are an alternative to industrial nitrogen fertilizers and a way to protect the environment [27]. The potential for nitrogen fixation through symbiosis is estimated to average 450 kg N/ha per year. According to [37], legumes fix between 15 and 25 kg of nitrogen per ton of dry matter. About 50 million tons of nitrogen are fixed annually in agroecosystems worldwide [18]. Crops such as alfalfa, red clover, peas, soybeans, and vetch fix about 65 to 335 kg N/ha [35, 22, 34]. Bird's foottrefoil is a valuable legume nitrogen-fixing species [41, 24]. In a study by [39] on the level of tuber formation of different forage legumes, the highest level of tuber formation was found for bird'sfoottrefoil. Likewise, bird'sfoottrefoil has the best phosphorus utilization efficiency (one of the factors that affect the process of tuber formation and nitrogen fixation) for tuber formation, both as a monoculture and in mixtures.

To increase biological nitrogen fixation and plant productivity, selecting highly productive genotypes with increased nitrogen-fixing potential is important, and in the case of already created varieties to study their capacity for tuber formation [29]. This phenomenon acquires special relevance under the conditions of mountain and foot-hill regions, both in agroclimatic terms and in terms of the reaction and fertility of the soil. Therefore, current farming systems need sustainable intensification by incorporating legumes.

In modern agricultural conditions, the requirements for obtaining ecologically clean plant production are increasing. Biological nitrogen fixation is a process related to the complete or partial replacement of nitrogen fertilizers in several crops and to protect the environment and production from pollution. Symbiotic nitrogen fixation is characteristic of forage legumes and is carried out by tuber-formation bacteria bacteria. It has been established that the amount of fixed nitrogen from symbiotic nitrogen fixation is 3 million tons per year. This directs the attention of researchers to search for ways to solve the nitrogen problem, so that the obtained forage production is ecologically clean, and the costs incurred in its production are minimal. The findings of [11] that depending on the legume species [30] and its symbiosis with bacteria from the genera *Rhizobium* and *Bradyrhizobium,* they fix atmospheric nitrogen in amounts up to 30 kg/da, determine further work in this direction.

Symbiotic nitrogen fixation determines the possibility of supplying the grass component with nitrogen in the mixed cultivation of forage grasslands [14]. The presence of a legume component in mixed crops regulates the processes of tuber formation and nitrogen fixation [26] and lowers the requirements for mineral nitrogen [5], which determines the positive impact on the nutritional value of the forage. Alfalfa, clover, and bird'sfoottrefoil accumulate 180, 170, and 92 kg/ha^{-1} N per year in the soil, respectively, and exhibit good adaptability to soil-climate conditions, altitudes, and other environmental conditions [12].

Scientific experiments defining the role of grass forages as one of the keys to increasing soil fertility, reducing the application of chemical fertilizers, and preserving agrobiodiversity are scarce [7, 38]. At the present stage, there are no comprehensive studies of the production of biological forage production from artificial grasslands in terms of its ecological effect [19].

The present research work aims to study the ecological effect of nitrogen fixation in different varieties of bird's foottrefoil varieties and to make a statistical analysis of the economic indicators in forage production.

MATERIALS AND METHODS

The study includes four-year data (2016-2019) from an experiment in the field of Research Institute of Mountain Stockbreeding and Agriculture – Troyan. The experimental design was a complete block with 4 replications with a plot size of 5 m^2. The following bird'sfoottrefoil cultivars were tested and compared with the Bulgarian variety Targovishte 1: Alvena, Lotanova and Frilo (Italy), Polom (Slovakia), Bonnie (France) and Bull (Canada). The data, on which basis the ecological effect was determined, were in the annual report P 163 on the scientific research activity of the Agricultural Academy of Bulgaria.

The indicators that determine the ecological effect are related to the study of the impact of the nitrogen-fixing capacity of different bird'sfoottrefoil varieties on the amount of bird'sfoottrefoil, to obtain quality forage production.

The ecological effect [33] of nitrogen fixation was interpreted by analyzing the relative share of bird'sfoottrefoil in the grassland and the impact of nitrogen fixation [40] on the share of the economically significant sown grass species in different bird'sfoottrefoil varieties.

Soil fertility was analyzed based on the amount of fixed nitrogen in the soil [16]. For this purpose, tuber formation was registered as the number of tubers/plant at the beginning

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of blossoming of the bird'sfoottrefoil (second regrowth) by taking soil monoliths [1]. According to the formula of [6] for a rough determination of the amount of fixed nitrogen in field conditions, it was calculated by years and averaged over the period. Experimental data were processed statistically using SPSS (2020) software.

The main methods used are index, graphic, tabular, comparative method, method of analysis and synthesis, descriptive statistical analysis, method of economic and index factorial analysis, method of establishing the complex influence of several factors, and correlation analysis.

The statistical processing of the data includes the relative level of the amount of fixed nitrogen, expressed as mean value, standard deviation, minimum and maximum values. Brave and Pearson's correlation coefficients were calculated to prove the relationships between yield and the main economic indicators [21].

Data were processed using Microsoft Excel.

RESULTS AND DISCUSSIONS

The soil of the experiment is a light gray pseudopodzolic with an acidic (pH_{H2O} 5.2-5.5; pH_{KCL} 4.3-4.4) reaction, which defines it as suitable for growing forage grasses. The availability of total and digestible phosphorus is 1.2-2.4 mg/100 g soil, which is very low, and absorbable potassium with 5.9-9.9 mg/100 g soil. The humus content (0.96-1.44%) is low. Their mechanical composition is from light to heavy sandy loam.

Amount of fixed nitrogen of bird'sfoottrefoil cultivars

The amount of fixed nitrogen per decare (Table 1) during the experimental period is influenced by weather conditions and the dry matter yield formed [10], as well as by the level of tuber formation. The growth of bird's foottrefoil and its rates of development largely determine the productivity of the grassland [3, 8], the activity of tuber-formation bacteria [14], and the degree of nitrogen fixation in individual bird's foottrefoil varieties. The least amount of fixed nitrogen per decare was found in the first experimental year, when the variation was from 4.12 to 5.78 kg/da, with an average value of 5.15 kg/da. The low values of fixed nitrogen correspond to low productivity, which is typical of the species during the initial stage of development.

Table 1. Amount of fixed nitrogen per decare of bird's foottrefoil varieties (N fix, kg/da)

Cultivars	***2016***		***2017***		***2018***		***2019***		***Average for the period***	
	N fix, kg/da	*+, - kg/da*	*N fix, kg/da*	*+, - kg/da*	*N fix, kg/da*	*+, - kg/da*	*N fix, kg/da*	*+, - kg/da*	*N fix, kg/da*	*+, - kg/da*
Targovishte 1	5.13	-	13.25	-	20.40	-	20.19	-	14.74	-
Alvena	5.55	+0.42	14.69	+1.44	21.63	1.23	24.47	4.28	16.58	+1.84
Lotanova	4.12	-1.01	14.38	1.13	20.70	0.30	30.39	10.20	17.40	+2.66
Frilo	5.78	+0.65	13.14	-0.11	18.78	-1.62	26.91	6.72	16.15	+1.41
Polom	5.10	-0.03	15.65	2.40	21.16	0.76	26.78	6.59	17.17	+2.43
Bonnie	5.20	+0.07	13.41	0.16	20.97	0.57	24.35	4.16	15.98	+1.24
Bull	5.16	+0.03	15.40	2.15	17.16	-3.24	23.49	3.30	15.30	+0.56
Average	5.15		14.27		20.11		25.23		16.19	
Stdev	0.52		1.04		1.58		3.21		0.96	
Min	4.12		13.14		17.16		20.19		14.74	
Max	5.78		15.65		21.63		30.39		17.40	

Source: Own calculations.

The maximum value was reported for Frilo, followed by Alvena. Alvena has the highest level of tuber formation and the highest dry matter yield. In the second experimental year, the dry matter yield was twice compared to the first year, and the amount of fixed nitrogen exceeded the values of the first year by almost three times. The variation is from 13.14 to 15.65 N fix,kg/da, as Polom and Bull cultivars had the highest values. The combination of favorable soil-climatic conditions, a high level of tuber formation, and high productivity determine the high nitrogen-fixing capacity in the third experimental year. Fixed nitrogen in Alvena and Polom cultivars per a decare registered almost similar values of the amount of fixed nitrogen per decare, 21.63 and 21.16 N fix, kg/da, respectively. The lowest amount of fixed nitrogen per decare was found in Bull (17.16 N fix, kg/da). In the fourth experimental year, the cultivars reached the highest amount of fixed nitrogen, from 20.19 to 30.39 N fix, kg/da, respectively, as Lotanova variety appeared as the most suitable of the studied varieties in terms of this indicator. On average over the study period, Lotanova and Polom had the highest yield of fixed nitrogen per decare (17.40 and 17.17 N fix, kg/da), exceeding the standard variety by 2.66 and 2.43 N fix, kg/da. These two varieties could be recommended as suitable for implementation in production from an economic and ecological point of view. The relatively high content of nitrogen fixed by them predetermines low costs in terms of fertilizing and defines the species as a suitable component for growing subsequent crops. The lack of mineral nitrogen fertilizer also proves the ecological effect of growing these varieties, due to the lack of nitrates in the soil.

The statistical processing of the nitrogen fixation data of bird's foottrefoil varieties shows the highest average value x=25.23 fix, kg/da of the fixed nitrogen in the fourth year of the experimental period, and the lowest (x=5.15 fix, kg/da) in the first experimental period year when the plants are weak and not strong. The standard deviation has a maximum value (Stdev = 3.21) in the fourth year when the average value of the amount of fixed nitrogen is the highest. The maximum amount of fixed nitrogen in the fourth experimental year for the Lotanova variety is 30.39 fix,kg/da.

Ecological effect of nitrogen fixation

The capacity of bird'sfoottrefoil to accumulate a certain amount of atmospheric nitrogen from the air contributes to its assimilation by plants. In this way, plants naturally acquire the necessary amount of nutrients for their growth and development. The increased nitrogen-fixing capacity and level of tuber formation, as well as the amount of fixed nitrogen per decare, are a prerequisite for increasing soil fertility of Lotanova and Polom bird's foottrefoil varieties. Plant nitrogen storage through symbiotic nitrogen fixation of bird's foottrefoil, as a suitable meadow legume crop for mountain conditions, determines the ecological effect of forage legumes. Nitrogen fixation is also important for increasing the quality of forage because nitrogen is the main element in the composition of all amino acids. The lack of chemical substances, which are introduced in the form of mineral fertilizers, complements the role of legumes in their cultivation in an ecological aspect related to improving soil fertility.

Figure 1 shows the impact of nitrogen-fixing capacity on the share of bird'sfoottrefoil (%) in the grassland over the years. In the first experimental year, the Alvena variety had the highest share of bird's foottrefoil in the grassland (54.5%), followed by the Frilo variety (50.0%), whereas the lowest share was registered in the Bull variety (18.8%) and Bonnie (19.5%).

There is a correlation between the high share of bird's foottrefoil in the grassland and the amount of fixed nitrogen by the legume species [13], which proves that bird’s foottrefoil forms root tubers that accumulate nitrogen and stimulate the development of the sown crop [23].

In the second year, the combination of favorable climatic conditions with maximum growth and development of the plants justified the reported high values regarding the share of the bird's foottrefoil in the grassland [4].

Polom (97.0%) and Alvena (93.8%) had the highest relative share of bird's foottrefoil, registering the highest amount of fixed nitrogen per decare, respectively 15.65 and 14.69 N fix, kg/da.

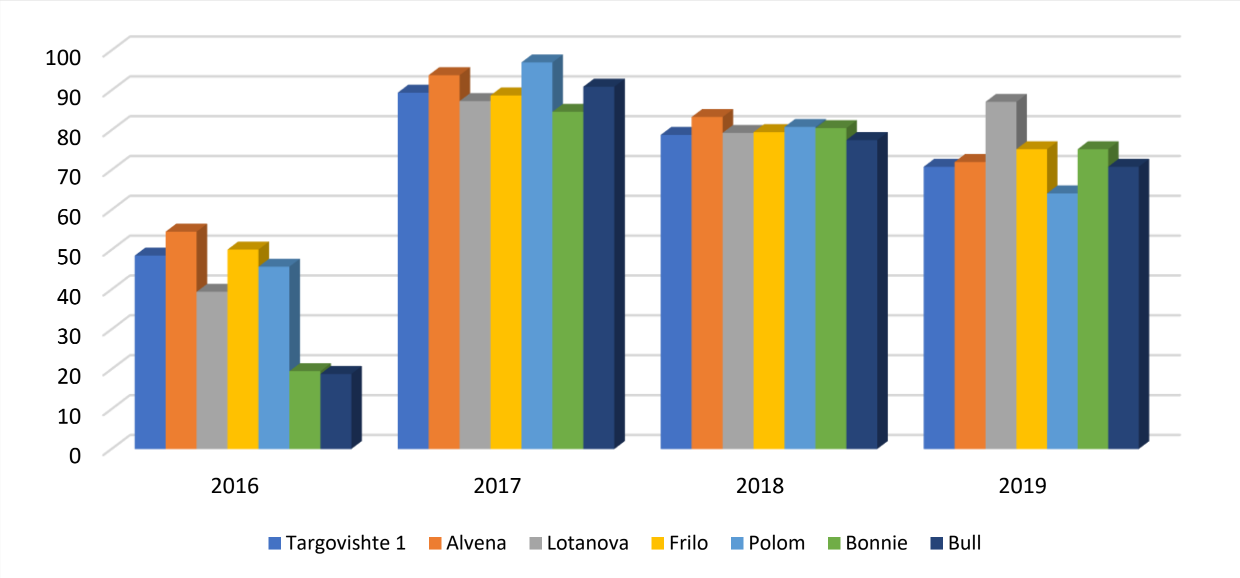

Fig. 1. The impact of nitrogen-fixing capacity on the share of bird's foottrefoil (%) in the grassland over the years.
Source: Own design and results.

This again proves the stimulating effect of the amount of fixed nitrogen of these varieties on the growth and development of the bird'sfoottrefoil [4].

In the third experimental year, all tested varieties registered a high share of bird'sfoottrefoil in the grassland at both mowings. Alvena (83.3%) and Polom (80.8%) N fix kg/da had the highest relative share of bird'sfoottrefoil in the grassland.

Bird'sfoottrefoil maintains a high percentage share in a large part of the tested varieties in the fourth year of the experimental period. Its share was maximum in the grassland with Lotanova variety (87.1%) with the highest amount of fixed nitrogen per decare, respectively 30.39 N fix, kg/da.

Correlation dependences

Table 2 presents the correlation dependences between the main economic indicators with the dry matter yield and the amount of fixed nitrogen per decare [9].

Table 2. Correlation dependences among the average yield, the amount of fixed nitrogen, and the main economic indicators in forage production from bird's foottrefoil varieties

	Average yield	***N fix***	***Production costs***	***Cost price***	***Gross income***	***Gross profit***	***Profitability***	***Efficiency coefficient***
Average yield	1							
N fix	1.0000	1						
Production costs	0.9990	0.9991	1					
Cost price	-0.9992	-0.9991	-0.9984	1				
Gross income	0.9999	0.9998	0.9982	-0.9990	1			
Gross profit	0.9998	0.9998	0.9982	-0.9990	1	1		
Profitability	0.9998	0.9998	0.9981	-0.9990	1.0000	1.0000	1	
Efficiency coeficient	0.9995	0.9995	0.9978	-0.9986	0,9998	0.9998	0.9998	1

Source: Own calculations.

A high degree of correlation was observed between forage yield and the amount of fixed nitrogen per decare (r=1.0000). This dependence proves the role of legumes as a nitrogen source that affects plant growth and development and determines the high dependence between production costs and yield (r=0.9990). This dependence predetermines and explains the reduced costs of dry matter production with reduced fertilizer inputs.

Gross revenues are highly positively correlated with yield (r=0.9999), production costs (r=0.9982), and the amount of fixed nitrogen (r=0.9998). Profitability is also highly correlated with gross revenue (r=1.0000) and gross profit (r=1.0000). The efficiency coefficient is highly correlated with yield (r=0.9995), amount of fixed nitrogen (r=0.9995), production costs (r=0.9978), gross revenue (r=0.9998), gross profit and profitability (r=0.9998). The correlation dependence of the cost price of production with gross revenues (r=-0.9990), gross profit (r=-0.9990), profitability (r=-0.9990), and respectively the efficiency ratio (r=-0.9986) is negative. The obtained values of the correlation coefficients confirm the obtained data on the economic indicators of the increased gross profit, gross revenue, and profitability, and reduced cost price of the obtained forage production from bird's foottrefoil varieties.

CONCLUSIONS

In the comparative test of seven bird'sfoottrefoil varieties, it was found that the Lotanova variety had the highest tuber-forming capacity. This predetermines the resulting high amount of fixed nitrogen per decare.

The amount of fixed nitrogen largely determines the average yield, gross revenue, and profitability of the obtained forage production, which is proven by the high values of the correlation coefficients.

The high nitrogen-fixing capacity and accumulated nitrogen per decare enhanced natural soil fertility and increased the ecological effect of meadow legume crops.

Lotanova and Polom with their high productivity, amount of fixed nitrogen per decare, economic efficiency and ecological effect can be recommended as suitable for growing in mountain conditions.

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ECONOMIC EVALUATION OF FERTILIZING WITH ORGANIC FERTILIZERS IN THE PRODUCTION OF BIRD'S FOOT TREFOIL FODDER

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Abstract

The impact of organic fertilizers, such as Blago 5 at doses of 300 and 600 ml/da and Fertileader Axis at doses of 500 and 1,000 ml/da were tested on a bird's foot trefoil grassland (Lotus corniculatus L.) in the experimental field of the Research Institute of Mountain Stockbreeding and Agriculture of Troyan (RIMSA) from 2020 to 2023. To analyze the main economic indicators based on dry matter yield, graphical and tabular methods, comparative methods were used; method of analysis and synthesis; descriptive statistical analysis and correlation analysis. The high productivity of the grassland treated with the Blago 5 at doses of 600 ml/da determined the lowest cost price and the highest profitability rate of this organic fertilizer. A strong correlation dependence of yield with gross revenue and gross profit (r=1.000) was established, and the high correlation coefficient between gross profit and profitability (0.994) proves the good interdependence between these two indicators. The established results show that Blago 5 applied at a dose of 600 ml/da is a suitable for practical use for the production of bird's foot trefoil forage.

Key words: *bird's foot trefoil, fertilizing, economic indicators, correlation dependences*

INTRODUCTION

The changes that have occurred in forage production, especially in the cost prices determine its rethinking from an economic point of view. This necessitates the application of new technological solutions, determining increased productive efficiencies of plants, reduced cost price, increased profitability, and efficiency of the obtained forage [7].

A large part of scientific research is related to the search for opportunities to increase the yield of green and dry matter in several forage legumes important for Bulgaria [10]. Bird's foot trefoil is a forage species [3], characterized by good adaptability for cultivation under different soil-climate conditions, especially on acidic soils [5]. It is rich in protein, with high dry matter yield and high nutritional value [2].

There are several experiments regarding obtaining profitable production. For this purpose, various agrotechnical events related to balanced fertilizing and treatment with foliar fertilizers are applied [4; 18].

The application of organic fertilizers in the agricultural sector is a good prospect for improving the quality of the harvested biomass, with smaller amounts of harmful emissions for the environment and the soil [8]. In recent years, agrarian science has been directed towards the application of organic agricultural products [16], which are used as substitutes for synthetic fertilizers.

One of the strategies for the development of the agricultural sector is the use of foliar fertilizers and biostimulants [1; 14; 19], which affect the biological potential of plants [11], replace mineral fertilizing and are an alternative for ecological and sustainable agriculture [7; 12; 20]. A large part of them contain living microorganisms and, through symbiotic nitrogen fixation, procure the necessary amount of nitrogen for the growth and development of plants [15; 17].

[13] demonstrated that the economic efficiency of grasslands depends on the costs and returns associated with the production of dry matter yield and the nutritional value of the forage [6].

The increase in yields leads to an increase in farmers' incomes [9], and this is related to the application of new innovative technologies.

Agricultural practices can contribute to the reduction of agrobiodiversity, which determines the demand for incentives to implement sustainable ones. Improving the condition and diversity of agricultural ecosystems will increase the sector's resilience to climate change and environmental risks. Fertilizing is such an economically effective ameliorating measure, preserving and improving agrobiodiversity.

The objective of the research work is to determine the economic efficiency and analyze the economic indicators in the production of bird's foot trefoil forage, after applying organic fertilizers Blago 5 and Fertileader Axis.

MATERIALS AND METHODS

The research experiment was conducted in the period 2020-2023 in the experimental field of the Research Institute of Mountain Stockbreeding and Agriculture of Troyan on light grey pseudopodzolic soil. It was set up according to the block method in four replications with a harvest plot size of 5 m^2 with Targovishte 1 variety, treated with the biological products Blago 5 at doses of 300 and 600 ml/da and Fertileader Axis at doses of 500 and 1,000 ml/da.

Blago 5 is a highly concentrated foliar fertilizer from lake sapropel. It lowers the lodging of the crops, as it increases the immunity of the plants; reduces the risk of diseases; stimulates growth; helps to overcome short-term droughts or in conditions of acute lack of moisture; and promotes the development of a powerful, secondary root system. The recommended dose is 300 ml/da.

Fertileader Axis is a systemic product. It has several effects, such as intensifying photosynthesis, a pronounced anti-stress effect, and slowing down the aging of chloroplasts. It improves the absorption and mobility of nutrients in the plant and its resistance to stress factors, improves metabolism supplies plants with zinc and manganese, and improves energy exchange in cells and energy transfer. The composition of the product is as follows: Nitrogen (3%); phosphorus (18%); zinc (5.7%); and manganese (2.5%). The recommended dose is 500 – 1,000 ml/da.

Foliar feeding with the experimental fertilizers was applied twice, before harvesting the regrowths each year. The working solution was applied with a backpack sprayer during the period of active vegetation of the bird'sfoottrefoil.

Yield data are averaged over the four years in kg/da. They were processed by the method of analysis of variance. The economic evaluation includes indicators, such as production costs (BGN/ha), gross revenue (BGN/ha), gross profit (BGN/ha), cost price (BGN/t) and profitability rate (%). Based on the received data of the economic indicators, the economic efficiency of the costs (C_{ef}) was calculated. The economic indicators are divided based on performed activities, indicated in technological maps, and obtained dry matter yield. The analysis of the economic evaluation was conducted based on dry extraction by applying a graphical and tabular method, a comparative method; a method of analysis and synthesis; and descriptive statistical analysis. The statistical processing of the data was conducted according to ANOVA and included correlation analysis between the main economic indicators and yield.

RESULTS AND DISCUSSIONS

Economic evaluation of the production of bird'sfoottrefoil forage after organic fertilizing

The economic indicators (Table 1) for the fertilizing variants largely depend on the productivity of the grassland. On average for the four years, the yield of dry matter with imported biofertilizer Blago 5 was 8,308.03 t/ha at a dose of 300 ml/da and 9,017.02 t/ha at a dose of 600 ml/da. The effect was reversed in fertilizing with Fertileader Axis, which was applied at a lower dose (500 ml/da) and realized higher productivity compared to the higher dose 1,000 ml/da, respectively 8,888.08 and 8,467.04 t/ha.

Table 1. Economic evaluation of the production of bird'sfoottrefoil forage after organic fertilizing for the period 2020-2023

Fertilizing variants	Average yield	Production costs	Cost price	Gross revenue	Gross profit	Profitability
	t/ha	*BGN/ ha*	*BGN/t*	*BGN/ha*	*BGN/ ha*	%
Blago 5 300 ml/da	8,308.03	691.40	0.83	1,961.12	1,952.39	282.38
Blago 5 600 ml/da	9,017.02	740.45	0.82	2,132.54	2,118.99	286.17
Fertileader Axis 500 ml/da	8,888.08	812.63	0.91	2,098.13	2,088.69	257.02
Fertileader Axis 1,000 ml/da	8,467.04	999.45	1.18	1,986.24	1,989.75	199.08

Source: Own calculations.

The production costs determine the amount of investments made for the produced dry matter yield, as their values are from 691.40 to 999.45BGN/ha. Differences in the minimum and maximum value of the production costs are evident, which is due to the different types of fertilizers, their price, doses, and their effect on forage yield. The fertilizing costs of Blago 5 are significantly lower than Fertileader Axis. The lower dose of both fertilizers determines a lower level of production costs in forage production. Therefore, the type of fertilizer and its amount are decisive for the production costs. The difference in the cost price of the obtained production is insignificant. The variants fertilized with Blago 5 in both doses realized similar cost price values (0.83 and 0.82 BGN/t). This is due to the extremely small difference in the values of the production costs of the fertilizer rates. The lower dose of Fertileader Axis gave a higher yield, lower production costs, and a lower cost price of the obtained forage (0.91 BGN/t) compared to the higher dose (1.18 BGN/t).

An opposite trend was observed at a dose of 1,000 ml/da, where the lower dry matter yield and higher production costs determined the higher cost price of forage production compared to the lower dose.

The amount of gross revenue is determined by the amount of mining. The highest incomes obtained, respectively 2,132.54 BGN/t after fertilizing with Blago 5 at a dose of 600 ml/da, corresponding to the highest productivity (9,017.02 t/ha). The grassland fertilized with Fertileader Axis at a dose of 500 ml/da, which also had a high dry matter yield, realized gross revenues of 2,088.69 BGN/ha.

The lower values of the cost price of the realized predetermine a higher gross profit. This explains the highest gross profit obtained from the forage production after fertilizing with Blago 5 at a dose of 600 ml/da (2,118.99 BGN/ha).

The grassland fertilized with Blago 5 at a dose of 300 ml/da, achieved the lowest productivity and the lowest gross profit (1,952.39 BGN/da). The high gross profit is an indicator determining the economic efficiency of forage production after applying organic fertilizing. The gross profit determines the effect of the applied fertilizing on the grassland under certain soil-climate conditions [7]. In this case, the fertilizing with Blago 5 at a dose of 600ml/da appears as an economically effective technological measure for forage production in growing bird's foot trefoil on light gray pseudopodzolic soils in the mountain regions.

The gross profit gives the necessary information about the achieved economic effect of the forage production as a result of fertilizing [6]. However, the measurement of economic efficiency requires a comparison of the effect with the production costs incurred to achieve it. Thus, the profitability rate is determined as a basic economic indicator, summarizing the economic evaluation of the organic fertilizers applied on a given grassland that is grown under specific soil-climatic conditions. The profitability depends on the gross profit, as its maximum values are registered after a higher dose of *Blago 5*, which showed a profitability rate, respectively 286.17%. The high profitability of this fertilizing is the result of the high dry matter yield. According to the presented economic indicators and productivity, fertilizing with Blago 5 at a dose of 600 ml/da can be recommended from an economic point of view. This fertilizer applied in this dose realized the highest dry matter yield (9,017.02 t/ha), the highest gross revenue (2,132.54 BGN/ha), gross profit (2,118.99 BGN/ha) and profitability (286.17%).

Economic efficiency in the forage grass production from artificial grassland as a result of organic fertilizing

The efficiency coefficient (Fig. 1) did not show significant differences in fertilization rates. The lowest economic efficiency was recorded in the first experimental year. An exception is fertilizing with Fertileader Axis at a dose of 1,000 ml/da. The values of the efficiency coefficient are from 0.612 to 0.625%. As a perennial legume, bird's foot trefoil realizes the most expenses for the creation of the grassland in the year of sowing. This also proves the significantly higher efficiency factor in the first experimental year [6] for all fertilizing variants. In the remaining three years, a decreasing trend of the efficiency ratio was observed from the first to the fourth years. Both by year and on average for the study period, the economic efficiency was higher after fertilizing with Blago 5. In the first, second, and fourth years, the lower dose determined a higher economic efficiency, which according to the efficiency coefficient is 0.625; 5.463 and 2.933%. The higher dose of Fertileader Axis (500 ml/da) in all experimental years had a lower economic efficiency (0.481; 3.458; 4.229; 2.349). The analysis of the obtained results proves that the values of the efficiency coefficient depend on the size of the costs, the type of fertilizers and their doses, and last but not least, the productivity of the grasslands.

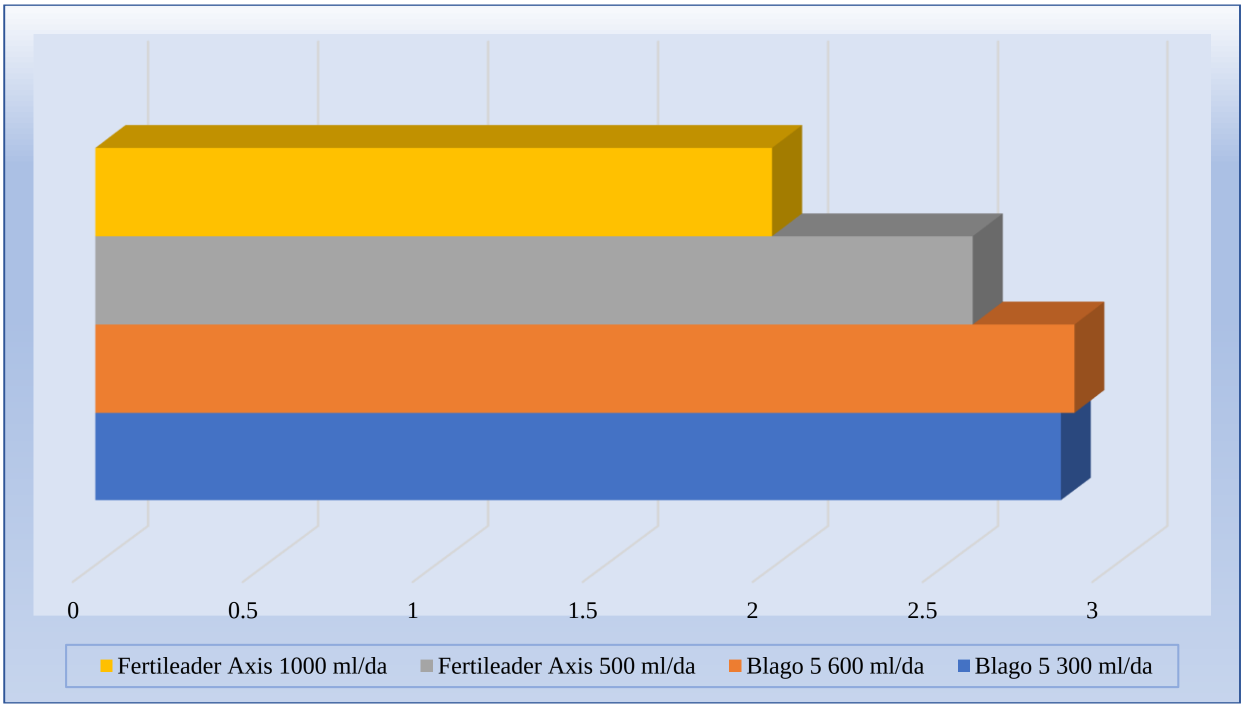

Fig. 1. Economic efficiency in the forage grass production from artificial grassland as a result of organic fertilizing average for the period 2020-2023
Source: Own results.

On average for the study period, the higher dose of Blago 5 the higher the efficiency coefficient (C ef = 2.880%), and when fertilizing with Fertileader Axis, the trend is the opposite, i.e. the lower dose realizes a higher efficiency coefficient (C_{ef} = 2.582%).

Correlation dependences

The correlation dependences in Table 2 show that the dry matter yield has the highest positive correlation with the gross revenues and gross profit (r=1.000), as well as with profitability (r=0.994). The cost price has a very high positive correlation with the values of production costs (r=1.000).

Table 2. Correlation dependences (r) between yield and main economic indicators of forage production from artificial grassland with bird's foot trefoil after organic fertilizing with Blago 5 and Fertileader Axis over the years

Indicators	Average yield	Production costs	Cost price	Gross revenue	Gross profit	Profitability
Average yield	1					
Production costs	-0.999	1				
Cost price	-1.000	1.000	1			
Gross revenue	1.000	-0.999	-1.000	1		
Gross profit	1.000	-0.999	-1.000	1.000	1	
Profitability	0.994	-0.998	-0.996	0.994	0.994	1

Source: Own calculations.

Analysis of the statistical correlation coefficients of production costs shows that they are in a very strong negative correlation with gross revenue (r=-0.999), gross profit (r=-0.999), and profitability (r=-0.998). Gross profit and profitability are highly correlated with gross revenue, with correlation coefficient values of r=1.000 and 0.994, respectively. The high correlation coefficient between gross profit and profitability (0.994) proves the good dependence between these two indicators. The correlation dependences mentioned above prove that fertilizing significantly influenced the change in yield values, and hence, the economic indicators of the dependence between them. High correlation coefficients make it possible to tentatively determine yield through economic indicators, and those with the highest correlation determine productivity prediction through regression equations.

CONCLUSIONS

Increased dry matter yields have an impact on the economic efficiency of forage production. This is proven by the application of the fertilizers Blago 5 (300 and 600 ml/da) and Fertileader Axis (500 and 1,000 ml/da) on the production of bird's foot trefoil forage.

The forage from a monoculture crop with bird's foottrefoil, fertilized with Blago 5 at a dose of 600 ml/da was the most cost-effective and economically efficient agro-ecological measure, according to the economic efficiency of costs.

Both biofertilizers determined the high positive correlation dependence of yield with gross revenue, gross profit (r=1.000), and profitability (r=0.994).

Foliar feeding with Blago 5 and Fertileader Axis on forage production from legumes is absolutely suitable in mountainous areas.

The application of Blago 5 at a dose of 600 ml/da on bird's foot trefoil forage production realizes high yields and high economic efficiency. This makes it practically applicable, and the resulting fodder production is ecologically clean, due to the use of organic fertilizers.

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TOWARDS SUSTAINABLE AGRICULTURE: ASSESSING THE ECONOMIC IMPACT OF ORGANIC FARMS IN MOLDOVA'S AGRICULTURAL SECTOR

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Abstract

The Republic of Moldova has made significant strides in adopting organic farming practices, supported by government subsidies and strategic focus on market demand. This paper aims to analyze the economic performance of organic farms in Moldova and their impact on the sustainable development of the agricultural sector, using primary data collected from 63 organic farms benefiting from subsidies between 2020 and 2022. The agricultural sector in Moldova has experienced a gradual increase in cultivated land, with a noteworthy 9.5% dedicated to organic farming. Economically, farmers have seen substantial growth in income per hectare, credited to favorable climatic conditions and advanced technologies. Although organic farming contributes significantly, constituting approximately one-third of total income, conventional agriculture remains the primary contributor with two-thirds. The impact of subsidies from the National Fund for Agricultural and Rural Development is evident in farm development, as calculated profits per one lei of subsidy have surged from 1.51 to 10.43 lei in 2022. This underscores the effectiveness of government support in fostering growth and development within Moldova's agricultural sector, emphasizing a positive trajectory for sustainable agricultural practices

Key words: *ecological agriculture, efficiency, economic performance, organic farming, subsidies*

INTRODUCTION

Extensive research has been conducted, employing productivity and efficiency analysis, to compare organic farming with traditional agriculture on a large scale. However, uncertainties persist regarding the efficiency and productivity of organic farming. Key questions related to productivity and efficiency studies in organic agriculture have received some answers, and a comprehensive overview can provide empirical evidence to address these queries.

Primarily, the extent to which organic farming is less productive than conventional agriculture [3, 6, 13, 16], and whether organic farming can offer solutions to global agricultural development challenges, are fundamental questions. Efficiency and productivity analysis plays a crucial role in contributing to this ongoing debate, delving into variations in productivity at the farm level and identifying the underlying drivers.

Secondly, organic farming receives support through diverse policies in the European Union (EU) and other nations [9, 17, 18, 14]. In certain EU countries, policymakers have even set quantitative targets for the proportion of organic farming in the agricultural sectors of Member States [8, 11, 14]. Literature on efficiency highlights that subsystems have a systematic impact on production decisions, farm efficiency, and productivity [10, 11, 15]. To formulate effective policies, understanding how different types of support affect farm productivity is imperative.

Lastly, organic farming operates based on the principles of organic production [17, 18], and its positive impact on biodiversity is well-documented [13]. However, there is a scarcity of empirical studies assessing the effectiveness of organic farms in generating environmental benefits compared to conventional farms.

Moldova's agricultural sector remains a vital component of its economy, making a substantial contribution to household incomes, with more than 20% of the workforce, totaling 179.3 thousand people, engaged in agriculture [4, 5]. Although its contribution has shown little change in recent years, Moldova boasts one of the highest proportions of arable land in Europe, with 74%, and possesses exceptionally fertile black soils.

In the past few years, the traditional agricultural landscape has undergone significant transformations. Crop production has surged by 55.3% between 2018 and 2022. Notably, staple crops with low added value, such as corn, sunflower, and wheat, continue to dominate annual harvests, comprising nearly 80% of the total sown area. Investments have been directed towards expanding the cultivation of horticultural crops and enhancing post-harvest infrastructure, particularly in the wine and fruit sectors.

The growth in cold storage capacity has facilitated increased exports during the off-season, enabling producers and cold storage operators to capitalize on higher prices post-harvest. These developments indicate a positive evolution in Moldova's agricultural sector, reflecting a strategic shift towards diversification and improved post-harvest handling.

In the context of a market-driven economy, economic entities in the Republic of Moldova are increasingly embracing organic farming practices, a trend that significantly influences the agricultural sector. The country has made notable progress in adopting organic farming, spurred by various government subsidies and a strategic focus on sectors with market demand. In 2019, Moldova emerged as one of the first three European nations to transition to organic land, and it stands among the top 20 countries exporting organic products to the E.U. [12].

The substantial demand for organic products in the EU market serves as a catalyst for the growth of Moldova's organic sector. Economic entities in the country are compelled to swiftly adapt to changing market dynamics within the EU, aiming to enhance their competitive standing. This shift towards organic farming not only aligns with global agricultural trends but also positions Moldova as a significant player in meeting the growing demand for organic products in the European market.

This paper aims to analyze the economic performance of organic farms in Moldova and their impact on the sustainable development of the agricultural sector.

MATERIALS AND METHODS

This research aims to assess the economic performance of organic farms in Moldova and examine their influence on fostering sustainable development within the agricultural sector.

To analyze economic efficiency of organic farms, primary data were used. The survey was realized in March-June 2023 and included 63 farms with 19456 hectares of agricultural land, from which 5320 hectares under organic farming (Table 1). The time period included in analysis refers to 2020-2022.

The largest share in the surveyed farms are LLC (73%), followed by family farms (24%). LLC farms manages 89% (17,306.7 ha) of the analyzed agricultural land, of which on 4,671.7 ha is implemented the technology of organic agriculture (87.7% of agricultural land producing organic products).

Table 1. The structure of the sample of organic farms

Variable	Category	Number of farms	Share, %
Region	North	24	51
	Center	32	38
	South	7	11
Legal form	Individual enterprise	1	1.5
	Individual farm	15	24
	LLC	46	73
	JSC	1	1.5
Total area, hectares	<20	18	29
	20-50	11	17
	50-150	12	19
	150-500	11	17
	>500	11	17
Converted area, hectares	<20	23	37
	20-50	11	17
	50-150	20	32
	>150	9	14

Source: author’s calculations.

Additionally, secondary data from Agency of Interventions and Payments in Agriculture regarding the allocated subsidies for organic farming were used.

RESULTS AND DISCUSSIONS

In the context of a market economy, agricultural enterprises in the Republic of Moldova are demonstrating a growing interest in adopting organic farming practices, with substantial implications for the agricultural sector. The country has made progress in the implementation of organic farming, stimulated by various government subsidies and a strategic emphasis on sectors aligning with market demand. In 2019, Moldova ranked among the first three European nations to transition to organic farming practices and secured a position among the top 20 countries exporting organic products to the European Union [2, 12].

From 66 surveyed farms, most agricultural land is managed by individual farms - 9.9% (1924.7 ha) and 505.7 ha of it is under organic farming (or 9.5%). By gender analysis, a majority of farms are managed by men (75%) while women lead only 25 percent of all organic farms.

The agricultural land converted to organic farming increased in 2022 comparing to 2020 by 461 hectares, according to the information collected from the surveyed farms.

Analyzing data related to agricultural land uses, in 2022 compared to 2020, the area of agricultural land converted to organic farming increased by 461 hectares. The slow dynamics in the development of organic farming can be due to different factors as:

-the consumption of the local population of local organic agri-food products is insufficiently developed;

-the promotion of domestic organic products on foreign markets is reduced, practically unimportant in terms of gross added value;

-economic entities implementing organic agriculture act on their own without having consultative support in the field;

-ambiguities with inspection and certification bodies demanding high costs for certification of organic products.

Among the 63 economic entities surveyed, only 40% of respondents indicated an increase in agricultural land dedicated to organic practices, while 60% either maintained or reduced their areas under organic farming. Consequently, out of the total 19,456 hectares of arable land cultivated by respondent farmers, 27.3% (equivalent to 5,320 hectares) are now dedicated to organic farming. This represents a modest 9.5% growth, or 461 hectares compared to the reported figures in 2020 (Figure 1).

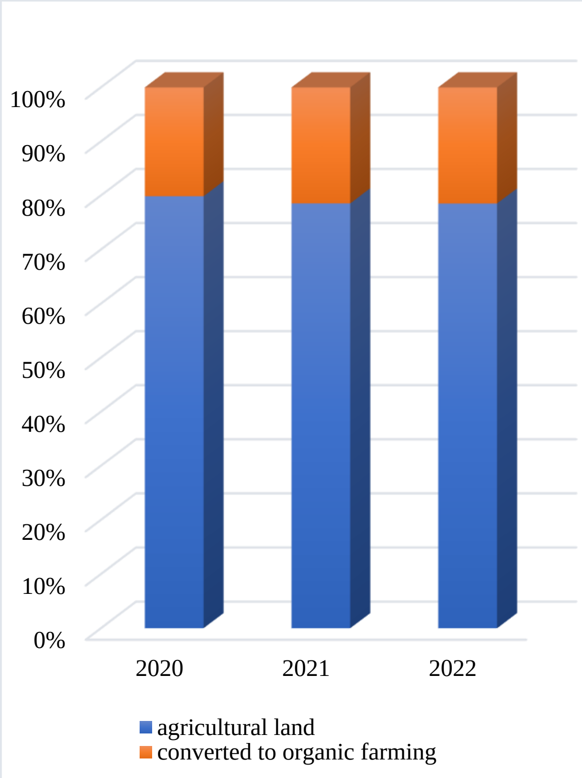

Fig. 1. Share of organic agricultural land in relation to conventional farming
Source: based on farm survey data.

The viability of adopting organic farming practices is at risk, particularly for farms without land ownership. Of 5,320 hectares dedicated to organic crop cultivation, only 16% (amounting to 861.7 hectares) are under secure ownership rights (Figure 2). The remaining 84% of agricultural land is leased from third parties, individuals who acquired ownership rights through the "Land" Program. These landowners retain the option to reclaim the agricultural land at any time if they find the contractual arrangements unsatisfactory.

The workforce in the organic farming system varies across economic entities, influenced by factors such as their profile, the extent of managed agricultural land, the nature of agricultural tasks, and the duration of employee training for such activities.

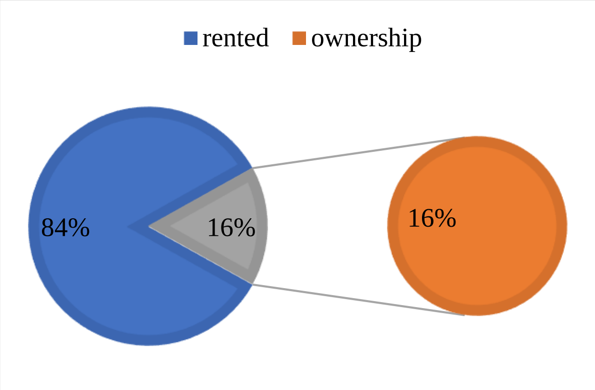

Fig. 2. Share of agricultural land ownership in organic farming, %
Source: based on farm survey data.

This variance is particularly evident when a significant part of the workforce is employed seasonally in activities like harvesting, processing, and storing the yield.
According to the results of surveyed farmers, their workforce comprises both permanent and seasonal employees. Seasonal workers accounted approximately 36% of the total in 2022. In that year, a total of 1,173 individuals were employed, including 864 engaged in regular activities and 309 involved in seasonal work.

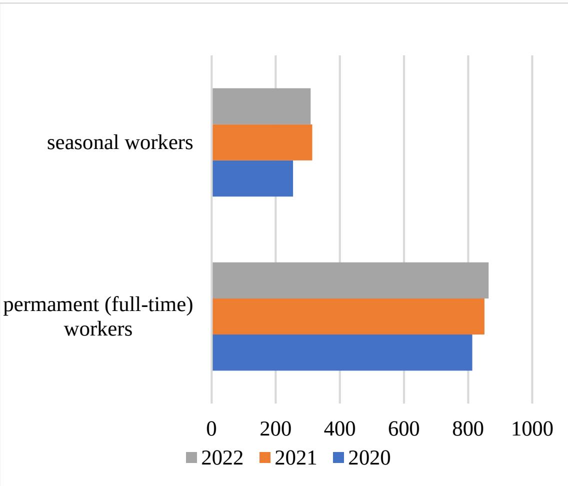

Fig. 3. Persons permanently or seasonally involved in the farm economic activity practicing organic agriculture
Source: based on farm survey data.

The number of farms permanent employees is primarily influenced by the extent of processed land and the farm complexity. On average, a farm with ownership of 450 hectares of arable land maintains a permanent workforce of around 20 individuals. In contrast, farms with land ownership ranging from 1 to 100 hectares typically have a permanent staff of up to 6 people (Figure 3).
A shared challenge in both organic and conventional agriculture lies in the shortage of qualified personnel. The low interest of younger generations in agriculture, coupled with a preference for alternative fields of activity, poses a pressing issue for farmers.
Another crucial indicator of the farm development is their reliance on state support for sectoral growth. In our surveys with farmers, we inquired about their use of subsidies from the Government. Among the 63 respondents, 53 farmers received this support consistently for three consecutive years, 3 benefited for at least two consecutive years, and an additional 4 were subsidized only once, while 3 farmers did not access subsidies at all (Figure 4).
When considering the amount of subsidies obtained, it's noteworthy that these depend on the developed investment projects.

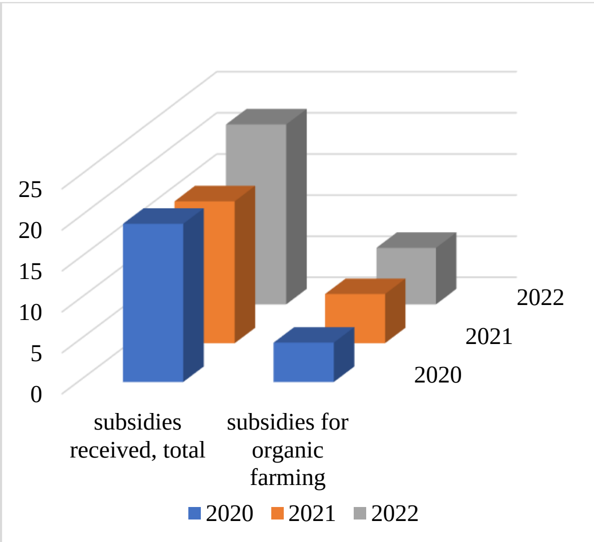

Fig. 4. Subsidies accessed overall versus subsidies for organic farming
Source: based on farm survey data and AIPA database [1].

A significant majority, 95% of farmers, availed subsidies for the acquisition of agricultural machinery and equipment, as well as for repaying installments on accessed loans. Additionally, 15% of the respondents undertook investment projects focused on establishing multiannual plantations and

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equipping them with irrigation facilities, with possible supplementary support.

Examining the provided data reveals that the 60 farmers who accessed subsidies executed investment projects valued at 19.3 million lei in 2020, 17.2 million lei in 2021, and 21.9 million lei in 2022. Notably, a significant part, 48 economic entities or 76% of those interviewed, received subsidies in 2022 to bolster the advancement and expansion of organic agriculture in the Republic of Moldova from the National Fund for the Development of Agriculture and Rural Environment. These farmers secured financial support totaling 6.9 million MDL, allocated for purposes such as transitioning to organic agriculture and reimbursing 20% of the value of the sold output (Figure 5).

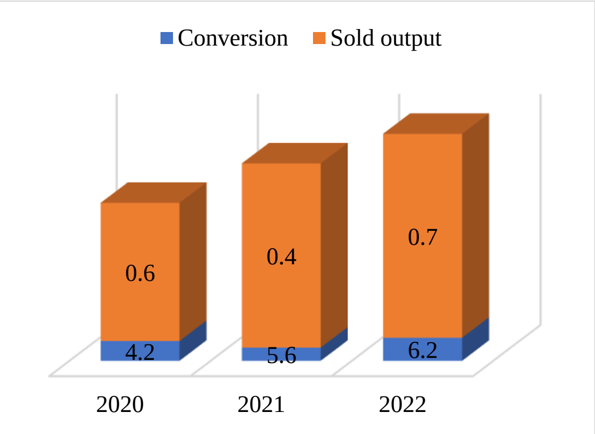

Fig. 5. Subsidies accessed for maintaining organic farming
Source: based on farm survey data and AIPA database [1].

In general, a trend is observed where more farmers are sustaining organic farming practices, while fewer are expanding their areas for certification. A key criterion for certification by inspection bodies is farmers' adherence to methodological norms of tillage while maintaining the designated areas for organic farming. To meet the requirements, the farmers often engage in land exchanges with other farmers. However, this is acceptable to inspection bodies only if both farmers are implementing organic farming practices.

When asked about whether the Government should tie subsidizing support for agricultural producers to the requirement of endorsing organic practices, opinions among respondents were divided. Approximately 54% of economic entities, representing 34 farmers, supported this process, while 46%, or 29 farmers, did not support these requirements.

Simultaneously, the respondents highlighted that each farm is urged to adopt specific minimum environmental requirements, which are obligatory to qualify for subsidies. These requirements include:

-obtaining a certain level of crop rotation;
-conservation of permanent pasture;
-maintaining a dedicated field for biodiversity-friendly practices;
-compliance with a farm sustainability tool on nutrient management.

The survey also delved into the farms activity profiles, revealing that the majority of those interviewed (90%) grow cereal crops, while only 10% are involved in activities related to multiannual plantations (Table 2).

Table 2. Area of land and average yield under organic farmers

		2020	2021	2022
Group I cereals	area, ha	1,526.4	1,857.6	2,087.1
	Average yield, tones per year	1,365.0	1,404.6	1,408.3
Group II cereals	area, ha	1,878.2	1,820.1	1,475.3
	Average yield, tones per year	533.8	339.5	202.7
Leguminous crops	area, ha	236.8	134.1	195.5
	Average yield, tones per year	2.5	5.4	4.7
Fruits and berries	area, ha	49.8	49.8	50.1
	Average yield, tones per year	11.6	9.2	34.3
Nuts	area, ha	290.4	426.5	426.5
	Average yield, tones per year	8.3	7.75	11.94
Grape	area, ha	0.2	23.6	36.8
	Average yield, tones per year	25	29	30
Herbs and flowers	area, ha	112.2	135.9	135.9
	Average yield, tones per year	518.9	519	516
Siderat (mustard+peas)	area, ha	764.9	766.3	912.8
	Average yield, tones per year	30.3	101.2	492.8

Source: based on farm survey data.

In 2022, the largest cultivated land area includes cereal crops in Group I, comprising 39.2% or 2,087.1 hectares of the total (Table

2). Within this category, gray holds the primary position at 1,823.3 hectares, followed by rye with 263.8 hectares. Crops in the large cereal category of Group II make up 27.7% of the overall land dedicated to organic farming, totaling 1,475.3 hectares. This category includes sunflower (1,095.9 hectares) and maize (379.4 hectares). Grain legumes and cover crops collectively constitute 20.8% of the organic land share, equivalent to 1,108.3 hectares. Notably, peas are the predominant crop at 682.2 hectares, followed by mustard at 230.5 hectares, and soybeans at 195.5 hectares. These crops, known for their nitrogen-fixing properties, not only enhance soil quality but also contribute to consistent profits for entities specializing in this field.

Farmers are increasingly showing interest in incorporating perennial plantations into the ecological cycle. In 2022, these plantations constitute 9.7% or 513.2 hectares of organic agricultural areas. Notably, walnut crops account for 8% of the organic areas, encompassing 416.9 hectares, while hazelnuts cover 9.6 hectares. Grapes occupy 36.8 hectares or 0.7% of the total area, and fruits (primarily plum) with berries cover 50.1 hectares or 0.9% of the overall land. It's worth mentioning that the area dedicated to nut crops has seen a notable 47% increase in 2022 compared to 2020, attributed to the entry of two additional economic entities into walnut plantation conversion.

In the field of organic farming, achieving successful outcomes for economic entities is contingent upon adhering to rotational practices, given the limited options compared to conventional producers who can utilize synthetic fertilizers and pesticides.

Researchers recommend implementing rotations encompassing several crops over a span of 4 to 6 years. For those prioritizing cereal cultivation, a rotation plan involving alfalfa, maize, peas, and Group I cereals is employed. On the other hand, for farms emphasizing vegetable crops, rotations include cereals and leguminous crops to enhance soil nitrogen content.

From an economic standpoint, pricing is influenced by two key factors: controllable and uncontrollable. Controllable factors are within the area of management decisions and actions, while uncontrollable factors are external variables that economic entities may have limited influence over.

Controllable factors can be manipulated in one form or another, or the economic entity can have a well-determined price policy and when a risk occurs, it reacts very promptly. As a rule, among the controlled factors are expenditure on materials, staff costs, other expenditures (transport, commissions, advertising, promotion), administration or management expenses.

Uncontrollable factors are those that the economic entity has no leverage of influence. De facto these are supply and demand in the market.

Both controllable and uncontrollable factors progress over time with different developments and require ongoing monitoring by the entity's administration.

The cost of production represents the overall expenses borne by an economic entity to acquire a product. At the entity level, the cost price serves multiple purposes, including: calculating economic and financial indicators for the entity; serving as the foundation for determining production levels and setting the marketing price; facilitating negotiations for production supply contracts; playing a pivotal role in decision-making processes at the management level of the entity.

The production costs within the examined organic farming entities exhibit year-to-year variability, influenced by fluctuations in input prices (such as fertilizers, seed material, diesel, etc.) and the resultant productivity levels. The year 2020 posed significant challenges for farmers, with natural disasters, specifically drought and hail, significantly impacting agricultural crop yields. Consequently, marketing prices also experienced fluctuations. For instance, farmers reported expenses of 6 MDL per kilogram of wheat, yet the final product was sold at an average price of 4.2 MDL per kilogram. In contrast, soybeans were sold at 5.75 MDL per kilogram, surpassing the production cost by 2.1 times.

Based on the survey data, we can mention that leguminous vegetables, mustard, fruits,

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grapes, and berries are being sold at prices surpassing the cost of production. This indicates that economic entities engaged in the production of these products are experiencing a positive economic return within their operations.

To support economic entities in agriculture, the Government extends support through compensations or financial aid for harvest losses due to adverse conditions. In 2020, Government Decision no. 582/2020 was enacted [7], outlining a mechanism to provide compensations for mitigating the consequences of natural disasters affecting the 2020 harvest. An allocation of 324.0 million lei from the Reserve Fund of the Government facilitated this initiative. Compensation was directed to farmers who incurred significant damage, as verified by factual evidence. Specifically, compensation was granted for drought-related losses on cereal crops of the first group and hail-induced damages on horticultural crops and peas, provided that the degree of damage exceeded 60%.

Organic farming constitutes a worldwide approach to agricultural management and food production. It integrates optimal environmental practices into a production system that promotes the well-being of soils, ecosystems, and individuals. At its core, organic farming seeks to ensure that farmers not only uphold sustainable practices but also derive a profitable return from their efforts.

The collected data from the surveyed farmers shows variable income during the researched period. Analyzed income data of 63 farms demonstrates a decrease in 2022 by 4.1% compared to the results of 2021 (74.5 million lei). Incomes increased with 87.6% or 819.9 million MDL compared to the results obtained by farmers in 2020.

In essence, a firm's income refers to the financial inflow generated during a management period through its regular operations. This encompasses gross income derived from the sale and collection of products as well as income from other activities.

Fig. 6. Financial results recorded by economic entities in organic agriculture, million MDL
Source: based on data from the surveyed farms.

Analyzing the provided data reveals that the surveyed economic entities report revenues not solely from organic agriculture but also from various other activities, such as conventional agriculture and other sources.

It is noteworthy that the declared incomes from organic agriculture constitute only a part of the total income, with 7% representing the earnings derived specifically from the marketing of organic products. In 2022, revenues from organic agriculture exhibit a 5.5% increase compared to those in 2021, amounting to 5.8 million lei. However, when compared with the figures from 2020, these revenues have experienced a decline of 123.4 million lei, equivalent to a 17% decrease. These variations can be attributed to several factors, including: crop rotation practices; climatic conditions, notably the impact of drought in both 2020 and 2022, influencing the production output, which, despite challenges, could be sold at an increased value; opportunities for exporting agricultural production, among other considerations.

Regarding the satisfaction level with the income derived from their managed activities:

-56.4% of respondents indicated that they perceive the magnitude of their income as very low.

14% mentioned that the income obtained in 2022, considering both their primary activity and organic farming, is low.

-28% of respondents classified the size of their income as average.

-1.6% mentioned that the income obtained in 2022, combining their primary activity and organic farming, is high.

-None of the respondents expressed the view that the income generated is very high.

To assess the influence of organic farming on the economic activity of farms, it is essential to conduct an economic efficiency analysis focusing on the land areas managed by the surveyed entities. Economic efficiency serves as a key indicator that not only highlights the evolution but also reflects the advancements achieved by the farms.

Table 3. Economic efficiency of farms implementing organic farming practices

Indicators	YEARS		
	2020	2021	2022
Agricultural area, ha	19,271.0	19,082.0	19,456.0
Agricultural area under organic farming, ha	4,858.9	5,213.9	5,320.0
Number of workers, persons	813	851	864
Subsidies, thousand MDL	19,338.4	17,266.8	21,916.3
Subsidies obtained for the implementation of organic farming practices, thousand MDL	4,809.9	6,028.2	6,919.5
Income, thousand MDL	937,901.0	1,832,249.0	1,757,769.0
Income from organic agriculture, thousand MDL	83,460.2	105,362.3	111,174.8
Profit, thousand MDL	29,176.4	180,313.0	228,617.2
Income to 1 hectare, MDL	48,669.0	96,019.8	90,345.9
Income from organic farming practices per ha, MDL	17176,8	20,207.9	20897,5
Profit per 1 ha, MDL	1,514.0	9449,4	11,750.5
Profit calculated to 1 MDL of allocated subsidies, MDL	1.51	10.44	10.43
Organic farming income in total income, %	35.3	21.1	23.1

Source: based on data from the surveyed farms.

Based on the provided data about economic efficiency in farms implementing organic farming practices (Table 3), it is observed that the land areas cultivated by farmers show a gradual increment each year, ranging from a 1% overall growth in the total agricultural land worked to a 9.5% expansion specifically in the agricultural land designated for organic farming practices. Additionally, there is a 6.3% increase in the number of employees in 2022 compared to 2020. When considering the area worked, this translates to an index of 0.04 employees per hectare of agricultural land managed by the surveyed farmers.

To identify economic efficiency, we analyzed farm income per land area. Thus, per 1 ha of agricultural land worked within the agricultural holding, the farmers income in 2020 amounted to 48.7 thousand MDL and in 2022, it increased to 90.3 thousand MDL. These developments were 1.9 times caused by favorable climatic conditions compared to the technologies applied by farmers in 2022, or, in 2020, the Republic of Moldova was affected by natural calamities expressed both by severe drought and hail. The income obtained by farmers from organic farming is lower compared to the total income, however from organic farming surveyed, farmers obtained 1/3 of it and from conventional agriculture 2/3.

Analyzing the profit calculated at 1 MDL subsidies accessed by farmers, we can mention that the support granted to farmers from the National Fund for the Development of Agriculture and Rural Environment has a major impact on business development, so that their evolution is obvious, or, in 2020, 1 MDLof the subsidies accessed led to obtaining 1.51 MDL profit and in 2022 to 10.43 MDL profit.

CONCLUSIONS

In the context of a market economy, the Republic of Moldova is witnessing a growing interest among economic entities towards adopting organic farming practices, significantly impacting the agricultural sector. The country has made substantial progress in organic farming, stimulated by government subsidies and strategic alignment with market demand. Moldova earned recognition in 2019, ranking among the first three European countries to transition to organic farming and securing a spot in the top 20 countries exporting organic products to the European Union.

Among the surveyed farms, individual farms manage the majority of agricultural land, with 9.5% dedicated to organic farming. Gender analysis reveals that men lead 75% of all farms, while women manage the remaining 25%, emphasizing gender disparities in organic farming leadership.

Despite facing challenges such as insufficient local consumption of organic products and limited promotion of domestic organic goods in foreign markets, organic farming in Moldova has seen a slight increase. The conversion of agricultural land to organic farming grew by 461 hectares in 2022 compared to 2020. However, this slow development may be attributed to factors like the lack of consultative support for entities implementing organic agriculture and uncertainties related to inspection and certification bodies, imposing high certification costs.

An analysis of economic efficiency indicates a variable income among surveyed farms. While organic farming revenues constitute a smaller portion of the total income, they have increased by 5.5% in 2022 compared to 2021. Leguminous vegetables, mustard, fruits, grapes, and berries are notable for being sold at prices exceeding production costs, indicating positive economic returns for entities engaged in their production.

Government support plays a crucial role in sustaining agriculture, as seen in compensations and financial aid provided for natural disaster-related harvest losses. Subsidies from the Government have supported farmers in various investment projects, with a significant focus on acquiring agricultural machinery and equipment.

The challenges faced by organic farming include land ownership issues, with only 16% of organic land under secure ownership rights. Additionally, the shortage of qualified personnel poses a common challenge in both organic and conventional agriculture, driven by waning interest among younger generations in pursuing careers in agriculture.

Despite the challenges, a positive trend is observed where more farmers are sustaining organic farming practices. However, fewer are expanding their areas for certification. The government's role in tying subsidizing support for agricultural producers to organic practices is met with divided opinions among respondents.

In conclusion, while Moldova has made strides in organic farming, there are ongoing challenges related to market development, land ownership, and workforce shortages. Government support remains crucial, and efforts to address these challenges can further enhance the sustainability and growth of organic farming in the country.

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ASSESSMENT OF THE PHYSICAL AND SOCIO-ECONOMIC POTENTIAL OF THE GRASSLANDS IN BANAT, ROMANIA IN A HOLISTIC APPROACH

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Abstract

Grasslands, the main natural resources of rural areas, are open systems, which are functionally and structurally linked with other geomorphological, climatic and/or socio-economic components. The purpose of the research was the diagnostic analysis of the grasslands in Banat, based on several criteria from: (i) the physical environment; (ii) the sphere of biodiversity and (iii) the socio-economic environment. For the analysis - diagnosis, 8 indicators were established: relief; reduction of livestock; the variation in the number of inhabitants; the area of grasslands /inhabitant; accessibility; overlap with protected areas; high biodiversity; touristic potential. Each experimental site was rated with a score according to the characteristics, later the final "grade" was established, and the spatial analyzes were done in the GIS environment. The obtained results show that the grasslands located in the hilly and mountainous areas had the highest scores for the predetermined indicators.They are grasslands restricted by climatic conditions and infrastructure, but they have a High Natural Value, they are located in protected areas and are considered areas with great touristic potential.

Key words: *grasslands, anthropogenic impact, socio-economic analysis, Banat, Romania*

INTRODUCTION

The grasslands cover approximately one third of the Earth's surface [7], distributed in varying proportions across all continents. These ecosystems fulfill multiple functions. In addition to their economic function, grasslands provide a series of services such as: environmental services, like maintaining the balance of greenhouse gases and the carbon cycle [2, 10, 6), biological control, protection of water and soil quality [17, 18]. Additionally, grasslands offer tourist services [8], cultural and social services [25, 34] and landscape elements [45].

Given the complexity of the pastoral space, a multicriteria analysis is necessary for its evaluation, serving as a support for decision-making or for advancing forecast scenarios.

Specialized literature presents numerous studies applying multicriteria spatial modeling using Geographic Information Systems (GIS), based on a differentiated approach to the involved factors, thus allowing for controlled determination of the weight of each factor [24, 22].

Spatial modeling can be applied in any type of study involving multifactorial approaches [46, 26], such as land stability [36], spatial modeling of carbon [11], hydrological risk [4, 38], spatial prediction of fire danger or natural hazard modeling [33].

Based on the spatial modeling techniques applicable to grasslands, the idea behind this study is based on the question: *"What is the physical and socio-economic potential of the grasslands in Banat?"* After analyzing studies in the specialized literature, it was found that in most cases, the evaluation and classification of grasslands are done unidirectionally: from a physico-geographical perspective, considering vegetation and land use, or as entities of the land fund. The working hypothesis of the study was formulated based on these findings, namely: a multicriteria approach, involving as many natural and anthropic factors as possible, spatialized, which provides the answer to the initial question. The necessity of such a holistic approach stems from the fact that grasslands are complex ecosystems and resources with multifunctional roles, especially within rural communities, which depend on them.

In this context, the aim of the research was the analysis-diagnosis and classification of the grasslands in Banat, based on several criteria of different aspects: (i) physico-geographical; (ii) biodiversity/subsidies; (iii) socio-economic environment, as well as to develop a spatial analysis model that integrates these factors for a holistic analysis of the pastoral space.

MATERIALS AND METHODS

The study area

Within this study, the grasslands in the southwestern region of Romania, specifically in Timiș and Caraș-Severin counties, were taken into consideration. The study area extends over a very wide altitudinal range, between 60 – 2,275 meters, encompassing a great variety of relief unitsabd landforms [41, 42], representing a complex territory from a geographical perspective. This is the first clue to the variability of grasslands in the area, identified based on Corine Land Cover (CLC) [15] datasets, covering an area of 238,866 hectares.

The working methodology

Within the study, 8 indicators were considered for the analysis of grasslands, with the final result being the map of grassland distribution, classified according to their potential.

With ArcGIS 10.4 software [5], the data selected and processed are shown in Figure 1.

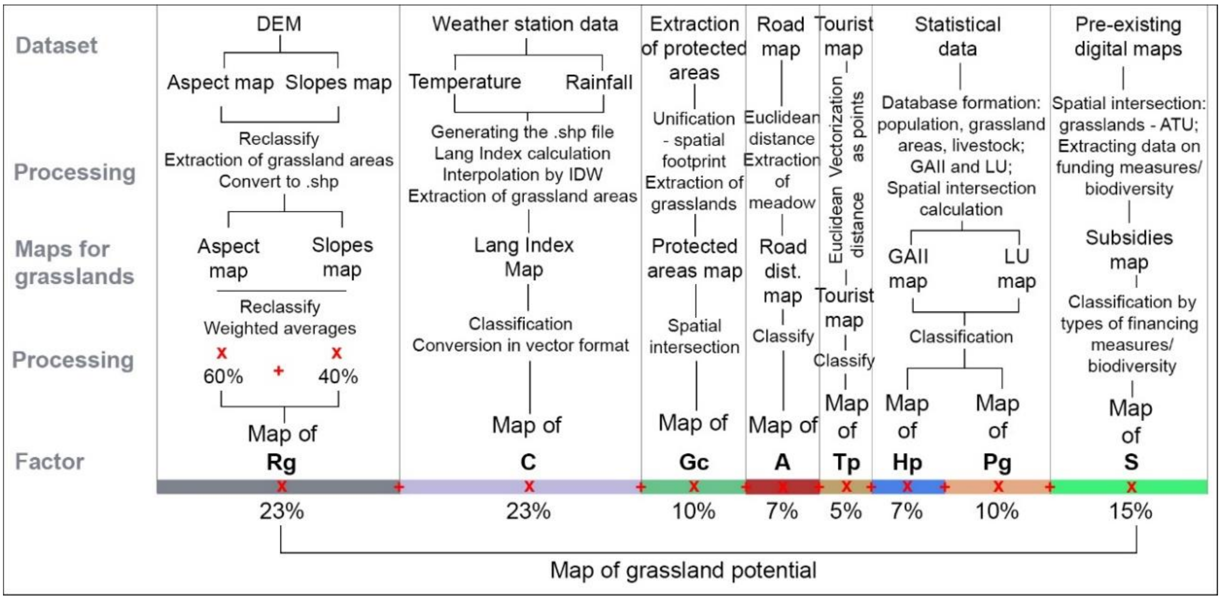

Fig. 1. The working methodology
Source: Original workflow.

- CLC data from the 2018 edition were used for identifying grasslands; cadastre maps, satellite images, and orthophoto plans were utilized for updating the geometries of the grasslands [1, 16];
- The Digital Elevation Model (DEM) with a spatial resolution of 25 meters, freely available through the Copernicus program [20], was utilized. From the DEM, slope maps (in degrees) and aspect maps were generated, necessary for determining the relief factor of grasslands (Rg);
- Climatic data including monthly average temperatures and monthly precipitation amounts were recorded at 13 meteorological stations in the area of interest for the year 2022 [12]. These data were used to calculate

the Lang Rainfall Index (R) used for the Climatic Factor (C);
- the natural protected areas boundaries [37] were used to determine the Grassland Conservation Factor (Gc);
- the road network in shapefile format [20] was utilized to determine the Accessibility Factor (A), while the tourist map of Banat [29] was used for spatializing the Tourism Potential Factor (Tp);
- Administrative-Territorial Units (ATU) boundaries and statistical data regarding the total population [30] and livestock numbers [19] were used to generate the Human Potential Factor (Hp) and the Potential for Animal Grazing Factor (Pg);
-the map showing the distribution of eligible areas for Measure 10 (M10) – Agri-environment and climate (with different Packages – P) and Measure 13 (M13) – Payments for areas facing natural constraints (ZM) or other specific constraints (SEMN) [3] was used to generate the Grassland Subsidies Factor (S) - to preserve biodiversity, without considering the amount (vary from year to year).
The indicators, expressed as thematic maps, analyzed within the spatial model for grassland analysis, were classified and quantified according to Table 1. The ratings for each indicator were awarded based on the degree of impact, ranging from 1 (no or weak impact) to 5 (very high impact).

Table 1. The quantification of indicators for grassland evaluation

Factor	Rg		C	Gc	A	Tp	Hp	Pg	S[4]
Data used for indicators	Slope map(40)	Aspect map(60)	Lang index(R)[1]	Map of protected areas(Pa)	Distance to roads (km)	Distance to landmarks(km)	GAII[2] (ha/ inhabitant)	Pg[3] (LU/ha)	-
Impact on grasslands									
1 - Null or very low	0–5	E - SE	100-160	Pa Present	0-5	0-5	0.71-1	0.7-1	A
2 - Low	5.1–10	S - SV	>160		5.1-10	5.1-10	1.1-4	0.41-0.7	B
3 - Moderate	10.1-20	V	60-100		10.1-15	10.1-15	0.51-0.7	1.1-3	C
4 - High	20.1–35	NV – NE	40-60		15.1-20	15.1-20	0.1-0.5	0-0.4	D
5 –Very high	35.1-58	N	20-40	Pa Absent	20.1-25	20.1-25	4.1-8	4.1-12	E

Legend

1	R = P / T P – Annualprecipitation(mm); T – annual average temperatures(ºC)Climate: 20-40 – steppe; 40-60 – semiarid; 60-100 – warm temperate; 100–160 – temperatehumid; >160 – humid (Satmari, 2010) [43]	3	Pg = LU / grassland area LU – livestock units; LU/ha LU = No. of animals x conversion coefficient: 1 – cattle; 0.14 – goats, sheep (Iacob et al., 2015) [28]
2	GAII = The area of grasslands/ inhabitant GAII - Grassland Anthropic Impact Index Ha/inhabitant (Cojocariu et al., 2024) [14]	4	The classification applies to differentiated subsidy categories: Category a - M10-P1, P2.1, P2.2, M13-ZM; Category b - M10-P1, P2.1, P2.2, M13-SEMN; Category c - M10-P1, P2.1, P2.2; Category d – M10-P11.2.1, P11.2.2, P11.2.3, P3.2.1, P3.2.2, M13-SEMN; Category e - Grasslands without subsidies from M10

Source: Original workflow based on literature data.

The class boundaries were established based on obtained data, field data, experiences, and specialized literature, adapted to the proposed grassland analysis model.
After obtaining ratings for each indicator, a weighted average was calculated in the GIS environment according to Figure 1.
The resulting grassland map was reclassified, and the grassland potential classes were obtained using the Natural Breaks classification method (Figure 2).
The grasslands of Banat have been divided into five classes: very high potential; high potential; moderate potential; low and very low potential.

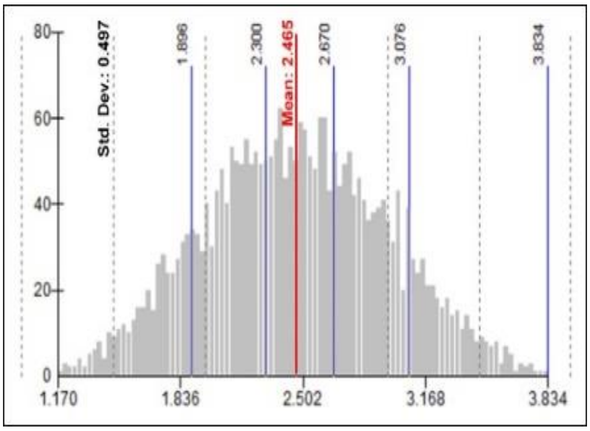

Fig. 2. The histogram of the dataset ”Grasslands”
Source: ArcGIS 10.4 [5].

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RESULTS AND DISCUSSIONS

Relief Factor (Rg)

Previous research has demonstrated the direct and/or indirect influence of relief on the distribution and constitution of vegetation cover. Relief acts on vegetation both through the slope of the terrain [9, 23, 31] and through the aspect of the slopes [32, 35]. The design of the Rg factor was based on the following hypothesis: the impact of relief on grasslands is minimal on gentle slopes and southern aspects (highest-rated grasslands) and very significant on steep slopes and northern aspects (lowest-rated grasslands). Relief has null or weak impact on 19% (43,960 ha) of grasslands (rating 1), which are located in all component subzones (Figure 3). Grasslands with slopes ranging from 5-10º and southern, south-western aspects received a rating of 2, covering a mosaic area of 92,714 ha (40% of total grasslands).

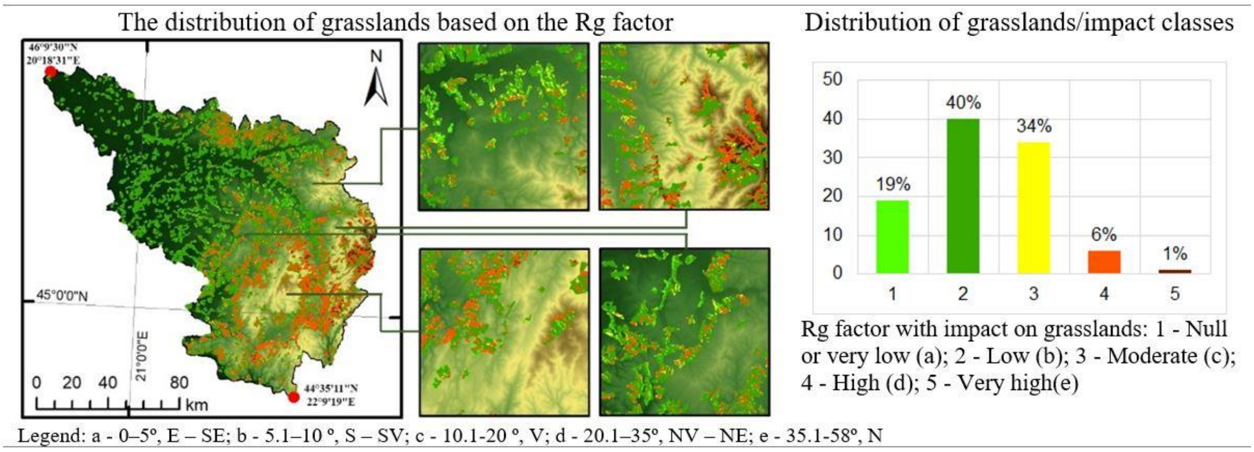


Fig. 3. The Rg factor in the study area
Source: Processing after: EEA, 2023; CLC, 2023; Geospatial, 2023 [20, 15, 21].

The relief has a moderate impact (rating 3) on 34% of grasslands (79,896 ha - slope between 10-20º and aspect west).

Grasslands with high (rating 4), 17,399 ha, and very high (rating 5), 552 ha, geomorphological risk, totaling 7% of the total, have slopes ranging from 20-58º and north-facing aspects; they are found in hilly and mountainous areas.

The climatic factor(C)

In this study, C was expressed through the Lang Rainfall Index, widely used in various climatic studies [43, 48] or phytological studies [44], to assess the precipitation-temperature relationship.

Depending on the requirements of grassland plants, we considered that the highest-rated grasslands are located in the temperate humid climate (rating 1), while the lowest-rated are the grasslands in the steppe climate (rating 5). Based on the C values, the grasslands in the analyzed area were classified according to Figure 4.

From Figure 4, it can be observed that 44% (104,459 ha) of the grassland areas are located in the temperate humid climate zone, which is beneficial for their vegetation and received a rating of 1. These are located in hilly areas and, with moderate temperatures and high precipitation levels. Among the analyzed grasslands, 31% (73,429 ha) fall into the humid climate zone (rating 2), in mountainous areas with low temperatures and high precipitation levels.

The remaining 26% of the total grasslands fall into the warm temperate (rating 3), semiarid (rating 4), and steppe (rating 5) climates, typical of plain regions with high temperatures and low precipitation levels.

The Grassland Conservation Factor(Gc)

In recent decades, both internationally and in Romania, there has been increasing emphasis on conserving grassland habitats. After Romania's accession to the European Union, the areas included in protected areas of various categories have significantly increased [13, 40, 47].

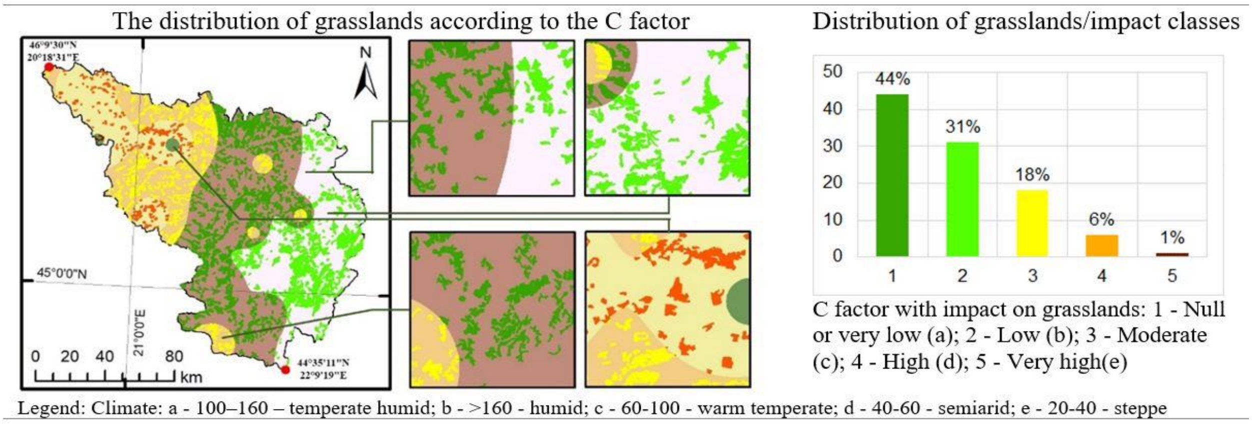


Fig. 4. C factor in the study area
Source: processing after: CLC, 2023; Climatic databases, 2023; Geospatial, 2023 [15, 12, 21].

In the study area, protected areas have a territorial "footprint" of 396,028 ha. Grasslands included in natural areas are aimed at preserving biodiversity and conserving genetic resources. Protected areas overlap with 21% of grasslands (50,691 ha) and have been rated with 1 (maximum value), while grasslands not within protected areas have been rated with 5.

The Accessibility Factor (A)

Studies in the field have shown that grasslands are exploited differently depending on accessibility, especially those near settlements and roads with immediate access are more intensively used [35]. The A factor is an indirect factor in grassland management, and we considered that its impact increases as they move away from access roads (Figure 5).

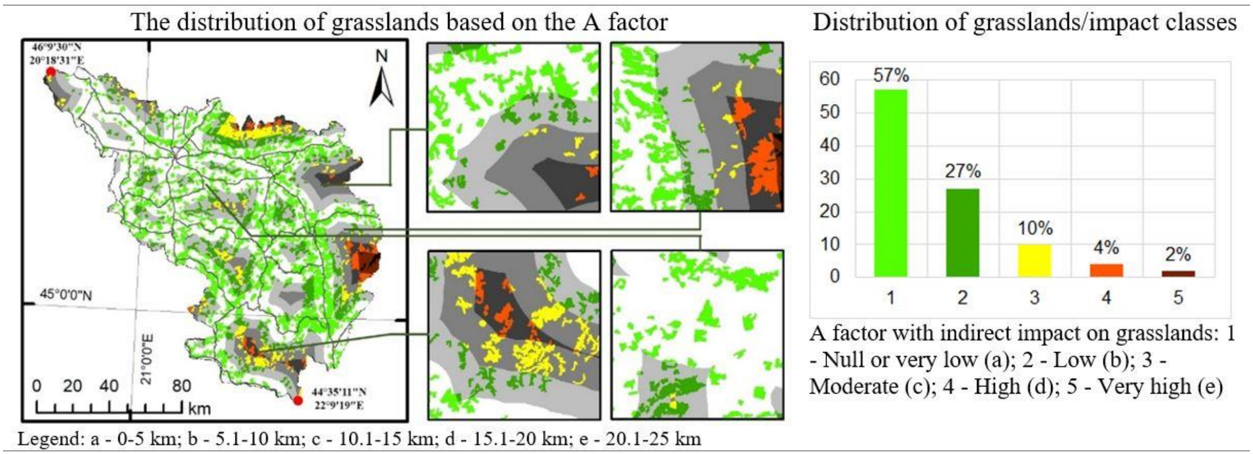


Fig. 5. A factor in the sudy area
Source: processing after: CLC, 2023; Geospatial, 2023 [15, 21].

Among the grasslands, 57% (136,509 ha) are located at distances less than 5 km from access routes (rating 1); 37% of grasslands (64,224 ha) were classified with a rating of 2, being located at distances between 5–10 km from the main access routes. Out of the total grassland area, 16% are located at distances between 10–25 km from the main roads, which classifies them with a lower score (in the high mountain area). Accessibility, broadly understood (transport infrastructure, water sources), plays an important role in the lives of livestock breeders and in the marketing of products. In plain areas, easily accessible, milk sales are daily, even twice a day. This explains the concentration of animals (sheep) in plain areas, which are more easily accessible, even though the grasslands occupy smaller areas and have a lower production potential.

The Tourism Potential Factor (Tp)

In Banat, there are many tourist and cultural attractions, natural and man-made (Figure 6).

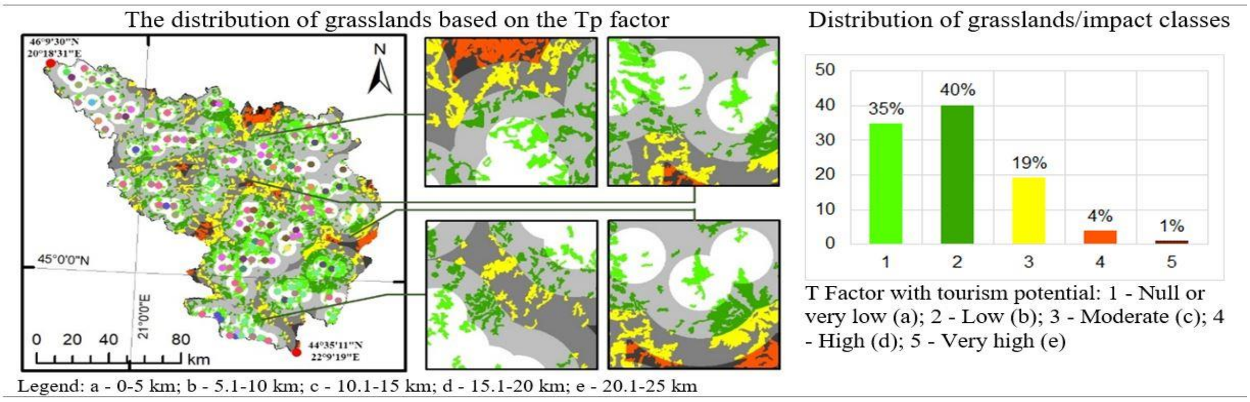


Fig. 6. Tp factor in the study area
Sourc: processing after: CLC, 2023; Geospatial, 2023; Intercultural Institute, 2023 [15, 21, 29].

In this study, the analysis of the tourist potential of grasslands was done based on their proximity to various attractions: balneoclimatic resorts, water mills, castles, industrial heritage, etc.

Additionally, the location of grasslands in areas with specific traditions (German, Hungarian, Serbian etc.) was taken into account, many of which are carried out in grasslands (rural festivals) or have connections to pastoral space, such as sheep measuring rituals [27].

Grasslands located close to tourist attractions were rated with maximum scores, on the principle that they can be easily integrated into tourist circuits.

Thus, 35% of the analyzed grasslands (83,348 ha) are located within 5 km of tourist attractions (Figure 6), being included in the class with the highest potential (rating 1).

The Human Potential Factor (Hp)

One of the most important resources of a territory is the human population, and in relation to grasslands, people direct the mode of exploitation and valorization, the dynamics of areas, or the role of these resources in the local economy.

In Banat, the anthropogenic potential in the exploitation of grasslands, appreciated through the GAII index [14], varies territorially (Figure 7).

Based on Hp, grasslands were rated as follows (Figure 7): with rating 1, accounting for 13% (30,240 ha), grasslands where GAII had optimal values (0.71 - 1.0 ha/inhabitant); with rating 2, accounting for 33% (78,686 ha), GAII values ranging between 1.1 - 4.0 ha/inhabitant; with rating 3, respectively 15% (36,634 ha), with GAII values between 0.51 - 0.70 ha/inhabitant; with rating 4, accounting for 33% (79,897 ha), with reduced GAII values, between 0.01 - 0.5ha/inhabitant; with rating 5, accounting for 6% (13,311 ha), with GAII ranging between 4.1-8.0ha/inhabitant.

In calibrating this indicator, we considered that low GAII values may indicate overexploitation of grasslands, while high values may indicate underutilization.

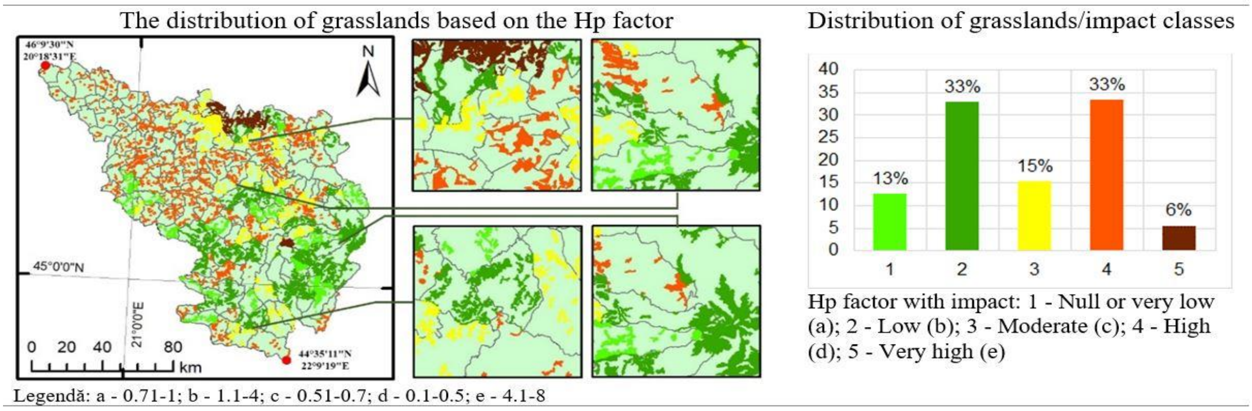


Fig. 7. Hp factor in the study area
Source: processing after: CLC, 2023; Geospatial, 2023; INS, 2023 [15, 21, 30].

Potential for Animal Grazing Factor (Pg)

In the case of grasslands, one of the modes of exploitation is their use with animals (Figure 8).

The current situation in our country shows that in the plain areas there are many animals and a small area of grasslands, while in the hilly areas where there are many grassland areas, the number of animals is reduced (INS, 2023)[30]. This situation is also reflected at the level of the study area (Figure 8).

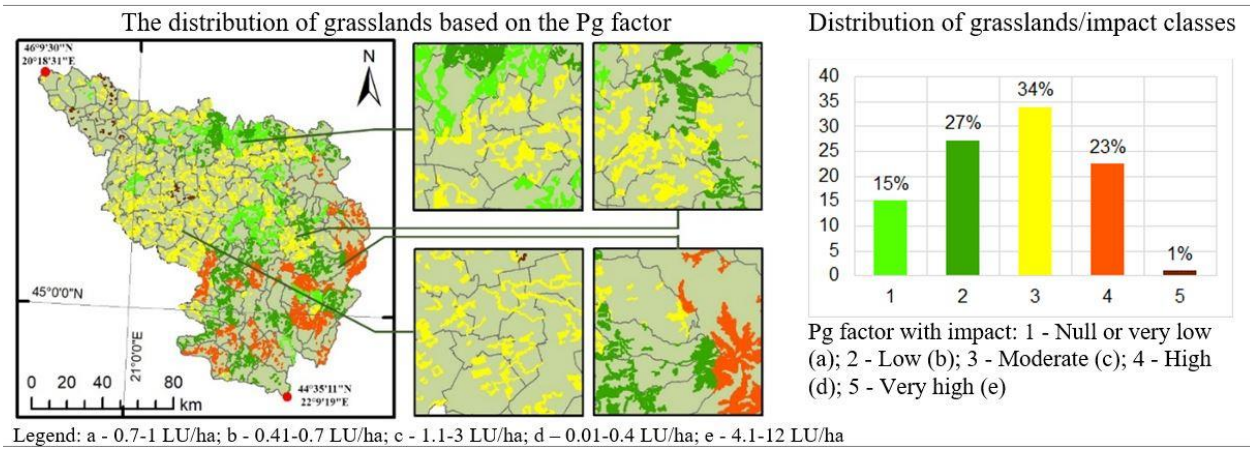


Fig. 8. Pg factor in the study area
Source: processing after: CLC, 2023; Geospatial, 2023; data.gov, 2023 [15, 21, 19].

In this context, we considered Pg as a factor for quantifying the 'density' of animals (LU) per unit area (ha). To enable integrated analysis, we quantified all categories of animals (cattle, sheep, goats) in LU.

From Figure 8, it can be seen that 15% of the total grassland area in the analyzed area (36,131 ha) received a rating of 1, with values ranging from 0.7 to 1.0 LU/ha (considered optimal for grassland exploitation). Of the total grasslands, 27% (65,200 ha) were rated 2, with values between 0.41 and 0.7 LU/ha, mainly in depressions or hilly areas, accessible areas with more intense agricultural activities. A percentage of 34% (81,043 ha) of the grasslands were quantified with a rating of 3, with values between 1.1–3.0 LU/ha, in the plain areas with a large number of animals and reduced grassland areas (risk of overexploitation).

In contrast, the grasslands rated 4, with values between 0.01 and 0.4 LU/ha, are found in mountainous areas (risk of underutilization and abandonment).

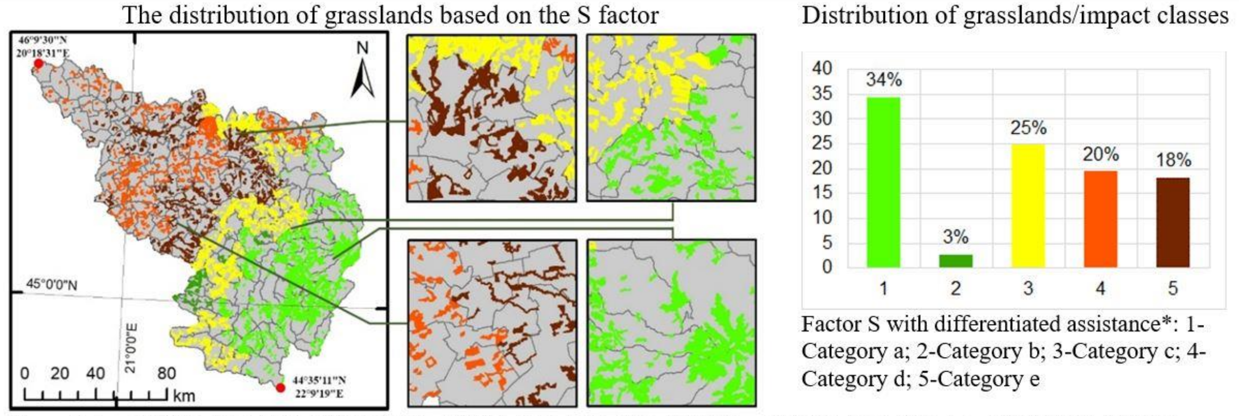
The Subsidies Factor for Grasslands(S)

At the EU level and implicitly in Romania, through the Common Agricultural Policy (CAP) and/or national programs (PNDR) [38], grasslands benefit from subsidies for exploitation. Measure 10 for Agri-environment and climate (M10) protects the biodiversity of grassland habitats and at the same time ensures the protection of soil, water, and carbon sequestration, in accordance with the principles of sustainable development.

In conceiving Factor S (Figure 9), the amount of subsidies was taken into account.Thus, M10 provides subsidies for forage losses, for High Nature Value Grasslands (used in traditional systems), and for Grasslands Important for Birds (used in extensive systems, with the protection of bird species nesting there).

Depending on the area, additional subsidies are added for initial packages through Measure 13, which includes areas located in mountainous regions (ZM) or areas with significant natural constraints (SEMN). The measure also provides subsidies for animals from traditional breeds, but this is not the subject of studies in this work, strictly referring to grassland areas.

The spatialization of factor S, at the level of Banat, showed that 34% of grasslands (82,150 ha) are under the incidence of M10 (HNV grasslands, in packages P1, P2, with the related variants) and M13-ZM, being located in mountainous areas and included in the maximum subsidy category (grade 1). In the second subsidy category, grasslands under the incidence of M10 (HNV grasslands), but located in SEMN, represent 3% of the total (6,627 ha). Category 3 funding includes only HNV grasslands (M10), located in hilly areas and depressions, accounting for 25% of total grasslands (59,505 ha). Looking strictly from a biodiversity perspective, grasslands included in category 3 are the most valuable, being complex ecosystems with a large number of species, grasslands unaffected by restrictive environmental conditions. Category 4 includes Grasslands Important for Birds, accounting for 20% of the total, located in plain areas and in the Lipova Hills. The minimum score (grade 5) was assigned to semi-natural grasslands that do not benefit from subsidies from M10, accounting for 18% (43,714 ha), located in the plain and hills.



*Legend: 1 a - M10-P1, P2.1, P2.2; M13-ZM; 2 b - M10-P1, P2.1, P2.2, M13-SEMN;3 c - M10-P1, P2.1, P2.2; 4 d –M10-P11.2.1, P11.2.2, P11.2.3, P3.2.1, P3.2.2, M13-SEMN; 5 e –grasslands without subsidies fromM10

Fig. 9. S factor in the study area
Source: processing after: CLC, 2023; Geospatial, 2023; PNDR, 2020; APIA, 2023 [15, 21, 38, 3].

Multicriterial analysis of grasslands

From the analysis depicted in Figure 10, it can be observed that the grasslands in Banat are classified into five classes based on their physical-geographic and socio-economic potential. Out of the total grassland area, 11% (24,558 ha) were categorized into Class 1, indicating very high potential. These grasslands are primarily located in the mountainous area, on plateaus, and in intramontane depressions; they are not restricted by relief factors and have minimal impacts regarding exploitation factors (Hp and Pg) and accessibility. These grasslands exhibit a high degree of biodiversity, overlap with protected areas, benefit from subsidies, and can be utilized for agrotourism purposes. Grasslands with high potential have been identified on 24% (55,155 ha) of the total area considered. They are mainly found in mountainous areas, depressions, and high hills.

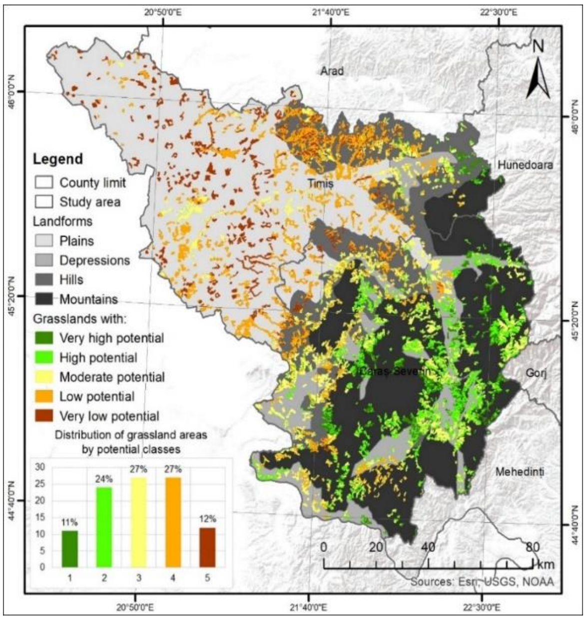


Fig. 10. The distribution of grasslands by potential
Source: processing after: CLC, 2023; Geospatial, 2023. [15, 21].

In their case, factors such as Rg, Hp, and Pg have a weak to moderate impact, while the other considered factors remain within optimal parameters. Grasslands with moderate potential (Figure 10), identified on 27% (62,097 ha) of the total area, are scattered from the lower mountain ranges to lowland areas.

In the case of these grasslands, the impact of the Rg factor is felt, most do not overlap with protected areas, the GAII index has lower values in certain areas, leading to a reduced number of animals. However, there is a high potential regarding climatic conditions, accessibility, and the fact that over 70% are HNV grasslands benefiting from subsidies.

Grasslands with low potential represent 27% (62,055 ha) of the total and are located in lowland and low hill areas. They are negatively impacted by factors such as Rg, C, Gc, Hp, and Pg. However, these are grasslands that benefit from subsidies to the extent of 80%, of which 60% are for HNV grasslands and 20% for important bird areas.

Grasslands with very low potential represent 12% (28,791 ha) of the analyzed grassland area. They are generally located in the lowland and Lipova Hills area and are disadvantaged by climatic conditions and exploitation factors (high population and large animal stocks relative to small grassland areas). Most of these grasslands are degraded due to overgrazing and lack of care.

CONCLUSIONS

The grasslands in Banat are located in different geographical conditions (plain, hill, mountain), which create territorial differences in their physical and socio-economic potential. Some grasslands are situated in subzones more favorable for harmonious development on multiple levels, while others face various degrees of difficulty (risk and/or impact factors).

The spatial variability of grasslands has been demonstrated through the eight indicators analyzed in this study. Their values differ both horizontally and vertically.

Based on the multicriteria analysis model applied in this study, it is evident that out of the total grassland area, 11% have very high potential, 24% have high potential, 27% have moderate potential, 27% have low potential, and 12% have very low potential.

According to the evaluation indicators established in the study, grasslands with the highest physical and socio-economic potential in Banat are located in mountainous areas, intramontane depressions, and hilly zones.

Spatial analysis models of grasslands based on individual and spatialized indicators in the form of thematic maps provide both the opportunity to use the results obtained separately for each indicator and to create an integrated overview considering all indicators. Such studies are useful in rural development strategies, spatial organization and territorial planning, regional economic development plans, pastoral management plans, and/or protected area management plans.

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THE WINEMAKING SECTOR IN THE REPUBLIC OF MOLDOVA-ANALYSIS AND PERSPECTIVES

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Abstract

This paper analyses the winemaking sector in the Republic of Moldova using econometric models. The use of econometric models in agriculture involves the application of statistical methods and economic theory to analyze and model relationships in the agricultural sector. These models help researchers, policy makers and practitioners to understand the factors that influence agricultural outcomes and make informed decisions. The article presents the results of regression estimations in which the endogenous factor is the volume of overall production in agriculture, but also the volume of production in the wine sector. On the basis of official statistical data of the Republic of Moldova, the Cobb-Douglas production function was estimated, whereas exogenous factors are labor and capital used in agriculture, but also technical and scientific progress observed in agriculture. The function is used for both short-term and long-term forecasts.

Key words: *agricultural sector, winemaking sector, econometric models, Cobb-Douglas production function, forecast scenarios*

INTRODUCTION

Economic development is a concept that characterises the direct or indirect economic effects at the level of a national economy or a single sector (e.g. the wine sector) as a result of the quantitative, structural and qualitative modernisation and transformation taking place in the economic activity of an entity, a country, over a specific period of time under the influence of a set of factors [18].

Economic development is the qualitative change of production results through the application and influence of the technological process [16]. In the view of the authors Timofti E. and Sargo A., "economic growth is a long-term process of quantitative and qualitative increase of production activity and maximization of their results through the efficient use of intensive factors and boosting investment processes provided that it is environmentally friendly" [19].

The most important part of the agriculture and food sector is the wine sector, generating about 16% of the total value produced in agriculture each year. Moldovan wine exports contributed more than $111 million in revenue in 2023, an increase of almost 9% compared to the previous year. Wine is also strategically important for Moldova's positioning as a country. This is the main reason why tourists visit the country, and recently Moldova's wines have attracted positive international media attention. The image and position of Moldovan wine on foreign markets can help shape the way Moldova is perceived in the world.

In order to promote the image of grape and wine products in the country and abroad and following the model of similar wine-making institutions in the leading wine-producing countries of the world, the National Office of Vine and Wine (ONVV) was organized in 2013 according to Government Decision No. 725 from 16 September 2013. This organization functions as a public-private partnership under the Ministry of Agriculture and Food Industry and implements policies in the wine sector. The aim of this organization is to promote quality Moldovan wine abroad.

According to the latest data from the ONVV reports, vineyards occupy 7% of the total moldovan agricultural area and 3.8% of the total territory of the country, revealing that Moldova has the highest density of vineyards per capita compared to the total agricultural area. The main economic indicators characterizing this sector are as follows, 50 thousand farmers and winemakers, 250 agricultural enterprises, 181 wineries, 10 agricultural cooperatives, 150 thousand people or 10% of the total labor force of the country are directly or indirectly involved in the wine industry, i.e. every fourth economically active citizen of the country [8,12,13].

In 2002, "The program for the restoration and development of viticulture and winemaking in the period 2002-2020" was approved by Government Decision no. 1313. The purpose of this Program being the restoration and consolidation of an efficient industry producing high quality wine products, competitive on the markets and with increased economic efficiency. During the implementation period, this program had a positive impact on the sector, namely stopping the decline of the wine industry.

The "Moldova Wine 2030" strategy, which is currently under discussion, aims to identify the actions that must be taken to influence state policies in the wine sector, but also to attract the necessary investments to give a new boost to the sector. Thus, the purpose of this paper is to analyze the wine sector in the Republic of Moldova and to develop the forecast for its future development using econometric modeling.

MATERIALS AND METHODS

The purpose of the paper is to analyze the winemaking sector in the Republic of Moldova and to elaborate the forecast for its future development using the econometric modelling.

The following research methods were used in this scientific work: induction and deduction, synthesis, logical, monographic, comparative, economic analysis of statistical data, econometric modelling, etc.

The method of econometric analysis that we used in this research work, we required to examine the cause-and-effect relationships between economic variables. This method is usually used to verify economic theories using statistical and other mathematical methods and models, to make forecasts and to understand the behavior of economic systems.

The information base of the research was provided by data from the:

-national and international scientific reports and publications [16, 17],

-statistical reports from the National Bureau of Statistics of the Republic of Moldova,

-reports from the Ministry of Agriculture and Food Industry,

-reports from the National Office of Vine and Wine (ONVV).

For the practical implementation of the methods used in the work the following Softwares were used:

-MS Word - for text processing,

-MS Excel - for spreadsheet processing,

-EViews statistical package - for data managing, econometric and statistical analysis performing, forecasts or model simulations generating.

RESULTS AND DISCUSSIONS

One of the objectives of the current analysis is to determine the interdependence between macroeconomic indicators concerning the agricultural sector, taking into account the availability of statistical data and the specific economic development of the Republic of Moldova. An important factor for the development of a country with a small economy, typical for the Republic of Moldova, is its openness to foreign trade. One of the factors that will influence the development of the agricultural sector will be the ability of producers to export goods to the EU markets. Favourable opportunities for this objective are the following:

-the European Council has opened of the negotiations on Moldova's
accession to EU in December 2023;

-the National Bank of Moldova (NBM) has signed an agreement to join the Single Euro

Payments Area (SEPA) at the end of January 2024;
-import duties and quotas on Moldovan agricultural exports have been suspended.
In this work, an econometric model with recursive equations was carried out, in order to have a picture of the evolution of the agricultural sector with an emphasis on the wine sector. The econometric model contains the following variables:
-PROD_AGRR - volume of agricultural production (million MDL, 2000 prices),
-P_PROD_AGR - price index for the sale of agricultural production by agricultural enterprises on the local market (year 2000=100),
-EXP_FOOD$R - export of food products (thousands USD, 2000 prices).
Logarithmizing for model's equations was applied for standardization, convenience of comparison and analysis of coefficients. Due to different units of variables measurement (they may be asymmetric) and different kinds of distributions, after logarithmization the distributions will tend to normal.
Student's t-test is used to determine the statistical significance of differences in mean values. We indicated the t-Student statistic under each coefficient:

$$Ln(P_{PROD_{AGR}}) = \underset{(5.28)}{9.51} - \underset{(-2.38)}{0.39}\,\text{Ln(PROD\_AGRR)} + \underset{(18.5)}{0.92}\text{AR(1)}$$

$$R^2 = 0.92, \qquad F = 156.84, \qquad n = 28$$

$$Ln(PROD\_AGR) = \underset{(115.23)}{7.19} + \underset{(3.97)}{0.21}\text{Ln(EXP\_FOOD*12.43)} + \underset{(5.08)}{0.015}\text{TREND}$$

$$R^2 = 0.73, \qquad F = 24.6, \quad n = 28$$

$$Ln(EXP\_FOODR) = \underset{(2.33)}{0.87} + \underset{(13.34)}{0.85}\,\text{Ln(EXP\_FOODR(-1))} - \underset{(-5.19)}{0.87}\,\text{D99}$$

$$R^2 = 0.88, \qquad F = 83.17, \quad n = 28$$

In order to elaborate the econometric model, a period of 30 years, from 1994 to 2022, was analyzed. And the equations included in this econometric model were developed and estimated using the least squares method (LSM) that contained the food export variables.
The inclusion of food export variables in the analysis is due to the importance of sales in the foreign market, as the domestic market is small and cannot absorb the entire volume.
The main factors that contributed to the improvement of the balance of payments of the Republic of Moldova are exports of agricultural products, especially wine production. For the significance of exogenous factors, absence of autocorrelation of errors, normality of residual coefficient and homoscedasticity of variance, regressions were tested econometrically.

$$D99 = \begin{cases} 1, & for\ 1999 \\ 0, & other\ years \end{cases}$$

To emphasize the last year of recession at the beginning of the recovery of agri-food exports in the equations a dummy variable D99 was introduced.
Regression analysis explains the interdependence of the macroeconomic variables analysed. The lack of price regulation of agri-food products, including wine, on the domestic market causes the negative dependence (1) between the volume of agricultural production and its price. According to this regression, if the volume of production increases by 1%, then the selling price of agricultural production by agricultural enterprises on the local market decreases by 0.39%. This is the problem faced by farmers in the Republic of Moldova year after year: a good agricultural year does not necessarily bring significant income, as prices in these years are low due to high supply and low demand on the domestic market. This statement is complemented by model 2, which shows that the export of agri-food products has a positive influence on the volume of agri-food production, i.e. a one percent increase in export volume leads to a 0.21% increase in production volume. Export of agricultural production will reduce the pressure on the domestic market from the supply side. The

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TREND variable included in the model demonstrates the positive influence in the agricultural sector of technological changes, the use of drought-resistant varieties and other technical and scientific innovations.

The positive trend in exports of agri-food production is shown in both the short-term and long-term. Thus, if in the short term the average annual export growth is 0.87%, then in the long term this indicator can reach 6%. The result can be explained by the fact that the external market is open for exports from the Republic of Moldova. The factors that can influence this development are mostly internal, namely the compliance with the requirements imposed by the European Union. The analysis of this model is like an equation system emphasizing the cause-effect relationship:

$$EXP\_FOODR \Rightarrow PROD\_AGR \Rightarrow P\_PROD\_AGR$$

On the basis of this analysis it can be concluded that the primary focus at the moment is to occupy new foreign market segments and this will lead to the propulsion of the agricultural sector, as the dependence between these variables is positive. At the same time, centralized regulations in the form of subsidies, purchases are needed to regulate prices on the internal market.

The wine sector is a strategic pillar for the national economy of the Republic of Moldova. It contributes to the formation of the main indicators of the national economy, but also to the development of the regions by attracting investments and maintaining jobs. The sector has strong related and supportive connections with other sectors of the economy through the value chain, and the traditions and regional and international recognition of wines and grapes are incontestable arguments that underline the major importance of this sector. Similarly, the added value of wine products is one of the landmarks that attracts investors to this important sector.

Viticulture represents a stable source of income for the population in rural areas, being a reason for their retention in rural areas, providing an incentive for their professional training oriented towards the initiation and development of the business in the field of viticulture or associated with it. This sector contributes to the socio-economic profile of the country, being attractive from several perspectives, including business development through investment.

State policy on wine quality has been based on the system of geographical indications and protected designations of origin. In accordance with the requirements of European Regulations, such as:

- EU Regulation, No. 492/2009;
- EU Regulation, No. 607/2009 [14; 15].

At the beginning of the 20th century, 4 soil-climatic zones were defined in the country. Then, in the 1960s, Moldovan scientists identified 23 production areas and united them into 4 regions - Northern, Central, Southern and left bank of the Dniester River (Transnistria) [22].

In 2006, the Government of the Republic of Moldova approved the division of grape-growing areas into regions, centers and districts intended for commercial production.

In April 2012, the Ministry of Agriculture and Food Industry by its Decree approved the division of grape and wine growing areas into "Valul lui Traian" in the South region, "Stefan Voda" in the South-East region and "Codru" in the Centre region and the PGI region "Divin".

Fig. 1 Wine-growing area of the Republic of Moldova
Source: https://wineofmoldova.com/ro/vin-in-moldova-acum/, Accessed on January 10, 2024 [22].

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The wine sector was the first to implement the system of protected geographical indications.

The PGI regulatory framework for the wine industry was finalized in 2015. PGI is usually represented by an association or group of producers. In some exceptional cases, there may be only one producer if there is only one producer of the product concerned in a certain region. Currently, there are three wine associations and one association of divine's and brandy producers in Moldova. These associations have developed technical specifications describing the rules for the production of wines with PGI, which, incidentally, are stricter than the general rules provided for other producers. This is the value of PGI products, which comply with the stricter production rules, guaranteeing compliance with the rules established directly by the producers [10].

At the same time, within each region there are a number of wine-growing areas and centres with their own specificities. Each of these has its own unique characteristics and produces grapes and wines of superior quality, recognised internationally. Since 2016, economic agents from the four wine-growing regions have started producing wines under quality labels - Wine of Moldova (WoM), Protected Geographical Indication (PGI), Protected Designation of Origin (PDO). The Moldovan wine industry is export-oriented - 85% of the wine produced is destined for international markets and only 15% is consumed on the domestic market. Strategic changes in the sector are creating a new socio-professional environment, which is contributing to an increase in demand and in the skill level requirements of future wine industry specialists: the involvement of winemakers in the production of PGI/PDO wines, the high degree of automation of agro-technical operations in viticulture, the complexity of the sector's regulatory framework, the diversification of markets, the development of direct sales and wine tourism, etc.

Vineyards are the most valuable asset of the wine heritage of the Republic of Moldova. The fertile soil and suitable climatic conditions in the country, the size of vineyard areas, traditions, low input and operating costs are advantageous factors compared to many other wine-growing countries. Viticulture in the Republic of Moldova has a high level of agricultural land use [3]. From the above we observe that the areas of vineyards and grape production volumes are not stable, being influenced by a number of factors (small vineyards, old plantations, unproductive varieties, low quality wines, excess stocks, poorly developed marketing). Thus, it is expected that by 2030, due to the current rate of decline, the area of vineyards planted with technical varieties for wine production will decrease to 52,400 hectares.

Fig. 2. Dynamics of vineyard areas in the Republic of Moldova, 2010 -2021, thousand ha
Source: elaborated by authors [1, 2, 9, 16].

Over the years, due to climatic conditions in the geographical territory of the Republic of Moldova, the overall grape production varies and the grape harvest per unit area -1 ha (Fig. 3).

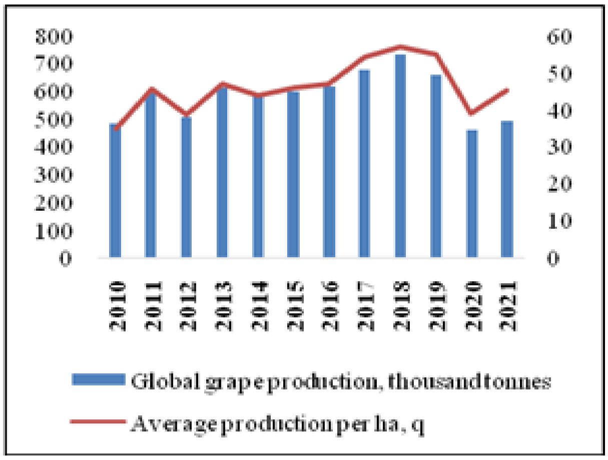

Fig. 3. Global grape production and average production per hectare,
2006-2021
Source: elaborated by authors [1, 2, 11].

Vineyard plantations in all categories of households, following the analysis of productivity per 1 ha, showed an increase in harvest from 34.9 q/ha in 2010 to 45.4 q/ha in 2021. Overall grape production (Fig. 3) varied between 482 thousand tonnes in 2010 and 491 thousand tonnes in 2021 [11, 13]. The wine sector has been growing recently, due to the sector's improvement policies, the increase in wine quality and expansion into new markets. According to ONVV [12] data in 2021 about 255 thousand tons of grapes were processed, which is 60% more than in 2020. From the processed quantity a quantity of wine of more than 14 mil. dal was produced, which is 58% more than in 2020. Following the analysis carried out we observe that the production is equivalent to the average of the years 2011-2021 which is 14.8 mil. dal of wine. Thus, in 2021 about 14.4 mil dal of wine were produced. The largest volume of PGI certified wines was recorded in the PGI Region "Valul lui Traian" - 469 thousand dal, followed by the PGI Region "Stefan Voda" - 243 thousand dal and the PGI Region "Codru" - 156 thousand dal [5, 6, 12].

Moldovan wine sector was affected by two shocks in 2006 and 2013, following the Russian Federation's decision to impose an embargo on wine imports, which had a significant impact on the sector. These embargoes highlighted the key problem of the Republic of Moldova - the dependence of wine sales on the low price category of the Russian market [6]. Despite the difficulties created by the embargo in 2006 and 2013, they also served as an impetus for the modernisation process of the sector.

Thus, following the analysis performed, we observe that the wine sector has experienced growth, which was due to the improvement policies in the sector, the increase in wine quality and the expansion into new markets. In 2021, the volume of wine produced amounted to 14.4 million decalitres, which is an increase of about 58% compared to 2020, with wine production being equivalent to the average of the years 2011-2021 which is 14.8 million dal of wine. In terms of exports, Moldovan wines in 2021 recorded a slight decrease of about 12% compared to 2020, thus, in 2021 the total volume of exported wine amounted to 12.1 million liters with a value of $169 million. Also, in 2021, the price per litre of exported wine recorded a slight increase, increasing by 14% (Figure 4).

The analysis revealed that there are several problems in the wine sector, but the most acute of them is the presence of small areas of 0.5 ha for wine plantations and old wine plantations with low quality grapes and low productivity. At the same time, it was concluded that the last 7 years, the commercial offer of wine on the domestic market (harvest + stocks) varied between 2.4 - 3.5 times higher than actual sales. The Republic of Moldova, after the first embargo introduced by the Russian Federation, sold more wine than it produced. Thus, the significant wine reserves are registered.

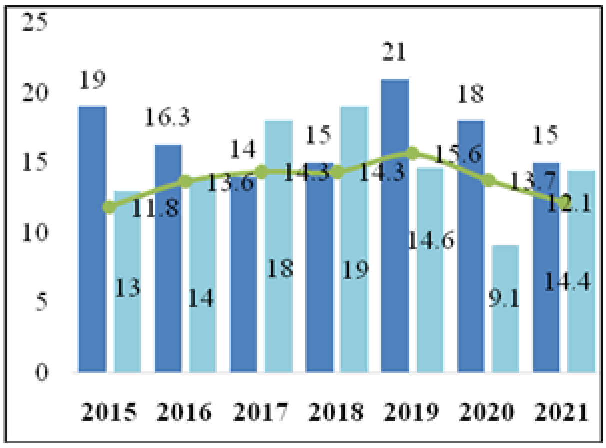

Fig. 4. Evolution of demand and supply of Moldovan wine
Source: elaborated by authors [6, 7, 12].

The Republic of Moldova has recently registered a diversification of the markets. If until 2006 the main market where wine products were exported was the Russian Federation, in 2021 Moldovan wines were exported to 71 countries of the world. The wine export volume constituted about 81% of the total wine produced. The main partners of the Republic of Moldova in the export of wine bottled in 2021 were: Romania - 428.4 million MDL; Russia - 295.1 million MDL; Poland - 176.1 million MDL. In the analysed period, especially in 2021, the total value of exported wine was about 169 million dollars, increasing by 7.6% compared to 2020.

Exports of bottled wine during this period amounted to 51.2 million litres of wine, which is about 69.3 million bottles. Also in 2021, the price per litre of exported wine increased slightly, rising by 14%. At the same time due to the dry weather, the Republic of Moldova imported bulk raw material in the volume of 4,751,427 liters, which increased compared to 2020. At the same time, the value of exported wine and divin increased compared to 2020 by 10% and amounted to 2.99 billion MDL. (Figure 5).

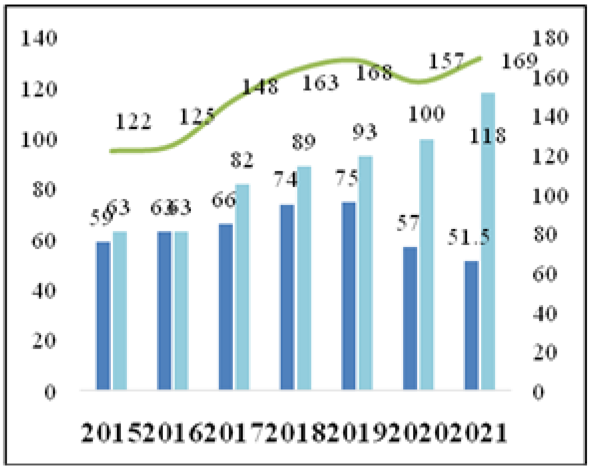

Fig. 5. Value of wine exports from the Republic of Moldova in 2015-2021
Source: elaborated by authors [6, 7, 12].

As for the last year, due to the fact that in 2023, the grape-growing countries of Central Asia were severely affected by spring frosts and little production was harvested there, the grape segment of Moldovan grapes and grape products was competitive on the CIS market.
Wines from the Republic of Moldova are becoming more and more known and demanded by foreign consumers on international markets. About 83% of the wine produced was exported by the 105 active exporters to 71 countries. The Republic of Moldova continued an increasing trend in bottled wine exports to the majority of countries except China. At the same time, the highest increase in demand for bottled wine was recorded by Turkey with 103.7% (the value of which amounted to 50.4 million MDL), followed by the USA with an increase of 64.6% or 70.3 million MDL, with Romania recording an increase of 29.2%. Top 10 partner countries of the Republic of Moldova for the export of bottled products in 2021, Figure 6.

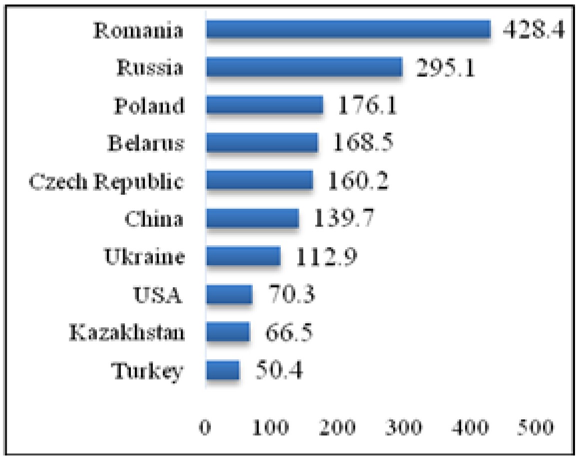

Fig. 6. Top 10 countries by bottled wine export, 2021, million MDL
Source: elaborated by authors [6, 7, 12].

The main centres of growth in wine exports by volume were Romania - 5%, the Russian Federation - 31%, the USA - 42%, Turkey - 85.3% and the UK - 25.6%. In terms of export value, Romania - 29.2%, the Russian Federation - 54.5%, the USA - 64.4%, Turkey - 103% and the UK - 55.5% [5, 6, 21].
Over the last few years, the geography of wine exports has increased significantly. The geographical shift in exports has been due to a number of opportunities, but also to constraints. Until 2006, the Russian Federation was the main export market for Moldovan wines. Nowadays, wine producers are paying more attention to the quality of their wines and the diversification of their markets, with significant quantities of wine products being exported to other countries on various continents.
The analysis reveals that an export-oriented approach to development would allow wine growers to make better use of both the country's natural advantages and the new opportunities offered by bilateral and multilateral trade agreements to which Moldova is a party. The level of product quality is an important criterion for the development of the wine sector, the 'visiting card' of the Republic of Moldova that brings fame to products abroad, but also the possibility of expansion/diversification of exports [16]. To achieve this goal, it is

necessary to implement new technologies, innovations, mechanisms and international practices.

Thus, in recent times, foreign trade between the Republic of Moldova and the EU has steadily increased. The EU has consolidated its position as Moldova's main trading partner, with almost 60% of exports going to the European market. The implementation of the DCFTA [20], part of the Moldova-EU Association Agreement, has contributed to the country's economic growth, generated by increased trade volumes, product diversification, competitiveness sand management [22]. Thus, we can mention that within the framework of this agreement about 16.2 thousand tons of table grapes were exported to the EU market in 2021, 81% of the established quota of 20 thousand tons. The DCFTA created by the Republic of Moldova with the EU provides access to a market of over 500 million consumers, and the multilateral free trade agreement within the Commonwealth of Independent States provides the country with another important outlet, which includes almost 280 million consumers.

The signing of the Free Trade Agreement with Turkey has resulted, with its implementation, in the reduction of customs tariffs on the most protected market for Moldovan exports - the average Most Favoured Nation tariff applied by Turkey for agricultural and food products is 42.2% (for some products exceeding 200%), and for non-agricultural products 5.4%. However, experience shows that access of Moldovan products to foreign markets is determined by non-tariff barriers rather than tariff barriers, in particular embargoes (Russian Federation) and high phytosanitary and trade standards (EU) [20, 21].

CONCLUSIONS

According to the analysis performed in this work, using the elaborated econometric model, it can be assumed that the main direction is to occupy new segments of the external market, which will lead to the stimulation of the agricultural sector.

In recent years, the total Moldovan horticultural sector, including viticulture, has been reorienting quite rapidly due to changing political-economic, logistical, climatic, social and other conditions.

Last year, 2023, due to frosts, floods and droughts, the grape harvest was relatively small in many European countries, which explains the high demand for Moldovan table grapes. However, in the future, all agrarians of the country, and especially winemakers, should be more active in re-profiling the assortment and improving the quality of production.

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THE "NĂDLAC FARMER" AGRICULTURAL COOPERATIVE – A MODEL OF GOOD PRACTICES FOR SMALL FARMERS, ROMANIA

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Abstract

In Romania, the numerous, dispersed family farms with small areas continued their activity in many cases considering a certain tradition as closed or partially open systems. After the accession of our country to the European Union in 2007, there has been a tendency to reduce small holdings through mergers, a phenomenon which is otherwise naturally manifested in all the states of the EU, but not to the extent that would be necessary for Romania. Following the analysis of agricultural holdings in Romania by size class in 2020, it was found that out of the 2,887.00 thousand of agricultural holdings, 2,606.98 are under 5 ha in size (54% are under 1 ha, and 36.30% are between 1 and 5 ha). The average size of farms increased in the period 2010-2020 from 3.45 ha to 4.42 ha. The chronic under capitalization of subsistence and semi-subsistence agricultural holdings also contributes to the modest performance of the Romanian agricultural and agri-food sector, compared to its natural potential and the population's expectations that agriculture and the food industry quickly adapt to the EU's common agricultural policy. Since these categories of farms mostly ensure self-consumption for the rural population in most Romanian villages, their association is required to achieve a level of economic development and efficiency. The purpose of this paper is to present a functional and performing agricultural cooperative from Nădlac, Arad County, Romania, that can be a model of good practices for the association of small farmers and Romanian agriculture.

Key words: *cooperatives, small farms, model, development, efficiency*

INTRODUCTION

Each country has a specific economic structure determined by its resources, its level of development, its historical evolution, and its specific policy that regulates the social life of the population [8, 9]. The privatization process that started in Romanian agriculture in the spring of 1990 has been much faster than in other sectors of the economy and with big leaps since the first years of the transition [10, 16, 17]. Romanian rural economy is currently largely represented by agriculture [2].
The favourable geographical conditions of Romania – relief, climate, high share of fertile soils, to which ads the attachment of the rural population to land and animals – could make Romania's agriculture a profitable and attractive production branch for investors, which could contribute substantially to the growth of Romanian economy [4, 5, 18].
In the last three decades, the evolution of agriculture has taken place under the influence of the phenomena generated by the transition to the market economy, against the background of the acute lack of financial and material resources, as well as of an unfavourable international situation [2, 3].
The land fund law no. 18/1991 divided agricultural areas into small plots and determined their dispersion, to which added the depreciation of the material base, the stagnation of investments, the destruction of assets, as well as the errors recorded in the management of state-owned assets and supporting the formation process of private agriculture, a fact that led to a sharp decrease in the profitability of agricultural holdings [1, 15, 13, 11].

Table 1. Agricultural holdings and used agricultural area by size classes in Romania

Size class (ha)	Agricultural holdings in Romania	
	Nr.	%
0.1 - 1	1,770,569	52.98
1 - 2	630,361	18.86
2 - 5	659,997	19.75
5 - 10	194,200	5.81
10 - 20	50,212	1.50
20 - 30	10,992	0.33
30 - 50	7,531	0.23
50 - 100	6,013	0.18
>100	12,310	0.37
TOTAL	**3,342,185**	**100.00**

Source: National Institute of Statistics, 2020 [12].

From the study carried out, we find that the phenomenon of reluctance towards association and cooperation is strongly manifested among small Romanian farmers [15, 6].

The purpose of this paper is to present a functional and performing agricultural cooperative from Nădlac, Arad County, Romania, that can be a model of good practices for the association of small farmers and Romanian agriculture.

MATERIALS AND METHODS

The information presented in this paper are partial results of the doctoral thesis *"Analysis of the implementation of the National Rural Development Program (NPRD) 2014-2020 in the Western Region and proposals to improve the implementation of measures in the next financial year".*

The information used in the writing of this paper was taken from the NIS databases.

The analysed information was collected through a documentary study of the literature in the field of the topic addressed and researched. The case study was carried out through a field investigation at the "Fermierul Nădlac" cooperative in Arad county Romania.

RESULTS AND DISCUSSIONS

The agricultural cooperative the "Nădlac Farmer" is an autonomous association of Romanian individuals and legal entities, established in 2015, according to the provisions of Law no. 566/2004 of agricultural cooperatives, with subsequent amendments and additions, which operate in the field of agricultural cooperatives of purchases and sales, which organize both the purchases of raw materials, material, and technical means necessary for agricultural production and the sale of production.

The general objective of the cooperative is to improve the quality of the products, their better valorisation, the efficient supply of inputs and the increase of the income of all members.

Initially, eight founding members laid the foundations of the agricultural cooperative the "Nădlac Farmer;" it currently includes 27 farmers, who own around 25% of the total arable land of Nădlac, which represents around 3,000 ha of arable land.

Fig. 1. The logo of the *„Fermierul Nădlăcan Cooperativa Agricola"*
Source: [7].

The Board of Directors consists of 5 members, who are elected by secret ballot by the General Assembly for a period of 4 years.

The first administrators were elected by the founding members.

The share capital of the Agricultural Cooperative is 24,030 RON, is made up of cash contributions, and consists of 2,403 subscribed shares, each with a nominal value of 10 RON. The turnover for the year 2022 was around 4,000,000 euros.

The tasks of the farmers were taken over by the cooperative and refer to drawing up the documentation for calamities; drawing up declarations for diesel support; making orders for inputs, selling production; and advising cooperative members in accessing European funds.

Thus, the work of each member of the cooperative is made easier, a fact that has a positive impact on their daily activity.

It should be noted that all the decisions taken at the Cooperative level are discussed, interpreted, and assumed together by all cooperative members.

At the cooperative level, the purchase of inputs is done through auction.

Auctions for inputs are done centrally for all cooperating members: in this way the discounts obtained are much higher.

To ensure the transparency of the auctions, they are organized at the cooperative level, where several reliable suppliers with whom the farmers who are members of the cooperative have collaborated are invited.

During the same days, at an interval of one hour, they submit their offers. The offer is received from each supplier, in a sealed envelope, which is opened only after the end of the auction. The offers are analysed by the members and the most convenient offer is chosen.

Upon completion of the bidding procedure, the winning supplier is notified and the procurement procedure begins.

The commercialization of agricultural products resulting from the activity of the cooperative is centralized at the level of the Cooperative.

The executive director of the Cooperative centralizes the productions of all members and, depending on the market price and the intention of the members to sell, the amounts sold and the final price for the entire amount are negotiated, to get the best price. The orders for grain transport, sales flow, etc. are made centrally. In 2016, the development of the Cooperative was based on four major actions.

These measures referred to:

- Obtaining the approval of the Group of producers;
- Purchase of land to build silos, storage halls, etc.;
- Accessing sub-measure 4.1 of the National Programme of Rural Development, NPRD;
- Accessing sub-measure 9.1 of the NPRD.

The group of producers of the “Nădlac Farmer” agricultural cooperative received a recognition notice from the Ministry of Agriculture and Rural Development and was established to sell agricultural products for cereals, oilseeds, sugar beet, and fodder plants.

In December 2016, the members of the cooperative submitted a project to the National Programme for Rural Development-NPRD under Sub-measure 9.1 *“Establishment of producer groups in the agricultural sector”* [15].

Through this sub-measure, an annual support was obtained for a period of 5 years, in the amount of approximately 100,000 euros/year, compared to the turnover of the Cooperative.

This measure covered the consultancy costs for the project submitted under Sub-measure 4.1, the creation of a presentation website, the payment of employees’ salaries and, finally, the purchase of inputs for the cooperative members.

They applied for financing under sub-measure 4.1 – *“Investments in agricultural holdings”* in the amount of 2,200,000 euros with an intensity of 90%.

A 6,000-t reception, conditioning, and storage system (silos) was requested, the whole being equipped with all the necessary equipment, i.e., LPG platform, welding group platform, probe, NIR instrument, generator, wall boiler, concrete platforms, and walkways, changing rooms, etc.

For the efficient management of the activity at the cooperative level, within the same measure, the purchase of a bridge scale was also foreseen, thus optimizing the technological flow. Also, the construction of a 315 m^2 hall intended for the parking of agricultural machinery was foreseen.

Through the same project, a beet-sugar harvester (2), a multifunctional loader with a telescopic arm (3) and a seed selection and treatment station (1) were purchased. These machines serve all members of the cooperative (Photo 1).

(1) (2) (3)

Photo 1. Machinery purchased by the cooperative
Source: Own research at [7].

The project submitted by the Cooperative under Sub measure 4.1 of the PNDR was implemented starting in 2017 and required long periods of time, especially because of the numerous approvals requested by the contractor. Another difficult aspect the cooperative members had to face was obtaining a bank loan to co-finance the investment.

In the year 2016, the cooperative purchased an area of 10,000 m^2 to build storage spaces.

During 2018, at the cooperative level, they continued the activities already started but decided to expand their activity. Thus, they submitted a new funding request, this time for Sub-measure 4.2 *"Support for investments in the processing/marketing and/or development of agricultural products."* It is intended to increase the grain silage capacity and add value to the products obtained.

Also, agricultural production was integrated at the Cooperative level through the purchase of a line for a Combined Feed Factory (CFF).

The "Nădlac Farmer" agricultural cooperative joined, in 2018, the Union of the National Branch of Cooperatives in the Vegetable Sector (UNBCV). This confirmed the status of the "Nădlac Farmer" agricultural cooperative as a functional cooperative, with correct principles and the willingness to evolve.

The benefits obtained due to the accession are multiple, but the most important aspect refers to the support provided by the UNBCV in the relationship with the state institutions.

From an economic point of view, from its foundation the cooperative concluded the financial years with profit, except the year 2015 the first year of activity.

The own equity increased from Lei 2,232 in 2015 to Lei 2,266,054 in 2022, meaning 1,015 times.

The fixed assets value went up from Lei 58,893 in 2016 to 9,274,456, meaning 157.4 times.

The working capital also raised 723 times from Lei 13,067 in 2015 to Lei 9,451,412 in 2022.

The turnover increased 524.6 times from Lei 35,937 in 2015 to Lei 18,856,119 in 2022. The evolution of the turnover of, "Fermierul Nadlacan Cooperativa Agricola" (Figure 2).

The net profit of the cooperative increased in the period 2016-2022 from 2,039 lei to 532,090 lei (260.9 times) is presented in Figure 3.

As a result, ***the share of net profit in the turnover*** increased from 0.03 % in 2015 to 2.82 % in 2022.

However, the debts also increased in the analyzed interval and exceeded more than 2 times the value of the own equity, a negative financial aspect.

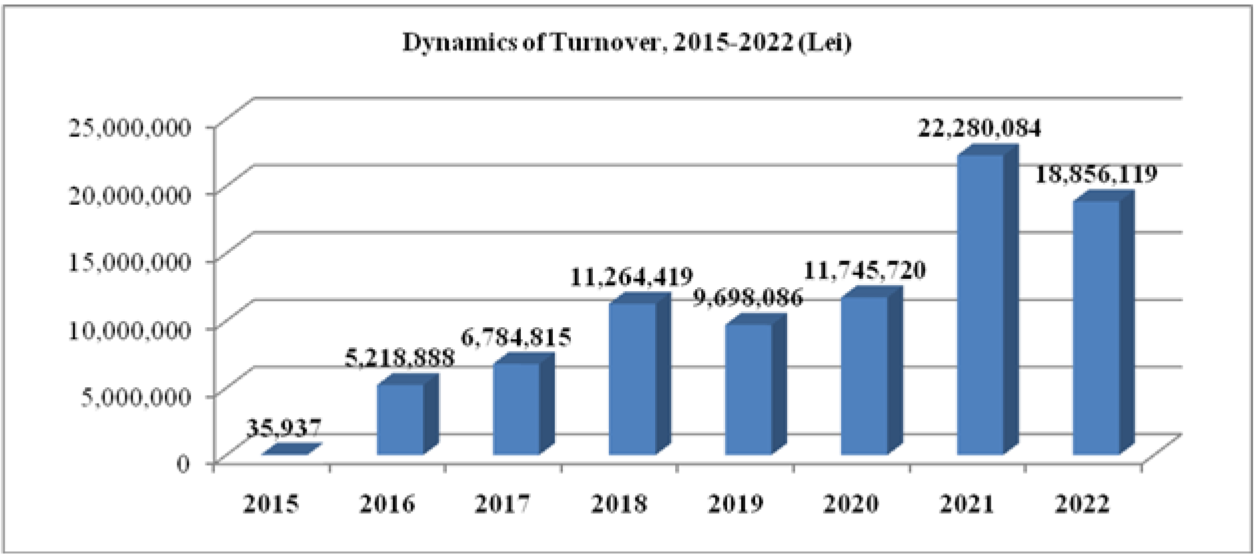

Fig. 2. Dynamics of turnover, Fermierul Nadlacan Cooperativa Agricola, 2015-2022 (Lei)
Source: Own design based on the data from [7].

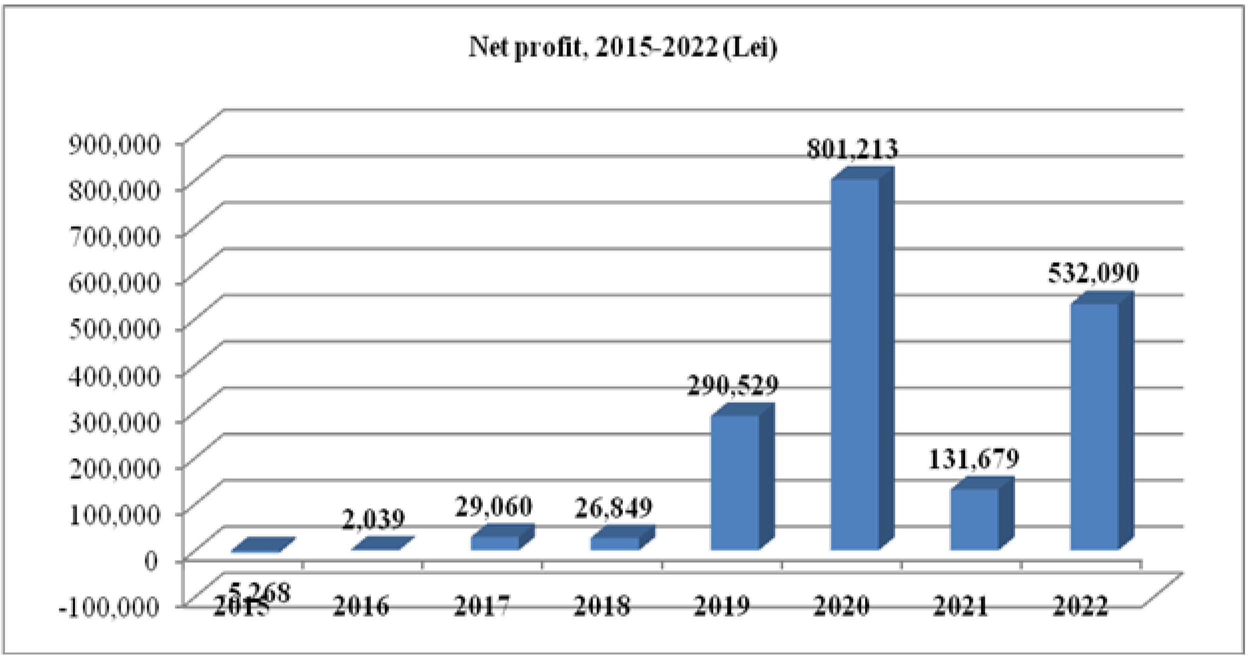

Fig. 3. Dynamics of net profit, Fermierul Nadlacan Cooperativa Agricola, 2015-2022 (Lei)
Source: Own design based on the data from [7].

CONCLUSIONS

Since small farms mostly provide self-consumption for the rural population in most Romanian villages, their cooperation is required to achieve a level of economic development and efficiency. In this context we consider that the "Nădlac Farmer" agricultural cooperative is a model of good practices for the association of small farmers in various activities in agriculture and the agri-food field.

From the discussions with the cooperative members, we found that there are certain deficiencies that affect the proper functioning of the cooperatives in Romania, which refer to:

-Non-compliance by the state institutions with the facilities provided by the cooperation law;

-Lack of sub-measures within European projects intended exclusively for Cooperatives or Producer Groups (excluding sub-measure 9.1);

-Difficulties in obtaining co-financing for projects submitted with European funds;

-The correlation by the state institutions of the information and regulations that refer to the requested documentation.

We can conclude that the lack of cooperation of small farms is not only a form of reluctance towards previous association: to this also ads the lack of interest of the Romanian state for these types of activities, which is also transferred to small farmers.

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ANALYSIS OF THE AGRICULTURAL LABOUR FORCE IN TERMS OF THE AREA CULTIVATED WITH THE MAIN CROPS IN ROMANIA, DURING THE PERIOD 2018-2022

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Abstract

At a time when expert analysts states that one of the main reasons why Romanian agriculture has been going through a major crisis for more than a decade is the labor crisis in agriculture, this article will examine the evolution of the areas cultivated with major crops and of the agricultural labor force from 2018 to 2022. The study will cover the entire country, the 8 development regions, and the 7 counties within the South-Muntenia development region, also indicating the total area under main crops per person employed in agriculture during the reference period. To create this article, statistical data have been analyzed using the data from the National Institute of Statistics of Romania, TEMPO Online database, and using both descriptive and inferential statistics. In the year 2022, the area cultivated with the main crops in Romania slightly exceeded 8 million hectares. In the same year, out of 7.8 million people with an income-generating occupation, only about 11% of these people had an occupation in agriculture, thus a person employed in agriculture had a little over 9 ha of the total cultivated area with the main cultures.

Key words**:** *labor force, cultivated area, evolution, ha/person.*

INTRODUCTION

The historical beginnings of agriculture date back to about 8,500 BC, when the inhabitants of the Middle East set a historical precedent when, instead of gathering from the wild, they began to grow grains for their own consumption. The early development of agriculture played a particularly important role in the development of close-knit local communities, villages, towns and countries as we know them today due to the fact that about 1500 years after humans began to cultivate grains at the expense of gathering them from wilderness, they began to put aside the nomadic lifestyle they had, starting to domesticate animals and therefore being forced to continue their existence established in one place, thus putting an end to a stage of long and arduous journeys aimed at finding wild animals and grains to provide them with the minimum food required for survival, thus giving the start to civilization as we know it today [23].

Ever since humans began to grow plants and raise animals for food, they have dedicated themselves to these activities and with the development of the agricultural sector human labor has become indispensable for its development. The reviving of rural communities can be done by practicing efficient agriculture, which means, equally, a better life for farmers and the village world, food security for all citizens, more legitimacy and competitiveness between the states of the European Union [7].

However, although for previous generations working the land and raising animals were daily occupations without which humans could not imagine their existence, with the emergence of intensive agriculture and the development of large industries, for ordinary people agriculture has taken a back seat, their interest regarding physical labor involved in working in agriculture decreasing, being more interested in intellectual work and working with their minds, reason for which the number of persons working in agriculture has been in decline for the last decades and which, according to the exports in the field, will continue to drop at the European union level with about 28% until 2030 [12]. Since 2020, Romania has been ranked seventh among European Union members in terms of the state's contribution to its agricultural industry's total production. This metric encompasses both agricultural output and related non-agricultural activities. Despite this ranking, Romania's extensive cultivated land and high yields continue to establish it as a significant player in agriculture within the European Union [24]. Although from a statistical point of view Romania has some of the best statistics in the European Union, 57% of the total area of the country being represented by the area used for agriculture, 23% of the workforce being employed in agriculture [6], the agricultural workforce in Romania follows the same downward trend present in the whole European Union, mainly due to the lack of interest of young people in agriculture and their migration from rural to urban areas or to other countries in search of a better living, as well as the ageing of the population employed in agriculture, over 44% of all farmers aged over 65 years in the European Union being active in Romania [6]. Echoing the previous point, many Romanians, in their ongoing search for a better life and higher-paying jobs, frequently migrate abroad, often bringing their entire families with them [5]. Given that agriculture has always been a fundamental element essential for human survival and significantly contributing to the development of civilization, it is crucial to analyze the agricultural workforce in relation to the area cultivated with major crops. This paper will undertake such an analysis. As a vital component of the global food chain, agriculture faces significant challenges due to climate change and the growing demand for food. In this evolving landscape, the concept of sustainability is increasingly important, representing not only a goal but also a collective responsibility for everyone involved in agricultural activities. [2]. To provide a cleaner understanding, this analysis will cover the period from 2018 to 2022 and it will begin with an overview of national statistical data, followed by an analysis of the 8 development regions, and conclude with a detailed examination of the 7 counties in the South-Muntenia development region.

MATERIALS AND METHODS

Building on the premise that probability forms the foundation of statistics, Sheldon M. Ross, a distinguished professor at the USC Viterbi School of Engineering and an author of numerous books on probability, asserts that *"statistics is the art of learning from data."* According to Ross, statistics involves drawing conclusions based on the description and analysis of collected data [11], this paper will analyze statistical data downloaded from the official website of the National Institute of Statistics of Romania, from the Tempo Online database, using both descriptive and inferential statistics [15]. Basically, the descriptive statistics part, being the component of statistics that deals with the description and synthesis of data [19], thus with the collection and synthesis of data, is downloaded from the NSI Romania website and inferential statistics, being the part of statistics that is responsible for formulating conclusions based on the analyzed data [19] will contribute to this work because through this branch of it, statistical data will be analysed, identifying the general trend that the reviewed data know in the analysed time period, by identifying the means, medians, standard deviation and coefficient of variation. Forecasting of the analysed data after the end of the analysis period will also be carried out using the method whereby a continuous function is determined for values outside a range of known values [16].

RESULTS AND DISCUSSIONS

The pronounced decline of the population due to its aging, the decrease in fertility and the presence of migration are demographic phenomen registered in all developed countries [22].

After 1970, the presumption of regional development in stages emerged in Romania, according to which the organization of the national economy evolves in stages, and a progressive evolution is necessary to obtain a balanced spatial structure, first national development would be polarized then integrated, then development would be concentrated in development centers then diffused to the periphery, and finally to the advantage of the peripheries there should be a progressive decentralization within urban units [1]. Subsequently, in 1998, the institutional framework, objectives, competencies, and specific instruments for regional development policy in Romania were established [13]. The promulgation of this law followed the initiation of a regional development program between the European Union and the Romanian Government in the framework of PHARE, a program whose main purpose was to prepare a set of fundamental principles for the development of regional policy in Romania, a program aimed at demonstrating that a properly designed and implemented regional policy will not only help the less developed regions but will also represent an advantage for Romania's overall socio-economic development, project presented through the Green Paper [3]. The objectives of the regional development policy proposed by the Interministerial Working Group included in the Green Paper were primarily to prepare the Romanian state for EU integration and to make Romania eligible for aid from the EU Structural Funds, secondly, to reduce regional disparities between different regions in Romania, and last but not least in order to achieve a higher level of development of the regions, the integration of public sector activities [3].

The administrative structure in Romania at that time, which consisted of 42 counties (including their towns and municipalities), was not suitable for developing an effective rural development policy, so the Green Paper proposed an administrative structuring of Romania into smaller administrative territorial units, while maintaining the existing number of counties, but grouping them into eight macro-regions of development taking into account economic and social profiles, functional relations, specific problems, etc [3].

Following the implementation of Regulation (EC) No 1059/2003 of the European Parliament and of the Council, which established a common classification of territorial units for statistics (NUTS) and was published in May 2003 which aimed to establish a common classification of territorial units in order to facilitate the collection, compilation and dissemination of harmonized regional statistics within the European Community [18], in 2004, a new law on regional development in Romania has been enacted to align with the objectives of the aforementioned Regulation, namely Law 315/2004.

In the annex of law 315/2004, the composition of the development regions in Romania was named and established, as it follows:

- North-East Development Region - comprising Bacău, Botoșani, Iași, Neamț, Suceava, and Vaslui counties.
- South-East Development Region - comprising the counties of Braila, Buzau, Constanta, Galati, Vrancea and Tulcea.
- South-Muntenia Development Region - comprising Argeş, Călărași, Dâmbovița, Giurgiu, Ialomița, Prahova and Teleorman counties.
- South-West Oltenia Development Region - comprising Dolj, Gorj, Mehedinți, Olt and Valcea counties.
- West Development Region - comprising the counties of Arad, Caras-Severin, Hunedoara and Timis.
- North-West Development Region - comprising Bihor, Bistrita-Nasaud, Cluj, Sălaj, Satu Mare and Maramureş counties.
- Centru Development Region - comprising Alba, Brasov, Covasna, Harghita, Mures and Sibiu counties.
- Bucharest-Ilfov Development Region, in which Bucharest municipality and Ilfov county are comprised [14].

The 8 development regions comprise the territories of the counties that make them up, respectively the territory of Bucharest municipality, however they do not have legal personality and are not considered administrative-territorial units, being classified, according to the average size in terms of population, in the NUTS 2 class [21].

As mentioned earlier, 57% of Romania's total land area is used for agriculture, according to Romania's CAP strategic plan approved by the European Commission in December 2022 [6].

However, although the area used for agricultural purposes is one of the largest in the European Union, the polarized structure of Romania's agriculture, with the largest area of land divided into small plots [4], and land used for its own consumption [17], hinders the authorities' efforts to enhance the natural advantage Romania enjoys compared to other EU Member States.

Table 1. Trends in cultivated areas for major crops in Romania and its development regions (2018-2022)

	2022/2018 -%-	2022/2019 -%-	2022/2020 -%-	2022/2021 -%-	2030/2022 -%- forecast
ROMANIA	-5.44	-8.37	-3.12	-3.12	-12.32
NORTH-WEST Region	-2.89	-4.18	-2.55	-3.87	-4.35
CENTRE Region	-6.83	-5.39	-2.28	-2.81	-12.42
NORTH-EAST Region	5.70	0.07	1.61	-0.52	7.80
SOUTH-EAST Region	-8.79	-6.94	-5.11	-8.26	-12.28
SOUTH-MUNTENIA Region	-1.43	-2.52	-0.30	0.62	-4.32
BUCHAREST-ILFOV Region	-7.29	-2.53	-0.58	-16.16	0.62
SOUTH-WEST OLTENIA Region	-5.29	-8.60	-5.94	-4.31	-11.21
WEST Region	-22.16	-34.05	-9.74	-0.95	-87.50

Source: National Institute of Statistics- Tempo-Online [10]. Accessed on April 2, 2024.

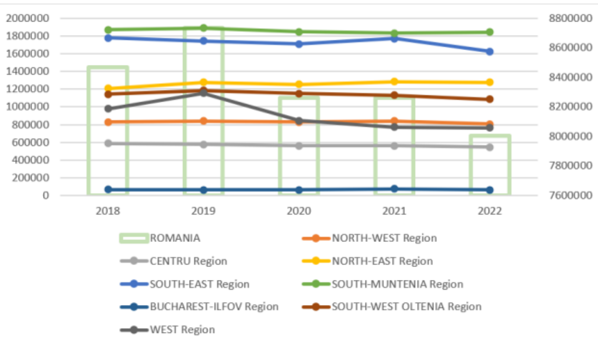
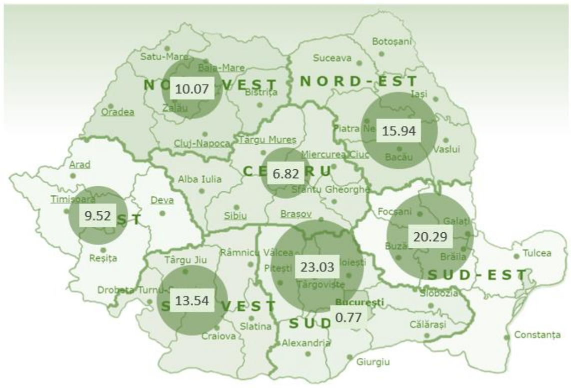


Fig. 1. The changes in the area under cultivation for major crops at both the national level and within Romania's development regions during the period 2018-2022

Source: National Institute of Statistics- Tempo-Online [10] Accessed on April 2, 2024.

An analysis of data from the National Institute of Statistics database reveals a consistent downward trend in the cultivation areas of major crops at the national level over the entire period studied. This trend persisted, resulting in the cultivation area of major crops in 2022 being lower than in any of the previous years analysed (Figure 1).

Although in 2019 compared to 2018 the value of the area increased by 3.19% and in 2021 compared to 2020 by only 155 hectares, an insignificant percentage increase, the decreases recorded in 2020 compared to 2019 of 5.4% and in 2022 compared to 2021 of 3.1% have led to the determination of a gloomy forecast, i.e. if in the next 8 years the values would know the same evolution, the cultivation area of major crops may experience a decrease of 12% compared to 2022 and nearly 18% compared to 2018 (Table 1).



Map 1. Proportion of land allocated to primary crop cultivation in Romania's development regions in 2022

Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

The projected outlook for 2030 regarding the cultivation area of primary crops across the 8 development regions is also concerning. Positive values have been determined for only two regions: North-East and Bucharest-Ilfov, which have recorded the lowest values of cultivated areas with the main crops throughout the entire reference period.

Over the five years analyzed, the regions whose area decreased the most at the end of the reference period compared to the beginning of it were the Bucharest-Ilfov region (decrease of 7.3%), the South-East region (decrease of 8.8%) and the West region, which recorded a record decrease of 22% in the area under main crops.

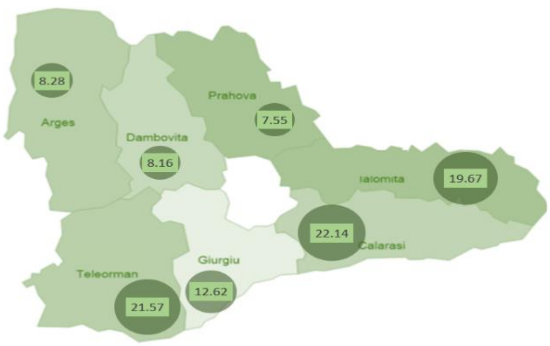
Except for the North-East region, where the cultivation area of main crops consistently increased over the reviewed period (rising by 5.7% in 2022 compared to 2018), the analysed indicator declined across all other regions. Specifically, the average annual decline in cultivated areas was 3.4% in the North-West region, 4.2% in the Centre region, 7.3% in the South-East region, nearly 1% in the South-Muntenia region, 6.6% in the Bucharest-Ilfov region, 6% in the South-West Oltenia region, and 16.7% in the West region.

Table 2. Shifts in Cultivation areas of primary crops in the South-Muntenia development region (2018-2022)

	2022/2018 -%-	2022/2019 -%-	2022/2020 -%-	2022/2021 -%-	2030/2022 -%- forecast
SOUTH-MUNTENIA Region	↓ -1.43	↓ -2.52	↓ -0.3	↑ 0.62	↓ -5.36
Arges	↑ 0.02	↓ -3.96	↓ -0.36	↓ -0.16	↓ -3
Calarasi	↓ -0.35	↓ -0.49	↑ 5.59	↑ 1.21	↓ -3.52
Dambovita	↓ -8.68	↓ -8.75	↓ -2.84	↑ 1.41	↓ -25.86
Giurgiu	↓ -3.26	↓ -6.96	↓ -8.91	↓ -2.74	↓ -6.7
Ialomita	↑ 4.18	↑ 4.09	↑ 5.34	↓ -1	↑ 10.56
Prahova	↓ -2.18	↓ -2.56	↓ -0.88	↑ 2.13	↓ -8.45
Teleorman	↓ -3.54	↓ -4.36	↓ -4.03	↑ 3.11	↓ -13.03

Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

When examining the data for the South-Muntenia development region, a similar downward trend is evident, although the declines in the cultivated area for primary crops in this region are not particularly alarming (Map 2).



Map 2. Proportion of land allocated to primary crops cultivation in the counties within the South-Muntenia development region in 2022
Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 4, 2024.

Over the initial four years analyzed, there was an average decrease of 0.7%, and in the fifth year, there was a marginal increase of less than 1% compared to the preceding year.

Projections for this region indicate a negative forecast, with an estimated reduction of slightly over 5% in the cultivated area for primary crops by 2030.

Analyzing the counties within the South-Muntenia development region and considering the cultivation area of primary crops over the same period reveals a fluctuating pattern.

The area values exhibit numerous instances of both increases and decreases in the analyzed indicator throughout the reference period.

By the end of the analyzed period, 5 out of the 7 counties in the South-Muntenia region experienced a decline in the cultivated area for major crops compared to the beginning of the period, the most affected being Dâmbovita county (decrease of 8.7%), Giurgiu, Prahova and Teleorman counties experienced decreases between 2.2% and 3.5%, Calarasi county recorded the smallest decrease in the area under main crops (0.35%), meanwhile Arges and Ialomita counties recorded increases of 24 hectares (not significant in percentage terms) in Arges county and just over 4% in Ialomița county.

Due to fluctuations in the values recorded over the 5 years analyzed, a decrease of 0.35%/year a change in the cultivated area for primary crops was documented in the South-Muntenia development region. The resulting averages within each county of the South-Muntenia region are decrease of 2.2%/year in Dâmbovița County, 0.82%/year in Teleorman county, 0.53%/year in Prahova County, 0.74%/year in Giurgiu county and 0.02%/year in Călărași county, and in Argeș and Ialomița counties increases of 0.04%/year and 1.08%/year respectively.

Table 3. Shifts in the agricultural workforce at the national level and within Romania's development regions from 2018 to 2022

	2019/2018	2020/2019	2021/2020	2022/2021	2022/2018
ROMANIA	↓ -0.71	↓ -3.77	↓ -49.65	↑ 1.45	↓ -51.19
NORTH-WEST Region	↓ -0.72	↓ -3.7	↓ -50.4	↑ 1.44	↓ -51.89
CENTRE Region	↓ -0.56	↓ -3.79	↓ -48.5	↑ 1.49	↓ -50
NORTH-EAST Region	↓ -0.79	↓ -3.92	↓ -50.82	↑ 1.33	↓ -52.5
SOUTH-EAST Region	↓ -0.83	↓ -3.88	↓ -48.96	↑ 1.79	↓ -50.48
SOUTH-MUNTENIA Region	↓ -0.78	↓ -3.67	↓ -49.41	↑ 1.34	↓ -50.99
BUCHAREST-ILFOV Region	↓ -1.08	↓ -2.91	↓ -43.82	↑ 2.67	↓ -44.6
SOUTH-WEST OLTENIA Region	↓ -0.63	↓ -3.63	↓ -50.98	↑ 1.61	↓ -52.31
WEST Region	↓ -0.4	↓ -3.91	↓ -47.51	↑ 0.93	↓ -49.3

Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
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Map 3. The agricultural workforce in Romania's development regions in 2022
Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

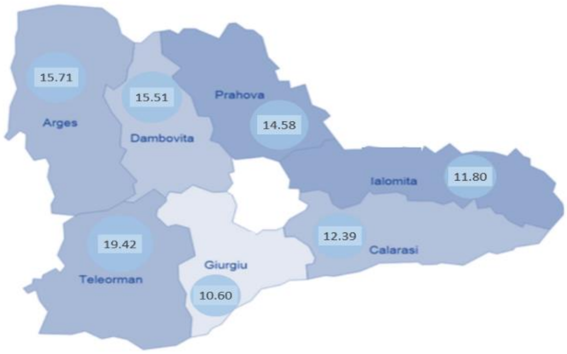
The statistical data analysis sourced from the NSI platform validates analysts' assertions regarding the decline in the agricultural labor force [9]. The data scrutinized over the 5-year period indicate that by the end of the analysis, compared to the outset, the employment figures in agriculture nearly halved both nationally and across the 8 development regions. Although in the first three years analyzed the resulting trend is slightly descendent, from 2020 to 2021 there was a significant decrease in the indicator analyzed, the largest decrease being recorded in the South-West Oltenia region (50.98%) and the smallest in the Bucharest-Ilfov region (43.82%). Despite minor increases in the analyzed indicator during the final year of the period, ranging from 2.67% in the Bucharest-Ilfov region to 0.93% in the West region, these changes did not significantly affect the overall results from the beginning to the end of the period. The overall trend remained downward, with the Bucharest-Ilfov and West regions seeing declines of just under 50%, and the Centre, South-East, and South-Muntenia regions experiencing an exact 50% decrease, while the North-West, North-East, and South-West Oltenia regions saw declines just over 50%. At national level, the same downward trend has been identified, with the values of the analyzed indicator decreasing from 2018 to the end of 2022 by 51%.

In 2022, the North-East region had the highest share of agricultural labor force (19.5% of the national total) and the lowest in the Bucharest-Ilfov region (1.79%).

Table 4. Trends in the agricultural workforce in the South-Muntenia development region (2018-2022)

	2019/2018	2020/2019	2021/2020	2022/2021	2022/2018
SOUTH-MUNTENIA Region	-0.78	-3.67	-49.41	1.34	-50.99
Arges	-1	-3.85	-50.63	1.28	-52.41
Calarasi	-0.83	-3.63	-46.67	1.63	-48.2
Dambovita	-1.01	-3.46	-51.58	1.74	-52.92
Giurgiu	-0.6	-3.65	-49.84	0.63	-51.66
Ialomita	-0.6	-3.63	-45.14	1.71	-46.55
Prahova	-0.66	-3.56	-49.88	1.38	-51.33
Teleorman	-0.66	-3.81	-50	1.03	-51.73

Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.



Map 4. The agricultural workforce in the counties of the South-Muntenia development region in 2022
Source: National Institute of Statistics- TEMPO-Online [10], Accessed on April 2, 2024.

In 2022, most individuals working in agriculture in the South-Muntenia region were in Teleorman county (19.42% of the region's total), while the fewest were in Ialomita county (11.8%). However, with the largest difference among the seven counties being just 7.6%, it can be concluded that the agricultural workforce is evenly distributed across the region. In the South-Muntenia development region and its constituent counties, a trend similar to that observed at the national level and across the eight development regions was noted over the analysed period, the same downward trend has resulted, following the same evolution in the 5 years analyzed, registering a significant decrease in the first years analyzed, followed by a drastic decrease from 2020 to 2021, with a slight increase in the last year analyzed. From the beginning to the end of the analyzed period, within the South-Muntenia region, the agricultural labor force decreased by almost 51%, as decreases of between 46.5% (Ialomița county) and 52.92% (Dâmbovița County) were recorded in each of the 7 component counties.

The decline in the agricultural workforce observed at the three levels examined in this article—national, across the eight development regions, and within the seven constituent counties of the South-Muntenia development region—is attributed to the advanced age of workers employed in the agricultural sector, the low level of professional training of agricultural workers [8] and the migration of romanian agricultural workers to other European countries that are offering more attractive salaries [25] [7]. Although for the first time after the Revolution of 1989 agricultural wages in Romania began to compete with wages in more developed countries, the level of the average wage in agriculture at national level is still half of the minimum wage in agriculture in the European Union. However, although more and more farmers are offering more than attractive salaries in relation to the national agricultural wage, they also require an appropriate level of professional training, which most workers employed in agriculture do not have, either because of a lack of education due to old age or because agriculture is not a top preference for young people [20].

Analyzing the data on the area under main crops and the agricultural labor force further helps us to determine the ratio between these two indicators to determine how many hectares of land under main crops a person employed in agriculture is entitled to, during the analysis period and how this ratio has evolved.

Table 5. Ratio of agricultural labor force to cultivated area of primary crops in Romania and its development regions (2018-2022) (ha/person)

	2018	2019	2020	2021	2022	Forecast 2027
ROMANIA	4.81	5.00	4.92	9.76	9.32	16.41
NORTH-WEST Region	3.14	3.21	3.27	6.69	6.34	11.45
CENTRE Region	3.30	3.27	3.29	6.42	6.15	10.68
NORTH-EAST Region	3.42	3.65	3.74	7.76	7.62	13.99
SOUTH-EAST Region	7.38	7.29	7.44	15.07	13.58	24.29
SOUTH-MUNTENIA Region	6.08	6.19	6.29	12.31	12.22	21.50
BUCHAREST-ILFOV Region	2.40	2.31	2.33	4.93	4.02	7.30
SOUTH-WEST OLTENIA Region	4.80	5.00	5.04	10.12	9.53	17.10
WEST Region	6.57	7.78	5.92	10.27	10.08	14.79

Source: National Institute of Statistics- TEMPO-Online [10], accessing and processing data-04.2024.

The analysis of data on the cultivation area of primary crops and the agricultural workforce shows that the ratio between these two indicators mirrors the overall downward trend observed during the analysed period. This trend is primarily driven by the decline in the agricultural workforce, which directly affects this ratio.

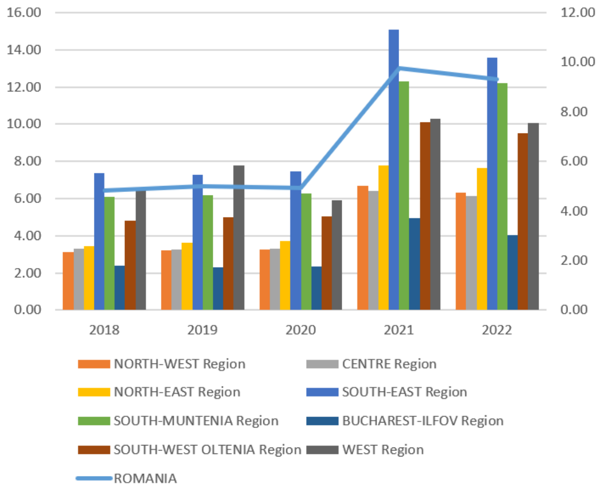


Fig. 2 The Ratio of Agricultural Labor Force to Cultivated Area of Primary Crops at the National Level and Across Romania's Development Regions (2018-2022) (ha/person)
Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

In both the national context and across Romania's 8 development regions, a pattern marked by fluctuations was observed over the 5-year analyzed period. In the initial years of the period, the resulting ratio exhibited minor fluctuations, averaging 4.64 ha/person in 2018, 4.84 ha/person in 2019, and 4.66 ha/person in 2020 across the 8 development regions, but in the last two years of the analyzed period the same average almost doubled in the penultimate year reaching a value equal to 9.2 ha/pers., and finally in the last year analyzed it decreased very little reaching an average equal to 8.69 ha/pers.

Each of the 8 development regions experienced downward slopes over the analysis period, with the values of the ratio being similar in the first three years analyzed, then roughly doubling in the fourth year and decreasing insignificantly in the last year analyzed. According to the data analyzed, the Bucharest-Ilfov region had the lowest ratio, with one person working in agriculture having the lowest number of hectares, the average over the analysis period being 3.2 ha/person, an intuitive result given that the same region

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has the smallest area cultivated with the main crops, but also the smallest workforce in agriculture. Conversely, the South-West region stands out with the highest number of hectares per person employed in agriculture, averaging 10.15 ha per person over the reference period.

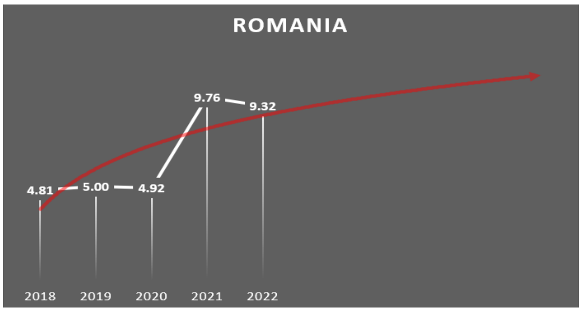

Fig. 3. Predictions for the agricultural labor force relative to the cultivated area of primary crops in Romania (ha/pers)
Source: National Institute of Statistics- TEMPO-Online [10], Accessed on April 2, 2024.

On a nationwide scale, at the start of the analyzed period, each agricultural worker was allocated nearly 5 hectares, while by the end of the period, this allocation had increased by almost 94%, the average for the total analyzed period being equal to 6.76 ha/pers., with a standard deviation of 2.27 ha/pers. and a coefficient of variation of 27%.

The forecast for both the national level and the 8 development regions suggests a grim outlook. By 2027, the ratio between the area cultivated with major crops and the agricultural labor force is expected to increase by 76% nationally and by an average of 75% across the development regions.

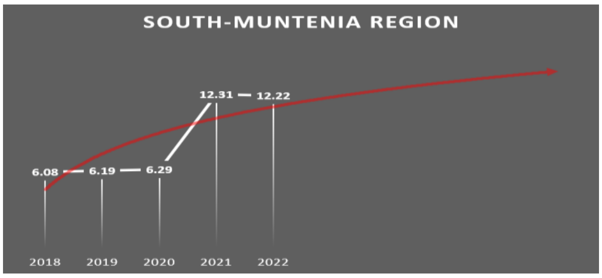

Fig. 4. Predictions for the agricultural labor force relative to the cultivated area of primary crops in the South-Muntenia region (ha/pers)
Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

At the level of the South-Muntenia development region, the analyzed ratio presents some of the highest values at national level, the resulting average over the analyzed period being equal to 8.62 ha/pers., with a standard deviation of 2.98 ha/pers. and a coefficient of variation equal to 34.6%.

Like the forecast determined at national level, in the case of the South-Muntenia region, it is predicted that in 5 years after the analysis period, an agricultural worker will receive 75% more hectares of the area cultivated with the main crops, reaching 21.5 ha in 2027 compared to 12.2 ha in 2022.

Table 6. Ratio of agricultural labor force to cultivated area of primary crops in the South-Muntenia development region (2018-2022) (ha/person)

	2018	2019	2020	2021	2022	Forecast 2027
SOUTH-MUNTENIA Region	6.08	6.19	6.29	12.31	12.22	21.50
Arges	3.07	3.23	3.23	6.54	6.45	11.55
Calarasi	11.35	11.46	11.21	21.92	21.83	37.56
Dambovita	3.32	3.35	3.26	6.45	6.43	11.09
Giurgiu	7.27	7.60	8.06	15.05	14.55	25.91
Ialomita	10.46	10.53	10.79	20.94	20.38	35.80
Prahova	3.15	3.18	3.25	6.28	6.33	11.06
Teleorman	6.79	6.90	7.15	13.30	13.58	23.53

Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

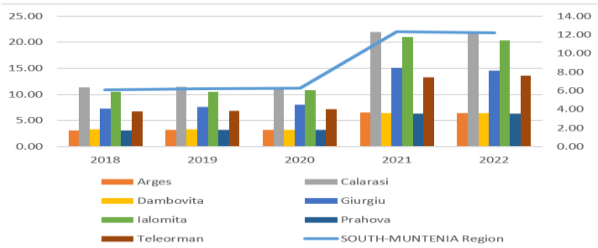

Fig. 5. The correlation between the agricultural workforce and the cultivated area of primary crops in the South-Muntenia development region from 2018 to 2022
Source: National Institute of Statistics- Tempo-Online [10], Accessed on April 2, 2024.

The counties within the South-Muntenia development region exhibit the same negative trend. Due to a significant reduction in the agricultural labor force, the analyzed ratio demonstrates a similar decline by the end of the period compared to the start. This results in an increase in the number of hectares per agricultural worker in each of the seven counties, with this ratio doubling in the final year of the analyzed period compared to the beginning.

On average, for the whole analyzed period, a person employed in agriculture is responsible for 9.10 ha, the highest value of this ratio being found in Calarasi County, where the average is equal to 15.6 ha/pers., with a standard deviation of 5.16 ha/pers., and the lowest value being found in Prahova County, where the average is equal to 4.4%, with a standard deviation of 1.53 ha/pers. In the case of the 7 counties analyzed, the coefficient of variation is on average 34%, which indicates a large spread of data, precisely because of the very large difference between the data analysis, especially in the last two years analyzed compared to the first three.

CONCLUSIONS

By analysing and processing data from the NSI database using inferential statistics, trends, averages, standard deviations, and coefficients of variation were calculated for the area cultivated with main crops, the agricultural labor force, and the ratio between them. The primary finding is a consistent downward trend in the area cultivated with main crops, the agricultural labor force, and the resulting ratio between the two. This trend is evident at both the national level and across the 8 development regions in Romania, including the 7 counties of the South-Muntenia development region.

Regarding the area cultivated with the main crops, the main conclusion is that although the percentage of this indicator that decreases from year to year is not very high, the continuation of this trend over time may lead to a decrease in the amount of agricultural land with which Romania has been endowed, thus losing an enormous advantage that Romania has over other EU Member States.

Regarding the agricultural labor force, it should be noted that, unlike the area cultivated with the main crops, this indicator has experienced a drastic decrease in the last two years of the analyzed period. The shrinking workforce in agriculture is mostly due to an ageing workforce, a lack of skilled labor, but especially to the decreasing interest of young people to pursue a career in agriculture and especially a career in agriculture in Romania where the income they can earn is not enough to ensure a decent living, which is why they choose to leave the country in search of a better living.

The result of the analysis of the agricultural labor force in terms of the area cultivated with the main crops is also gloomy because the data analysis show that from year to year, a person working in agriculture is given an increasing number of hectares, which over time, if things do not improve, will lead to a negative influence on labor productivity and the yields obtained.

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AN ANALYSIS OF NATIONAL SANITARY VETERINARY AND FOOD SAFETY AUTHORITY (ANSVSA)`S ACTIVITIES DURING THE 2023 SUMMER SEASON IN CONSTANTA COUNTY, ROMANIA

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Abstract

This paper presents an analysis of the actions undertaken by the ANSVSA inspectors during the 2023 summer season in the areas of tourist interest within Constanta County. Based on the analyzed data concerning the Summer Season Command period and the periods and areas overcrowded with tourists, specifically from June 26, 2023, to September 3, 2023, several conclusions can be drawn: The research highlights the fact that food business operators still require support in order to meet food safety standards and to comply with the legislation in force. These issues have resulted in increased inspections in order to prevent food safety risks, including the prevention of food poisoning. A total of 2,245 units were inspected, leading to the enforcement of 471 penalties for offences, totaling 4,962,200 RON, and over 2 tons of non-compliant food were confiscated. These conclusions provide an overview of the evolution of the activities conducted by food business operators in the South-East Region of Romania, indicating both the challenges to and opportunities for their development and the continued implementation of good hygiene and food safety practices.

Key words: *food quality, official inspections, South-East Region, Romania*

INTRODUCTION

Most tourists and consumers on the Romanian coast seek to spend their vacation time relaxing, visiting and discovering the local cuisine. ANSVSA (The National Veterinary Sanitary and Food Safety Authority) [11]., together with the county's DSVSA (The Veterinary Sanitary and Food Safety Directorate) [30] are closely supervising the food establishments/units, with the aim of ensuring the hygiene and safety of the food products and, especially, the consumer's health [3].

The launch of the "2023 Summer Season Command" took place on Monday, June 26, 2023 (ANSVSA, 2023) [12].

From June 26, 2023 to September 3, 2023, inspectors from the county's Veterinary Sanitary and Food Safety Directorate carried out control/inspection activities aimed at preserving the desired objective, i.e., "0 food poisoning", according to G4 Media (G4 Media, 2023) [10].

The inspection teams carried out activities in the tourist resorts and in the areas of tourist interest, i.e.: Mamaia Resort divided into 3 sectors, Năvodari, Corbu and Vadu, Mangalia divided into 3 sectors and Costinești divided into 2 sectors.

These teams were organized into five consecutive two-week series. Food establishments with a varied profile were checked/inspected: public food establishments, school camps, restaurants, pizzerias, brasseries, buffets, bistros, fast foods, pastry/confectionery laboratories, snack bars, beach bars, food stores, bars, etc [15].

Regarding the economic situation of Constanta County (CJC, 2023) [5], Constanta County Council claims that the business environment has a share of 78.63%, of which 8.69% is represented by "hotels and restaurants" and 69.94% - other services. Budeanu (2023) [2], in the paper "Modeling the relationship between the tourist flows and the performance of the hotel industry in Romania", notes the fact that economic analysts consider the tourism field as one of the most important economic sectors, with an ever-changing evolution caused by various factors, being defined as the most profitable industry.

At the end of the control activities carried out, 2,127 units operating during the summer season were identified in the resorts Mamaia North, Center and South, Năvodari, Mangalia, Costinești, Eforie North and South, Techirghiol, Vama Veche, 2 Mai, Neptun, Venus, Olimp and in areas of tourist interest Corbu and Vadu.

Ene and Matei (2006) [6] emphasized the fact that Romania encountered difficulties in the agri-food sector during the pre-accession to the European Union period. These conflicts were related to the correlation of the EU requirements with the control activities, the training of employees from the relevant public institutions, the implementation of certain surveillance and control programs, the insufficient education of the population, which led to difficulties in achieving the food security and safety national objective [1].

The development of the economy in the South-East Region of Romania is closely related to the economic operators in the food field. The challenges and opportunities to which they are exposed can award a bonus to the coast and the region compared to the current economy and bring advantages to the economic agents in the field and benefits for the consumers and tourists. Stanciu and Sarbu (2015) [29], in the study "Resilience in the Romanian Food Industry. Preliminary Research"highlighted the fact that there are critical food safety incidents in the agri-food chain, giving cause for concern at the level of the final consumers, authorities, and companies in the food sector. The paper led to the conclusion that it is necessary to supervise the economic operators, to advise them and to implement sanctioning or additional measures, if necessary.

MATERIALS AND METHODS

This paper uses information from the press releases issued by the National Veterinary Sanitary and Food Safety Authority/ANSVSA, and the Ministry of Agriculture and Rural Development, scientific articles published in the Clarivate, SCOPUS, Google Scholar, Research Gate databases. Information was extracted from the website of the Constanta County Council, the National Institute of Statistics and from scientific literature. The research was based on official documents and information provided by ANSVSA and their further processing, through graphics and interpretation, conducted by the authors. In the data gathering process, the legislative basis of ANSVSA was selected. The scientific literature reviewed was necessary in order to validate the obtained data.

RESULTS AND DISCUSSIONS

From Fig. 1, one can notice the fact that between June 26, 2023, and September 3, 2023, 2,245 food establishments were checked/inspected. About a quarter of them (471) did not comply with the national and European legislation in force, which is why they were penalized/sanctioned.

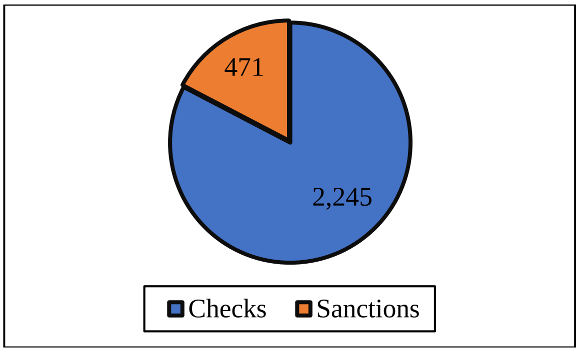

Fig. 1. Analysis of the 2023 Summer Season ANSVSA Activity
Source: Authors, based on ANSVSA (2023) [16].

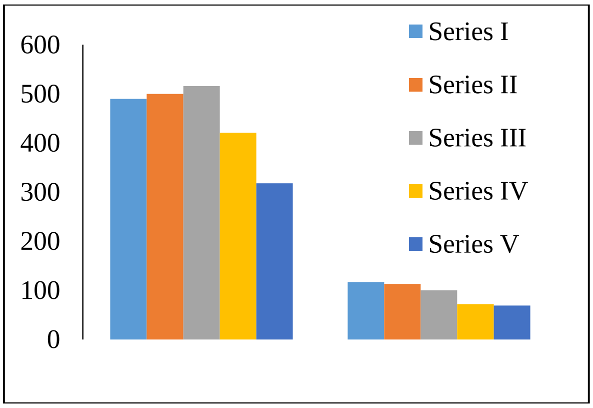

Fig. 2. Inspection activities, by series, during the 2023 Command period
Source: Authors, based on ANSVSA (2023)[17].

Figure 2 highlights 490 inspections of public food establishments, pastry/confectionery laboratories, food stores, etc., and 117 fines.

In series no. III, the inspection activities were intensified, and the number of inspections reached 516, given the fact that the number of tourists and consumers also increased, since Navy Day is celebrated in the middle of August. Starting from series no. IV, both the inspections and the adopted measures were on a downward trend, due to the temporary activity of veterinary sanitary and food safety-registered units. Due to a lack of customers or other incidents, such as the weather, they decided to stop their activity for the 2023 season.

Figure 3 highlights the total amount of fines from the 2023 Summer Season Command period [17], respectively 4,962,200 lei.

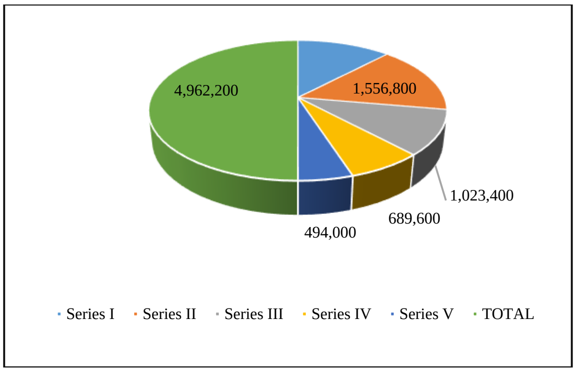

Fig. 3. Fines imposed (26.06.2023 to 03.09.2023)
Source: Authors, based on ANSVSA (2023) [27].

During series no. I, fines were imposed in the amount of 1,198,400 lei, during series no. III the value reached 1,023,400 lei, and in series no. IV - 494,000 lei.

These measures were enforced according to H.G./General Decision 984/2005 and O.G./General Order 2/2001 by the specialists in the field for various deficiencies found during the control activities [27, 28].

The main deficiencies noticed by ANSVSA inspectors were:

-Improper hygiene of the premises, utensils, machinery or work equipment
-Improper storage of food products
-Improper labeling of food products
-Failure to demonstrate products' traceability
-Marketing of expired food products
-Handling the products in violation of the veterinary and sanitary rules in force
-Marketing of food products in non- approved or not sanitary and veterinary- registered premises.

Figure 4 shows the fact that additional measures were also taken, such as the confiscation or seizure of non-compliant food products [19, 21]. The total amount of confiscated products was over 2 tons. The measure was imposed for fish products or fish without identification elements, ice cream, pork, chicken or beef, eggs, seafood [22, 23].

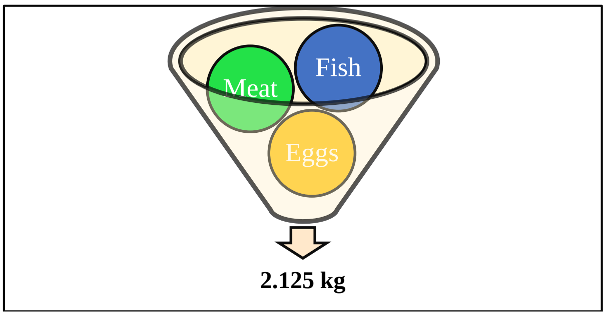

Fig. 4. Food products confiscated in 2023.
Source: Authors, based on ANSVSA (2023) [10].

During series no. III, a luxury resort in Costinești stood out with expired food products or food products stored in poor conditions [19]. In this case, 593 kg of fish and meat were seized, a penalty of 72,000 lei was imposed and an activity prohibition order was issued (ANSVSA, 2023) [20].

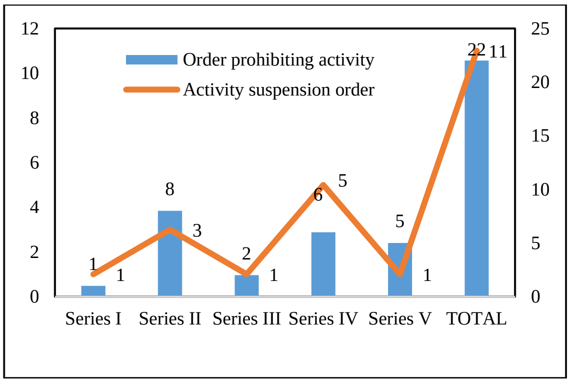

Fig. 5. Additional measures (26.06.2023-03.09.2023)
Source: Authors, based on ANSVSA (2023) [16,17, 18].

In series no. I, 2 Orders were issued, 1 Activity Prohibition Order (OIA/Ordonanță de interzicerea activității) and 1 Activity Suspension Order (OSA/Ordonanță de suspendare a activității) [13, 14]. 8 OIAs and 3 OSAs were issued in series no. 2, in the middle of the Command period, 2 OIAs and 1 OSA were imposed, in series no. IV - 6 OIAs and 5 OSAs, and in the last series, 5 OIAs and 1 OSA were issued. The total number of Orders issued during the 2023 Summer Season Command period was 22 OIAs and 11 OSAs, according to Figure 5.

These drastic measures were taken for serious violations against the legislation in force encountered during the control activities [7, 8, 9].

Table 1. Balance Sheet of 2021-2022-2023 Summer Season Commands

Year	Checks	Sanctions	Seizures	Value of fines
2021	1,284	225	133.08	1,877,200
2022	1,996	394	2,116.74	4,075,800
2023	2,245	471	2,125	4,962,200
TOTAL	5,525	1,090	4,374.82	10,915,200

Source: Drafted by the authors, based on ANSVSA's press releases (2023) [24, 25].

Public food establishments were forced to close during the COVID-19 pandemic, which can also be noticed in Table 1. Both the control activities carried out, and the measures taken in the year 2021 are far fewer than those in the year 2023.

Figure 6 shows the major differences year by year regarding the number of establishments inspected, the number of measures implemented, the value of the fines and the quantities of the confiscated products.

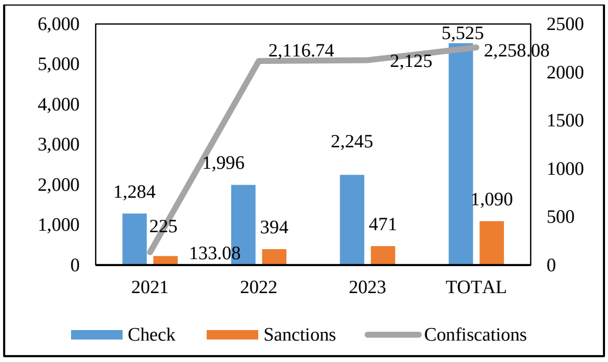

Fig. 6. Balance Sheet 2021-2022-2023 Commands
Source: Authors, based on ANSVSA (2023) [24, 25, 26].

This is primarily due to the COVID-19 pandemic which disrupted the global supply chains and closed tourism sector facilities, according to the National Institute of Statistics (INSSE, 2023) [11].

CONCLUSIONS

This paper demonstrates that the objectives of ANSVSA and DSVSA Constanta have been achieved. There were no cases of food poisoning [4], even though 471 fines were imposed, over 2 tons of non-compliant food products were confiscated, and 22 Activity Prohibition Orders, respectively 11 Activity Suspension Orders were issued.

Tourism and trade on the Romanian coast have been disrupted since the COVID-19 pandemic. In the year 2021, 1,284 establishments were inspected, and in the year 2023, the control activities reached 2,245. The total number of inspections carried out during the 2021-2022-2023 Summer Season Commands period was 5,525, and the value of fines - 10,915,200 lei.

The temporary opening of certain food establishments is generating an upward trend in the control activities in the South-East Region during the summer period. The large number of inspections is primarily caused by the number of existing units within the analyzed radius; however, it increases when deficiencies are identified. The deficiencies encountered are mostly similar and are caused by a lack of knowledge of the current veterinary, sanitary and food safety legislation or even by negligence.

Veterinary sanitary inspectors advise economic agents year after year before the opening of the summer season. The measures taken by them prove the fact that not all operators in the food sector are aware of the risks to which tourists, respectively consumers, are exposed. Nevertheless, one can conclude that the training and counseling carried out by DSVSA Constanta established the basis for the implementation of good hygiene and food safety practices by the economic agents, given the fact that in the last three years there have been no cases of food poisoning.

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RESEARCH ON THE INFLUENCE OF BIOSTIMULANTS ON PRODUCTIVITY IN THE MILKWEED (*SYLIBUM MARIANUM* L.)

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Abstract

The purpose of the paper is to study to what extent the production and productivity elements of the armory culture is influenced by biostimulators in the pedo-climatic conditions of the experimental field located in the town of Măciuca, Vâlcea county. The work is based on a trifactorial experience, where factor A is the genotype, with 5 gradations: from Prahova, from Secuieni, from Iasi, Dacia Plant and from Brașov; factor B is the applied biostimulator, with 4 grades: untreated, Cropmax, BioHumusSol and Bioenne; factor C is the sowing density, with 3 gradations: 15 pl/m², 10 pl/m², 25 pl/m². The three-factor interaction genotype x biostimulator x decime influenced calathidium diameter, production and MH. The Prahova population showed differences of 25 pl/m², when treated with BioHumusSol and Bioenne. The Sequoia cultivar was more productive at plots of 10 pl/m² and 25 pl/m² both untreated and treated with BioHumusSol and Bioenne. Desimea and the biostimulator influenced the Iași cultivar to a very small extent. Dacia Plant was the only one that reacted very significantly to the treatment with Cropmax, at the rate of 25 pl/m². The Brașov population recorded increases in production when treated with Bioenne, in both plots. These interactions technological requests for the cultivation of armors in experienced pedoclimatic conditions.

Key words: *armory, genotype, calathidium, seeds, biostimulator*

INTRODUCTION

Silybum marianum is one of the most important medicinal plants, which are grown on the globe. The seed contains important substances used in the pharmaceutical industry, commonly known as silymarin, consisting of an isomeric mixture of 6 phenolic components: silidianine, silicristine, silibin a, silibin b, isosilibin a and isosilibin b. Silymarin is used for countless medical purposes namely: antidiabetic, hepatoprotective,hypocholesterolemic, antihypertensive, anti-inflammatory, anticancer and antioxidant. It can also be antispasmodic, neuroprotective, antiviral, cardiorpotector, and antihemorrhagic [6, 12]. Worldwide, studies on armorarium have been numerous and with differentiated topics (technological aspects, morphological aspects, aspects related to phytochemical components, etc.). In our country there is little research on this species.

In a study the effect of nitrogen fertilization on biomass production and structure in two milk thistle populations was examined [19]. Higher production of achenes and biomass were obtained in a Polish population, relative to the cultivar Silma. The production of achenes increased proportionally with the dose of nitrogen. The population responded better than the cultivar to increasing nitrogen doses.

The highest percentage of achenes in the total biomass was obtained by applying 2 g of N to the experimental vessel. In order to meet the growing demand for armour, the production and productivity of the armoury should be optimised by the use of appropriate technologies. A field experiment was conducted, for two years, by Arampatzis [5] to assess the effects of plant density, and a growth regulator in plants, on armorarium crop growth, seed production, and silymarin accumulation, under Mediterranean semiarid conditions.The results showed that plant density had a significant impact on plant growth and seed production. Rahimi and Kamali [13] conducted studies on the influence of sowing date and fertilization system on seed production and essential oil content in milk thistle, in Iran, for 2 years. Hendawy [9] investigated the response of armorarium plants to irrigation intervals combined with fertilization. The study was undertaken to investigate the influence of various types of organic and bio fertilizers, on different irrigation norms, on the growth, production, and chemical constituents of *Silybum marianum* plants. Studies on the effect of foliar or soil fertilization and treatment with the growth regulator Thidiazuron (TDZ) on the vegetative and reproductive growth, several physiological parameters, production, and silimarin content in Silybum marianum were conducted by Stanceva [16]. Angelopoulou [4] conducted a field experiment in western Greece to determine the effects of organic fertilization on the root growth of medicinal plants oregano (*Origanum vulgare* L.) and milk thistle (*Silybum marianum* L. Gaertn.). Katar [10] presented a study aimed at determining the effect of seeding density on achene and silimarin production on yield, number of branches/plant, seed weight/plant, and 1,000 grain of armorarium. The effect of sowing date (23rd September, 12th October, and 1st November) and plant density (4, 6, and 8 plants/m2) on characteristics including: phyllochron, stem diameter, number of capitula/plant, main capitulum weight, average weight of secondary capitula, seed number were studied by Tahernia [18]. Numerous researchers [7],[11], [1], [2], [13], have shown that delaying sowing decreases achene yield but increases silimarin content. Silimarin content is also affected by row spacing. A row spacing of 25 cm increases achene yield but reduces oil and silimarin content compared to plants at 50 cm row spacing [3], [20].

In this context, the purpose of the paper is to study to what extent the production and productivity elements of the armory culture is influenced by biostimulators in the pedo-climatic conditions of the experimental field located in the town of Măciuca, Vâlcea county.

MATERIALS AND METHODS

The experiment is three-factorial, where factor A is the genotype, with 5 levels: from Prahova, from Secuieni, from Iași, Dacia Plant, from Brașov; factor B is the biostimulant, with 4 levels: untreated, Cropmax, BioHumusSol, Bio enne; and factor C is the seeding density with 3 levels: 15 plants/m2, 10 plants/m2, 25 plants/m2. The experiment was conducted between the years 2020 and 2021, in the locality of Măciuca, Vâlcea county, on chernozem soil.

The cultivar "de Prahova" is the only one registered in the Official Catalog of Crop Plant Varieties in Romania, 2022 edition. It was re-registered in 2020, being maintained by the National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection (INCDA Fundulea) [17]. The seed from the "de Secuieni" population is available in the SCDA Secuieni's offer, both for organic and conventional agriculture [14].

For the other three genotypes, the name is primarily linked to their origin, without having too much information about their source. The one from Brașov seems to originate from Hungary.

The foliar fertilizers used were: Cropmax, Biohumusol, and Bio enne.

Cropmax is a concentrated foliar fertilizer, rich in macro and microelements, growth stimulators, vitamins, polysaccharides, enzymes, etc., with favorable effects on directing plant metabolism. Its application leads to the rapid development of the root system and leaf mass growth, allowing plants to reach their biological production potential.

Certified organic fertilizer, being approved for use in organic farming (certificate issued by BCS-ÖKO), brings a series of benefits to plants, as follows: significant increases in

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production, with boosts of 15-25%; improvements in crop quality; enhances the effectiveness of mineral fertilizers and pesticides used; contributes to better and faster root system development, consequently increasing plant resistance to drought and stress considerably; improves shoot growth and plant branching; significantly enhances plant resistance to diseases and pests; improves plant recovery after damage caused by adverse weather phenomena (hail, frost, drought); product compatible with pesticides and NPK soluble fertilizers.

Biohumussol liquid is a 100% organic fertilizer, an active humic fertilizer, purely ecological, which stimulates plant growth and health. It contains salts of humic acids, humic acids, fulvic acids, amino acids, micro and macro elements, live bacteria, and other easily absorbable substances.

It can be applied to both the foliar and root system, through any spraying or irrigation method, increasing the numerical and dimensional growth of leaves and roots [15].

Bio enne contains in its composition organic nitrogen (N) - 12%, water-soluble sulphur (SO^3) - 23%, and organic carbon (C) - 35%.

The data processing was carried out using the statistical analysis program specific to the three-factor experiments, based on the methodology presented by N. A. Săulescu, N.N. Săulescu (PSUB 3).

For presenting the distribution of values from a series of data, in the case of studying the genetic variability of the traits determined throughout the experiment, the boxplot was used [8].

The pedoclimatic conditions during the experimental period were moderately favorable in both experimental years.

RESULTS AND DISCUSSIONS

Results regarding the influence of genotype, biostimulant, and density on: head diameter, achene yield, 1,000-achene weight, and hectoliter weight are presented. The three-factor interaction population x biostimulant x density significantly influenced yield (Table 1). Thus, the Prahova population showed increased yields at a density of 25 plants/m², with statistical significance when treated with the biostimulants BioHumusSol and Bio enne.

The Secuieni population was more productive at densities of 10 plants/m² and 25 plants/m², both untreated and treated with BioHumusSol and Bioenne.

Density and biostimulant had a very minor influence on the Iași population.

The Dacia Plant population was the only one that reacted very significantly to treatment with Cropmax when seeded at a density of 25 plants/m².

Statistically significant increases in production were also observed with the other two biostimulants: BioHumusSol and Bio enne, but at different densities. The Brașov population recorded production increases when treated with Bio enne at both densities tested compared to the recommended density.

Table 1. Influence of population x biostimulator x density interaction on yield

Factor A - Population	Factor B – treatment with biostimulant	Factorul C – density	Prro duction Kg/ha	Difference from mt.	Meaning
a_1-FROM PRAHOVA	b_1 - UNFERTILIZAED	c_1- 15 pl/mp	522	0	
		c_2- 10 pl/mp	599	77	
		c_3- 25 pl/mp	460	-62	
	b_2 - CROPMAX	c_1- 15 pl/mp	657	0	
		c_2- 10 pl/mp	622	-35	
		c_3- 25 pl/mp	685	28	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	694	0	
		c2- 10 pl/mp	762	68	
		c3- 25 pl/mp	818	124	*
	b_4– BIOENNE	c1- 15 pl/mp	871	0	
		c2- 10 pl/mp	925	54	
		c3- 25 pl/mp	1141	270	***
a_2-FROM SECUIENI	b_1 - UNFERTILIZED	c1- 15 pl/mp	532	0	
		c2- 10 pl/mp	890	358	***
		c3- 25 pl/mp	780	248	***
	b_2 - CROPMAX	c1- 15 pl/mp	720	0	
		c2- 10 pl/mp	730	10	

		c3- 25 pl/mp	697	-23	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	737	0	
		c2- 10 pl/mp	763	26	
		c3- 25 pl/mp	889	152	**
	b_4 – BIOENNE	c1- 15 pl/mp	625	0	
		c2- 10 pl/mp	933	308	***
		c3- 25 pl/mp	778	153	**
a_3-FROM IASI	b_1 - UNFERTILIZED	c1- 15 pl/mp	612	0	
		c2- 10 pl/mp	745	133	*
		c3- 25 pl/mp	532	-80	
	b_2 - CROPMAX	c1- 15 pl/mp	552	0	
		c2- 10 pl/mp	587	35	
		c3- 25 pl/mp	628	76	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	693	0	
		c2- 10 pl/mp	723	30	
		c3- 25 pl/mp	719	26	
	b_4– BIOENNE	c1- 15 pl/mp	745	0	
		c2- 10 pl/mp	840	95	
		c3- 25 pl/mp	586	-159	oo
a_4-DACIA PLANT	b1 - UNFERTILIZED	c1- 15 pl/mp	610	0	
		c2- 10 pl/mp	631	21	
		c3- 25 pl/mp	497	-113	o
	b2 – CROPMAX	c1- 15 pl/mp	581	0	
		c2- 10 pl/mp	628	47	
		c3- 25 pl/mp	771	190	***
	b3 - BIOHUMUSSOL	c1- 15 pl/mp	665	0	
		c2- 10 pl/mp	719	54	
		c3- 25 pl/mp	811	146	**
	b4 – BIOENNE	c1- 15 pl/mp	812	0	
		c2- 10 pl/mp	1,103	291	***
		c3- 25 pl/mp	846	34	
a_5-FROM BRASOV	b1 - UNFERTILIZED	c1- 15 pl/mp	681	0	
		c2- 10 pl/mp	715	34	
		c3- 25 pl/mp	686	5	
	b2 - CROPMAX	c1- 15 pl/mp	743	0	
		c2- 10 pl/mp	688	-55	
		c3- 25 pl/mp	625	-118	o
	b3 - BIOHUMUSSOL	c1- 15 pl/mp	640	0	
		c2- 10 pl/mp	737	97	
		c3- 25 pl/mp	619	-21	
	b4 – BIOENNE	c1- 15 pl/mp	572	0	
		c2- 10 pl/mp	886	314	***
		c3- 25 pl/mp	718	146	**
		DL 5%	104 kg/ha		
		DL 1%	138 kg/ha		
		DL 0.1%	179 kg/ha		

Source: original data.

Variability analysis through the boxplot method allowed the identification of two outliers (variants significantly deviating from the cluster of determinations made), namely: the Prahova population treated with Bio enne and seeded at 25 pl/mp (interaction a1b4c3) as well as the Dacia Plant population treated with Bioenne and seeded at 10 pl/mp (interaction a4b4c2). These two interactions represent technological recommendations for cultivating milk thistle under the pedoclimatic conditions in which it was experimented (Figure 1).

The results obtained from the calculation using QUARTILE.INC function represents:

Min	459.55	The minimum value of the series of 60 data points
Q1	624.4417	The maximun value of 25% data points
Med	696.6533	The maximun value of 50% data points
Q3	772.835	The maximun value of 75% data points
Max	890	The maximum value of data set does not include outliers
mean	713	The average of the data set
range	430.45	The difference between mim and max value
IQR	148.3933	interquartil = Q3-Q1
	222.59	interquartil x 1,5
	401.8517	The value at which the lower outliers appear
	995.425	The value at which the upper outliers appear

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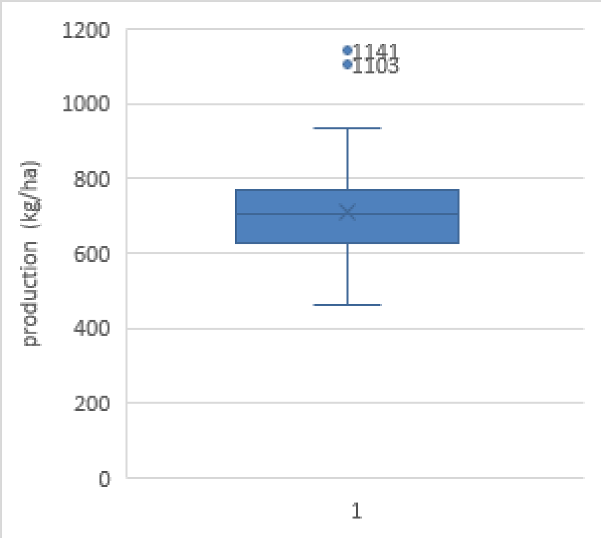


a_1	b_4	c_3	1,141
a_4	b_4	c_2	1,103

Fig. 1. Yied variability presented by boxplot method
Source: Authors' data.

Regarding the biostimulant used, treatment with BioHumusSol resulted in a significant increase in production compared to the unfertilized variant (Figure 2). The boundary differences had small values due to the fairly uniform dimensions of the variants studied both among themselves and between the repetitions of the same variants.

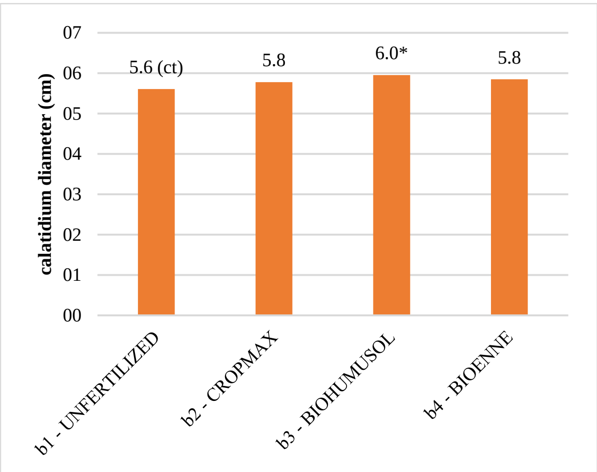


Fig. 2. The influence of the biostimulator on the capitulum diameter at milk thistle
Source: Authors' data.

The three-way interaction population x biostimulant x density significantly influenced the diameter of the capitulum (Table 2). Thus, the Prahova population showed decreases with statistical assurance at a density of 25 pl/mp when treated with BioHumusSol.

Diametrically opposed differences were recorded at a density of 10 pl/mp. It is possible that errors in ensuring the correct density may have occurred here, or it may be that the biostimulant Bio enne provided a significant increase at the same density.

Table 2. Influence of population x biostimulator x density interaction on capitulum diameter

Factor A - population	Factor B – treatment with biostimulator	Factorul C – density	Calthidium diameter (cm)	Difference from mt.	Meaning
a_1- FROM PRAHOVA	b_1 - UNFERTILIZED	c1- 15 pl/mp	6.5	-0.5	
		c2- 10 pl/mp	6.1	-0.9	o
		c3- 25 pl/mp	6.6	-0.4	
	b_2 - CROPMAX	c1- 15 pl/mp	6.0	0.0	
		c2- 10 pl/mp	6.3	0.3	
		c3- 25 pl/mp	6.2	0.2	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	6.9	0.0	
		c2- 10 pl/mp	6.4	-0.5	
		c3- 25 pl/mp	5.6	-1.3	oo
	b_4– BIOENNE	c1- 15 pl/mp	5.9	0.0	
		c2- 10 pl/mp	6.8	0.9	*
		c3- 25 pl/mp	5.8	-0.1	
a_2- FROM SECUIENI	b_1 - UNFERTILIZED	c1- 15 pl/mp	6.2	0.0	
		c2- 10 pl/mp	5.9	-0.3	
		c3- 25 pl/mp	6.5	0.3	
	b_2 - CROPMAX	c1- 15 pl/mp	5.8	0.0	
		c2- 10 pl/mp	6.4	0.6	
		c3- 25 pl/mp	6.9	1.1	**
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	6.1	0.0	
		c2- 10 pl/mp	6.2	0.1	
		c3- 25 pl/mp	6.7	0.6	
	b_4– BIOENNE	c1- 15 pl/mp	6.4	0.0	
		c2- 10 pl/mp	6.6	0.2	
		c3- 25 pl/mp	6.6	0.2	
a3- FROM IASI	b_1 - UNFERTILIZED	c1- 15 pl/mp	5.6	0.0	
		c2- 10 pl/mp	5.0	-0.6	

		c3- 25 pl/mp	5.2	-0.4	
	b_2 - CROPMAX	c1- 15 pl/mp	6.4	0.0	
		c2- 10 pl/mp	6.1	-0.3	
		c3- 25 pl/mp	6.0	-0.4	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	6.1	0.0	
		c2- 10 pl/mp	5.1	-1.0	o
		c3- 25 pl/mp	4.9	-1.2	oo
	b_4– BIOENNE	c1- 15 pl/mp	5.3	0.0	
		c2- 10 pl/mp	5.1	-0.2	
		c3- 25 pl/mp	5.1	-0.2	
a_4-DACIA PLANT	b_1 - UNFERTILIZED	c1- 15 pl/mp	4.7	0.0	
		c2- 10 pl/mp	5.6	0.9	*
		c3- 25 pl/mp	4.8	0.1	
	b_2 - CROPMAX	c1- 15 pl/mp	5.6	0.0	
		c2- 10 pl/mp	5.0	-0.6	
		c3- 25 pl/mp	4.9	-0.7	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	5.6	0.0	
		c2- 10 pl/mp	6.1	0.5	
		c3- 25 pl/mp	5.5	-0.1	
	b_4 – BIOENNE	c1- 15 pl/mp	5.3	0.0	
		c2- 10 pl/mp	5.9	0.6	
		c3- 25 pl/mp	5.8	0.5	
a_5- FROM BRASOV	b_1 - UNFERTILIZED	c1- 15 pl/mp	4.0	0.0	
		c2- 10 pl/mp	5.7	1.7	***
		c3- 25 pl/mp	5.7	1.7	***
	b_2 - CROPMAX	c1- 15 pl/mp	4.4	0.0	
		c2- 10 pl/mp	6.0	1.6	***
		c3- 25 pl/mp	4.6	0.2	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	6.2	0.0	
		c2- 10 pl/mp	6.9	0.7	
		c3- 25 pl/mp	5.1	-1.1	o
	b_4– BIOENNE	c1- 15 pl/mp	5.0	0.0	
		c2- 10 pl/mp	5.3	0.3	
		c3- 25 pl/mp	6.8	1.8	***
		DL 5%	0.9 cm		
		DL 1%	1.1 cm		
		DL 0,1%	1.5 cm		

Source: Authors' data.

The population from Secuieni presented a larger calathidium at the density of 25 pl/mp in the variant treated with Cropmax.

The density and biostimulant had a very minor influence on the population from Iași. Here, only BioHumusSol intervened by decreasing the calathidium at the densities of 10 pl/mp and 25 pl/mp. Additionally, the density and biostimulant had a very minor influence on the population from Dacia Plant.

The population from Brașov recorded very significant increases in diameter when treated with Bioenne or untreated at the density of 25 pl/mp compared to the recommended density, as well as very significant increases in the calathidium when treated with Cropmax or untreated at the density of 10 pl/mp.

The three-way interaction of population x biostimulant x density had a minor influence on the weight of 1,000 achenes (seeds) (Table 3). The density of 10 pl/mp, indicating sparser plants, was the one that stimulated statistically significant increases in the treatment with Bio enne for the Dacia Plant population and for the unfertilized variant of the Secuieni population.

Table 3.Influence of population x biostimulator x density interaction on weight of 1,000 seeds

Factor A - populațion	Factor B – treatment with biostimulator	Factorul C – density	The weight of 1000 de achenes (g)	The difference from mt.	Meaning
a_1- FROM PRAHOVA	b_1 - UNEFERTILIZED	c1- 15 pl/mp	24.3	0.0	
		c2- 10 pl/mp	24.9	0.6	
		c3- 25 pl/mp	27.9	3.6	
	b_2 - CROPMAX	c1- 15 pl/mp	26.4	0.0	
		c2- 10 pl/mp	27.6	1.2	
		c3- 25 pl/mp	26.9	0.5	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	30.5	0.0	
		c2- 10 pl/mp	27.3	-3.2	
		c3- 25 pl/mp	25.5	-5.0	o
	b_4 – BIOENNE	c1- 15 pl/mp	27.0	0.0	
		c2- 10 pl/mp	29.3	2.3	
		c3- 25 pl/mp	30.5	3.5	

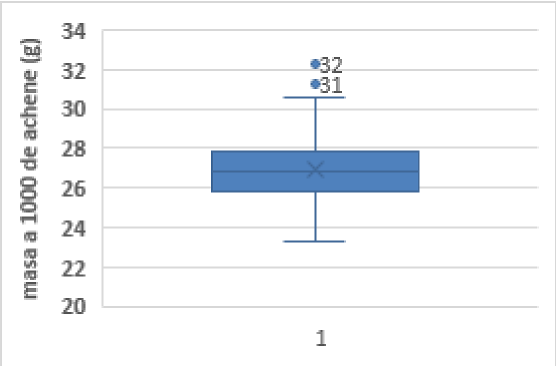
a_2- FROM SECUIENI	b_1 - UNEFERTILIZED	c1- 15 pl/mp	25.9	0.0	
		c2- 10 pl/mp	32.3	6.4	**
		c3- 25 pl/mp	27.5	1.6	
	b_2 - CROPMAX	c1- 15 pl/mp	27.9	0.0	
		c2- 10 pl/mp	26.0	-1.9	
		c3- 25 pl/mp	27.2	-0.7	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	27.2	0.0	
		c2- 10 pl/mp	26.1	-1.1	
		c3- 25 pl/mp	28.5	1.3	
	b_4 – BIOENNE	c1- 15 pl/mp	27.9	0.0	
		c2- 10 pl/mp	27.7	-0.2	
		c3- 25 pl/mp	26.4	-1.5	
a_3.FROM IASI	b1 - UNEFERTILIZED	c1- 15 pl/mp	26.5	0.0	
		c2- 10 pl/mp	27.1	0.6	
		c3- 25 pl/mp	25.6	-0.9	
	b_2 - CROPMAX	c1- 15 pl/mp	25.3	0.0	
		c2- 10 pl/mp	24.1	-1.2	
		c3- 25 pl/mp	23.7	-1.6	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	28.9	0.0	
		c2- 10 pl/mp	28.0	-0.9	
		c3- 25 pl/mp	26.1	-2.8	
	b_4– BIOENNE	c1- 15 pl/mp	28.3	0.0	
		c2- 10 pl/mp	28.5	0.2	
		c3- 25 pl/mp	26.9	-1.4	
a_4-DACIA PLANT	b_1 - UNFERTILIZED	c1- 15 pl/mp	27.1	0.0	
		c2- 10 pl/mp	25.6	-1.5	
		c3- 25 pl/mp	23.3	-3.8	
	b_2 - CROPMAX	c1- 15 pl/mp	25.6	0.0	
		c2- 10 pl/mp	23.3	-2.3	
		c3- 25 pl/mp	26.7	1.1	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	28.3	0.0	
		c2- 10 pl/mp	27.5	-0.8	
		c3- 25 pl/mp	25.6	-2.7	
	b_4– BIOENNE	c1- 15 pl/mp	26.8	0.0	
		c2- 10 pl/mp	31.3	4.5	*
		c3- 25 pl/mp	26.4	-0.4	
a_5- FROM BRASOV	b_1 - UNFERTILIZED	c1- 15 pl/mp	28.0	0.0	
		c2- 10 pl/mp	25.1	-2.9	
		c3- 25 pl/mp	25.3	-2.7	
	b_2 – CROPMAX	c1- 15 pl/mp	26.7	0.0	
		c2- 10 pl/mp	26.4	-0.3	
		c3- 25 pl/mp	26.7	0.0	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	25.1	0.0	
		c2- 10 pl/mp	26.5	1.4	
		c3- 25 pl/mp	26.7	1.6	
	b_4 – BIOENNE	c1- 15 pl/mp	26.8	0.0	
		c2- 10 pl/mp	30.5	3.7	
		c3- 25 pl/mp	27.8	1.0	
		DL 5%	4.2 g		
		DL 1%	5.5 g		
		DL 0.1%	7.2 g		

Source: Authors' data.

The analysis of variability through the boxplot method allowed the identification of two outliers, namely: the Dacia Plant population treated with Bioenne and seeded at 10 pl/mp (interaction a4b4c2) and the untreated Secuieni population seeded at 10 pl/mp (interaction a2b1c2). These results, especially the latter interaction, indicate that the Secuieni population, when sparsely seeded, develops larger seeds, with the biostimulator playing no stimulating role (Figure 3).

The results obtained from the calculation using the QUARTILE.INC function represent:

Min	23.33333	The minimum value of the series of 60 plants
Q1	25.96667	The maximum value of 25% data
Med	26.86667	The maximum value of 50% data
Q3	27.86667	The maximum value of 75% data
Max	32.26667	The maximum value of the data set that
Mean	27.0	does not include outliers
Range	8.933333	The difference between max and min
IQR	1.9	interquartil = Q3-Q1
	2.85	interquartil x 1,5
	23.11667	The value at which the lower outliers appears
	30.71667	The value at which the upper outliers appears



a_4	b_4	c_2	31.3
a_2	b_1	c_2	32.3

Fig. 3. Weight of 1,000 seeds variability presented by boxplot method
Source: Authors' data.

The interaction between biostimulators and population shows that, similar to the test weight, there are no statistically significant differences between the population of Prahova and the other populations tested under any of the biostimulator-treated conditions, regardless of the type of biostimulator used (Table 4). However, differences exist when not fertilized between populations, compared to the Prahova population, in the sense that the populations of Secuieni, Iasi, and Brasov showed statistically significant increases in hectoliter weight.
The trifactorial interaction of population x biostimulator x density significantly influenced the hectoliter weight (Table 4). Thus, the Prahova population showed statistically significant increases in hectoliter weight at densities of 10 pl/mp and 25 pl/mp when untreated, as well as with treatment with Cropmax.
The population of Secuieni had a higher hectoliter weight with statistical assurance at densities of 10 pl/mp and 25 pl/mp treated with Cropmax.
The density and biostimulator had a small influence on the hectoliter weight of the Iasi population. The same was observed for the Dacia Plant population.
The Brasov population recorded an increase in hectoliter weight when treated with Bio enne at a density of 25 pl/mp compared to the recommended density.

Table 4. Influence of population x biostimulator x density interaction on test weight

Factor A - populație	Factorul B – treatment with biostimulator	Factor C – density	Mass Helect olitre	Difference	Semificația
a_1- FROM PRAHOVA	b_1 - UNEFERTILIZED	c1- 15 pl/mp	65.2	0.0	
		c2- 10 pl/mp	74.2	9.0	**
		c3- 25 pl/mp	79.0	13.8	**
	b_2 - CROPMAX	c1- 15 pl/mp	67.9	0.0	
		c2- 10 pl/mp	81.9	14.0	***
		c3- 25 pl/mp	80.4	12.5	***
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	80.4	0.0	
		c2- 10 pl/mp	76.5	-3.9	
		c3- 25 pl/mp	75.4	-5.0	
	b4 – BIOENNE	c1- 15 pl/mp	81.2	0.0	
		c2- 10 pl/mp	72.8	-8.4	oo
		c3- 25 pl/mp	79.3	-1.9	
a_2.FROM SECUIENI	b_1 - UNEFERTILIZED	c1- 15 pl/mp	75.8	0.0	
		c2- 10 pl/mp	80.0	4.2	
		c3- 25 pl/mp	83.5	7.7	*
	b_2 - CROPMAX	c1- 15 pl/mp	68.8	0.0	
		c2- 10 pl/mp	78.4	9.6	**
		c3- 25 pl/mp	79.7	10.9	***
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	79.6	0.0	
		c2- 10 pl/mp	78.5	-1.1	
		c3- 25 pl/mp	73.2	-6.4	o
	b_4– BIOENNE	c1- 15 pl/mp	77.4	0.0	
		c2- 10 pl/mp	81.0	3.6	
		c3- 25 pl/mp	78.4	1.0	
a_3- FROM IASI	b_1 - UNEFERTILIZED	c1- 15 pl/mp	72.9	0.0	
		c2- 10 pl/mp	79.7	6.8	*
		c3- 25 pl/mp	80.5	7.6	*
	b_2 - CROPMAX	c1- 15 pl/mp	76.5	0.0	
		c2- 10 pl/mp	78.8	2.3	
		c3- 25 pl/mp	77.9	1.4	
	b3 - BIOHUMUSSOL	c1- 15 pl/mp	80.9	0.0	
		c2- 10 pl/mp	77.8	-3.1	
		c3- 25 pl/mp	79.0	-1.9	
	b_4– BIOENNE	c1- 15 pl/mp	82.3	0.0	

		c2- 10 pl/mp	79.7	-2.6	
		c3- 25 pl/mp	72.5	-9.8	oo
a_4-DACIA PLANT	b1 - UNEFERTILIZED	c1- 15 pl/mp	66.2	0.0	
		c2- 10 pl/mp	62.1	-4.1	
		c3- 25 pl/mp	63.5	-2.7	
	b_2 - CROPMAX	c1- 15 pl/mp	81.2	0.0	
		c2- 10 pl/mp	75.2	-6.0	o
		c3- 25 pl/mp	75.9	-5.3	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	82.9	0.0	
		c2- 10 pl/mp	72.3	10.6	ooo
		c3- 25 pl/mp	80.8	-2.1	
	b4 – BIOENNE	c1- 15 pl/mp	81.1	0.0	
		c2- 10 pl/mp	81.2	0.1	
		c3- 25 pl/mp	76.1	-5.0	
a_5-DE BRASOV	b_1 - NEFERTILIZAT	c1- 15 pl/mp	81.1	0.0	
		c2- 10 pl/mp	76.5	-4.6	
		c3- 25 pl/mp	78.6	-2.5	
	b2 - CROPMAX	c1- 15 pl/mp	78.0	0.0	
		c2- 10 pl/mp	77.0	-1.0	
		c3- 25 pl/mp	81.5	3.5	
	b_3 - BIOHUMUSSOL	c1- 15 pl/mp	80.4	0.0	
		c2- 10 pl/mp	82.1	1.7	
		c3- 25 pl/mp	80.7	0.3	
	b_4– BIOENNE	c1- 15 pl/mp	72.6	0.0	
		c2- 10 pl/mp	77.5	4.9	
		c3- 25 pl/mp	81.5	8.9	**
		DL 5%	6.0 kg/hl		
		DL 1%	8.0 kg/hl		
		DL 0,1%	10.4 kg/hl		

Source: Authors' data.

CONCLUSIONS

The three-way interaction between population, biostimulator, and density significantly influenced production. Thus, the Prahova population showed statistically significant production increases at a density of 25 pl/mp when treated with the biostimulators BioHumusSol and Bioenne.

The Secuieni population was more productive at densities of 10 pl/mp and 25 pl/mp, both untreated and treated with BioHumusSol and Bio enne. Density and biostimulator had very little influence on the Iași population. The Dacia Plant population was the only one to react significantly to Cropmax treatment when seeded at a density of 25 pl/mp. Production increases with statistical assurance were also observed with the other two biostimulators: BioHumusSol and Bio enne, but at different densities. The Brașov population showed production increases when treated with Bio enne at both tested densities, compared to the recommended density.

The three-way interaction of population x biostimulator x density had a significant influence on the diameter of the capitulum, although to a lesser extent on the Iași and Dacia Plant populations.

The analysis of the variability of the weight of 1,000 achenes using the boxplot method allowed the identification of two outliers, namely: the Dacia Plant population treated with Bio enne and seeded at 10 pl/mp, and the untreated Secuieni population seeded at 10 pl/mp. The latter interaction shows that the Secuieni population, when seeded sparsely, develops larger seeds, with the biostimulator not playing a stimulating role.

The trifactorial interaction between population, biostimulator, and density influenced the hectoliter weight to a greater or lesser extent. Thus, the populations of Prahova and Secuieni showed statistically significant increases at the densities of 10 pl/mp and 25 pl/mp when treated with Cropmax. Density and biostimulator had a minor influence on the hectoliter weight of the Iași population. The same was observed for the Dacia Plant population. The Brașov population recorded an increase in hectoliter weight when treated with Bio enne at the density of 25 pl/mp compared to the recommended density.

The analysis of variability through the boxplot method identified two outliers (variants that significantly deviate from the cluster of determinations): the Prahova population treated with Bio enne and seeded at 25 pl/mp, and the Dacia Plant population treated with Bio enne and seeded at 10 pl/mp.

These two variants represent technological recommendations for cultivating milk thistle under the pedoclimatic conditions in which the experiment was conducted.

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FUNDING OPPORTUNITIES FOR SMART VILLAGE PROJECTS THROUGH THE LEADER INTERVENTION

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Abstract

Rural communities face problems related to depopulation, lack of jobs, weak digital infrastructure, decline of basic public services. LEADER is an initiative to support rural communities, which takes shape in a Local Development Strategy with a role in using local resources in a way that meets the needs identified in the territory. The support of projects for smart villages must be encouraged through local development strategies that pursue various fields: reducing the depopulation of villages, providing quality services, developing local services, promoting digitization. The paper proposes the role that the LEADER intervention belonging to the Strategic Plan, which is one of the instruments of the European Union, can contribute to supporting these rural development projects, which can represent local initiatives and which can benefit from funding sources that will contribute to the identification of strategies and future solutions to promote smart villages. The information used in the work was collected, processed and interpreted starting from data belonging to the Bureau for the Financing of Rural Investments, along with insights from the Ministry of Agriculture and Rural Development, converge in a rich tapestry of thought at the paper's conclusion. Here, they weave forward-thinking strategies for the cultivation of smart villages, which are envisioned as vibrant oases capable of elevating the quality of life for rural dwellers. These innovative settlements promise to champion the cause of sustainable rural development, casting a verdant future where community and sustainability flourish side by side.

Key words: *LEADER, local development strategy, rural development, smart village, rural communities*

INTRODUCTION

A crucial prerequisite for nurturing rural regions is the enhancement of the inhabitants' quality of life within these pastoral landscapes. Rooted in a thorough analysis of the necessities discerned within the LEADER rural territories, the community uncovers streams of financing, channelling these resources to elevate and enrich the living standards of its people, thereby sowing seeds for a more prosperous future. How communities will intelligently use local resources and new technologies presents an ongoing challenge that they must learn to manage.

The previous reference to the LEADER area refers to the territory made up of territorial administrative units - municipalities and territorial administrative units -small towns with a maximum population of 20,000 inhabitants.

PNDR are programs that support both the economic development and the social development of rural areas, making non-refundable funds available to those interested. These projects began to be financed in 2007, with Romania's entry into the EU, their purpose being to promote the economic and social growth of poor rural areas in Romania, but also to attract young people to these areas (by offering support financially in the conditions of the manifestation of their migration to the urban environment). At the same time, the financing sources encouraged the development of some businesses in the rural environment, they encouraged the increase in the employment rate [10].

Among the vital tools at the community's disposal, one stands out for its pivotal role in championing projects nestled within the realm of rural development, blossoming at the grassroots level, is "Liaison Entre Actions de Développement de l'Economie Rurale", i.e. "Links between economic development actions rural", whose acronym is LEADER and which was the basis for the establishment of Local Action Groups (GAL). Those entities operate under the same category of legislation that also includes non-governmental organizations, but operating at the local community level.

LEADER/DLRC [4] is a program implemented as a result of the application of the local development strategy, which is led by a community (DLRC) and which is based on certain specific characteristics. These characteristics were known in the previous programming period as the LEADER method" or "the 7 LEADER principles" (page 10 from “Guidelines: Evaluation of LEADER/CLLD”) [4].

For the 2014-2020 programming period, a European policy instrument was established with a role in the development and promotion of cohesion at the territorial level, this being called the Responsibility for Local Development (DLRC), with a role in covering local needs belonging to both urban areas and and the rural ones, but also the fishing areas. At the same time, financial support was given to specific target groups, the aim being to mobilize local capacities, but also to strengthen the links established between the different actors belonging to the areas that are given support. In general, the DLRC contributes to supporting the Europe 2020 strategy, this is achieved by capitalizing on that growth potential that is both intelligent and sustainable, but especially favorable to inclusion within the European Union.

DLRC planning is done both within the Partnership Agreement, but also through relevant, national and regional programs, supported through ESI funds. In this way, the DLRC fulfils the role of combining local policies, resulting in a single strategy that leads to obtaining results that contribute to the achievement of wider EU objectives, and not just a single policy.

In the period 2023-2027, the Strategic Plan (SP) will continue to support the economic and social development of rural areas, this effort was also found in the other categories of programs that aimed at rural development, and that took place in the 2007-2013, and then 2014-2020 programming periods. The "Smart Villages" concept becomes a pillar in the development of the LEADER intervention described in the Strategic Plan, growing from the Local Development Strategies' seeds as well, as it is the most capable of sustaining this idea and entails the creation of projects that seek to capitalize on knowledge belonging to members of local communities and seeking solutions through the use of technology and innovation with visions of curbing depopulation and overcoming demographic challenges, the endeavor seeks to enhance the quality of local health services and fortify the safety of its citizens. Simultaneously, it embraces the transformative shift towards a circular economy, weaving sustainability into the very fabric of community life, in which reduced emissions of carbon to have an important role, as well as social/administrative/educational digitization, etc. (RO CAP SP, DR-36 LEADER/CLLD, page 1043). Therefore, this new program pursues different digitization activities (both social, administrative and educational) to be carried out at the level of a territory that is covered by the LAG, and which are innovative, which support the villages, and which, at this moment are authorized at the MADR level. For the 2014-2020 programming period, a tapestry of 237 Local Action Groups (LAGs) orchestrates the Local Development Strategies (LDS), channeling a collective bounty of 707.1 million euros derived from the National Program of Rural Development. These groups are the custodians of the Development Strategy’s vision, now in its second epoch of programming, crafting a roadmap of activities scheduled to unfold through 2025. Rewinding to the 2007-2013 programming period, 163 Local Action Groups were empowered, their strategic implementations casting a net over 63% of the eligible territory, weaving the threads of local development across the landscape (municipalities and cities with a maximum population of 20,000 inhabitants)

[6], in the 2014-2020 programming, 237 Local Action Groups were authorized and total coverage of the eligible territory was over 92% [7] (Fig. 1).

For the 2023-2027 programming period, we expect to see an increase of the number of Local Action Groups, over 245, as well as 98% coverage of the eligible territory [8].

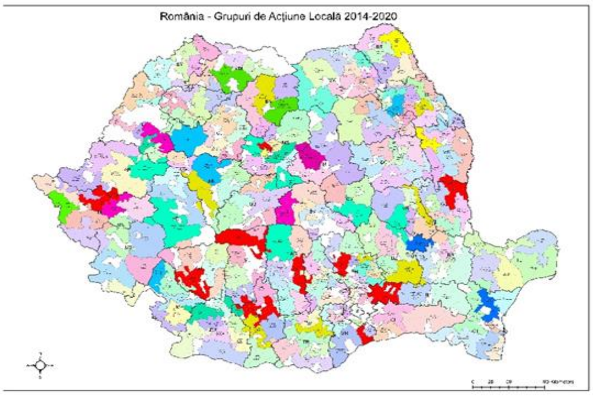

Fig. 1. LEADER area during 2014-2020
Source: MADR, https://madr.ro/axa-leader/leader-2014-2020.html, Accessed on Jan. 5, 2024 [5].

The LEADER tool presents itself as a tool and a source of funding for future strategies and solutions for smart villages. One of the most important characteristics of Smart Villages is innovation. Innovation is caused by the need and desire to change something or to address a particular challenge, continuously keeping in mind the local circumstances.

Similar to Romania, many rural areas in Europe face problems such as youth exodus, lack of appealing job prospects, a shortage of skilled workers, and insufficient funding for infrastructure and basic services. .

In the year 2017, under the auspices of the European Parliament and the European Commission, the European Union unfurled the Action Plan for the development of smart villages, marking a pivotal chapter in the narrative of rural modernization. The following year, amidst the picturesque backdrop of Bled in Slovenia, a declaration was signed, heralding a visionary future for the rural expanses of the European Union—an oath to an intelligent, prosperous era for its quaint hamlets and sweeping countryside.

Phil Hogan, the European Commissioner for Agriculture and Rural Development, paints a picture of "smart villages" not just as technological hubs but as heartlands of human endeavor. He describes them as communities where the spirit of initiation thrives, where rural denizens forge paths through innovative problem-solving and seize burgeoning opportunities. The essence of a smart village extends beyond mere digital enhancements; it embodies collaborative spirits and the birth of novel alliances, all while nurturing an independent mindset and carving paths toward both prosperity and ecological harmony.

The Smart Rural 27 project is another initiative taken at the level of the European Union, its launch date being December 2020, its purpose being to ensure the necessary conditions for the implementation of the PAC regarding rural areas in the member states after 2020, but also for the identification of solutions that can be found in policies or initiatives that lead to the emergence of new smart villages at the community level. "Smart" measures and solutions have been identified through various projects, some of these approaches being Pilot Smart Eco-social Villages and Smart Rural Project 21 [3].This project serves as a crucible for understanding and disseminating Smart Village strategies across various Member States. It facilitates a rich exchange of insights via the European Smart Villages Pilot Observatory and strengthens the infrastructure needed to support these burgeoning communities.

As the narrative shifts from European dimensions to national narratives, the focus zooms into Romania's experience within its National Rural Development Program for 2014-2020, extending into the monitoring period until 2025. Notably, Romania has not officially adopted the "smart village" terminology within this timeframe, focusing instead on digitization, information technology, IT services, and innovation—components integral to the smart village construct.

At the level of Romania, the Smart Village concept was also adopted, which represents a means of modernizing villages through the use of modern, extensive and efficient means of information and communication technology, which can contribute to the social and economic development of them.

This vision for the future promises to elevate living standards across rural landscapes swiftly.

However, this bright future is clouded by a significant challenge—the digital skill level of the population. This gap places Romania at the rear of EU member states in a EUROSTAT survey measuring digital proficiency from 2021 onwards, highlighting a critical area for improvement in the journey toward truly smart villages.

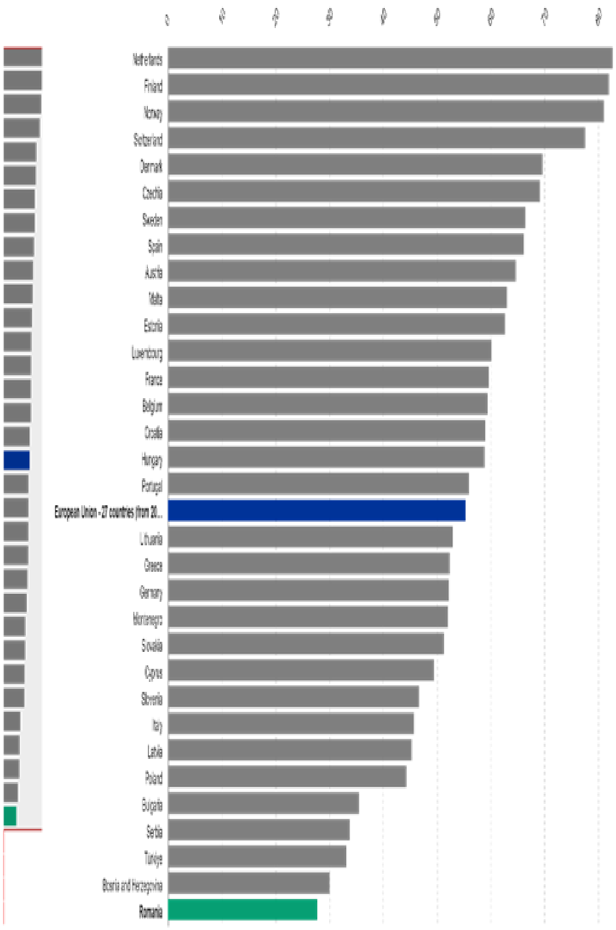

Fig. 2. Individuals' level of digital skills (from 2021 onwards)
Source: Eurostat, isoc_sk_dskl_i21, Accessed on Jan 5, 2024 [12].

Instead, from another EUROSTAT ranking, we can view e-government activities of individuals through websites, reporting related to the year 2023 (Fig. 3).

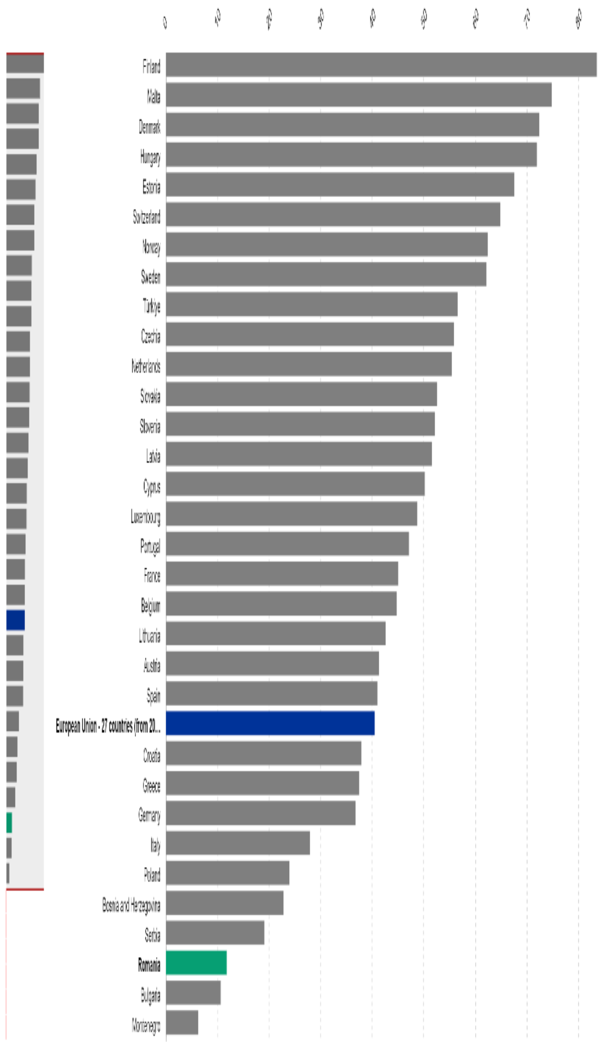

Fig. 3. E-government activities of individuals via websites
Source: Eurostat [12].

MATERIALS AND METHODS

In order to present the stage of implementation of the LEADER instrument in Romania in terms of information technology, digitization services, e-governance, we started from an analysis of the projects at the LEADER rural area level, by presenting the type of projects that were financed in period 2014 – 2020, the number of beneficiaries of these projects, the value of the contracts and their impact on the rural population.

We will see from the graphs presented, projects that use information technology, projects that by their essence represent the first step towards the smart village concept. Thus, we are talking about a Romanian digital rural society that is becoming closer and closer to reality.

The article was based on research methods and techniques, respectively: the identification and collection of specific data, their analysis, synthesis, interpretation. The information is presented below in graphical and tabular form. The information analyzed and used in the paper was taken from the websites of institutions with a role in the elaboration, management, implementation and control of rural development programs in Romania, namely: the Governing Authority for the National Rural Development Program, operating under the Ministry of Agriculture and Rural Development; Office for the Financing of Rural Investments [1].

Furthermore, a key role involved the analysis and processing of information from the European Commission website (Figs. 2 and 3) as mentioned earlier.

RESULTS AND DISCUSSIONS

Understanding the strategic concerns of the European Union regarding the development of rural areas, follows the same directions as those related to the policies related to the agricultural development of these areas. These priorities fulfill the specific strategic objectives of the Europe 2020 strategy, which seeks to ensure aspects related to affordability, social inclusion, and the provision of opportunities for a safe future not only for the current generations, but also for those that will follow. Regulation 1305/2013 of the EU, followed the application of the measures for the future period as well, placing even more emphasis on the revitalization of rural landscapes, as a measure to attract young people to these areas, and ensuring sources of funding through FEADR. This regulation came to gradually replace the previous decrees that belonged to Regulation 1698/2005 belonging to the Council, ushering in a fresh epoch of rural flourishing.

The priorities unfurl like chapters in a grand rural manifesto: Priority 1 celebrates the cultivation of knowledge and the sprouting of innovation across the verdant fields of agriculture, forestry, and rural domains. Priority 2 promotes farm resilience by working to increase agricultural competitiveness and encourage innovative farming and forestry methods in all areas. . Priority 3 focuses on fortifying the food chain, enhancing everything from the processing and marketing of farm yields to the welfare of animals and the management of agricultural risks.

Further into the heart of the landscape, Priority 4 is dedicated to the restoration, preservation, and enhancement of ecosystems entwined with agriculture and forestry, ensuring they thrive and sustain. Priority 5 advocates for prudent resource use and supports a shift toward the agriculture, food, and forestry industries' transition to a low-carbon, climate-resilient economy. Finally, Priority 6 commits to knitting the social fabric tighter, alleviating poverty, and propelling economic propulsion in rural territories.

Together, these priorities sketch a vision of rural Europe as a tapestry of lush landscapes and thriving communities, where tradition meets innovation on the fertile ground of future possibilities.

Priority 6 emerges as a pivotal chapter in the narrative of local development strategies, painting a broad canvas with the following vibrant strokes: intervention area 6A weaves a tale of diversification, heralding the birth and growth of small enterprises, alongside the blossoming of new employment opportunities; intervention area 6B champions the flourishing of local development within the heart of rural communities; intervention area 6C crafts a digital renaissance, enhancing the reach, usage, and sophistication of information and communication technologies (ICT) across rustic landscapes.

The efficacy of each carefully chosen rural development initiative is quantified through monitoring indicators, each meticulously aligned with its designated intervention area, ensuring that each stroke of policy paints towards a cohesive and vibrant rural tableau.

In principle, the LEADER approach is focused on intervention area 6B "Encouraging local development in rural areas".

In the following paragraphs, we will see the projects financed by the LEADER tool, which are based on intervention areas 6 B and 6 C.

Rural development priorities are included in local development strategies based on strengths, weaknesses, opportunities and threats ("SWOT analysis")

The LEADER instrument's deployment in Romania has produced notable outcomes in a number of rural areas and will continue to be crucial in helping the rural environment adjust to the rapidly changing modern world. . Its specific "bottom-up" approach represents a method that offers new perspectives for rural development, based on the identification of local needs, the improvement of development capacity, and the implementation of local development strategies, to preserve the cultural and rural heritage, to develop the economic environment and improve the organizational skills of local communities.

By determining future growth directions and defining the characteristics of the local economy, the public administration at the local level contributes significantly to the economic development of the rural community.

Local authorities have the responsibility to manage the human, financial, material, and informational resources needed to support local or regional entrepreneurship.

As can be seen from the table below, a number of 358 territorial administrative units, that have benefited from funding through the LEADER instrument, the projects benefiting from funding with a value of 14,249,228.86 euros, the total eligible value contracted.

One of the monitoring indicators specific to LEADER tool is the population that benefited from these services and improved infrastructure which is 1,031,245 and the population that benefited from Information and Communication Technology services (ICT) which is 94,436.

Table 1. The number and value of financed and contracted project

Territorial administrative units/Project financed And contracted	Total eligible value contracted (EURO)	The population that benefits from improved services/infrastructures (intervention area 6B)	The number of inhabitants who benefited from ICT services (intervention area 6C)
358	14,249,228.86	1,031,245.00	94,436

Source: MADR monitoring, data processed by the authors.

The information presented below is outlined as a conclusion of the progress registered in the period 2014-2020 at the level of the LEADER area, through the implementation of projects financed at the level of UAT, in areas such as: modernization and efficiency of public services; the acquisition and implementation of an internal/managerial control system (SCI/M), accessible through a WEB platform and by equipping it with IT equipment and software packages, the acquisition of IT equipment necessary for digital literacy to improve the quality of life of the inhabitants; digital literacy of the inhabitants of the Moldovan commune through the purchase of IT equipment; improving the public lighting system and reducing CO2 emissions, by installing street lighting devices with new LED technologies; public street lighting network with photovoltaic panels; acquisition and/or extension of video surveillance system; e-government solutions for improving public services, etc. We made an analysis taking into account the monitoring data relevant to the intervention field 6C: which refers both to improving the quality and accessibility and use of ICT in rural areas. As it results from the analysis carried out based on the data in Table 2, each of the development strategies adopted at the local level must refer to the population that benefited from these ICT services, at the level of each administrative-territorial unit (Table 2).

Table 2. Population that benefited from Information and Communication Technology services (ICT)

The number of inhabitants who benefited from ICT services	Number of projects	The total eligible value contracted
94,436	28	712,891.78 EURO

Source: MADR monitoring, data processed by the authors.

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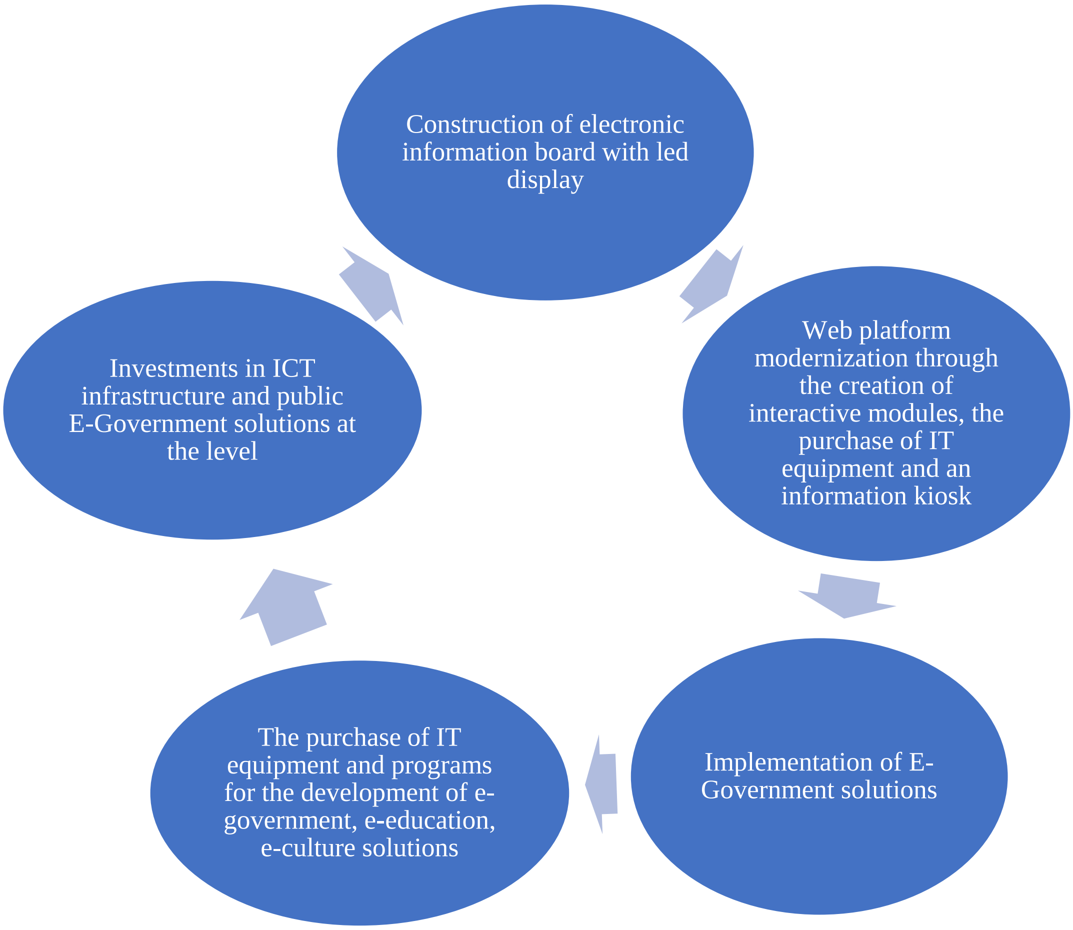

Fig. 3. The typology of ICT projects
Source: MADR monitoring, data processed by the authors.

Even if the number of projects is not very large in the field of information technology, 29 territorial administrative units wanted to become SMART through the new digitization services and technologies introduced. I will exemplify these types of project, even if they are also presented in the graph.

Even if the type of projects is not varied, we can note that an important role is played by investments representing the rehabilitation and efficiency of the street lighting system, through the installation of LED lighting devices.

For the most part, the projects aim at the acquisition and/or expansion of the video surveillance system, IT equipment.

Only a little number of the initiatives dealt with putting the e-governance and e-administration system into place.

CONCLUSIONS

Romanian rural communities can now be comparable with those in Europe thanks to the new strategic plan's approval of the smart village concept and its implementation in the country's rural areas.
The third programming period can be considered a SMART programming, by introducing the concept of SMART VILLAGE and by implementing SMART VILLAGE type projects that will surely change the life of the rural population.
From the analysis, it's evident that the challenges confronting the Romanian village are multifaceted, spanning social, educational, economic, and environmental spheres. The village's resilience hinges on leveraging community strengths and opportunities while also depending on the active participation of local authorities

Employing nuanced research methodologies, the rise of smart villages within Romania's rural landscapes is poised to significantly influence the socio-economic fabric of these communities. The introduction of smart technologies and innovative practices promises to transform the day-to-day lives of rural inhabitants, offering them new pathways to prosperity and enhanced community well-being. This development could potentially redefine rural life, making it more connected, sustainable, and responsive to both local and global challenges.

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RESEARCH ON THE IMPACT OF THE HOSTILITIES IN UKRAINE ON TOURISM IN THE DANUBE DELTA

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Abstract

The purpose of the paper was to study the tourism in the Danube Delta and to evaluate the impact of the hostilities in Ukraine on tourist flows and other aspects. The study was carried out between February 15 and March 15 2024, by applying a questionnaire with 6 questions, on site and during the Romanian Tourism Fair (February 15-18). The questions in the questionnaire addressed how the tourism structures in the Danube Delta have been affected by the hostilities in the neighborhood and whether they were helped by the central and local public authorities. Representatives of 178 accommodation units, totaling 3,080 accommodation places, as well as representatives of some public institutions and NGOs answered the questionnaire. It was tried to find out exact data from all areas of the Danube Delta, so the authors went to the representative localities from a tourist point of view: C.A. Rosetti, Letea, Periprava, Chilia Veche, Crisan, Mila 23, Jurilovca, Maliuc, Murighiol, Sfântu Gheorghe and Sulina. The conclusions pointed out a deep decline in the number of tourists in the Danube Delta in the year 2023, by 42% compared to 2022.

Key words: *tourist flow, accommodation, the Danube Delta, hostilities in the neighborhood, Romania*

INTRODUCTION

At the end of a road that exceeds 2,840 km collecting the waters of an impressive hydrographic basin whose surface covers more than 8% of the surface of Europe, the Danube, the second largest river of the old continent, builds at its meeting with the Black Sea, from more than 16,000 years, one of the most beautiful deltas in Europe and even in the world, also known as one of the great wetlands of the planet [1]. The oldest branch of the Danube, the Sf. Gheorghe branch, flowed into the sea through a passage located at the southern end of the Letea-Caraorman ridge, developing the first Danube delta: the Sf. Gheorghe I Delta (Buianu, V., 2001) [3]. The second arm of the Danube, Sulina, developed with the blocking by alluvium of the Sf. Gheorghe arm (Wikipedia) [12, 19].
The Sulina Arm took over an ever-increasing flow of sediments and began to form its own deltaic edifice: the Sulina Delta [2].
At the same time, a small secondary delta, the Cosnei Delta, was formed in the southern part of the area due to the Dunavat secondary arm. The Sulina Delta was gradually eroded, while the Chilia arm, to the north and Sf. Gheorghe, to the south built their own deltas: the Chilia Delta and the Sf. Gheorghe II Delta [4].
The Black Sea, which created the conditions for a strong alluvium resulting in meanderings and ramifications of the main branches [10].
Currently, the total area of the Danube Delta Biosphere Reserve is 5,820 km^2, of which:
– 3,520 km^2 Delta proper – the Romanian sector, [6].
– 1,245 km^2 Razim – Sinoie lake complex,

– 1,130 km^2 Marine waters up to the 20 m isobath, [15].
– 14 km^2 Danube bed between Cotul Pisicii and Isaccea (on Romanian territory) and
– 103 km^2 floodplain of the Danube between Isaccea and Tulcea.

According to specialized literature [7], the Danube Delta represents the territory between the first bifurcation of the Danube (Ceatalul Chiliei), bordered to the east by the Black Sea coast, to the north by the Chilia arm and to the south by the Razim Sinoie lake complex [11].

The Danube Delta itself is the largest component of the reserve and has a total area of about 4,178 km^2, of which the largest part is found on the territory of Romania, i.e. 3,510 km^2, representing about 82%, the rest being located on the left side of the Chilia arm, including its secondary delta, in Ukraine [18].

The climate of the Danube Delta belongs to the temperate-continental climate with Pontic influences [14].

The thermal regime (air temperature) has moderate values with a slight increase from west to east [5].

The large amount of heat is given by the average annual duration of sunshine which is of approx. 2,300-2,500 hours, and the annual global solar radiation amounts to 125-135 kcal/cm^2, being among the highest in the country [9].

Biodiversity in the RBDD is represented by a number of 7,280 species of which:
FLORA – 2,994 species of flora
FAUNA – 4,286 species of fauna.

RBDD remains, however, the most famous for its ornithological fauna, with a total of 365 species recorded.

The 365 bird species include:
• most of the European population of common pelican (*Pelecanus onocrotalus*) and curly pelican (*Pelecanus crispus*);
• 60% of the world population of little cormorant *(Phalacrocorax pygmaeus*)
• 50% of the world population of the red-necked goose (*Branta ruficollis*) (during the winter).

97% of bird species existing in the RBDD are protected by the Bern Convention.

Mammals are represented by 51 species.

Ecosystems in RBDD: 30 types of ecosystems are found in the RBDD (23 natural and 7 anthropogenic) (Table 1).

Table 1. Ecosystems from the Danube Delta

1	The Danube and its arms
2	Channels with active water circulation
3	Channels in natural areas with free water circulation
4	Channels within polders with controlled/absent water exchange
5	Lakes with extensive water bodies or active water exchange
6	Lakes with low water exchange, partially covered with vegetation
7	Lakes inside the facilities, with controlled water exchange
8	Isolated lakes
9	Lagoons connected to the sea
10	Partially enclosed bays
11	Coastal marine lakes with low water exchange and salt concentrations
12	Wet areas covered with reeds
13	Plaur formations inside depression areas and around lakes
14	Willows flutter in the mix on beams and islands
15	Meadows on fluvial banks, frequently flooded
16	Mixed oak forests on high maritime ridges
17	Grassy vegetation mixed with shrubs on calcareous rocks
18	Meadows on pretzel fields
19	Steppe meadows, degraded, on predeltaic erosion witnesses
20	Meadows on low sea beds
21	Mobile and partially mobile sand dunes covered with vegetation
22	Little consolidated littoral cordons
23	Beaches
24	Agricultural facilities
25	Forestry arrangements
26	Poplar plantations along flowing waters
27	Fish facilities
28	Complex layouts
29	Polder in ecological reconstruction
30	Human settlement

Source: Own contribution.

The fish fauna of the RBDD has a remarkable variety, comprising 135 species (which represents about 75-80% of Romania's ichthyofauna). Most of them are freshwater species, but there are also marine species as well as species that live in the Black Sea and enter the Delta and the Danube during the breeding season [8]. Approximately one third of the species have been and are exploited economically.

In the period of the Covid-19 pandemic, tourism in the Danube Delta like in other destinations declined [13].

The farmers who practice agriculture, which is mainly organic in the Danube Delta, have also been affected by climate change, the decline in the number of tourists, the pandemic and the hostilities in the neighborhood [16].

In the last years, rural tourism, agrotourism and ecotourism suffered during the pandemic and also due to the hostilities in the proximity [17].

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In this context, this study tried to quantify in what measure tourism in the Danube Delta was affected by the hostilities in the neighborhood in the period 15 February and 15 March 2024 by interviewing based on questionnaires the representatives dealing with tourism in the main localities situated in the geographical area.

MATERIALS AND METHODS

The study was carried out between February 15 and March 15 2024, by applying a questionnaire with 6 questions, on site and during the Romanian Tourism Fair (February 15-18). The questions in the questionnaire addressed how the tourism structures in the Danube Delta were affected by the hostilities in the proximity and whether they were helped by the central and local public authorities.
The 4 questions refer to the forecasts for the tourist year 2024.
The 5 questions refer to: what measures do you intend to take considering attracting tourists in the current context? The last, questions refer to: what methods of promotion do you consider for business recovery?
The questions are presented in Table 2.

Table 2. The questions in the questionnaire

1	How your business in the year 2023 was affected by the hostilities in the neighboring country Ukraine?
2	Have you received financial compensation from the government for losses suffered in the context of events in Ukraine?
3	Have you received financial compensation from local authorities for losses suffered in the context of events in Ukraine?
4	To what percentage do you think that the tourism situation in the Danube Delta will recover in 2024?
5	What measures do you intend to take considering attracting tourists in the current context?
6	What methods of promotion do you consider for business recovery?

Source: Own contribution.

Representatives of 178 accommodation units, totalling 3,080 accommodation places, as well as representatives of some public institutions and NGOs answered the questionnaire.
We tried to find out exact data from all areas of the Danube Delta, so we went to the representative localities from a tourist point of view: C.A. Rosetti, Letea, Periprava, Chilia veche, Crisan, Mila 23, Jurilovca, Maliuc, Murighiol, Sfântu Gheorghe and Sulina (Table 3).

Table 3. The Location

Location	Accommodation structures studied	Number of related accommodation places
C.A. Rrosetti	3	52
Chilia veche	14	154
Crișan	28	586
Letea	2	16
Jurilovca	15	250
Maliuc	12	210
Mila 23	20	376
Murighiol	18	280
Periprava	3	20
Sfântu gheorghe	30	526
Sulina	34	610
TOTAL	**178**	**3,080**

Source: Own contribution.

RESULTS AND DISCUSSIONS

The percentages obtained from the questionnaire are worrying.
Compared to 2022, in 2023, tourism in the Danube Delta was severely affected due to the conflict situation in the proximity (Table 4). The percentage for the whole area is 42%.

Table 4. The percentage for the whole area

Location	How affected was your business in 2023 due to the conflict in the neighbour country Ukraine?
C.A. Rosetti	65%
Chilia veche	67%
Crișan	40%
Letea	35%
Jurilovca	15%
Maliuc	25%
Mila 23	30%
Murighiol	18%
Periprava	82%
Sfântu Gheorghe	28%
Sulina	54%
Total	**42%**

Source: Own contribution.

Tourism in the area was substantially affected, because tourists are afraid to travel in destinations which could be touched by accident by the army conflicts, like Chilia Veche, C.A. Rosetti and Periprava, and also Sulina, which is a port at the Black Sea.
After a period of total panic, the situation was improved and towards the end of summer the tourists returned for the beach.
The other localities studied were less affected because they are further away from the critical areas.
Regarding the financial compensation from the Government or local authorities, tourism

entrepreneurs said that the government did not offer any help. Only a few local councils have supported landlords by deferring or reducing local taxes (Table 5).

Table 5. Financial compensation

Location	**Have you received financial compensation from the government for losses suffered in the context of events in Ukraine?**	**Have you received financial compensation from local authorities for losses suffered in the context of events in Ukraine?**
C.A. Rosetti	0%	10%
Chilia veche	0%	10%
Crișan	0%	10%
Letea	0%	10%
Jurilovca	0%	0%
Maliuc	0%	0%
Mila 23	0%	10%
Murighiol	0%	0%
Periprava	0%	10%
Sfântu Gheorghe	0%	0%
Sulina	0%	10%
Total	**0%**	**6%**

Source: Own contribution.

For the year 2024, tourism entrepreneurs are more optimistic, with 72% stating that the situation in local tourism will recover, either by the fact that tourists have become accustomed to this situation, or by the end of the conflict (Table 6).

Table 6. Forecasts for the tourist year 2024

LOCATION	Do you think that the tourism situation in the Danube Delta will recover in 2024?
C.A. Rosetti	63%
Chilia veche	67%
Crișan	82%
Letea	72%
Jurilovca	95%
Maliuc	82%
Mila 23	80%
Murighiol	78%
Periprava	53%
Sfântu Gheorghe	63%
Sulina	74%
TOTAL	**72%**
Source: Own contribution	

To the question: what measures do you intend to take in order to attract tourists in the current context, the owners of tourism structures answered:

-Online promotion
-Better collaboration with the destination management organization
-Price reduction
-Offering bonuses
-Improving the quality of services
-Providing circuits in safe areas

When asked what promotion methods you have in mind for business recovery, the owners of tourism structures answered:

-Online promotion
-Participation in national and international tourism fairs
-Promotion through influencers
-Promotion of the Danube Delta in the university environment.

Intelligent technologies are slowly making their way into many industries that want to be competitive in a changing world. The tourism industry is also experiencing all the adoption and adaptation of Artificial Intelligence in its various forms, from natural language processing (NLP), spoken to written and written to spoken, machine learning and more. The automation of business processes through the use of applications designed to help business, from Enterprise Resource Planning (ERP) systems - in this case SAP (Systems, Applications and Products in Data Processing) to applications using AI in its various forms are welcome in this industry – tourism.

The application presented in this paper aims to retrieve information from a customer, in the form of voice, transform it into text, interpret this text using AI - NLP branch, upload the request into an ERP - SAP system (creation of initial request, creation of master data: customer, supplier, holiday ticket, stay, relations with other service providers, etc.). Once the request has been validated, the relationship between the organisational structure (travel company), the master data and the actual creation of the document flow required for a service provided by the company where this IT system is installed is started. With the help of the app - installed on smart devices (smart phone, tablet or desktop), each person has the right to register as a customer and be able to see (on the company's website) what offers are available, then if they decide, they can order what they want for their desired stay. Finally, the application creates all the legal documents (including accounting, marketing, logistics, etc.) required for the stay ordered by the client and will send all the necessary and useful data.

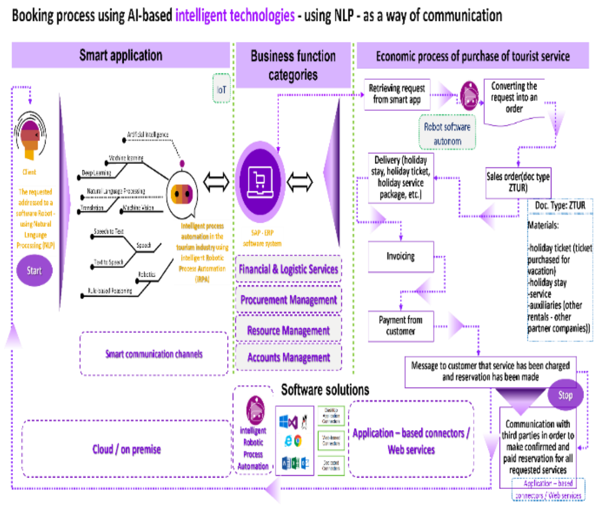

Fig. 1. Booking process using AI-based Intelligent Technologies, using NLP as a way of communication
Source: Own contribution.

Figure 1 shoes that through this application the management of the travel company's business is much easier, all the situations are in real time, the possibility of making a mistake is very small - a series of software robots are used that take at any time holiday requests (non-stop), services related to the purchased stay, online booking, practically there is no impediment that a request is not processed in a very short time, from the moment it is taken.

CONCLUSIONS

The critical situation in Ukraine reduced the pace of economic growth and significantly boosted inflation in Europe.
The National Bank of Switzerland warns that negative effects will follow. Since February 2022, Europe has faced an explosion in energy prices, turbulence in financial markets and a sharp contraction of the economies of the two countries in the conflict.
After examining the impact of this situation on the economies of Germany, Britain, France, Italy and Switzerland, the authors of this study concluded that economic activity would have been 0.1% to 0.7% higher in the fourth quarter of 2022 if the situation in the proximity was not like this.
This study proved that during the last years, more exactly, starting since February 2022, the economies were affected not only the pandemic, but also by the conflict existing between various countries, among which the hostilities in Ukraine are the most relevant in the Eastern Europe.
Discussing about the tourism in the Danube Delta, it resulted that in the last years it was seen a decline due to tourists fear to travel to spend their vacations as they prefer a safe destination where to spend their vacations.
The interviewed entrepreneurs had financial difficulties which could not be covered by aids from the Government, except a few situations when the local authorities reduced or exempted the payment of taxes.
However, they look to be optimistic and for attracting tourists they developed a strategy which include various stimulating measures like: a better online promotion, a closer collaboration with the destination management organization, a price discount, bonuses, tours in safe places, participation with offers at tourism fairs, promotion through influencers etc.
The use of the tools of the new AI in social media will strengthen tourism in the Danube Delta for sure.

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EMBRACING THE CIRCULAR ECONOMY: A PARADIGM SHIFT FOR SUSTAINABLE PROSPERITY

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Abstract

The study aimed to set up a review of the scientific literature concerning the circular economy, called to become a viable alternative to the linear "take-make-dispose" approach and assure sustainability. It synthesizes, in a logical order, the main aspects regarding the circular economy versus linear economy and has a critical approach comparatively pointing out the benefits and restrains. The two economic models are illustrated in schemas in such a way to clearly distinguish the difference in their objectives, principles and benefits. Also, the study presents the key policies and initiatives of the circular economy, highlighting the EU's commitment and the metrics for measuring the circularity. Regarding the circular agriculture, it is emphasized the efficiency in resource use, recycling, and waste reduction, closed nutrient loops, biodiversity conservation, climate change mitigation, food production and consumption, and the creation of economic value. Circular agriculture practices such as agroforestry, crop rotation, composting organic farming, and regenerative agriculture are also presented. Circularity in agriculture should cease to be seen merely as a concept, it should be considered a necessity for building a sustainable and resilient economy of the future.

Key words: *circular economy versus linear model, objectives, good practices in circular agriculture*

INTRODUCTION

The circular economy has been issued as a new economic model adapted to the present reality and has the goal to become an alternative to the traditional linear model of development, nicknamed "take-make-dispose" approach.

The circular economy highlights the importance of the efficiency in using the resources, the need to diminish wastes and to assure the sustainability.

The circular economy means that the use of raw materials, products and resources to be on a long-term and, at the same time, to find solutions to reduce wastes and maximize value. This feature is completely different from the linear economic model which is based on the extracted raw materials, manufactured commodities and waste disposal [45].

The circular economy incorporates new orientations and solutions of development, involving both theoretical economical and environment principles, rethinking the model design, and promoting new good practices with the purpose to develop production and consumption systems which are more sustainable and resilient [46].

Starting from its roots traced back to various historical and contemporary influences, the concept of the circular economy has evolved over time [24] as mentioned below:

Economic Theory*:* The idea of maximizing resource efficiency and minimizing waste has been present in economic thought for centuries. Concepts such as "waste equals food" and "cradle-to-cradle" thinking, which emphasize the cyclical nature of resources, have been discussed by economists like Kenneth Boulding and Nicholas Georgescu-Roegen [23].

Industrial Ecology: In the 1970s, industrial ecologists began exploring the parallels between industrial systems and natural ecosystems. They emphasized the importance of closed-loop systems, where waste from one process becomes a resource for another, mirroring the nutrient cycling found in ecosystems.

Cradle-to-Cradle Design: In the early 2000s, the architect William McDonough and the chemist Michael Braungart popularized the concept of cradle-to-cradle design [42], which sustains those products to be designed in such a way based on raw materials so that later to be continually recycled or biodegraded, without losing quality or value.

Performance Economy**:** In 2006, Walter R. Stahel, often named as the "father of the circular economy," published the book "The Performance Economy," where it is discussed the need to pass from the linear "take-make-dispose" model to a circular economy model, which has to assure the performance in business and the efficient use of resources.

Ellen MacArthur Foundation*:* The Ellen MacArthur Foundation, established in 2010, has significantly promoted the circular economy concept [14, 15].

The combination between research and education, and also the collaboration between businesses and policy, could emphasize the role of circular economy as a solution to global sustainability challenges.

In this context the purpose of the paper is to synthetize the basic ideas spread by the scientific literature in connection to the circular economy emphasizing the sustainability problem strengthen by the innovative perspective considered a viable alternative to the linear "take-make-dispose" approach.

Objectives and good practices in agriculture and also highlighted.

MATERIALS AND METHODS

In order to characterize the circularity of the economy, the paper starts from the Circularity Gap Report set up The Circular Economy Foundation (CEF), a non-profit organization in Brussels. Their approach in assessing the circularity of the economy is a data-driven approach and produces both metrics for circularity and proposes practical solutions.

The period analysed in this study spans from 2018 up to 2023.

The 2018 report established that the world economy was only 9.1% circular, but in 2023 the global circularity fell to 7.2%.

Based on the data provided, the present paper reviewed a number of 30 scientific publications on the topic of circularity in economics and synthetizes the main problems and principles of the transition to circularity in economics [8, 12].

RESULTS AND DISCUSSIONS

1. The take-make-dispose Approach

The take-make-dispose approach, also known as the linear economy, is characterized by a linear flow of materials and resources through the economy, with little emphasis on resource conservation, waste reduction, or sustainability.

This linear model is increasingly recognized as unsustainable in the face of growing environmental challenges and resource constraints, leading to calls for a transition towards more circular and regenerative economic models.

This traditional economic model is characterized by several key features, such as:

Resource Extraction

In the take-make-dispose approach, natural resources are extracted from the environment to meet production needs.

This often involves the depletion of finite resources, such as fossil fuels, minerals, and timber, without considering the long-term implications for resource availability and ecosystem health.

Production

Once resources are extracted, they are used to manufacture products through various production processes. These products may range from consumer goods to industrial equipment and infrastructure. The emphasis is typically on maximizing production efficiency and output to meet consumer demand.

Consumption

In the consumption phase, products are distributed to consumers through retail channels and consumed for their intended purposes.

Consumers purchase goods based on their needs, preferences, and purchasing power, often leading to the accumulation of goods and materials that may ultimately be discarded.

Waste Generation

At the end of their life cycle, products in the linear economy are typically disposed of as waste.

This results in significant waste generation, including both solid waste and pollutants, which can have adverse environmental and health impacts.

Waste management strategies often focus on disposal methods such as landfilling or incineration, rather than prioritizing resource recovery or recycling.

Limited Value Retention

One of the defining characteristics of the take-make-dispose approach is the limited retention of value throughout the product life cycle.

Once products reach the end of their useful life, they lose their economic value and are treated as waste, leading to the inefficient use of resources and economic inefficiencies.

Environmental Degradation

The linear economy is associated with significant environmental degradation, including habitat destruction, pollution, and greenhouse gas emissions.

The extraction of natural resources, energy-intensive production processes, and waste disposal contribute to environmental pressures and negative ecological outcomes.

The linear economy model is schematically illustrated in Fig. 1.

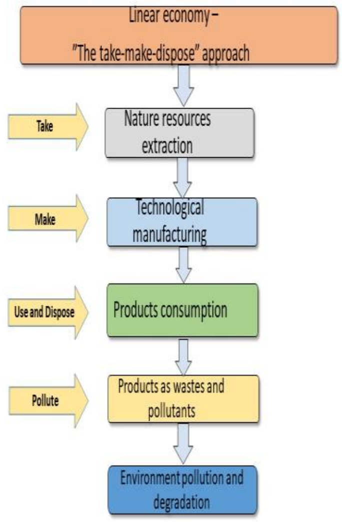

Fig. 1. The linear economy model
Source: Own design.

2.The Circular Economy Model as an Alternative

The circular economy is based on the following main principles as mentioned by [33]:

Products have to be designed eliminating Waste and Pollution: Products should be carefully designed for allowing them to have a long life cycle, also the chance to be recycled and repaired, under the conditions that wastes and pollution to be eliminated. In this way, the circular economy aims tries to minimize the negative impact on the environment along the product life.

Keeping Products and Materials in Use: Instead of discarding products at the end of their life cycle, the circular economy emphasizes reuse, refurbishment, and recycling. This prolongs the lifespan of products and reduces the need for new raw materials.

Key principles and strategies of the circular economy include:

Product Life Extension: Extending the lifespan of products through repair, refurbishment, and remanufacturing.

Resource Recovery and Recycling: Recovering and recycling materials from products at the end of their life cycle to create new products or inputs for manufacturing [36].

Sharing Platforms and Collaborative Consumption: Encouraging shared use of products and resources through platforms such as car-sharing, co-working spaces, and tool libraries.

Product-as-a-Service Models: Shifting from ownership to service-based models where consumers pay for the use of products rather than owning them outright, incentivizing product longevity and resource efficiency.

Industrial Symbiosis: Fostering collaboration among industries to exchange materials, energy, and by-products to reduce waste and maximize resource efficiency [36].

Beneficial impact on Regenerating Natural Systems: According to the principle of the circular economy, natural systems will be regenerated using good practices destined to recover ecosystems, preserve biodiversity, and diminish the negative effects of climate change. This means that land to be used in a sustainable manner so that ecosystems to be restored and energy sources to be renewable.

Therefore, the circular economy represents "a paradigm shift in how we produce, consume, and dispose of goods and resources" as mentioned by [22].

By transitioning to a circular economic model, societies can achieve environmental sustainability, economic resilience, and social well-being while minimizing the negative impacts of resource depletion and waste generation.

The circular economy model is displayed in Fig. 2.

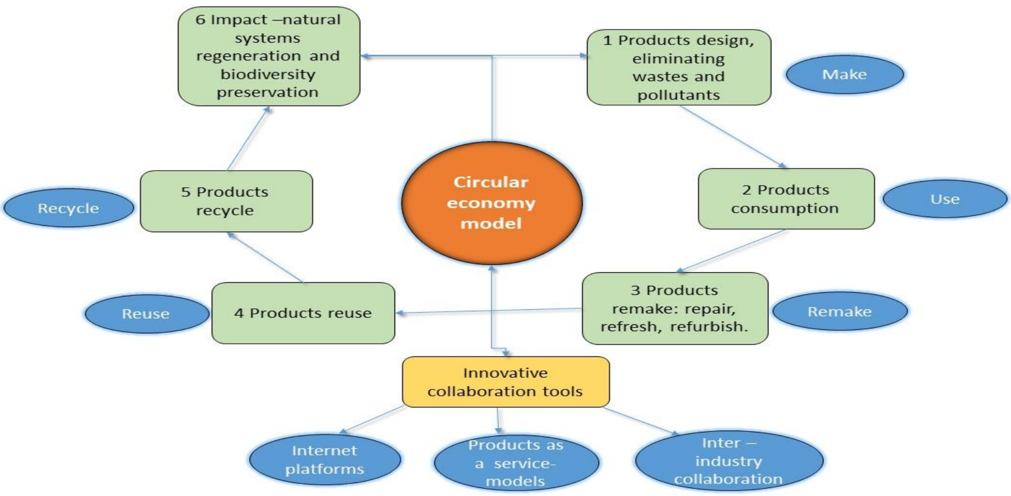

Fig. 2. The circular economy model
Source: Own design.

3. The Circularity Gap Assessment

The Circularity Gap Report is an annual publication that assesses the global progress towards circularity.

It provides insights into the current state of the global economy's circularity, highlighting the gap between the current level of circularity and the level required to achieve sustainability goals.

It draws on data and analysis from various sources to evaluate key indicators of circularity, including material use, waste generation, and resource efficiency [8, 41]. The Circularity Gap Report serves as a valuable tool for policymakers, businesses, researchers, and civil society organizations to understand the current status of circularity globally and identify opportunities for improvement. It contributes to ongoing efforts to promote sustainable consumption and production patterns and address pressing environmental challenges [12].

Key components of the Circularity Gap Report typically include:

Circularity Indicators: The report assesses various indicators of circularity, such as material circularity, waste generation rates, and resource productivity. These indicators help to quantify the extent to which resources are being used efficiently and kept in the economy.

Circularity Gap Analysis: The report identifies the gap between the current level of circularity and the level required to achieve global sustainability goals, such as reducing greenhouse gas emissions, mitigating resource depletion, and minimizing waste generation.

Regional and Sectoral Analysis: The Circularity Gap Report often provides insights into regional and sectoral variations in circularity. It assesses the progress made by different countries, regions, and industries towards adopting circular economy practices.

Policy Recommendations: Based on its analysis, the report offers recommendations for policymakers, businesses, and other stakeholders to accelerate the transition to a circular economy. These recommendations may include policy interventions, business strategies, and investment priorities [47].

4. Metrics development

These metrics provide a comprehensive framework for evaluating progress towards a circular economy, helping businesses, governments, and stakeholders to identify opportunities for improvement and track performance over time [25]. Metrics used to measure circular economy typically focus on several key aspects [41]:

Resource Efficiency: This metric assesses the amount of resources used in production processes compared to the output generated. It includes indicators such as material productivity, energy efficiency, and water usage.

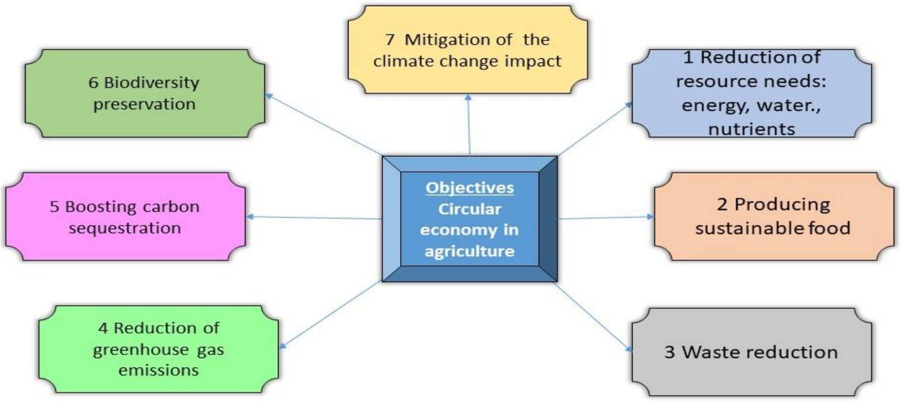

Fig. 3. The objectives of the circular economy
Source: Own design.

Waste Reduction: Measures the amount of waste generated throughout the product lifecycle, including production, consumption, and disposal. This can include metrics like waste diversion rates, recycling rates, and the percentage of materials reused or repurposed.

Product Longevity and Durability: Evaluates the lifespan of products and materials, aiming to prolong their use and reduce the frequency of replacement. Metrics may include product lifespan, repairability, and the percentage of products designed for reuse or refurbishment.

Circular Input-Output Flows: Tracks the circulation of materials, components, and products within the economy, aiming to minimize the extraction of new resources and maximize the utilization of existing ones. Metrics can include the percentage of recycled content in products, remanufacturing rates, and the proportion of materials recovered for reuse.

Value Retention: Measures the ability of products and materials to retain their value over time through reuse, remanufacturing, and recycling processes. This metric can include indicators such as the economic value generated from secondary materials and the percentage of products and materials retained within the economy.

Ecosystem Health: Considers the broader environmental impacts of economic activities, including biodiversity conservation, ecosystem restoration, and carbon emissions reduction. Metrics may include the ecological footprint of production processes, the restoration of natural habitats, and the preservation of biodiversity.

Social and Economic Benefits: The circular economy is destined to strengthen social and economic effects such as: the appearance of new jobs in the labour market, creating and strengthening new initiatives, in the field of innovation and community resilience. the effects will be quantified in terms of: employment in the sector where circular economy is implemented, high investments in research and development, and the benefits repartition in an equitable manner across society [20].

5. EU Policies

The EU makes many actions destined to promote the circular economy, by developing new strategies for implementing modern and effective technologies and circular economy for a sustainable growth as shown the EU's Circular Economy Action Plan [16], the European Green Deal [17], the Shaping Europe's Digital Future [19], the European Digital Strategy [19], and the European Skills Agenda 18, 10].

In general, foundations and organizations dedicated to the circular economy typically work towards advancing the principles of resource efficiency, waste reduction, and sustainability within various sectors of society, including business, government, academia, and civil society. They may engage in activities such as research, advocacy, policy development, education, and collaboration to foster the transition to a circular economy.

Romania has access to EU funding programs that support circular economy projects [6, 44]. These funds can be utilized to implement initiatives aimed at improving resource efficiency, reducing waste, and promoting circular economy which and can contribute to restoring biodiversity naturally in Europe [9, 11].

Biological resources are an essential contribution to the Romania's economy and will play an even more important role in the future. Through actions taken as a result of the strategy and of the action plan in the field of bio economy, policy makers aim to ensure sustainability and renewable biomaterials.

6. Importance of circularity in agriculture. Circular Agriculture Practices

Circular agriculture focusses on optimizing resource utilization, minimizing waste and fostering sustainable food production [41]. Some benefits of adopting circularity in agriculture are: reducing the needed resources (energy, water, nutrients), producing less waste, use of close nutrient loops, ensuring biodiversity, lowering greenhouse gas production and boosting carbon sequestration [13] etc.

Some examples of good practices in circular agriculture are given by [29].

An illustrated presentation of the directions where good practices of circular economy are oriented are shown in Fig. 4.

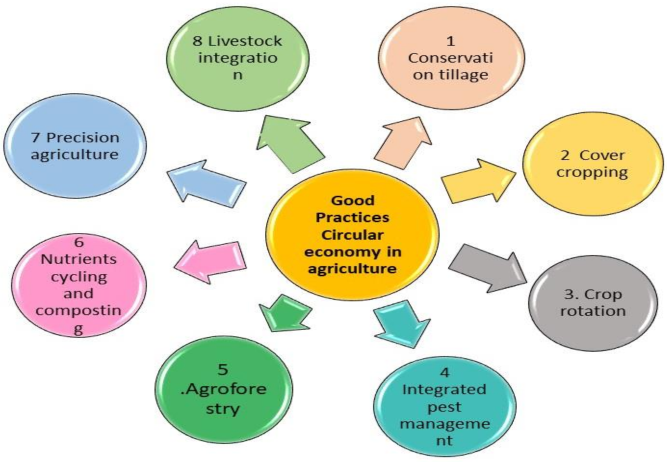

Fig. 4. Good practices of circular economy in agriculture
Source: Own design.

Conservation Tillage: Instead of traditional plowing, conservation tillage minimizes soil disturbance, preserving soil structure and organic matter. This practice reduces erosion, improves water retention, and promotes soil health [7, 4].

No-tillage associated with fertilization had a positive effect on wheat yield and grains quality in terms of protein and gluten content [30, 31, 32].

Cover Cropping: Planting cover crops between cash crop seasons helps prevent soil erosion, suppress weeds, and improve soil fertility. Cover crops also enhance biodiversity and provide habitat for beneficial insects [43].

Legume cover crops protect soil against compactation and erosion, improve its fertility, reduce weeding degree, assure nitrogen captation and a better biological and physical features [37].

Double and multicropping. In the USA, after winter wheat it is practice to cultivate soybean to intensify the use of land and increase production based on healthier and richer soils, a higher soil fertility and farm resilience [5].

Compared to mono-cropping, a three-crops systems could assure an additional USD 100 per acre [27].

Crop Rotation: Rotating crops on a field over time helps break pest and disease cycles, improve soil structure, and maintain nutrient balance. Different crops have varying nutrient needs, reducing the risk of nutrient depletion and promoting soil health.

In Romania, wheat yield was increased practicing a three crop rotation, using peas like ameliorative plant [2].

Integrated Pest Management (IPM): IPM combines biological, cultural, and mechanical methods to manage pests, minimizing reliance on chemical pesticides. Practices include crop diversification, habitat manipulation, and use of natural predators to control pest populations [3, 35].

Agroforestry: Integrating trees and shrubs into agricultural landscapes enhances biodiversity, improves soil health, and provides additional income streams [43]. Agroforestry systems can include alley cropping, silvopastures, and windbreaks, among others [28, 38, 39, 40].

Nutrient Cycling and Composting: Recycling organic matter through composting and nutrient cycling reduces the need for synthetic fertilizers and improves soil fertility. Compost can be made from crop residues, animal manure, and food waste, returning nutrients to the soil in a closed-loop system [43].

Animal manure could be a good soil amendment after composting [26].

Valorization of biocompost of ornamental plants could also sustain circular economy [48].

Precision Agriculture: Using technology such as GPS, sensors, and data analytics, precision agriculture optimizes inputs such as water, fertilizer, and pesticides, minimizing waste and environmental impact while maximizing crop yields [34, 1].

Livestock Integration: Integrating livestock into cropping systems through rotational grazing or mixed farming systems can improve soil fertility, reduce weed pressure, and enhance nutrient cycling. Livestock manure can be used as fertilizer, closing nutrient loops within the farm [21].

These circular agriculture practices contribute to sustainable food production by conserving resources, protecting ecosystems, and promoting resilience in the face of environmental challenges [49]. By adopting these practices, farmers can enhance productivity, reduce environmental impact, and contribute to the transition towards a circular economy.

CONCLUSIONS

The transition to the circular economy will be systemic, profound and transformative, both in EU and outside it. Most of the times the transition will be destabilizing.

This will require the cooperation of all stakeholders at all levels – from international to local ones.

There are a large number of barriers to adopting circular agriculture practices and the main ones are specified below:

-The lack of education and awareness regarding the promotion and adoption of circular economy. For example, in the field of agriculture, it is needed to pay more attention to organic farming, which has to be extended on larger surfaces in the EU member states; regenerative agriculture had to maintain land structure, quality, fertility, promoting modern technologies friendly with the environment and other sustainable practices.

-Resistance to change is a matter of mentality and a common barrier to accept and implement sustainable agricultural practices. A part of the people are reluctant to change due to their working routines, long practice technologies, or mind-sets due to various reasons.

-Lack of infrastructure is also a barrier in promoting new technologies.

-Also, the lack or non sufficient funding are restrains in implementing and expanding modern technologies, and applying innovations.

-Limited access to markets is favoured by the weak the cooperation between government organizations, private sector stakeholders, farmer organizations, and civil society.

But circularity in agriculture should not be seen merely as a concept but a necessity for building a sustainable and resilient economy of the future.

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THE IMPACT OF THE COVID 19 PANDEMIC ON RURAL TOURISM IN EUROPE

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Abstract

This paper seeks to analyze the development of rural tourism in Europe and the tourist specifics of countries with renowned destinations, focusing on the impact of COVID-19 from 2019 to 2022 and its influence on tourism trends. By utilizing data and documentation from the pandemic period, we aim to identify emerging trends in Europe and evaluate the sector's ability to recover to pre-pandemic levels. The analysis and conclusions are inevitably shaped by the COVID-19 pandemic period, with its effects compared against specified parameters. The statistical analysis, utilizing specific indices, shows that the pandemic had a negative impact on tourism activities, resulting in significant declines and underscoring the sector's vulnerability during crises.

Key words: *rural tourism, COVID-19 pandemic, tourist flow, number of overnight stays, Europe*

INTRODUCTION

The World Tourism Organization defines tourism as "travelling carried out for the purpose of recreation, rest or business", and rural tourism as "a form of tourism that includes any tourist activity organized and conducted in rural areas by the local population, capitalizing on local tourist resources (natural, cultural-historical, human), as well as facilities, tourist structures, including guesthouses and agro-tourism farms." [2].

"Rural tourism is a concept that includes all the tourist activities that take place in the countryside", this being a statement accepted by most partners in the world of rural tourism [3, 8].

Rural tourism is done on a small scale, in their own households, by family members, as a source of income or as a supplement to it.

By early 2020, tourism had a global growth rate of at least 3% or higher [15]. This growth contributed to the development of rural areas in Europe and consequently boosted the rural tourism sector [1]. Rural tourism has developed in recent years as an alternative economic branch, especially in rural regions with a rich cultural heritage, special and as natural landscapes, or activities specific to the rural environment [16].

At the same time, rural tourism created new jobs, compensating for losses in the agricultural or forestry sectors, which did not develop as much.

In countries where infrastructure and transport have been developed, rural tourism has seen significant growth since the 1970s. Tourism can stimulate and enhance various aspects of the tourism industry, as well as other economic sectors, both directly and indirectly contributing to economic growth.[11].

The COVID-19 pandemic began in early 2020 and spread rapidly globally, causing major disruptions in all economic sectors, including tourism. Rural tourism, characterized by activities and accommodation in rural areas, often in isolated and less populated places, was the one affected. This form of tourism is vital to many European rural communities, providing an essential source of income and employment opportunities [8]. In recent years, because of the national and international recognition of some protected areas, such as UNESCO's conservation programs, rural tourism has attracted more and more tourists every year [10].

An important role in attracting tourists, in the rural environment, is represented by the traditional character, the hospitality of the hosts and the quality of the products, the prices and tariffs lower than in the urban area, the proximity to nature, aspects that contribute to the satisfaction of the visitors and make them return. The promotion mix in the tourism field involves, among other things, the establishment of a promotion policy, a strategy for presenting tourist services but at the same time attracting as many tourists as possible to increase the efficiency of tourism [8].

MATERIALS AND METHODS

The study utilized statistical analysis of data sourced from Eurostat, the World Tourism Organization, national statistical institutes of various countries, as well as specialized websites and articles. This data pertained to the number of tourists and the GDP of countries where rural tourism significantly impacts the economy. Additionally, bibliographic research of specialized literature was conducted, enabling comparative analysis and providing a robust interpretation of the data.

After the SARS epidemic of 2003 and the global economic crisis of 2009, the Covid-19 pandemic, 2020-2022, seems to be the biggest crisis to affect the tourism industry.

In Europe, too, the tourism crisis was keenly felt, which also significantly influenced rural tourism, which was manifested by a sudden drop in demand, which tended to zero, during the lockdown period, which led to the closure of many related activities this sector and automatically this drastically affected the labor market [14]. Analyzing the impact of the Covid 19 pandemic on rural tourism, we want to identify some ways for people to spend their free time in an enjoyable and comforting way [9].

RESULTS AND DISCUSSIONS

In 2020, many European countries implemented stringent travel restrictions such as border closures and mandatory quarantines, significantly limiting both international and domestic travel. These measures directly impacted rural tourism, leading to substantial declines in tourist numbers and a consequent drop in sector-generated revenue. According to the UNWTO, international arrivals decreased by 74% in 2020, the year most affected by the COVID-19 pandemic [3]. In 2020, numerous European countries enforced strict travel restrictions, including closing borders and mandating quarantines, which significantly curtailed both international and domestic travel. These measures had a direct effect on rural tourism, resulting in a sharp decline in tourist numbers and a substantial reduction in sector revenue [10].

In certain countries, like Germany and Ireland, tourism businesses have received substantial government support to prevent widespread insolvency and the loss of thousands of jobs [12, 6].

In Europe, tourism represents 10% of GDP. The COVID-19 pandemic has had a drastic impact, serving as an economic shock to the GDP of many countries, with the effect being much more severe in nations where the tourism sector is highly developed. Countries such as France, Spain, Italy, Germany, Greece, and Great Britain are among those significantly affected. According to the World Tourism Organization, during the lockdown imposed in 2020, the effect was a 98% decrease in the number of international tourists compared to the same period in 2019. In Germany, the number of overnight stays in March 2020 decreased by 90% compared to the same month in 2019, followed by a 50% decline during the summer months. Overall, throughout 2020, there was a 60% reduction in the number of accommodation places compared to 2019 [12]. In Italy, in 2020, the number of tourist arrivals decreased by approximately 60% compared to 2019, a percentage which was not recorded until 1960, when air travel was considered a luxury.

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Table 1. Number of overnight stays in tourist accommodation units during 2018-2022 (thousand

Country / Year	2018	2019	2020	2021	2022
Austria	125,229	127,891	79,133	66,709	115,063
Croatia	89,568	91,178	40,771	70,172	90,005
France	442,760	446,554	257,875	324,389	449,778
Germany	419,556	436,955	260,758	266,103	400,409
Greece	142,940	143,594	38,475	73,887	132,746
Italy	428,845	436,739	208,447	289,178	412,009
Ireland	35,071	32,581	16,140	14,930	34,931
Netherlands	116,082	123,443	85,415	101,094	132,638
Portugal	74,408	77,594	30,158	42,444	76,948
Romania	28,461	29,890	14,454	20,658	26,614
Spain	466,949	469,814	144,677	259,580	451,625

Source: Eurostat [5, 7].

Additionally, Spain experienced substantial negative impacts on turnover, with Madrid and Barcelona being the most affected areas. Across the European Union, tourism was severely impacted during the pandemic, with varying effects observed in different countries, as illustrated in Table 1. According to EUROSTAT, tourism was one of the most economically affected sectors during the Covid-19 pandemic. Within the European Union, in 2020, the number of nights spent in tourist accommodation decreased by 51% compared to 2019. The EU accommodation sector started to recover in 2021, with 28% more nights spent compared to 2020, reaching nearly two-thirds of 2019 pre-pandemic levels [13].

In 2020, at the level of the European Union, tourist trips were made, for personal purposes, with several 51 million fewer inhabitants, compared to 2019, in which 243 million Europeans made at least one tourist trip with overnight stays. In percentage terms, this number decreased by 21% to 193 million in 2020. Expressed as a share of the population (aged 15 and over), 52% participated in tourism in 2020, down from 65% in 2019 [5].

The evolution of overnight stays in the period before, during and after COVID-19, of a selection of countries, with more frequented tourist destinations, was as follows [4]:

From the data provided by EUROSTAT, we can see that in countries like Austria and Ireland, the downward trend continued in 2021, and countries like Greece, Spain or Croatia recovered quite easily, having an upward trend from 2021 compared to 2020. At the level of 2022, the year in which the restrictions during the Covid-19 pandemic no longer existed, growth continued in all the countries analyzed.

To emphasize this point, the number of overnight stays was compared using 2019 as a benchmark, given it was a peak year. This calculation aimed to assess the tourism sector's recovery capacity in the analyzed countries and to highlight the impact of COVID-19 on this sector.

The study will be continued in 2020, when the Covid-19 pandemic reached its highest levels, to observe the tourist's preference for domestic tourism, in favor of international tourism, as evidenced by the data in Table 2.

Table 2. Share of the number of overnight stays in tourist accommodation units, in the period 2018-2022

Country	Total no. nights (thousands)	Internal %	International %
Austria	61,846	59.2	40.8
Croatia	19,449	78.9	21.1
France	849,090	90.8	9.2
Germany	777,642	58.6	41.4
Greece	56,908	93.8	6.2
Italy	191,721	86.2	13.8
Ireland	30,872	57.9	42.1
Netherlands	159,862	58.1	41.9
Portugal	60,603	90.8	9.2
Romania	42,926	93.2	6.8
Spain	388,330	90.9	9.1

Source: Own calculation based on Source: Eurostat [5].

As part of the research, a graphical representation was created to illustrate the preferences of tourists within the European Union for destinations within their country of residence during the pandemic.

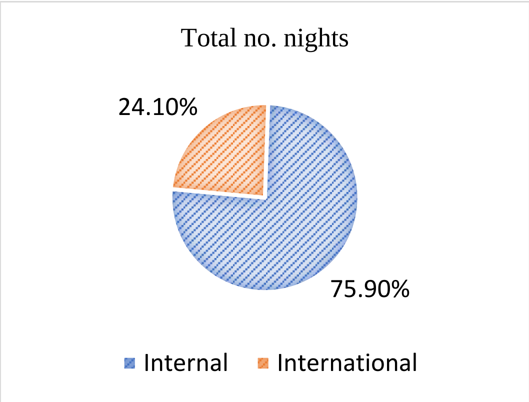

Fig. 1. Total number of nights spent in tourist accommodation units, in 2020 at domestic and international level.
Source: Own graph based on EUROSTAT data [5].

Table 3. Distribution of overnight stays in tourist accommodation units in 2020

Country	Total	Cities	Towns & sub.	Rural
Austria	1,038,263	117,432	191,424	729,407
Croatia	1,085,713	99,584	368,331	617,798
France	5,058,665	1,134,577	1,099,053	2,825,035
Germany	3,467,225	945,573	1,117,954	1,403,698
Greece	1,019,052	80,429	199,993	738,630
Italy	5,120,175	1,012,329	2,341,562	1,766,284
Ireland	215,499	74,830	51,951	88,718
Netherlands	1,406,166	304,042	516,463	585,661
Portugal	650,934	209,914	254,063	186,957
Romania	358,134	111,125	131,059	115,950
Spain	3,750,449	990,789	1,836,019	923,641

Source: Extract from the EUROSTAT [5].

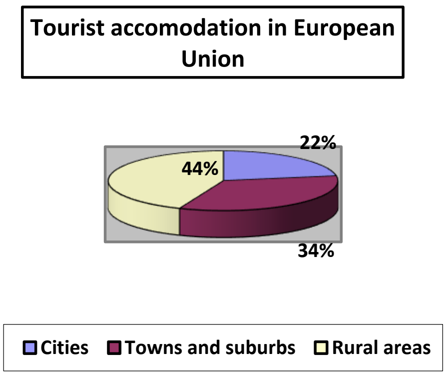

Fig. 2. Total number of overnight stays in tourist accommodation units in 2020 (urban vs. rural)
Source: Own graph based on EUROSTAT data [5].

During the COVID-19 pandemic in 2020, tourists in the European Union showed a stronger preference for rural areas over urban environments, as illustrated in Figure 2.
For a clearer example, we will present the data, representing the number of accommodation places in tourist units, and at the level of the selected countries, in Table 4 [7].

Table 4. Number of accommodation places in tourist facilities in 2020

Country	% 2019/2018	% 2020/2019 2021/2020	% 2022/2019
Austria	2.13 ↑	38.12 ↓ 15.70 ↓	10.03 ↓
Croatia	1.80 ↑	55.28 ↓ 72.11 ↑	1.29 ↓
France	0.86 ↑	42.25 ↓ 25.79 ↑	0.72 ↑
Germany	4.15 ↑	40.32 ↓ 2.05 ↑	8.36 ↓
Greece	0.46 ↑	73.21 ↓ 92.13 ↑	7.55 ↓
Italy	1.84 ↑	52.27 ↓ 38.73 ↑	5.66 ↓
Ireland	7.09 ↓	50.46 ↓ 7.50 ↓	7.21 ↑
Netherlands	6.34 ↑	30.81 ↓ 18.36 ↑	7.45 ↑
Portugal	4.28 ↑	61.13 ↓ 40.74 ↑	0.83 ↓
Romania	5.02 ↑	51.64 ↓ 42.92 ↑	10.96 ↓
Spain	0.61 ↑	69.21 ↓ 79.42 ↑	3.87 ↓

Source: Extract from the EUROSTAT [4].

As observed, the rural environment was preferred in most countries, with a few exceptions, likely due to the lower development of rural areas or the administrative-territorial divisions within those countries. The dynamics were represented in both table and graphic forms to highlight the evolution of tourist overnight stays in the European Union from 2018 to 2022. This representation helps to observe the impact of the pandemic crisis on tourist preferences in 2020, the year most affected by COVID-19.
As for Great Britain, which is no longer part of the European Union, the situation in 2020 is as follows:
- London recorded the biggest drop in room occupancy, just 20% in July 2020, compared to 90% in the same month of 2019;
- between March and May 2020, the workforce in accommodation units decreased by 21.5% compared to the same period in 2019;
- between April and June 2020, trips decreased by 96% compared to the second quarter of 2019;

- turnover for the tourism sector decreased by 26% from February to May 2020;

Appropriate explanations accompanied the results, and finally, conclusions were reached that highlighted the main ideas from this research.

CONCLUSIONS

The analysis of COVID-19's impact on rural tourism in Europe reveals a complex mix of challenges and potential opportunities. To remain relevant and vibrant in the post-pandemic period, the industry must continue to adapt and innovate. From the analyzed data, we conclude that the pandemic's impact in Europe was profound and extended, with some countries not yet reaching the 2019 levels by 2022. During the pandemic, due to the restrictions imposed by each country, there was a reluctance on the part of tourists to travel outside their country of residence, but also in crowded places, preferring locations in rural areas, as close to nature and as isolated as possible. This aspect was influenced by the pandemic, which acted on human behavior, as a response of the individual to protect himself, becoming more cautious.

This fact was due to isolation, the obligation to wear a mask, working from home, etc., rules imposed during the pandemic crisis.

Also, the pandemic produced an economic shock on GDP, mainly in countries where tourism has a significant share.

We can say that the pandemic blocked the movement of people and changed their attitude towards human interaction, towards travel and towards the tourist phenomenon in general.

Considering that the evolutions of overnight stays or domestic and international destinations did not follow a certain algorithm, this topic should be explored further, possibly to identify collateral influences. Many rural tourism operators have implemented new safety protocols such as online check-in, enhanced cleaning and social distancing. Also, tourism packages adapted to the new conditions have been developed, such as private tours or outdoor activities with small groups. Therefore, in addition to their own responsibility, there is also a need for government policies to contribute to sustainable tourism.

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STUDY ON TOURISM ACTIVITY IN THE WESTERN DEVELOPMENT REGION OF ROMANIA

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Abstract

In this article the authors present the tourist activity in the Western Development Region, analyzing the evolution of the following indicators: tourist accommodation facilities, accommodation capacity in operation, the number of incoming tourists and the total number of overnight stays in tourist accommodation facilities. The information needed for this study were provided by the local authorities, the National Institute of Statistics and other bibliographic sources. The analysis, centralization and processing of the obtained data allowed the elaboration of the most important conclusions regarding the evolution of the main tourist indicators found in the studied area. Tourists arriving in the Western Development Region are attracted by the natural tourist potential, which is represented by rich natural resources and the existence of unique natural elements, recognised and protected through the numerous protected natural areas, including the Retezat National Park, the most important in Europe, but also by the existing anthropic potential. On the territory of the region, there are 14 tourist resorts, 6 of which are of national interest and 8 of which are of local interest. The authors of the work made a diagnosis regarding the evolution of the tourist accommodation structures, the capacity of the tourist accommodation structures, existing and in operation, but also other very important aspects for the tourist activity in the analyzed area. The tourist accommodation structures in the Western Region had an upward trend in the analyzed period, the same evolution can be observed in terms of the existing accommodation capacity. Instead, the accommodation capacity in operation had an oscillating evolution from one year to the next, with the most accommodation places being found in 2015, and the fewest in 2020. The total number of tourists arriving in the region recorded an upward trend until 2019, and in the pandemic, arrivals drastically decreased, but then, from 2021 they began to register slight increases. Tthe number of overnight stays followed a similar tendency, the lowest number being recorded in 2020, both for Romanian and foreign tourists. Therefore, the development of tourism in the Western Development Region is accessible also thanks to the accommodation possibilities for tourists who want to spend their leisure time in this region.

Key words: *Western Development Region, tourist accommodation, tourist facilities, tourists, accommodation capacity, Romania*

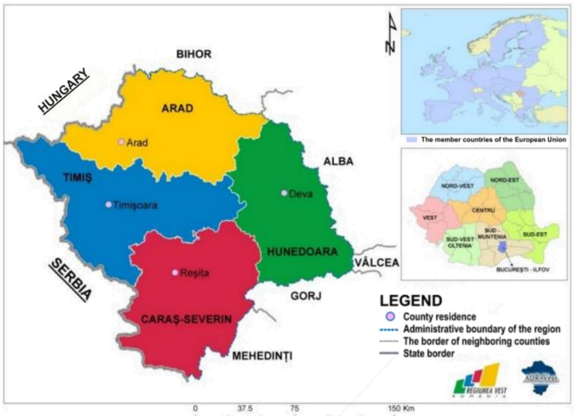
INTRODUCTION

Tourism is, first of all, an economic activity, because many tourist regions have tourism activity as their main source of income [4, 6]. The role of tourism in the national economy of various countries is particularly important, due to the complexity of this phenomenon, the scope of activities determined by its emergence, maintenance and development [11]. Therefore, we can state that tourism activity has a complex content, and the tourism product is, in fact, the organic unity of tourism effects, resources, goods and services [2, 3, 5].

Therefore, tourism services are presented as a set of activities aimed at satisfying all the needs of the tourist during and related to the period of travel [7, 8].

The tourist values of the Western Development Region are given by a particularly rich and varied natural setting, with a multitude of types of relief, climate elements under oceanic and subsouthern influences, a representative hydrographic network and a rich and varied forest and game fund, all of which constitute tourist destinations with a high degree of attractiveness [10].

West Development Region is of Romania is located on the border with Hungary and Serbia, which was created in 1998 and comprises the territories of four counties: Arad, Caraș-Severin, Hunedoara and Timiș [14].



Map. 1. Location of the Western Development Region within Romania and Europe
Source: Adapted by authors after 15 [15].

The Western Development Region has an area of 32,034 km^2 (13.4% of the country's area) and is organized into 42 cities (of which 12 municipalities) and 276 communes (318 territorial administrative units) [12]. The most economically developed counties, Timiș and Arad, have a predominantly lowland relief, which makes tourism based on anthropic objectives predominant. On the other hand, the economically less developed counties, Caras-Severin and Hunedoara, enjoying a predominantly mountainous relief, have a tourism activity based on natural resources and objectives.

The outstanding natural tourism potential of the Western Development Region is given by a diversified relief, rich natural resources and the presence of unique natural elements, which are recognised and protected through numerous protected natural areas, many of them of national and even European importance.

The purpose of the work is to highlight the diversified tourist potential of the Western Region, which is not known in Romania as a tourist region, the main reason being the lack of promotion of the tourist offer it has.

MATERIALS AND METHODS

In order to make this article we used as research methods: documentation, analysis, comparison and interpretation of statistical data obtained from various local, county and National Institute of Statistics sources.

After collecting the data, we followed the stage of their interpretation, through methods of processing the information, both quantitatively and qualitatively, but also through a detailed analysis. At the end of the paper, the main conclusions of the research were formulated.

The period taken into study in this article was between 2010-2022.

RESULTS AND DISCUSSIONS

On the territory of the region, there are 14 tourist resorts, 6 of them are of national interest and 8 of them are of local interest. In the countryside there are 8 of them.

Therefore the development of tourism in the Western Development Region is accessible thanks to the possibilities of accommodation for tourists.

According to some specialists, a tourist accommodation structure is any construction and arrangement intended, by design and execution, for the accommodation of tourists, the serving of meals for tourists, recreation, special transport for tourists, spa treatment for tourists, together with related services [9].

In the following, we will analyse the evolution of the existing tourist accommodation structures, in the period 2010-2022.

From Figure 1, it can be seen that, at national level, the West Development Region holds the 5th place, out of the 8 regions, with 882 accommodation units, i.e. 10% of the total accommodation units.

The Centre Region has the highest percentage, 26%, followed by the South-East Region (18%) and the North-West Region (16%).

Tourist accommodation facilities in the West Region in the period 2010-2022 are shown in Table 1.

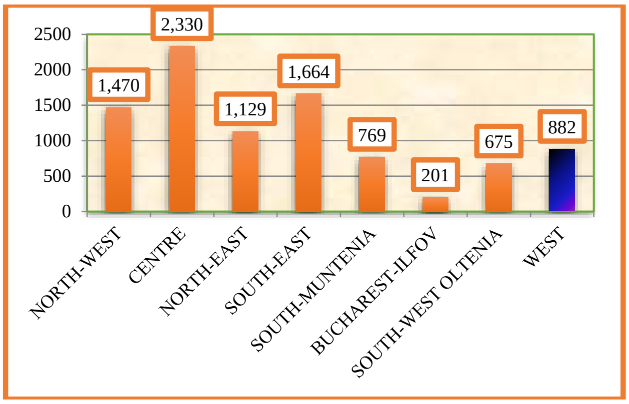


Fig.1. Tourist accommodation structures by development region in 2022 (number)
Source: The authors' processing according to the NIS [10]

Table 1. Evolution of tourist accommodation facilities in the Western Region, 2010-2022 (number of units)

Specify	2010	2015	2020	2021	2022
WEST Region	**497**	**652**	**888**	**874**	**882**
Arad	138	145	156	153	152
Caraş-Severin	143	231	258	268	267
Hunedoara	94	108	313	301	323
Timiş	122	168	161	152	140

Source: NIS, http://statistici.insse.ro [10].

An increase in the number of tourist accommodation facilities between 2010-2020 were noticed in the regions, in 2021 being a slight decrease and from 2022 there was an upward trend (Figure 2).

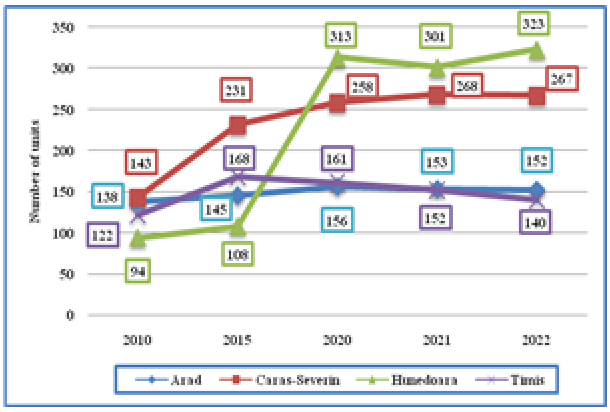


Fig. 2. Evolution of tourist accommodation facilities in the Western Development Region, 2010-2022
Source: The authors' processing according to NIS [10].

In the period 2010-2022, at the level of the counties in the region, a similar situation is observed, with the exception of Timis county, which shows an increasing trend in the period 2010-2015, and from 2020 a decreasing trend, reaching 140 tourist accommodation units in 2022.

The highest number of tourist accommodation units can be found in Hunedoara county, with 323 units, followed by Caras-Severin county, with 267 units, Arad county with 152 units, and the last place is Timiș county, with 140 units.

The evolution of the existing tourist accommodation capacity at regional level was slightly increasing, as can be seen in Table 2.

Table 2. Existing accommodation capacity in the West Development Region between 2010-2022 (places)

Specify	2010	2015	2020	2021	2022
WEST Region	**23,257**	**27,821**	**30,929**	**30,173**	**30,407**
Arad	5,554	5,695	5,288	5,261	5,042
Caraş-Severin	7,139	9,159	9,623	9,924	9,590
Hunedoara	3,707	4,942	8,531	7,911	8,587
Timiş	6,857	8,025	7,487	7,077	7,188

Source: NIS, http://statistici.insse.ro [10].

The counties of Arad and Caras-Severin, from 2020 until now, have recorded a downward trend, while the counties of Hunedoara and Timis have had a slightly increasing trend in 2022.

As for the tourism capacity in operation, in the period 2010-2022, it can be observed that this fluctuated from one year to another.

Regarding the accommodation of tourists, they preferred to stay in hotels, agritourism guesthouses and tourist guesthouses, and on their last in their preferences are tourist stops and tourist villas.

Accomodation capacity in number of places-days is shown in Table 3 and Figure 3.

Table 3. In operation Accommodation capacity in the Western Development Region, 2010-2022 (number of places-days)

Specify	2010	2015	2020	2021	2022
WEST Region	5,950,545	7,453,990	5,348,982	6,799,426	6,975,223
Arad	1,349,551	1,557,800	1,019,822	1,229,576	1,404,356
Caraş-Severin	1,525,136	2,040,177	1,520,210	2,051,632	2,126,193
Hunedoara	933,333	1,293,654	1,001,781	1,444,533	1,491,958
Timiş	2,142,525	2,562,359	1,807,169	2,073,685	1,952,716

Source: NIS, http://statistici.insse.ro [10].

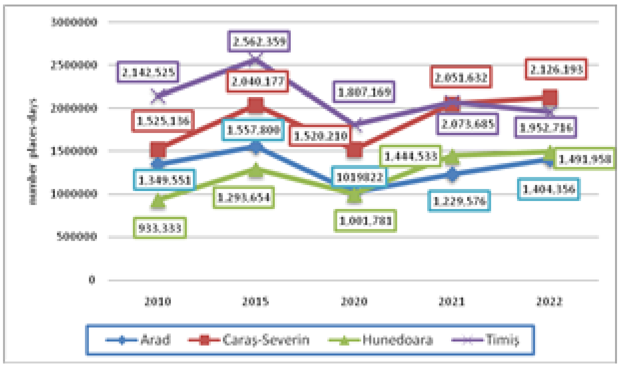


Fig. 3. Evolution of accommodation capacity in operation in the West Development Region, 2010-2022 (Number of places-days)
Source: The authors' processing according to NIS [10].

In terms of total number of tourist accommodation units, Timis county attracts the most tourists in the West Region (Figure 4).

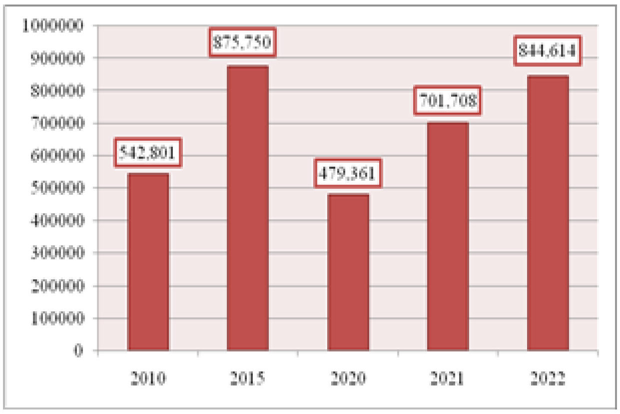


Fig. 4. Evolution of the total number of tourist arrivals in the West Region, 2010-2022
Source: The authors' processing according to NIS [10].

Figure 4 presents the dynamics of the total number of tourists arriving in the Western Development Region which has fluctuated from one year to the next. In 2020, due to the COVID pandemic, the lowest number of tourist arrivals in the region was recorded, 479,361 tourists, compared to 875,750 tourist arrivals in 2015 and 844,614 tourist arrivals in 2022.
Between 2010 and 2022, tourist arrivals, by type of tourist, in the Western Development Region fluctuated from one year to the next. The highest level of Romanian tourist arrivals was recorded in 2022, with a number of 722,639 tourists, and in terms of foreign tourist arrivals in the region in 2015 (Figure 5).

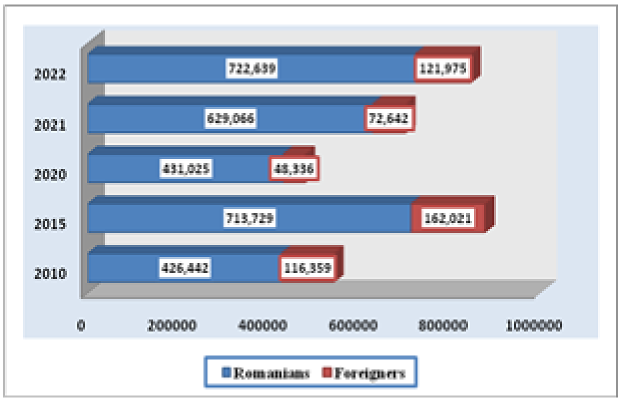


Fig. 5. Evolution of the total number of tourist arrivals in the West Region, 2010-2022
Source: The authors' processing according to NIS [10].

If so far we have analysed tourist arrivals in the Western Development Region, we will now analyse the total number of overnight stays in tourist accommodation and by type of tourist (Table 4).

Table 4. Evolution of the number of overnight stays in tourist accommodation establishments, by type of tourists, in the West Region, 2010-2022 (number)

	2010	2015	2020	2021	2022
WEST Region	**1,504,943**	**2,233,754**	**1,099,737**	**1,528,016**	**1,778,195**
Arad	304,879	379,994	171,695	274,440	310,218
Caras-Severin	471,000	711,026	439,922	594,593	664,558
Hunedoara	222,679	343,788	126,412	241,505	234,555
Timiş	506,385	798,946	361,708	417,478	568,864
Romanians					
WEST Region	**1,254,705**	**1,872,194**	**993,352**	**1,378,249**	**1,545,162**
Arad	239,028	298,635	150,441	224,832	240,823
Caras-Severin	453,654	666,286	432,274	585,674	651,028
Hunedoara	205,625	325,422	119,966	236,842	226,770
Timiş	356,398	581,851	290,671	330,901	426,541
Foreigners					
WEST Region	**250,238**	**361,560**	**106,385**	**149,767**	**233,033**
Arad	65,851	81,359	21,254	49,608	69,395
Caras-Severin	17,346	44,740	7,648	8,919	13,530
Hunedoara	17,054	18,366	6,446	4,663	7,785
Timiş	149,987	217,095	71,037	86,577	142,323

Source: NIS, http://statistici.insse.ro [10].

Important fluctuations were noticed in the number of overnight stays at regional level. The peak of stays was in 2015 and the lowest level in 2020. Since 2021 the number of overnight stays has started to show an upward trend (Figure 6).

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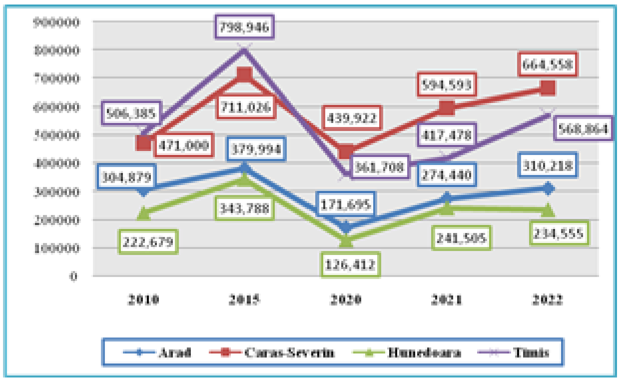

Fig. 6. Evolution of the number of overnight stays in the counties of the Western Development Region between 2010 and 2022
Source: The authors' processing according to NIS [10].

Between 2010 and 2022, the number of overnight stays, at county level, is similar to that at regional level.
In 2015, the overnight stays reached the peak level, accounting for 798,946 in Timis county, but in 2020, it was registered the lowest level, only 126,412 in Hunedoara county.
The same situation is observed for the number of overnight stays, at county level, by type of tourists (Figure 7).

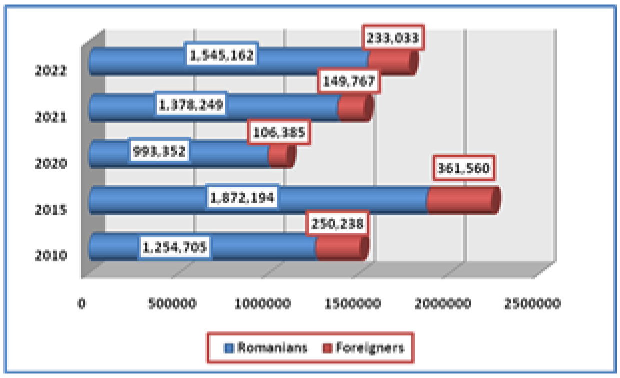

Fig. 7. Evolution of the number of overnight stays, by type of tourists, in the West Region, 2010-2022
Source: The authors' processing according to NIS [10].

Both Romanian and foreign tourists registerd the lowest number of stays in 2020, in all the counties, except Hunedoara county, which carried out the smallest number of stays in 2021, while in the other years it fluctuated from one year to another.
This sharp drop from 2020 was due to the restrictions imposed during the Covid-19 pandemic, affecting not only tourism activity in the region, but also nationally and globally [1].
The development of the Western Development Region has been driven and continues to be supported by the existing natural resources, which have a diversified relief and include the plains of Timis and Arad counties, the hilly areas with important mineral resources, as well as an important segment of the Southern and Western Carpathians, which includes one of the most significant natural parks in Europe, namely the Retezat National Park. Therefore, it can be said that, at the moment, we cannot speak of a full exploitation of the existing natural and man-made resources within the Western Development Region [13, 16].

CONCLUSIONS

Although the region has a great variety of tourism resources, the West Development Region is not known as a tourist region in Romania. The main reason for this is the lack of promotion of the tourist offer, with emphasis on the development of those tourist sectors that have a great natural and anthropic tourist potential.
The West Development Region ranks 6th out of the eight regions at national level in terms of the number of tourist accommodation facilities.
At the level of the region there is an increase in the number of tourist accommodation facilities, a similar situation is recorded at the level of the counties in the region, with the exception of Timis county, which in 2022 will have 140 accommodation units.
Timis county, even though it has the fewest accommodation units, attracts the most tourists in the Western Development Region.
The lowest number of tourists arriving in the region was recorded in 2020, due to the restrictions imposed during the Covid-19 pandemic.
The higher and higher number of tourists obliges the owners of accommodation units and also the local authorities to adapt and modernise their resorts.
COVID-19 pandemic affected all the branches of the national economy, but especially tourism which registered the lowest level of tourists as a result of the travel restrictions imposed by the authorities, and consequently

the income from this sector has also fallen drastically. Tourism is the most vulnerable sector when it comes to threats related to a medical, economic or military crisis.

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ROMANIAN RURAL TOURISM IN GUESTHOUSES - EVOLUTION PERSPECTIVES

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Abstract

In Romania, domestic tourism is increasingly incorporating rural tourism. The number of travelers using the specific services provided by agritourism and tourism guesthouses increased during the pandemic. In this context, in this paper it was analyzed the evolution of this categories of guesthouses, at the national level in the period 2018-2023, with the following statistical indicators: tourist destinations, types of tourists, degree of occupancy, accommodation capacity, tourist arrivals, occupancy rate, and number of overnight stays. The study reveals a preference of tourists for guesthouses and the efficient use of natural, cultural and human zonal resources. The creation of tourism products that capitalize on the zonal development potential is one of the options with a great development potential. Tourism and agritourism guesthouses have adapted more easily to the requirements of the health crisis by promoting a personalized tourist offer closer to the needs of tourists. The creation of diversified tourism products that capitalize on the regional specificity is one of the options with a great potential for future development.

Key words: *rural tourism, agritourism guesthouses, tourism guesthouses, Romania*

INTRODUCTION

Tourism and agritourism pensions (guesthouses) represent an important segment of Romanian tourism that contributes to the development of rural areas and the exploitation of authentic tourism potential of Romania in all its regions [1, 4, 7, 13].

In 2019, the tourist accommodation capacity has the following structure: hotels had the largest share of 58.7% of the total tourist accommodation capacity, then agritourism guesthouses 13.3%, tourism guesthouses 11.6%, tourist villas 4.2%, hostels 3.8%, motels 3.1% and the rest of the types of tourist reception structures with tourist accommodation functions 5.3% [9].

During 2020-2023, Romanian tourism faced the following major challenges:

- During March 2020 and March 2022, the Covid crisis marked the economy and especially tourism due to health restrictions and travel bans [6, 14].

That is why the Government of Romania has adopted measures to support the tourism sector (for example OG no. 224/30.12.2020) [11].;

- The liberalization of the energy market on January 1-st, 2021, which led to the accelerated increase in energy prices;
- The substantial increase of the inflation rate especially in the period 2022-2023 (Table 1) ;
- Increase cost of air and terrestrial transport [2].

Table 1. Evolution of inflation rate during 2018-2023 (%)

2018	2019	2020	2021	2022	2023
4.6	3.8	2.6	5.1	13.8	10.4

Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

This study aims to analyze the evolution of Romanian tourism through tourism and agritourism guesthouses, in the period 2018-2023.

MATERIALS AND METHODS

We used the data series offered by the National Institute of Statistics Tempo online.

They were analyzed in order to assess the following statistical indicators: number of guesthouses by type, tourist destinations evolution, types of tourists (foreigners and Romanians), tourist arrivals and number of overnight stays, degree of occupancy and accommodation capacity, by type of comfort.

The questions we wanted to answer have been:

(a)What was the impact of the Covid crisis on tourist and agritourism guesthouses in Romania?

(b)What is their development potential in the post-Covid period?

The trend analysis and comparison method were the main instruments used to interpret de data.

RESULTS AND DISCUSSIONS

The numerical evolution of tourism and agritourism guesthouses, in the period 2018-2023

In 2019, the lowest number of tourism and agritourism guesthouses was recorded, with a number of 1,669 units, respectively 2,800 units.

On March 11, 2020, the World Health Organization declared Covid-19 a Global Pandemic, which led to the application of restrictions that affected tourist activity. In 2020, 1,729 tourism guesthouses operated with 60 units, more than in 2019 and 3,022 agritourism guesthouses, with 222 units more than in 2019.

In Romania, in 2021, 1,745 tourism guesthouses operated with 16 units more than in 2020 and 3,460 agritourism guesthouses with 438 units more than in 2020.

Despite the Covid restrictions, the increase in the number of tourism and agritourism guesthouses in 2021 is noticeable. One explanation is the fact that the number of boarding houses that were accredited increased because they could benefit from the vacation vouchers [8].

Also, the guesthouses, due to their small size, were able to manage the restrictions more easily compared to other larger accommodation units [5].

In March 2022, the Covid restrictions were lifted, but the effects of the energy price increase became more acute. All this affected especially tourism guesthouses, their number decreased by 49 units compared to 2021 to 1,696 units, while agritourism guesthouses registered an increase to 3,484 units, 24 more than in 2021.

The evolution of tourist destinations in tourism and agritourism guesthouses, in the period 2018-2023

The evolution of tourist destinations in tourism guesthouses, during 2018-2023

In 2020, Bucharest and the county seat cities, excluding Tulcea, were the preferred destinations of tourism guesthouses with a number of 570 units, followed by other localities and tourist routes with a number of 454 units. The resorts in the mountain area registered with 455 units in 2019.

The trend is of a slight decrease in the period 2022-2023, with the exception of the units in the spa resorts where there is a sharp increase to 240 units.

Table 2.The evolution in tourist destinations of tourism guesthouses, in the period 2018-2023

Tourist destinations/ year	2018	2019	2020	2021	2022	2023
Total	1,709	1,669	1,729	1,745	1,696	1,642
SPA resorts	204	202	214	206	205	240
Coastal area resorts, exclusive city of Constanta	10	15	19	22	23	23
Mountain area resorts	471	455	446	435	427	409
Danube Delta area, including the city of Tulcea	26	13	26	63	59	24
Bucharest and the county seat cities, excluding Tulcea	540	534	570	561	507	502
Other localities and tourist routes	458	450	454	458	475	444

Source: NIS, Tempo online, Accessed on January 10, 2024 [9, 10].

The evolution in tourist destinations of agritourism guesthouses, in the period 2018-2023

In the analyzed period the number of agritourism pensions registered a constant increase of 24%. In the year 2023, most agritourism pensions are in other localities and tourist routes with a number of 1,832 units and in resorts in the mountain area with a number of 1,333 units [3].

Table 3. The evolution of agritourism guesthouses in tourist destinations, in the period 2018-2023

Tourist destinations/ year	2018	2019	2020	2021	2022	2023
Total	2,821	2,800	3,022	3,460	3,484	3,498
SPA resorts	63	64	75	77	94	91
Coastal area resorts, exclusive city of Constanta	6	15	12	11	10	12
Mountain area resorts	1,161	1,134	1,217	1,317	1,334	1,333
Danube Delta area, including the city of Tulcea	123	107	102	301	204	202
Bucharest and the county seat cities, excluding Tulcea	25	30	35	19	21	28
Other localities and tourist routes	1,443	1,450	1,581	1,735	1,821	1,832

Source: NIS, Tempo online, Accessed on January 10, 2024 [9, 10].

Evolution of the number of tourists, by types of tourists (Foreigners/ Romanians), in the period 2018-2022

The evolution of the number of tourists in tourism guesthouses

In 2019, the largest number of tourists stayed in tourism guesthouses with a value of 1,254,476 tourists, of which 120,802 were foreign tourists.

In 2020, the first pandemic year, the decrease was 47% compared to 2019. In the case of foreign tourists the decrease is 85%.

In the following years, there is a slight increase in the number of tourists, but without reaching the values from the period before the pandemic.

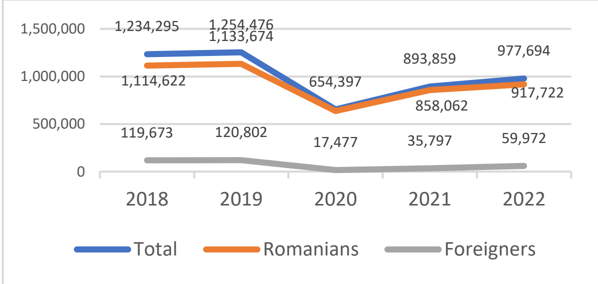

Fig. 1. Evolution of the number of tourists, by types of tourists (Foreigners/ Romanians), during 2018-2022
Source: NIS, Tempo online, Accessed on January 10, 2024 [9, 10].

The evolution of the number of tourists in agritourism guesthouses

In 2019, the largest number of tourists stayed in agritourism guesthouses, namely 1,272,878 tourists, of which 101,088 were foreign tourists. The next year the decrease in the number of tourists is 40% compared to 2019, and that of foreign tourists is 90%. In the following years, in the case of Romanian tourists, the number of stays in agritourism guesthouses increased constantly and reached values close to those before the pandemic. In 2022, the number of foreign tourists' accommodations represents only 58% compared to foreign tourists' accommodations in 2019 [6].

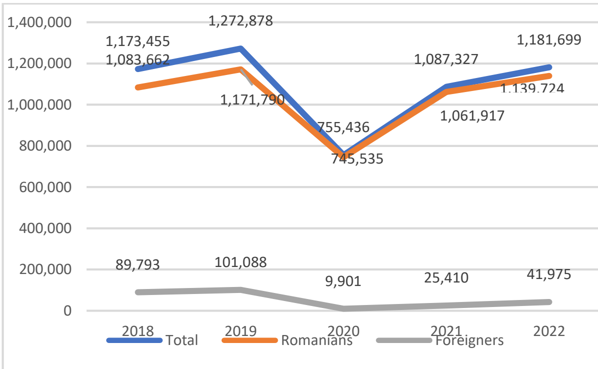

Fig. 2. The evolution of the number of tourists in agritourism guesthouses, in the period 2018-2022
Source: NIS, Tempo online, Accessed on January 10, 2024 [9, 10].

The evolution of the number of tourist arrivals by comfort category and by type of tourist, in the period 2018-2022

The evolution of the number of tourist arrivals by comfort category and by type of tourists in tourism guesthouses

In 2019, the arrivals of foreign tourists in 3-star (56%), 4-star (24.93%) and two-star

(12.54%) tourism guesthouses houses were recorded. In 2022, the preferences have changed in the sense of the decrease to 21.50% of the number of arrivals in 4-star tourism guesthouses and the increase of the number of arrivals in 3-star tourism guesthouses to 59.11%. The total decrease in the number of foreign tourist arrivals was 50%.

In 2019, the arrivals of Romanian tourists were in 3-star (62.76%) and 2-star (17.55%) tourism guesthouses. In 2022 the number of arrivals in 4-star tourism guesthouses increased from 16% in 2019 to 21.6% . While the number of Romanian tourist arrivals at 2 and 3-star ones decreased.

Table 4. Number of tourist arrivals evolution by comfort category and by type of tourists in tourism guesthouses

Comfort category	Type of tourists	Year				
		2018	2019	2020	2021	2022
		No of persons	No of persons	No of persons	No of persons	No of persons
Total	**Total**	1,234,295	1,254,476	654,397	893,859	977,694
	Romanians	1,114,622	1,133,674	636,920	858,062	917,722
	Foreigners	119,673	120,802	17,477	35,797	59,972
5 flowers	**Total**	28,793	24,619	12,062	19,442	21,125
	Romanians	21,424	19,012	10,611	16,821	17,745
	Foreigners	7,369	5,607	1,451	2,621	3,380
4 flowers	**Total**	215,566	216,783	115,542	185,475	211,127
	Romanians	186,257	186,656	112,063	177,802	198,231
	Foreigners	29,309	30,127	3,479	7,673	12,896
3 flowers	**Total**	751,159	779,768	412,535	542,161	593,594
	Romanians	684,651	711,556	402,120	521,397	558,141
	Foreigners	66,508	68,212	10,415	20,764	35,453
2 flowers	**Total**	219,321	214,198	101,265	131,652	139,039
	Romanians	204,669	199,043	99,351	127,417	131,763
	Foreigners	14,652	15,155	1,914	4,235	7,276
1 flower	**Total**	14,967	14,843	9,929	11,303	9,166
	Romanians	14,760	14,645	9,888	11,257	8,946
	Foreigners	207	198	41	46	220
Non classified on flowers ?	**Total**	4,489	4,265	3,064	3,826	3,643
	Romanians	2,861	2,762	2,887	3,368	2,896
	Foreigners	1,628	1,503	177	458	747

Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

The evolution of the number of tourist arrivals by comfort category and by type of tourists in agritourism guesthouses

In 2019, arrivals of foreign tourists in agritourism guesthouses were recorded as follows: 3 flowers (61.14%), 2 flowers (22.64%) and 4 flowers (13.23%). In 2022, there will be changes in the preferences of foreign tourists in the sense of an increase in the percentage of those who prefer agritourism guesthouses of 4 flowers (18.08%) and decreases in guesthouses of 2 flowers (18.14%) and 3 flowers (59.41%). Compared to 2019, the decrease in the number of arrivals of foreign tourists in agritourism guesthouses was 60%.

In 2019, the arrivals of Romanian tourists in agritourism guesthouses were in agritourism guesthouses of 3 flowers (62.63%), 4 flowers (18.43%) and 2 flowers (15.48%). In 2022, there were increases in arrivals in agritourism guesthouses of 5 flowers (4.32%) and 4 flowers (19.99%) and slight decreases in those of 3 flowers (61.56%) and 2 flowers (15.48%).

Index of net use of tourist accommodation capacity in tourist and agritourism guesthouses by comfort category

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The index of net use of tourist accommodation capacity in tourism guesthouses

In 2022, the highest values of the index of net use of tourist accommodation capacity in tourism guesthouses are recorded in tourism guesthouses not classified by stars with a value of 30.8%.

Then come the 5-star tourism guesthouses (29.8%) and the 4 stars (25.9%).

The evolution of the index indicates a slightly increasing trend (Table 5).

Table 5. The index % of net use of tourist accommodation capacity in tourism guesthouses, by comfort category

Comfort category	Year				
	2018	2019	2020	2021	2022
	Percent %				
Total	20.9	22.2	16.5	18.3	19.9
5 flowers	31.4	32.3	25.1	32.2	29.8
4 flowers	24.1	26.8	19.1	23.6	25.9
3 flowers	21.4	22.7	17.3	18.5	20.4
2 flowers	17.3	17.8	12	13.1	13.5
1 flowers	14.3	15.4	13.8	13.3	12.2
Nonclassified on flowers	34.6	43.9	28.6	30.6	30.8

Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

The index of net use of the tourist accommodation capacity in agritourism guesthouses

Table 6. The index % of net use of the tourist accommodation capacity in agritourism guesthouses, by comfort category

	2018	2019	2020	2021	2022
Total	18	20	16.5	17.1	17.1
5 flowers	20.8	24.6	20.2	30	28.9
4 flowers	22.3	25.2	21.3	21.5	21.1
3 flowers	18.6	20.4	16.9	16.8	17
2 flowers	14	15.2	11.7	13	12.8
1 flower	12.7	13.6	11.5	15	12.2

Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

In the year 2022, the highest values of the index of net use of tourist accommodation capacity in agritourism guesthouses are registered in the agritourism guesthouses of 5 flowers (28.9%) and 4 flowers (21.1%).

The evolution of the index indicates a slightly increasing trend [12] (Table 6).

Evolution of the number of overnight stays, in the period 2018-2022

Evolution of the number of overnight stays in tourism guesthouses, in the period 2018-2022

In 2019 the maximum number of overnight stays in tourism guesthouses was 2,324,217. The number of overnight stays in 2022 was 1,754,388, with a decrease of 24.51% compared to 2019 (Figure 3).

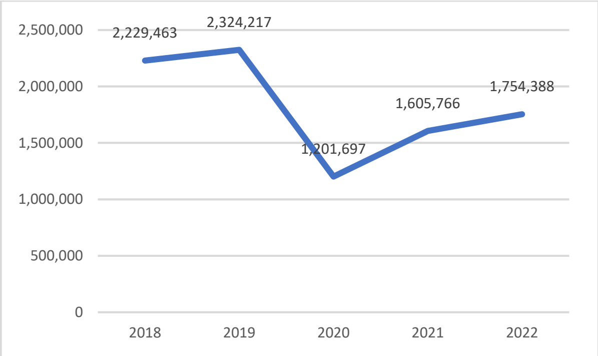

Fig. 3. Evolution of the number of overnight stays in tourism guesthouses, in the period 2018-2022
Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

Evolution of the number of overnight stays in agritourism guesthouses, in the period 2018-2022

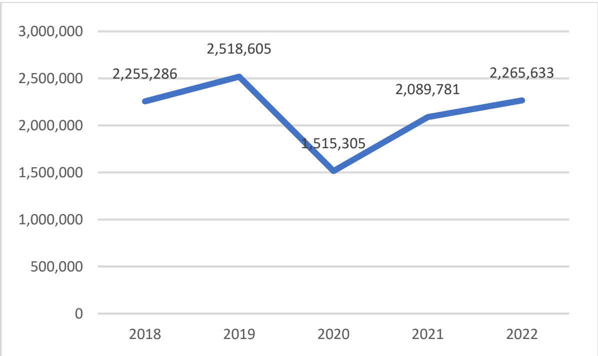

Fig. 4. Evolution of the number of overnight stays in agritourism guesthouses, in the period 2018-2022
Source: NIS, Tempo online, Accessed on January 10, 2024 [9].

In 2019 was recorded the maximum number of overnight stays in agritourism guesthouses with a number of 2,518,605 overnight stays. In 2022 the number of overnight stays was 2,265,633 with a decrease of 10% compared to 2019 (Figure 4).

CONCLUSIONS

Tourist and agritourism guesthouses have adapted more easily to the requirements of the health crisis by promoting a personalized tourist offer closer to the needs of tourists.

The increase in demand for Spa tourism offers a development opportunity for tourist and agritourism guesthouses.

The number of stays in agritourism guesthouses has increased constantly and reached values close to those before the pandemic in the case of Romanian tourists.

A trend of Romanian tourists' preferences is taking shape in the sense of increasing demand for 4-flowers tourism guesthouses and 5 and 4-flowers agritourism guesthouses.

The decrease in the number of foreign tourists staying in tourism and agritourism guesthouses makes it necessary to develop a National Tourism Development Strategy that intensively promotes authentic tourism, based on local natural and cultural resources.

The creation of diversified tourist products that capitalize on the regional specificity is one of the options with a great potential for future development.

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PRELIMINARIES ON THE AGRITOURISM TOURIST'S TYPOLOGY IN ROMANIA. CASE STUDY *SATUL BANULUI GUESTHOUSE*, PRAHOVA COUNTY

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Abstract

Touristic and agritouristic guesthouses in Romania own authentic resources that represent elements of maximum attraction, and Satul Banului Guesthouse is representative for promoting the authentic vernacular Romanian, Muntenia style in the touristic offer. The study aims to identify the rough guide criteria by which tourists select guesthouses and how much it is appreciated, according to multiple socio-demographic categories, the local national authenticity through services and other opportunities. The data were collected through an original questionnaire which includes 33 subjects, customers of Satul Banului Guesthouse, with the following demographic structure: 51.5% men and 48.5% women, ages between 31-50 years are predominant, and 66.7% of the respondents have university degrees. The results indicated that: the proximity to the home is not a significant indicator; tourists between 31-50 years choose a good quality/price offer; especially male tourists choose a guesthouse appreciating Romanian authenticity (56.67%); participation in outdoor activities is strongly segregated, and cultural tours is especially important for women.

Key words: *Romanian rural tourism, tourist typology, case study Satul Banului Guesthouse, vernacular, authenticity*

INTRODUCTION

Touristic and agritouristic guesthouses in Romania own authentic resources that represent elements of maximum attraction [1, 2, 3].
Specialization of guesthouses is a new challenge for rural tourism [5, 9] and what is important is the preservation of the authenticity [6, 8].
Satul Banului Guesthouse is self-characterized as *a project for offline life*, is representative for promoting the authentic vernacular Muntenia - Southern Romania - style in the touristic offer, in terms of location, architecture, interior decoration, gastronomy, cultural services and outdoor activities [7].
The name of *Satul Banului* comes from *"sat"* meaning *"village"* in Romanian language and *"ban"* meaning *"governor"*. This name was inspired by southern Romanian region Oltenia, where *ban* is the title of the governor delegated by the ruler – so *Satul Banului* may have the meaning of a village which belong (as property or just from a valuable administrative point of view) to the governor, and this meaning is deeply connected with the vernacular features of this guesthouse.
Additionally the option for the case study at this guesthouse, we mention that it also recommends itself through multiple opportunities to involve customers in various activities such as hike/travel/explore/live and play in nature with "toys for all: stones, sand, hay, and wood", without plastic slides and the "famous" trampoline [13].
More than 20 tourist attractions with outstanding cultural and natural heritage value, located at distances between 3 and 55 km from Satul Banului Guesthouse, are presented to interested customers (among which we exemplify former palaces and mansions: Cantacuzino's Aristocrat Palace, the so called *Little Trianon* from Floresti, Bellu's Mansion, Pană Filipescu's Mansion, Drăghici Cantacuzino's Palace; Filipeștii de Pădure Church; memorial houses/museums such as those of exceptional Romanian

personalities: Nicolae Iorga, Ion Luca Caragiale, Nicolae Grigorescu, Iulia Hașdeu; Upper Peasant School; shelter for wisents).

It is well known from tourism marketing that tourists' behavior is determined by a set of variables.Taking into account the criteria for tourists segmentation from different points of view: socio-economic [11], psychological [4, 12], and the combination of these dimensions [10], at the moment tourist products needs to meet the safety and standardization criteria, but also to bring together the elements of authenticity and specificity at the same time.

In terms of rural tourism and especially agritourism, tourists want to relax in a natural setting, in contardiction with the stress of big cities and at the same time they want to discover as many specific elements related to the culture heritage of the area (traditional ethnography and folklore) from the respective destination.

Under these conditions, during a vacation we can see the emphasis is not only on relaxation, but also on the cultural enrichment of the tourist, his involvement in various activities specific to the respective tourist destination.

As we didn't find in the rural tourism specialized literature relevant information for the typology of the client of agritouristic guesthouses in Romania, our study aims to identify some of the main criteria by which tourists select the tourist guesthouse and how much it is appreciated, according to multiple socio-demographic categories, the local national authenticity through services and other opportunities offered.

MATERIALS AND METHODS

For data collection, we developed a questionnaire with the socio-demographic indicators of age, occupation, residentship, gender, level of education and other variables necessary to identify the rough guide criteria by which tourists select (such) a guesthouse, respectively

1. if the client is traveling alone or in a group (family/friends),
2. criteria to justify the option for a guesthouse with a Romanian vernacular profile,
3. the type of services which is preferred by the customer (standard services or services that comply with quality standards, additionally reflecting the specific Romanian hospitality),
4. the proximity to home,
5. the quality/price criteria,
6. the preference for outdoor activities,
7. the preference for visiting natural and cultural objectives in the area.

The items are predominantly closed-ended, with multiple answers.

As general observations, while developing the instrument, the necessary measures to ensure validity and fidelity were taken into account (the conceptual framework and the relationship between concept - variable – item; multiple successive draft versions and verification tests); also the text for the covering letter was developed to ensure the fulfillment of the criteria imposed by the efficiency and the ethics of the research.

The sample for the case study consists of 33 subjects. Regarding its representativeness, we mention that the respondents present the common socio-demographic background found at Satul Banului Guesthouse.

Data collection period utilized in this work: Oct 1 – Dec 31, 2023.

Method of administration: self-administered, paper & pencil.

We recorded the data using the SPSS program, with which we also performed descriptive statistics and correlation tables.

RESULTS AND DISCUSSIONS

Regarding age, we found the following structure: 63.6% of the respondents fall into the age category 31-50 years, respectively the mature age group, professionally active and with family, with increased propensity for communication, receptivity, energy and responsibility relative to requests from the internal and external environment, 18.2% of respondents belong to the 18-30 age group, 12.1% are tourists aged 51-65 and 6.1% are children under 18 (Fig 1).

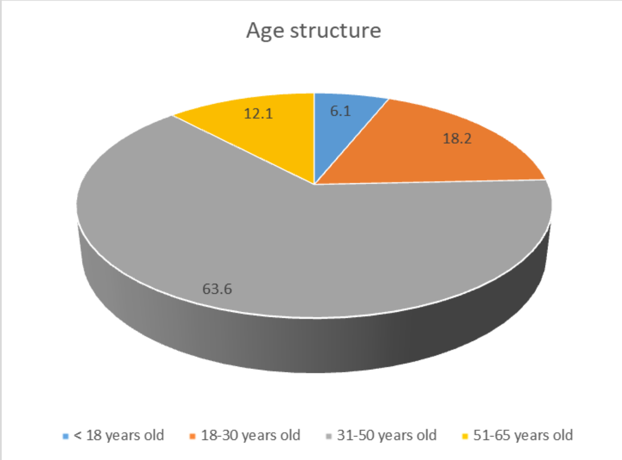

Fig. 1. Age structure
Source: own processing.

From the occupational perspective, 78.8% of respondents are employed, 9.1% are entrepreneurs, 6.1% are pupils and 6.1% are students (Fig 2).

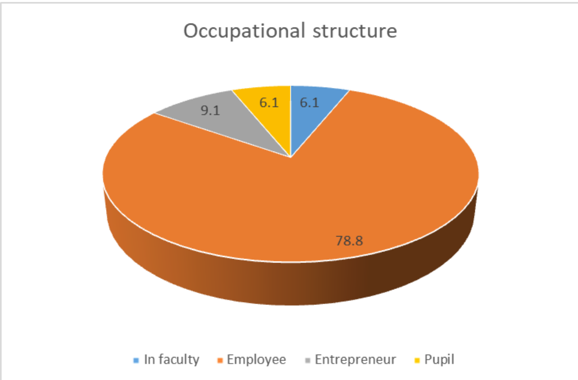

Fig. 2. Occupational structure
Source: own processing.

We notice a balanced distribution of respondents according to the "gender" variable: 51.5% of the respondents are men and 48.5% are women (Fig. 3).

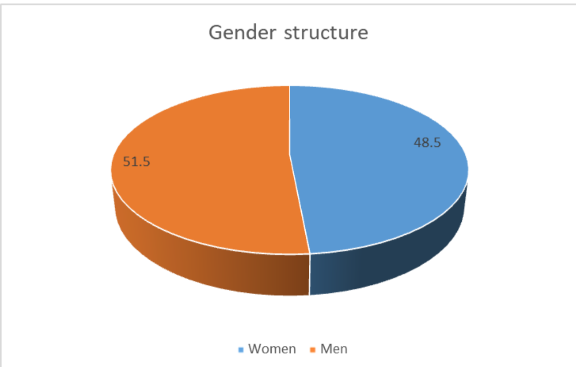

Fig. 3. Gender structure
Source: own processing.

In terms of education level, the majority indicates a (very) educated sample (66.7% of respondents have university studies, 9.1% master's studies and 3% other post-graduate studies), 18.2% of respondents have high school studies and 3% have graduated from secondary school (Fig. 4).

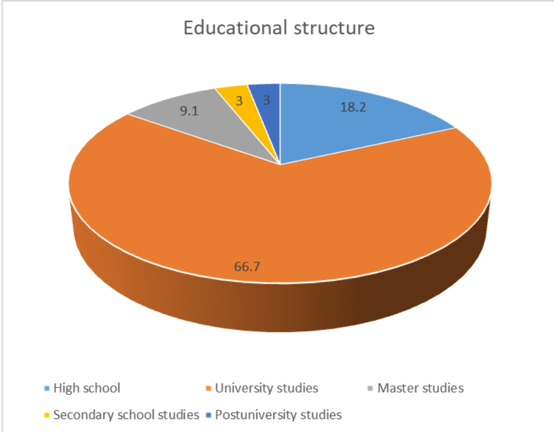

Fig. 4. Education level structure
Source: own processing.

From the perspective of the residentship (Fig. 5) we notice that 72.7% of the respondents come from the urban environment, which indicates the need for regeneration in the middle of nature and still a need to keep in touch with the vernacular roots, while 27.3% of the tourists come from the rural environment.

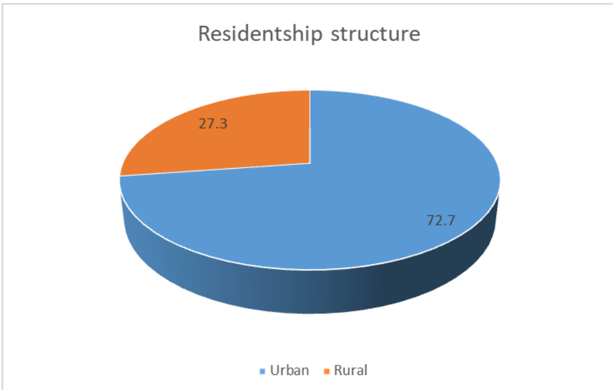

Fig. 5. Residentship structure
Source: own processing.

The option for this guesthouse concerning the rural residents could be argued by the extremely diverse palette of services offered, which go far beyond the common activities of a peasant household where the adults in the family, professionally busy and probably additionally busy with household chores (so busy at least as much as there are the city dwellers), currently have little leisure left to spend with their family, little time for relaxation (active and passive) in nature.

Are the tourists accompanied during their travel and stay at the guesthouse? Tourists prefer to travel and stay with their family (87.9%), respectively with friends (12.1%) (Fig. 6).

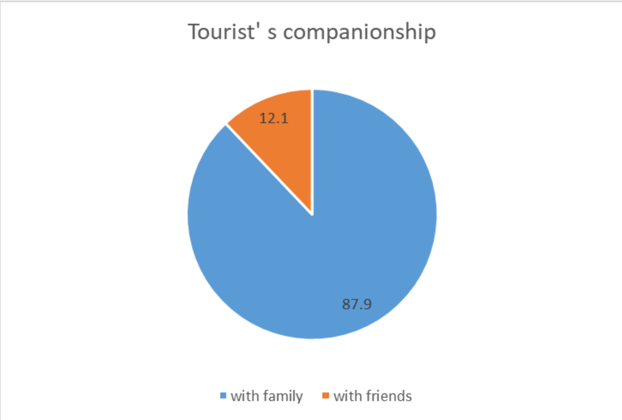

Fig. 6. Tourist’s companionship
Source: own processing.

Data analysis according to the guesthouse selection criteria:

-the accommodation unit's proximity to home is not a significant indicator for 90.9% of the subjects (Fig. 7);

-an advantageous quality/price ratio is preferred for tourists aged between 30-50 years (Fig. 8);

-services representative for Romanian vernacular authenticity are sought/appreciated especially by male tourists (56.67%), but also 43.33% female tourists value them (Fig 9);

-participation in outdoor activities is important for the categories of employees and students, especially for employees (75%), but within the category of employees there is also a large percentage (80%) for which the aforementioned criterion is not relevant (Fig. 10).

Moreover, 76% of tourists aged between 30 and 50 do not choose the guesthouse according to this criteria (Fig. 11);

-visiting cultural and natural tourist attractions of the area is targeted by women tourists (58.82%), while the majority of male tourists (62.50%) do not show interest in this aspect (Fig. 12);

-the vast majority of Satul Banului Guesthouse’s clients (90.91%) prefer tourist services that reflect the Romanian vernacular authenticity over the standard services offered in tourism, which may indicate a growing demand for elements of regional authenticity to be included in the offer of agritouristic guesthouses which exploits the zonal ethnographic potential (Fig. 13).

And/or we can also interpret (somewhat idealistically) the percentage in favor of some clients aware of the fact that “*a people that does not know its history is like a child that does not know its parents*” as the Romanian historian Nicolae Iorga used to say.

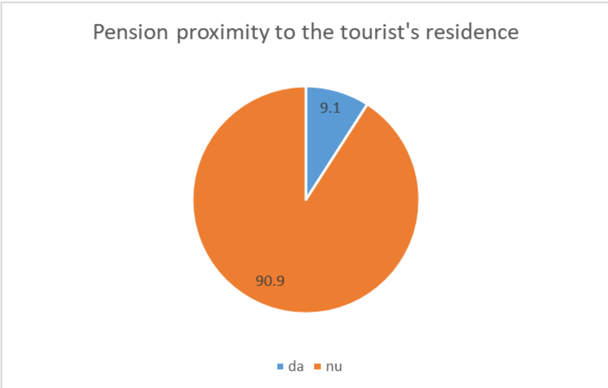

Fig. 7. Selection of the guesthouse according to proximity to the tourist’s residence
Source: own processing.

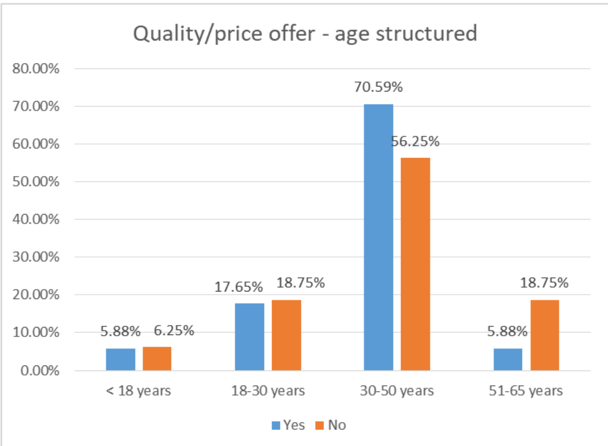

Fig. 8. Selection of the guesthouse by the age structured quality-price offer
Source: own processing.

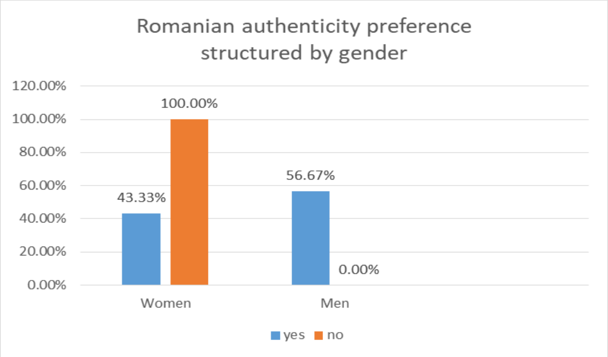

Fig. 9. Appreciation for Romanian authenticity services by gender
Source: own processing.

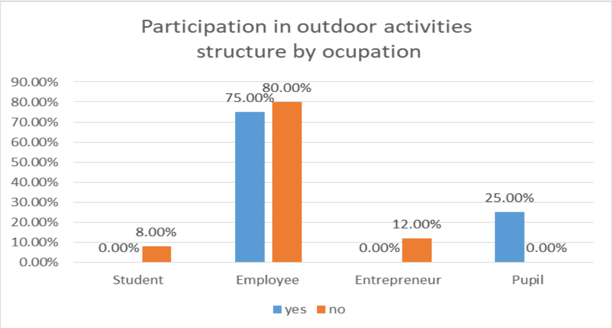

Fig. 10. Participation in outdoor activities by occupational category
Source: own processing.

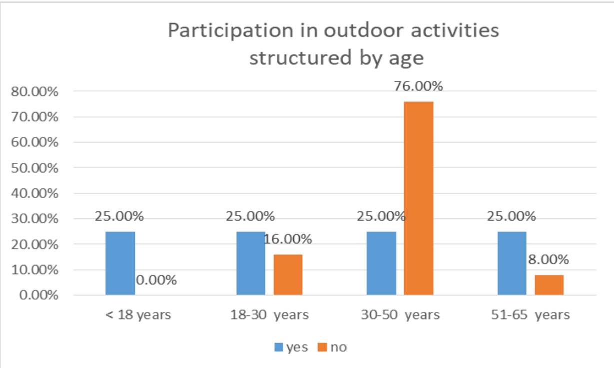

Fig. 11. Participation in outdoor activities by age
Source: own processing.

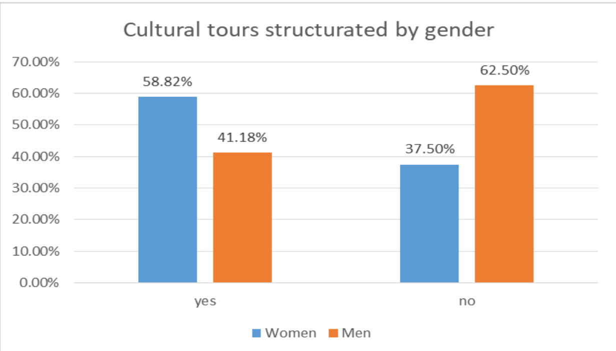

Fig. 12. Visits to natural and cultural touristic targets by gender category
Source: own processing.

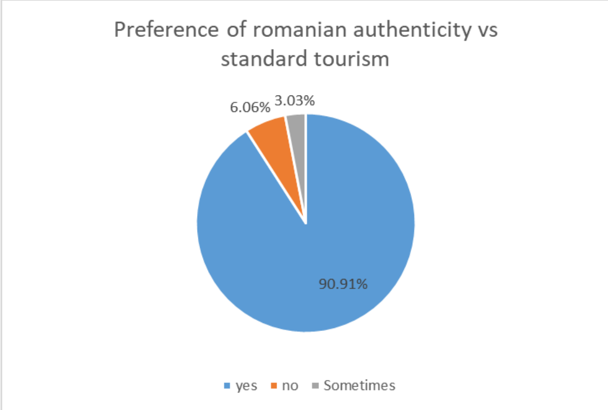

Fig. 13. Preference for touristic services with authentic Romanian specificity
Source: own processing.

CONCLUSIONS

Based on this research, the main conclusions are:

-Promoting the authentic regional countryside represents a huge potential for the development of touristic and agritouristic guesthouses in Romania. Satul Banului guesthouse is representative for its special offer that reflects and promotes the authentic vernacular of Muntenia and Romania style.

-According the age structure of the pension's tourists, the highest percentage of 63.6% belongs to the 31-50 age group, respectively the professionally and socially involved age group, with a well-defined cultural level. A percentage of 18.2% of respondents are young, aged between 18 and 30, and 6.1% are children under 18. The elderly who visit the guesthouse represent 12.1% and are between 51-65 years old.

- The level of education of the respondents indicates tourists with university studies (66.7%) and postgraduate studies (12%), so with a high level of education, which makes them appreciate the true value, the authenticity of objects and services from this Muntenia guesthouse.

- The Romanian authenticity, as criteria for choosing the guesthouse, is found both in the case of male tourists (56.67%) and female tourists (43.33%).

-Regarding the option for outdoor activities, an aspect in which Satul Banului Guesthouse excels, offering opportunities and means (various hikes - including cultural destinations, horse riding, bike rides, carriage/carriage rides, off-road, enduro, visit to the blacksmith, visit to the varnish shop, picking mushrooms) the answers are segregated probably by the level of stress/fatigue, the state of health etc. so some tourists prefer a more sedentary style, while others are actively involved in the outdoor activities suggested by the guesthouse management.

-Visiting tourist attractions of the area is a criterion for choosing a guesthouse, especially for women tourists (58.82%), while male tourists are less attracted to this activity (62.50%).

-A very high percentage of tourists express their preference for the authentic Muntenia - south of Romania experience promoted by Satul Banului Guesthouse over the standard services offered by classic tourism. This indicates the extremely high demand for the exploitation of authentic regional resources through rural tourism.

-Rural tourism is seen overall as a way of preserving the natural and human qualities of a destination combined with cultural tourism, it contributes both to education and to increasethe quality of life for those who practice these forms of tourism.

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QUANTITATIVE APPROACH TO INFLUENCING DRIVERS FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

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Abstract

The need to address the complex exchanges between natural resource efficiency and economic growth has become increasingly discussed in worldwide strategies and position papers. Resource depletion, environmental challenges and climate change are just a few topics related to fast industrialization and economic expansion. The question is how information regarding crops, climatic factors, or solutions used in plant treatment are managed. The purpose of this paper is to provide an overview of the scientific environment regarding quantitative indicators and models for the assessment of sustainable agriculture practices. The study is based on a bibliometric analysis made using Web of science database and processing using biblioshiny environment from R package. The most relevant works and influential authors in the field of quantitative modelling for sustainable agriculture were identified and a set of indicators and metrics for evaluating efforts in transitioning towards sustainability were synthetised. Integrating practical data into quantitative models can provide insights into trends, correlations, or even predictions, and the results obtained serve as inputs for decision-makers.

Key words: *sustainable agriculture, econometric methods, multicriteria indicators, strategic thinking*

INTRODUCTION

Sustainable agriculture plays a fundamental role in fostering economic development on local, national, and global scales, as highlighted by its substantial contribution to the gross domestic product and added value. Over the years, agriculture has undergone paradigm shifts, evolving into a sector driving economic growth and addressing various societal challenges, including food security, environmental degradation, and population growth [14].

Sustainable agriculture is defined as managing renewable and non-renewable resources in order to meet the food demands of a growing population.

On a societal level, sustainable agriculture works towards providing enough food for current and future generations while also protecting the environment [9]. As a result, sustainable agriculture and the circular economy are seen as ways to address problems like hunger, food insecurity, and climate change [7, 18]. According to statistics from the United Nations Food and Agriculture Organization, around 9.2% of the global population is currently facing hunger, and it is expected that about 600 million people will be chronically undernourished by 2030 [6, 22]. Not only do sustainable agriculture practices pose challenges at the macroeconomic level, but farms also encounter optimization issues when pursuing sustainable economic activities. While profit remains the primary outcome of economic activity, achieving it necessitates a combination of modern technology with traditional land maintenance and crop rotation methods [2].

Different methods to assist farmers in sustainable production management range from simple approaches based on saving money in the supply chain [5, 4], to more advanced strategies like precision agriculture using technologies like GPS, IoT, satellite imagery, and robots to track soil quality and plant health [21, 19].

Romania, being a European nation, is required to implement policies that will facilitate the shift towards a sustainable economy.

Nevertheless, Popescu (2018) points out that Romanian farmers' technological resources are nearly 26 times below the European average [16]. In this situation, advanced techniques like precision farming are difficult for the majority of Romanian farmers to achieve. Analysing influencing factors, as well as examples of best practices from literature and statistical data can be used as future strategies for sustainable growth [3].

Econometric models may be used at the intersection of economics, environmental science standing as tools for assessing the economic, social, and environmental impacts of sustainable agriculture. Econometric models offer a systematic framework for analyzing relationships within agricultural systems, incorporating variables such as inputs and outputs together with environmental factors [23], policy interventions and socio-economic dynamics [20, 15]. By quantifying the resulting interdependencies, the quantitative models enable researchers to provide the interested parties, such as policymakers and business environment to evaluate the effectiveness of various sustainable agriculture strategies, from precision farming techniques to organic practices, agroforestry, and water management initiatives [11, 24, 25].

In this context, the purpose of the paper is to provide an overview of the scientific environment regarding quantitative indicators and models for the assessment of sustainable agriculture practices.

MATERIALS AND METHODS

The study is based on a bibliometric analysis made using the web of science database. In the first phase, a query was carried out including the search terms "quantitative method sustainable agriculture". This query returned a number of 1,815 documents. Analysing the annual production of articles on the searched topic, it was observed that starting with 2013, there was an increase in interest in this field. so that, for the bibliometric analysis, the previous years were excluded. Furthermore, only documents in English were selected. Editorial material (5 documents), correction (1 document) as a document category was excluded from the selection. Following the analysis of the resulting documents, those titles that were not relevant for the sphere of interest proposed in this study were eliminated.

The PRISMA flow diagram used in the research is given in Figure 1.

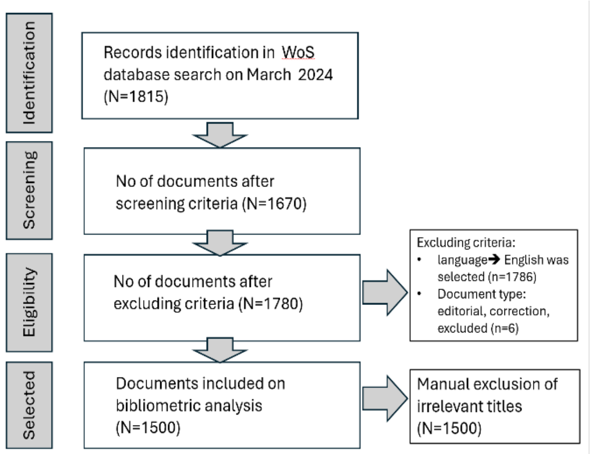

Fig. 1. Prisma FLOW diagram of the bibliometric analysis.
Source: authors own processing.

The bibliographic data including authors, publication titles, journal names, publication years, abstracts, and citation counts were collected in a separate file. The retrieved date were analysed using biblioshiny environment from R package [1]. Citation analysis techniques were applied to identify most relevant works and influential authors in the field of quantitative modelling for sustainable agriculture. Keyword analysis was conducted to uncover prevalent themes and emerging trends within the literature, aiding in the identification of knowledge gaps and areas for further investigation. The findings of the bibliometric analysis are synthesized in the following sections and interpreted to provide an overview of the scientific environment regarding quantitative indicators and models for the assessment of sustainable agriculture practices.

RESULTS AND DISCUSSIONS

The annual scientific production of articles on a quantitative approach to sustainable agriculture has shown a notable trend of growth over the years (Figure 2).

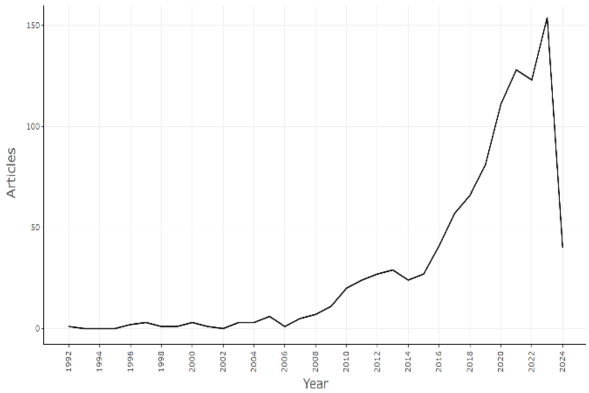

Fig. 2. Annual production of scientific literature on the quantitative approach to sustainable agriculture
Source: authors processing after Web of Science data.

Starting from the year 1992, there were intermittent periods of stagnation or minimal output until the late 1990s. From the late 1990s to the early 2000s there was a gradual increase with occasional fluctuations, reaching 20 articles by 2010.

The increase became more evident in the following years, particularly from 2013 onwards, with an exponential rise in publications.

This data suggests a growing interest and emphasis on employing quantitative methodologies in addressing sustainability challenges within agriculture.

Analysing the literature landscape, the ten most relevant sources for the documents retrieved regarding quantitative approaches to sustainable agriculture are presented in Figure 3.

The Journal "Sustainability" from Mdpi publisher stands out as the primary source, with 71 articles dedicated to exploring various quantitative methodologies applied within sustainable agricultural contexts. "Frontiers in Sustainable Food Systems" and "Journal of Cleaner Production" contribute significantly, with 18 and 17 articles, respectively, offering insights into quantitative techniques for enhancing sustainability in agricultural practices.

This selection includes a Romanian edited Journal as well. "Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development" contributed with 13 articles, exploring quantitative insights into management strategies and economic aspects of sustainable agriculture.

These sources provided a framework for understanding and improving quantitative methodologies within the area of sustainable agriculture, gathering diverse research interests and interdisciplinary perspectives.

The discussions focused on sustainable development of agriculture sector and environmental stewardship revealed the key terms that emerged as essential to designing a quantitative framework for understanding and evaluating the challenges of sustainability of the agricultural system.

Among these, "strategy" stands out with 118 occurrences, indicating a strong emphasis on careful planning and deliberate actions as well as design of appropriate policy measures and application of integrated management of crops in agriculture.

The concept of "cause and effect" was also a cornerstone within the documents retrieved. This is highlighting the recognition of the need to understand the repercussions of the practical approach agricultural production systems within environmental systems.

“Conceptual model" and "system thinking" are also frequently mentioned highlighting the importance of creating conceptual frameworks as model for quantitative assessment while implementing holistic approaches in analysing and addressing environmental and societal issues occurred on the pathway to achieve sustainable development of the agricultural systems.

Considering the terms that occurred most, it can be concluded that the selected articles reflect the study towards understanding of interconnected systems and the need for broad strategies in tackling challenges like climate change, which is referenced 48 times.

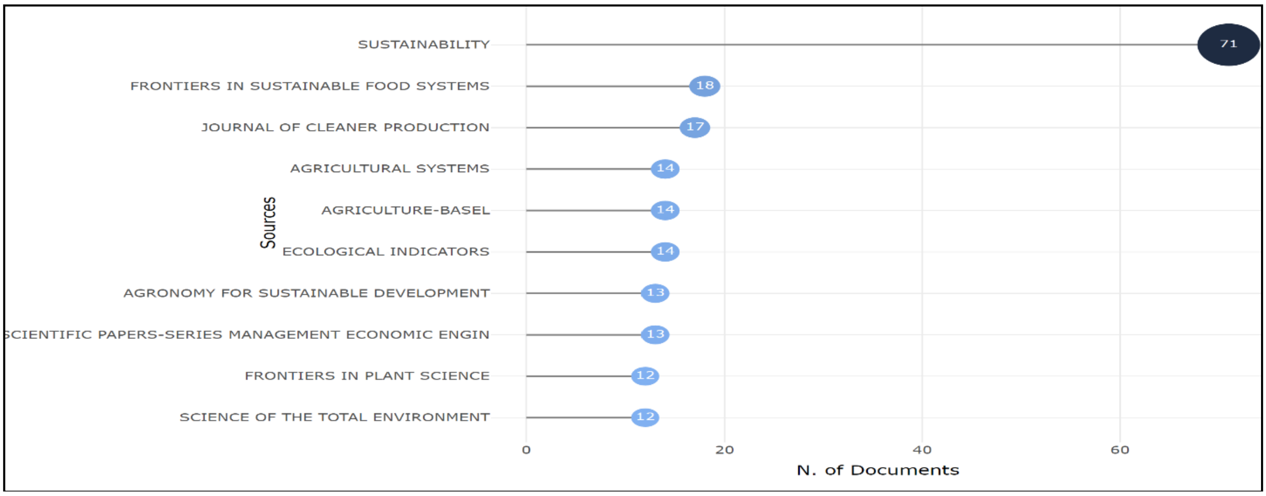

Fig. 3. Most relevant Journals that published research on the quantitative approach to sustainable agriculture
Source: authors processing after Web of Science data.

Sustainable growth" is a core theme as well, pointing the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This is closely tied to considerations of "environmental quality" (34 occurrences) and "conservation" (29 occurrences), indicating a commitment to preserving natural resources and ecosystems.
Occurrence of terms such as “water”, “soil”, and “biodiversity” are further demonstrating the recognition of the natural resources cornerstone roles in sustaining life and ecosystem functioning [13, 11, 10].
In Figure 4 it was plotted the thematic map of the keywords included in the retrieved documents. The keywords were grouped by synonyms and irrelevant terms were excluded from the map.
The thematic map is organised in four sectors comprising the niche themes, and motor themes in the upper part.
These two themes are including word with high density over the selected documents, meaning they are linked to many other keywords, and their occurrence in the selected literature is high.
In the lower quadrants are situated the terms belonging to basic themes and emerging or declining themes.
The lower the word is situated in the thematic map, the interest for the concept is decreasing over the studied articles.
Therefore, motor themes were found to be climate change as related to environmental quality, water efficiency and soil conservation.
Strategy is seen as a concept integrating policy measures, integrated management of agricultural sector.
Niche themes are related to grain-yields, resistance, crop pests and diseases, and genetic traits.
It is interesting that organic matter, carbon, nitrogen and plant diversity are rather basic themes, giving a recognition of the fact that evaluation of any production system should be done by applying a systemic thinking, imbedding multiple criteria indicators and metrics.
Analyzing the articles from the database, it was observed that in the application of some methods for evaluating the development of sustainable agriculture systems, aspects such as economic yield, efficient use of resources, biodiversity conservation, carbon sequestration, food safety and social equity are included.
By integrating these indicators across multiple development areas, multicriteria methods provide a comprehensive perspective on the global performance of agricultural systems in terms of sustainability [8, 17].
In Romania, the agriculture sector plays an important role in the country's economic development providing essential resources for both local communities and the global market. With a rich agricultural potential and fertile soil, Romania has emerged as one of the key

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Vol. 24, Issue 2, 2024
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players in the European Union's agricultural ecosystem.

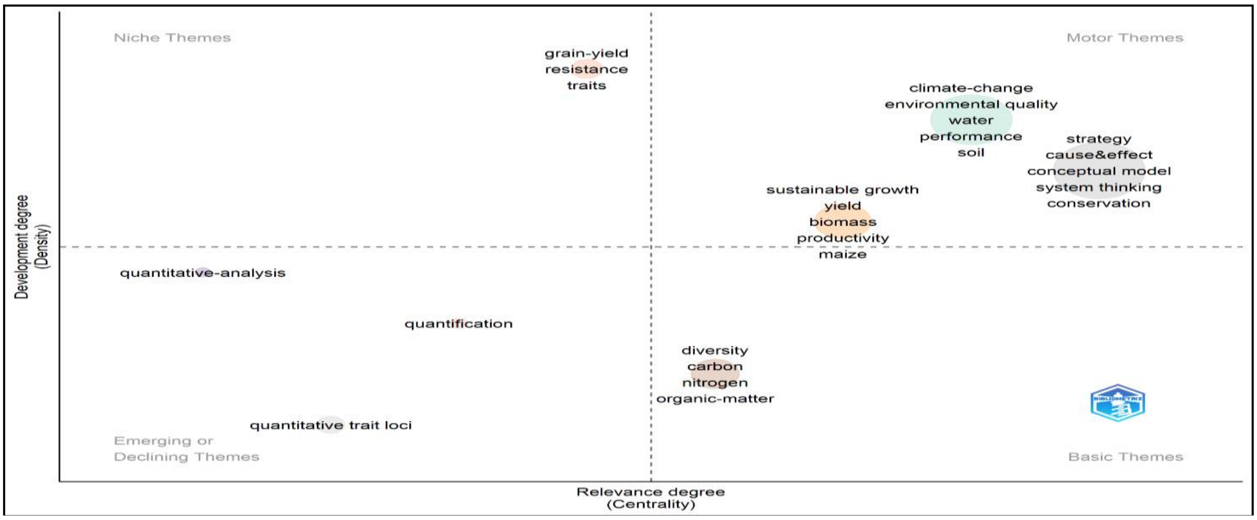

Fig. 4. Thematic map of keywords extracted from selected documents
Source: Biblioshiny own processing.

The development of modern farming techniques and the adoption of digital technologies have contributed to an increase in the average size of agricultural holdings, reflecting a shift towards more efficient and productive farming methods [12].

However, the agricultural sector in Romania still comprises a significant proportion of small, subsistence farms, highlighting the importance of recognizing their role in the development of rural areas.

As Romania continues to cross economic, social, and environmental challenges, sustainable agriculture remains a cornerstone of its growth strategy, promoting resource efficiency, resilience, and equitable development across rural communities.

The emphasis on non-financial indicators and the role of small farms in local development drives to the conclusion that we need to take into consideration the multi-layered nature of agricultural sustainability, which extends beyond economic profitability to include social and environmental considerations.

Analysing available data from various sources (official statistics, farm level surveys, literature, expert opinion) and using quantitative and qualitative analysis methods in research studies it can be provided to stakeholders a proof of concept of the dynamics of agricultural development.

The integration of multiple indicators covering economic efficiency, the use of available resources, actions towards the conservation of biodiversity, the techniques for carbon sequestration are aspects that need to be considered.

The economic efficiency and productivity may be measured by indicators such as yield, land equivalent ratio (LER), water use efficiency and eco-efficiency scores. Furthermore, several metrics were identified, such as net income, disposable income, and benefit/cost ratio (BCR).

The environmental dimension was described by indicators related to soil quality, nutrient cycles, carbon sequestration rates, nutrient status (N, P, K, Mg, Ca), soil microbial biomass, and soil organic matter.

Social aspects were tackled by investigations related to knowledge dissemination, awareness, gender balance, and youth inclusion. In the same category, indicators related to the involvement of farmers within professional networks emphasize the importance of community engagement and equitable development.

Therefore, considering the above bibliometric analysis, a set of indicators are provided in Figure 5.

This set of indicators and metrics cover various categories related to economic efficiency and productivity, environmental conservation and preservation, and social

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sustainability within the context of sustainable agriculture.

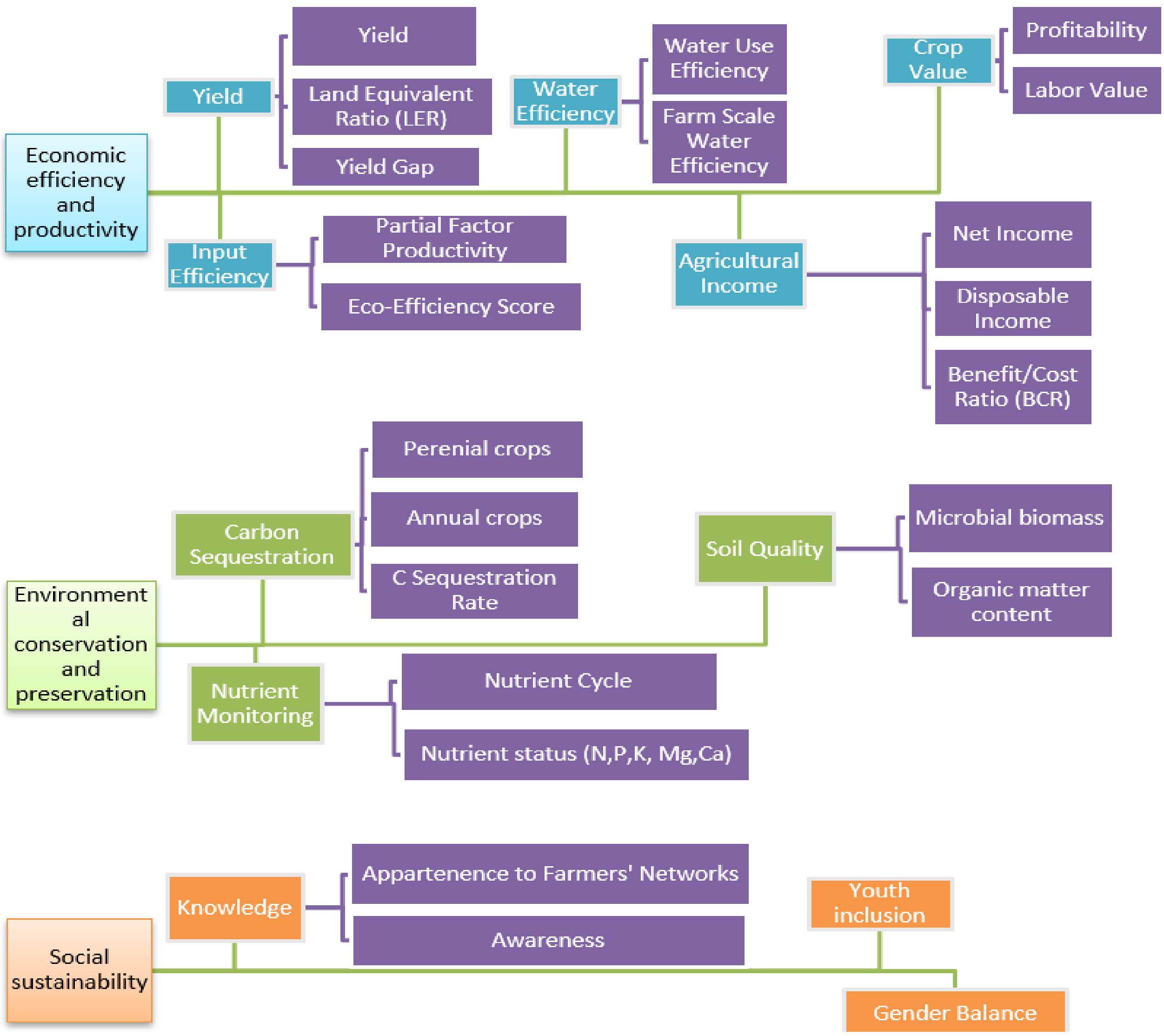

Fig. 6. Three pillars indicators for quantitative assessment of sustainable agriculture
Source: authors own processing.

CONCLUSIONS

So far, the literature on quantifying sustainable agriculture contains a rich variety of indicators and metrics for evaluating efforts in transitioning towards sustainability. These define relevant concepts for sustainable agricultural practices. Metrics represent critical tools for assessing progress towards these objectives and for evaluating trade-offs between them. However, some of the frequently cited indicators currently have few associated metrics, especially regarding the social aspects of sustainability. As future recommendation, an integrated approach that considers economic, environmental, and social indicators is for sure essential for the quantitative evaluation of the sustainability of the agricultural sector. Such perspective ensures that all relevant aspects are taken into consideration.

Furthermore, development of platforms that incorporate these multidimensional indicators identified above, and other metrics and various works as well as continuous data collection and analysis will provide better projection of the dynamics of agricultural development and inform evidence-based decision-making.

As the debate on sustainable development continues and gaps in the literature are addressed, it will remain the responsibility of researchers and stakeholders to select quantitative approaches for the objectives, constraints, and specific local context of each individual effort in sustainable agriculture.

ACKNOWLEDGEMENTS

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EVALUATION OF INSTITUTIONAL CHANGE IN TOUR AGENTS BRANCH - NEW INSTITUTIONAL ECONOMICS ANALYTICAL FRAMEWORK

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Abstract

The study aims to adapt an analytical framework for the analysis of the institutional environment and institutional change. The activity of the tour agents (TA), part of the tourism sector of Bulgaria in the period 2005 - 2021, was a subject of the study. The institutional impact is integrated with the transaction cost economics, monitoring the dynamics of rules and distribution of economic effects. Relative institutional analysis retrospectively follows the rules. Legal realism explains the institutions and measures used to resolve concomitant crises (Covid-19), turning them into synthetic values. Discrete structural analysis fragments processes and thus makes coordination clear. The adaptation of the actors is analysed by transaction cost (TC) measurement. The results show that the institutional changes are many and are designed in favour of the great actors. TC are increasing, and TA problems are systemic and are not a consequence of concomitant crises.

Key words: *concomitant crisis, financial incentives, institutional change, tour agents, transaction cost*

INTRODUCTION

The article aims to adapt an appropriate analytical framework for assessing the institutional environment. The subject of the study is the integration of Institutional impact and Transaction costs economics (TCE). The diverse mix of institutions located at different hierarchical levels is at the heart of complexly defined coordination mechanisms. The rules set the directions for the distribution of financial flows and cost effects. The intensity of the change is an additional “barrier” affecting the adaptation of the actors. On the other hand, the integration in the TCE analysis explains the institutional change at the micro level, setting the depth of knowledge about the considered system. Indirectly, the transaction costs (TC) measurement in the processes provides a new perspective for studying the adaptation of actors and formulating an assessment of the system under consideration - the industry of tour agents. The terms tour agent, respectively tour agent branch, are used in this study as a collective term of the categories tour operator and travel agent/agency, defined in Art. 3, par. 1, item 1 of the Law on Tourism (LT).

The subject - the tour agent branch - was chosen because of its dual role in the economic system.

On the one hand, due to EU law, similar mechanisms defining tourism and its activities exist in 27 countries. The cross-border nature of the legal framework creates positive effects related to the increase in capital mobility and the increase in the scale of contracts.

On the other hand, tour agents support the participants in the processes by maintaining low levels of information asymmetry, resulting from the activities in a common digital environment and the similarities of the mechanisms of the governance structure. On the other hand, their actions may be related to profit from non-market funds and capitalization of appropriated rights from the processes, i.e. rent-seeking (RS). The issue of process costs and their relation to RS is more detailed in [16]. [23] considers these costs to evaluate opportunistic behaviour.

They describe the existence of higher-cost process alternatives than the distribution of property rights, and the trajectories along which economic systems, sectors, and branches move.

The effects of the distribution of property rights represented as TC are the basis of this analytical approach for the TA industry. The aim of the study is to identify measure and justify the resulting institutional trajectories.

New institutional economics and tour agent's branch

[18 and 13] started the New Institutional Economics (NIE). The social architecture linking the micro and macro levels of social evolution [22] should be combined with the TCE [19] and the discrete structural analysis (DSA) [20]. The abstract fragmentation of processes through the hierarchy and subordination of the microanalytical actions of the actors underlies the governance structure [21]. [6] explains that institutional change should be driven by alternative changes to the contractual frameworks.

[25] developed a theoretical framework linking social transactions in tourism.

[11] uses NIE to explain the overt and covert objectives of private tour agents. The latter have created organisational models through which they force public institutions to change their behaviour during Covid-19. Such a change is driven by the transaction governance structure.

Tour agents (TA) are central institutional actors who control the processes in tourism [7, 15]. The coordination mechanisms of the services offered by the TA are analysed by [2]. [5] in the context of the conditions for supply-chain integration and shortening in tourism evaluate alternatives with the help of TC [14].

In this context, the paper aimed to evaluate the impact of institutions and governance structures on the TA branch, based on an analysis of the dynamics in the institutional environment in crisis conditions and the corresponding adaptation reactions of the actors.

MATERIALS AND METHODS

A comparative analysis of 27 formal institutions was made in this study. 507 are the surveyed TA firms for a period of 17 years. Information from 362 firms was used in the analysis of the distribution of payments in the TA branch in connection with the measures and state aid arising from the Covid crisis.

The impact of institutions and the two-way effects of governance structure is also interpreted retrospectively through the means of American legal realism [9, 10]. The rules are presented in synthetic form in Table A1. Thus, it can be explained whether formal institutions and their changes are more than necessary [24], i.e. to make a connection with adaptability by introducing “institutional error“ in the analysis. The “institutional error” is not the same as a negative effect. It incorporates the dualism of the premise and the effect of law and economics. Sometimes change improves the situation in the short term. At other times, the measured indicators deteriorate. For example, changes that lower individual TC may be assessed as unsuccessful at other times, both for the same entity and when measuring the total TC. The question arises: can we talk about a “failed” institution?

Quantitative TC values are measured as the sum of market costs suporting property rights [1] and non-market costs following subjective effort and time to complete the transaction [3, 4, 17]. [8] use TC as a measure of the adaptability of the economic system.

The measurement of the macro dynamics of institutional change is as follows:

$$TChI_N = \sum_{i=1}^{n} I_{ij}\ ; \quad j=1, 2,\dots\dots,m \qquad (1)$$

where:

$TChI_N$ - the total number of changes of institutions during the N-year;

N - the particular year of the survey;

I_i - specific institution (law, regulation, measure or tariff);

j - the sequence number of the corresponding change in Ii-institution during concrete N-year.

The approach for analysis of institutional change in the firms starting and closing their activity is similar.

The analysis of the dynamics of the coordination structure is done by:

(a) measuring the average duration of the entry and exit processes of the activities of TA firms;
(b) analysis of the ratio between the number of actors in relation to the number of transactions - their uncertainty, specificity and frequency. In cases where the change is bound only by positive values, the data find a place in the first quadrant of the coordinate system, when it is entirely negative - in the fourth quadrant. In other cases they are in the second and third.
Analysis of the change in:
- Uncertainty (un) of transactions - the average value is positive or negative in connection with the increase or decrease of their average number compared to the previous year. As the duration of transactions increases, the uncertainty increases;
- Specificity (sp) of transactions - the average value is positive or negative in connection with the increase or decrease of their average number compared to the previous year. When the number of “physical transactions” increases at the expense of “e-transactions“, the specificity decreases. “Physical transactions” are: movements from point A to point B; waiting - inaction in an administrative office; paper documents. “E-transactions” are in a digital environment: electronic documents, payments, etc.;
- Frequency (fre) of transactions - the average value is positive or negative in connection with the increase or decrease of the same type of transactions - their number compared to the previous year. As the number of transactions of the same type increases, the repeatability decreases.
The TC is measured as follows:
- Individual transaction costs

$$TC = TC_{market} + TC_{nonmarket} \qquad (2)$$

- Average transaction costs per year

$$ATC_N = \sum_{i=1}^{n} (TC_n)/n \qquad (3)$$

where:
ATC_N - average transaction costs per year;
N - the particular year of the survey;
n - number of measured processes, corresponding to the number of analysed firms.

Within the study, the TCs were calculated at the entry and exit of the system:
EnTC – entry transaction costs;
ExTC – exit transaction costs.

RESULTS AND DISCUSSIONS

Institutions, Institutional Change and Covid-19 in Tour Agents Branch

Institutions in the TA branch should be divided into three types:
coordination institutions - formal norms determining the hierarchy and subordination of the processes in TA activity. For example, these institutions, determining the sequence of transactions for firm registration or formally described deadlines, such as those in Art. 77 par. 1 of the Tax and Social Insurance Procedure Code (TSICP), or Art. 13 par. 4 LRA, etc. Or informal institutions, indirectly imposing certain deadlines. For example, informally determined deadlines for action of an administrative body in case of termination of the activity through liquidation of the property - the requirement for the administrative body to audit the payrolls in the firm Art. 5 par. 10 of the Social Security Code.
institutions directly determining costs - formal norms directly changing TC as the tariffs determining the amount of the administrative fees, which describe how much it costs to register a firm or obtain a license to start a TA activity.
financial incentives - traditional norms determining measures related to state or other financial assistance as the TA Grant Legal Acts in Relation to *Covid-19* and P-55 for insurance benefits for non-working staff.
The institutional change in the branch is marked by numerous amendments and additions to the existing regulations - a total of 254 for the study period, 29 of which are tariffs that have a direct impact on the amount of fees and hence the TC.
Figure 1 shows that the total number is increasing, and “clusters of legal changes” in

the TA branch can be seen in 2008, 2014 and 2019.

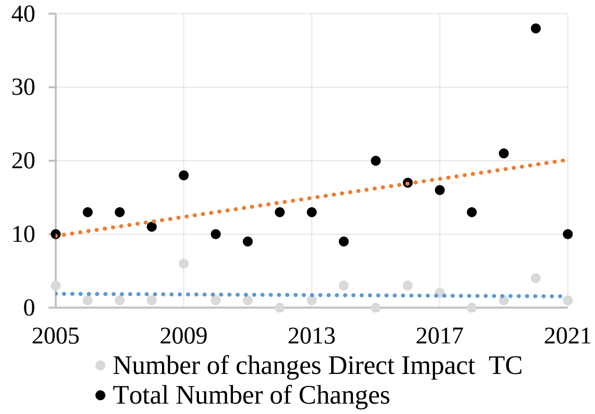

Fig. 1. Total number of changes per year in regulations and tariffs determining TC
Source: own measurement.

In the first of the years cited, many changes are a consequence of the introduction of digital process formats. This creates a completely new coordination of processes and, accordingly, worsens the adaptation of the actors. In the next two periods, the increase can be explained by new institutions introducing new fees and various alternatives. However, if the new alternatives require additional costs to be paid by the TA, the same changes should be considered as creating additional barriers.

Figure 2 presents the number of TAs starting and closing business for a period of 17 years. Since 2005, when 507 TA firms started operating, there has been a clear declining trend. The global economic crisis of 2008 has created, above all, liquidity problems. In contrast, the *Covid-19* crisis of the last 2 years is a consequence of structural problems. The decline in revenues of hotels and restaurants reached 53%, for cruise organisers and airlines the reduction was 91%, and for tour operators and travel agencies - almost 70%. The digital formats of the administrative services offered in the branch do not replace the lack of conducted activities and are used by only 3% of the firms in the branch.

The reduction in fees for working in the e-environment has been "absorbed" by the increase in administrative fees and private costs. TAs fail to participate in the distribution of these values.

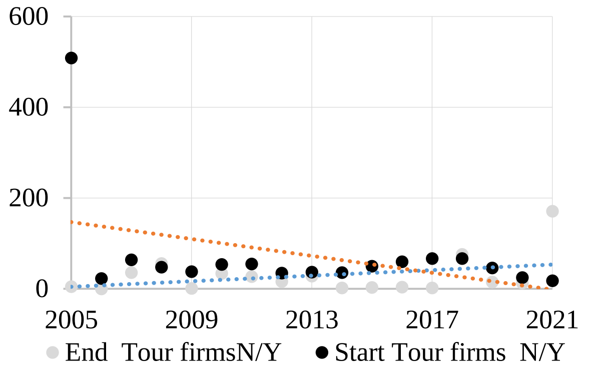

Fig. 2. Number of TA firms starting and closing business
Source: own study, adapted information from the Ministry of Tourism [12].

Measures, Allocation and Financial Flows

According to the European Union countries' plan for recovery from the financial crisis related to Covid-19, 2364.3 billion euros should be allocated. Bulgaria should receive funds under the three protective mechanisms, and TA firms can participate in the allocation of funds under: a.) measures for the tourism sector, b.) measures for small and medium-sized enterprises and c.) measures related to compensation for labour costs. Specifically for TA at the national level there are deliberately created measures. For the research period 2020 - 2021 the object of study were 362 TA firms that received payments under some of the measures.

Measure BG16RFOP002-2.092: 802 applicants, approved - 88%. The total amount allocated is BGN 10 million. 37 TA firms were surveyed.

Measure Support for SMEs / Operational programme "Innovations and Competitiveness": financial ceiling of BGN 150 thousand. 74 TA firms were surveyed.

Measure BG-176789478-2021-03 for reimbursement of amounts due to clients of tour operators in case of unsold tourist packages because of COVID-19. The total amount allocated is BGN 16,491,711. The amount provided is up to 15 percent of the turnover for 2019. Of the 120 applications submitted, 74% were approved. 97 TO firms were surveyed.

Measure BG-176789478-2021-02 for the provision of state aid to support TO, which provide tourist packages to consumers

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Vol. 24, Issue 2, 2024
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arriving in Bulgaria in order to mitigate the socio-economic consequences of the Covid-19 pandemic and stabilise the liquidity of TA. 38 TAs were surveyed.

Measure 60/40 on the granting of state aid for the payment of part of the labour costs, representing payments to employers for social security, in enterprises that have suspended their activities and have unemployed employees due to Covid restrictions. 75 TA firms were analysed.

Measure BG-176789478-2021-05 for state aid to ensure liquidity of enterprises with a reduction of at least 30/100 of the realised trade turnover - the company turnover in 2019 is taken as a basis. Total budget of BGN 30 mil. where 1 BGN = 0.51129 EURO. The amount granted may not exceed 20% of the turnover. The applicants are 2799 firms. The funds are paid after receiving a positive decision from the European Commission on the compatibility of the aid with the internal market on the basis of Art. 107 (3) (b) of the Treaty on the Functioning of the European Union. The annual turnover is calculated without VAT. The surveyed TA firms are 15.

There is a group of 19.7% of TAs who applied but was not approved and did not receive any amount. The smallest individually received amount is BGN 51, and the largest - BGN 2 million. The largest group - 89%, is that of the TA firms compensated with amounts up to BGN 10 thousand (Figure 3).

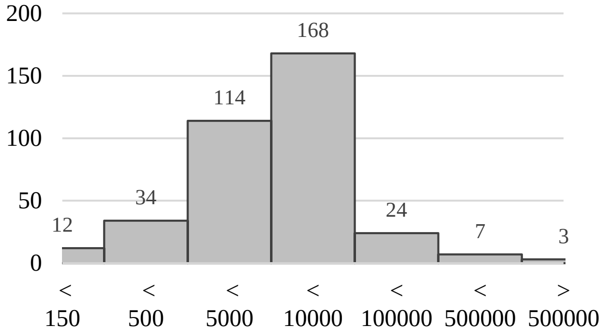

Fig. 3. Consolidated distribution - Number of TAs/BGN
Source: own study.

Such an amount of annual compensation is less than the average amount of the minimum wage for the country equated for a year, and is sufficient to support 0.8 workers in the TA branch.

Figure 4 provides information on what percentage of a firm's turnover is the aid received under Covid measures, with 2019 taken as a basis. A total of 5 of all 507 companies received support amounting to 20% of the budget they had before the crisis. Only 3 of the companies received funds exceeding - 10% of their annual turnover. There are firms that have received tens of millions in the form of aid, with the utilized amount representing 1.2% of their turnover. Large amounts are received from large TAs, and the proportional nature of the measures does not reduce the liquidity problems of small TAs. The tendency for termination of business of TAs has not been stopped.

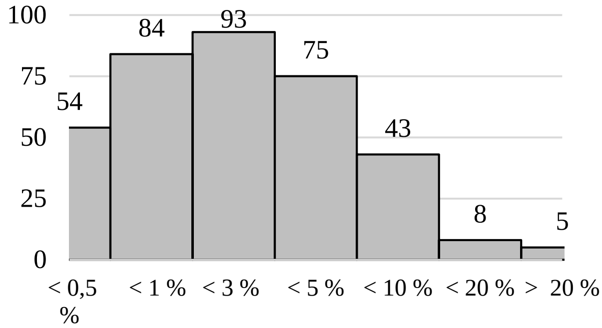

Fig. 4. Consolidated distribution - Number of TAs / funds received % of turnover
Source: own study.

Evaluations of tour agents branch. Governance and TCE perspective

The total duration, both for starting and terminating business, increases (Figure 5).

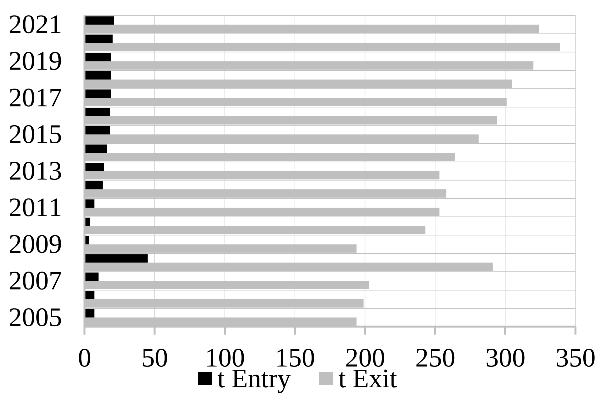

Fig. 5. Time required carrying out the business activity in days
Source: own study.

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The existing "peak" of the increase in duration in 2008 coincides with the introduction of the TP e-form. The trend for 2005-2021 is for processes to "slow down". Part of the explanation can be seen in the following coordination diagram.
In some periods the staff decreases, which is accompanied by an increase in the number of physical transactions and their duration. Uncertainty, specificity and frequency increase (Figure 6).

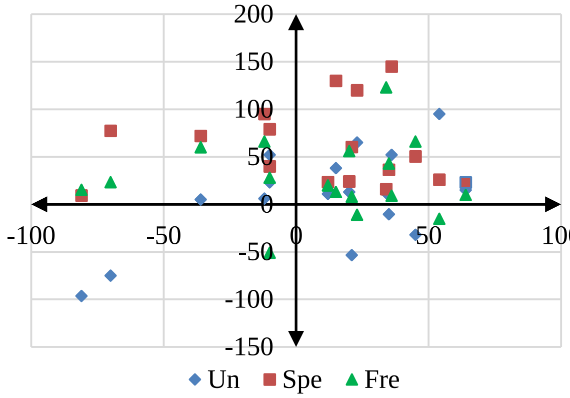

Fig. 6. Uncertainty, specificity, frequency in TA branch
Source: own study.

This means that the time for transactions in the sector, as well as their dependence on physical actions is increasing. We find that specificity is always increasing. This means that the introduction of electronic formats has not reduced the total number of transactions. This conclusion is confirmed by the increase in frequency. Most of the duplicated transactions were for movement, which did not allow their merging.
TC (Figure 7) - both at the start of the business activity and at its end - increase as at the end of the period – "entry costs" are four times higher and "exit costs" - approximately seven times higher than those in the beginning. Market TCs have increased the most (3 times), including payments to those actors who support and assist in the coordination of processes: lawyers, administrative services.
Non-market costs have also increased. Only 15% of firms have managed to realise governance savings in their activities due to the use of e-transactions.

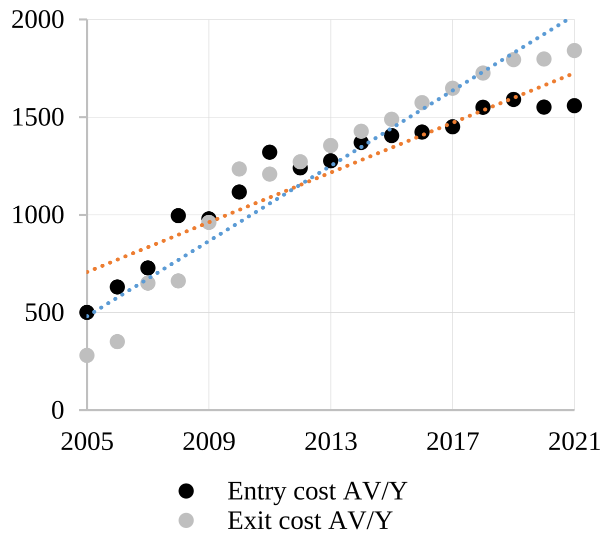

Fig. 7. TC for starting and terminating TO business
Source: own study.

CONCLUSIONS

The results convincingly show that:
Institutional change creates a dual effect. Negative and positive results can be reported simultaneously, as the indicators that are measured increase their numerical values. Frequent changes in legislation require intensive institutional change, which in turn should be associated with a negative impact on the adaptation of actors in the economic system. Improperly designed financial incentives are not in favour of most actors. The resulting inefficient distribution of financial flows does not solve liquidity problems and exacerbates structural problems in the branch. Actors exiting the markets are becoming more than those entering them.
There is no consolidation of the processes in the studied system. This gives reason to believe that e-alternatives do not always create more efficient processes. When coordination mechanisms lead to an increase in uncertainty and a decrease in the specificity of transactions, even in the case of multiple frequent transactions of the same type, there is always a general increase in transactional TCs.
The problems in the institutional segment under consideration - the TA branch - should be defined as systemic and not as a consequence of the financial crises. The imposition of intensive legislative change, accompanied by the creation of digital process

formats and proportional financial incentives, does not lead only to positive results. We allow the possibility of developing institutional errors.

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APPENDIX A

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Table A1. Total number of changes of institutions during the period 2005-2021

No	Identification	Formal institutions (regulations, schemes, measures)	Amend-ments (2005-2021)
Laws			
1	CRB	Constitution of the Republic of Bulgaria	1
2	ML	Commerce Act	47
3	LRA	Commercial Register Act	28
4	LES	Law on Measures and Actions during the State of Emergency, announced by a decision of the National Assembly of 13 March 2020, and on overcoming the consequences 2020);(Title. suppl. – SG, no. 44 of 2020, effective from 14.05.2020);	18
5	LESD	Law on Electronic Signature and Document	10
6	LEM	Law on Electronic Communications	59
7	LT	Law on Tourism	11
8	LMFEU	Law on the Management of Resources from the European Structural and Investment Funds	10
Normative acts: ordinance, tariffs, regulations			
9	N -16	Regulation № 16-1399/11.10.2013 on the requirements for the location, suitability and equipment of the premises for carrying out tour operator and/or tour agency activities and on the education, language qualification and length of service of the staff;	1
10	N -261	Regulation № 261 of 13.07.2006 on the common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing	1
11	N-18	Regulation N-18 of 13 December 2006 on recording and reporting sales at retail sites by means of fiscal devices, the requirements to the software for their management and requirements to the persons who make sales through an e-shop (title amend., SG No. 80/2018)	34
12	P - 57	Decree № 57 of 28 March 2017 on the adoption of the Regulation on the identification of irregularities, grounds for financial corrections, and the percentage indicators for determining the amount of financial corrections under Law on the Management of Resources from the European Structural and Investment Funds.	1
13	N - TRD041	Regulation № T-RD-04-1 of 22 January 2021 on the procedure for granting persons performing tour operator and travel agency activities to compensate for losses due to the epidemic outbreak of COVID-19;	1
14	N - CT	Regulation on children's and students' tourist trips	1
15	P - 55	Decree № 55 of 30 March 2020 determining the terms and conditions for payment of compensation to employers in order to maintain the employment of employees in a state of emergency, declared by a decision of the National Assembly on 13 March 2020.	2
16	TNF	Tariff for notary fees	2
17	TAF	Tariff for attorney's fees	9
18	TTF	Tariff for fees under the law on tourism	7
19	TTAR	Tariff for fees collected by the Registry Agency	11
Measures/Mechanisms			
20	M 60/40	Compensation to employers in order to maintain the employment of employees	-
21	BG-176789478-2021-02	State aid scheme for tour operators using air carriers with a valid operating license to operate charter flights to the Republic of Bulgaria for tourism purposes.	-
22	BG16RFOP002-2.092	Support scheme for companies registered under the Law on Tourism as a tour operator or travel agent to overcome the economic consequences of the COVID-19 pandemic.	-
23	BG-176789478-2021-03	Grant scheme for persons performing TO activities for reimbursement of amounts due to customers for unrealized trips in the period from 01.03.2020 to 31.12.2020 due to the outbreak of COVID - 19.	-
24	BG-176789478-2021-05	Support scheme for companies engaged in tour operator activities - companies affected by the decline in turnover excluding VAT in 2020.	-
25	MMF	Measure “Support for small and medium-sized enterprises to overcome the economic consequences of the COVID-19 pandemic”. Under the Operational Program “Innovation and Competitiveness” (OPIC).	-

Source: own qualification.

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ANALYTICAL FRAMEWORK OF THE CONTRACTS IN BULGARIAN AGRICULTURE – NEW INSTITUTIONAL ECONOMICS (NIE)

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Abstract

This article analyzes the agricultural contract through the eyes of the NIE. The article has built its analytical framework on contracts in agriculture. This choice was dictated by the presence of more than 40 enumerated forms of the types of contracts, and the research realizes that such an enumeration is conditional and not exhaustive. The need to find specific forms of management of common resources - water, land; of general products - for example the "quality schemes" known by the CAP; the need for rapid deployment of specific technologies that are needed to derive synergistic benefits from ecology and agriculture; solving the food and farming problem. The agricultural contract is defined as a social category combining: (1) a system of interconnected institutions, uniting common rules and contractual clauses; (2) market and non-market, contractual and non-contractual processes; (3) a hierarchical structure combining heterogeneous, hybrid economic mechanisms of exchange. Relying on the theory of Governance structure (GS) and the theory of the hybrid contract, the study matches the classical understanding of contract law and the procedural nature of the neoclassical organization, with the modern understanding of the economy as a system of contractual and non-market relations. A unified analytical toolkit is proposed for the subordination of relationships between companies, administrative hierarchies, hierarchies including arbitrators, in property rights disputes; market and non-market contracts, the hybridity of the technological process and the essence of the organization as a type of procedure.

Key words**:** *contract, institutions, legal forms, governance structure, agriculture*

INTRODUCTION

This article aims to clarify the nature of the agricultural contract in the New Institutional Economics (NIE) context. This means analyzing contracts as part of legal, economic and organizational theory, and at the same time explaining the specifics of contracts in agriculture. According to the NIE, a contract can be both an organizational structure, a system order, a process and together with this a rule of conduct.

Institution has a dualistic meaning, it can be both a rule of conduct and an organizational structure, but if we look at the contract, we will see that it has the same characteristics. Because of the dualism of contracts, rules and organizations, is it necessary to develop a universal, comprehensible, easy-to-use analytical structure? We must ask ourselves: what exactly is a "contract"? The legal approach differentiates the contract according to its legal forms. For example: sale, lease, donation, division, etc. It is suitable for a fragmentary analysis of the means of acquiring property and its protection. In reality however, contracts prevail, often informal, with a difficult-to-define form, for which the legal form implies a multitude of desired and undesired effects, most of which are not only legal.

Externalities accompany every contract, and in the translation of subjective rights, there is a real diversity defined by the forms generated especially in some of the quasi-markets. For example, those related to servicing fee payments, indirect costs related to the actions of supplying some document or additional actions to secure available information. The question arises: how to analyze and compare contracts with different functions, different durations, which overflow into other legal forms, and sometimes become institutions of a new type. When is it more appropriate to use the different market forms of contracts, such as those of lease and sale? In which case is the legal form more effective? How to make objective comparisons if, due to the different time frames of the sale and the lease, it is difficult to compare the actual cash flows?

The same applies in cases of comparison of market and non-market contracts, for example: donation and division of agricultural property. Or contracts containing one legal relationship with contracts containing multiple legal relationships but with a different legal form, for example: a contract of sale between one buyer and one seller, to be compared with a contract with assignment of company property between several partners.

On the other hand, it is important to mention that many of the contracts merge with other unilateral legal transactions, which are protected by actions similar to administrative processes, and sometimes, the same pass into disputes about subjective rights. All this indirectly affects not only the original contractors but also third parties. For example, in the purchase and sale, we can have an authorization, from which follows a preliminary contract of purchase and sale, in turn leads to the conclusion of a final contract, during which a series of documents are drawn up (these are administrative processes that themselves can be part of a separate quasi-contract) and finally even lead to a new trial, this time a judicial one.

Formally usable for analysis contract forms that use individuals, firms, households, public and private entities, classical type investors - all other institutional actors usually do not create conditions for balancing different interests - all kinds of issues. That is, very often modern legal doctrines allow to be seen as a single alternative in which both rules and process effects are integrated to see a larger overall picture of the social structure in a long-term horizon.

In agriculture, the assessment of these relationships is further complicated by the difference in governance of the assessment of contractual frameworks arising from the employment of family farms, and the assessment of subjective property rights as homogeneous, when in fact, the dependence of contractual frameworks on natural resources and the natural environment, on the other hand, the inhomogeneity of the goods. Developing an appropriate analytical framework for agricultural contracts is of key importance for the analysis, respectively, for solving the food and farming problem.

NIE tries to adapt it to such frameworks by including in the analysis and management of public costs. It is a challenge to bring together horizontal and vertical organizations with mixed functions representing a mix of hierarchies, market and hybrid forms. Governance structure (GS) theory helps with this. Public relations occurring in the territory of Bulgaria have been chosen as the subject of the article. However, this is conditional because the cross-border element of modern contracts/contracting organizations cannot be avoided.

The study goes through:

- Identification of the available legal, economic, and organizational theory.
- Comparison between different contract forms.
- Description of the agricultural contract in the NIE context.
- Analyzing the dependence of the agricultural contract on transaction costs.

MATERIALS AND METHODS

The methods used are: (1) positive legal analysis, which serves to describe some of the legal acts; (2) a combination of comparative legal and comparative institutional analysis to compare institutions, rules and different forms of contracts; (3) discrete structural analysis to compare the characteristics of different contractual forms, as part of some longer-term and effects-integrated institutional alternatives.

RESULTS AND DISCUSSIONS

The contract from the point of view of law, economics, and organizational theory

From a legal point of view, a contract is an agreement between two or more parties with the aim of settling, changing, or terminating a legal relationship between them. At the same time, theories of the state and law allow general rules, such as the basic laws of states - constitutions - to be analyzed as a kind of "social contract". This 'technology' of public relations has also been adopted by EU legal doctrine. The founding treaties of the EU impose a public legal order in which the method of equality, characteristic in the principle of private contractual relations, is combined with an imperative approach known from the way in which legislative acts operate. On the other hand, at the level of market exchange, the contract has the character of agreed rules, clauses, thanks to which the interests of the subjects are realized, the same infiltrated in a narrower framework of relations, but dependent on the general legal order and public rules.

With the Treaty of Rome, for example, the agricultural policies of the Member States are introduced, and as for the agricultural market contracts, including those through which the daily relations between farmers are carried out, they are perceived as relations of a secondary nature. There is a conflation of general rules with those that determine the order between private subjects.

The types of private contracts from the point of view of law are unilateral, bilateral, multilateral, causal, consensual, aleatory, and accessory. Legal theory also divides them into civil, commercial and others, formally distinguishing the economic from the other functionality of relations. The speculative purpose of any commercial contract may not establish a level playing field between the contracting parties. Who and what exactly gained and whether someone did not lose from the exchange of property rights transfer - cannot always be determined. Therefore, the contractual organization should be known discreetly, simultaneously in a legal, organizational and economic aspect (Table 1).

Table 1. Contracts according to Law, Neoclassical Economics, and NIE

	Law	Neoclassical Economics	NIE
Nature	Agreement to initiate, terminate, change legal relationship	Exchange of assets	Exchange of assets Institution; Company; Hierarchy; Market; Exchange of subjective property rights in process
Structure	Legal structure	Market perspective	Governance Structure (GS)
Types	Written, oral; notarized, registered, etc. Consensual, remunerative, aleatory. One-sided, two-sided, multi-sided, etc.	Biliteral	Formal; informal Classical, neoclassical, relational (behavioral). Hybrid contract
Forms	Purchase and sale, lease, rent, service loan, mortgage, donation, division, etc.	Sale or lease	Completed contract. Incomplete contract.
Number of parties	Two parties or more	Always two parties	One or more parties involved in the proceedings
Relationships	Obligation (performances)	Goods are exchanged, and specific relations in services	Biliteral or quasi-relations
Actors Contractors	Buyer – Seller. Tenant – Lessor. Donor – Gifted. Partners, etc.	Buyer – Seller.	Rights holders. Actors Agents Arbitrators

Source: Own research.

A combined understanding of the contract because of economics, law and organization is the foundation of the WE approach [80].

[49] believes that a special distinction should be made between contracts in which goods are exchanged, for example, commercial contracts and labor contracts. These differences follow not only from differences in the method of legal regulation. The differences are both in the *ex-ante* moment of conclusion, and in the ways of terminating a contract *ex-post*as a consequence not only of the execution but also of the legal framework, show that the economic goals characteristic of contracts with the exchange of property rights [2, 3] goods cannot to be applied analogously.

[77] makes a further distinction between intra-firm and extra-firmcontracts [81], but in his explanation, this distinction is related to the idea of the problem of organizational boundaries. By the law, some companies can enter into agreements with the administrative body, that is, to move from *relations* of an orderly nature to those of a market type [57]. In some multilateral contracts - owners of one legal entity-company participate in a

partnership with managers of the public. The spillover of egalitarian, hierarchical legal regulation forms the basis of an instrumental explanation of the boundary processes of market and organization [19, 20].

[34] states that the abdication of courts of regulatory authority through business judgment rules can be seen as a significant contribution to corporate governance. The courts are sometimes substituted in deciding the legal dispute. The institutional environment has imposed a new role for arbitrators to guide understanding [41, 31]. However, the idea of them resolving their legal disputes is an idea of blending contract types into a single [33] framework, which not only reduces opportunism but also evaluates long-term alternatives. To this concept, we can also include contracts imposed by administrative or judicial order [67].

The NIE directs the meaning of what a contract is to an integrated process in which different alternatives are more easily evaluated.

The contract as a Governance structure (GS). Types of contracts.

[76] considers the contract to be an institution in which the exchange takes place. As already explained according to the theory of state and law, contracts are a unit of measurement of the whole social structure [79]. On the other hand, they are an economic organization [78] and which allows relations to be analyzed discretely and bilaterally. The contract combines the idea of a single structure - GS - a symbiosis between different forms of "markets, hybrids, hierarchies" [78], vertically integrated [75], subject to a single governance [78]. The GS describes the contract approach, as a way of unifying relations in GS according to the idea of [78].

According to [48] and [36] the firm is a structure creating a hierarchy through which power is exercised. The firm is an indivisible process-technological set of competencies [22, 23, 74].

[37] argued that the firm is an artificial order. [73] considers the firm to be a corporate actor-institution.

[4, 46, 27, 61] consider the firm as a contractual form. Apart from the firm-market dichotomy, the authors gradually move us towards the thesis that the firm is not just a collection of assets and property, but a structure in which hierarchical control is exercised through certain contractual relationships [39, 40].

Table 2. Governance structure

	Market	Hierarchies	Hybrids
Essence	Contract processes and market mechanisms	Companies, Administrative and Judicial bodies	Institutions; organization. Actors and organization.
Integration	Looking for subordination of transactions horizontally	Looking for subordination of transactions vertically	Looking for subordination of transactions horizontally and vertically. The possible trade-off between physical and e-transactions is being sought.
Forms of exchange	Exchange of subjective rights in contracts. Exchange of subjective rights in quasi-trials	ST; Companies; Cooperatives; Incorporated companies. Rights in administrative and judicial processes	Assignment of rights (franchise). Technological. Related to the management of general property management. In the conditions of new analytical frameworks in which legal forms merge
Analytical framework	According to the legal form	According to the organizational form	Time (process) analytical framework

Source: Own research.

Hybrid relations are observed in association and interfirm cooperation [1, 55, 26].

Cheung (1969b) examines agreements that mix the form of the contract as well as its physical and technological nature [17, 18].

[14, 35, 60] in their research consider the contracts that are characteristic of the joint sharing and management of resources and also the management of common property [25].

Hybrid contracts can merge economic and legal organization, unite opposing functions and create a "balance" in the analysis of institutional and technological structures, that is, compare alternatives as a special type of contract.

Contracts in agriculture. Examples from the Bulgarian reality.

Agricultural contracting has been studied by [5, 6, 7, 16, 17, 58, 62, 65, 68].

As a coordination management structure it was studied by [8, 9, 10, 11, 13, 15].

These authors use NIE as a tool to solve production, system and other, for example, political problems of the agricultural environment.

Due to the instability of the markets caused by the inelasticity of the demand for food and the inflexible factors of production, as well as the excesses in the supply which means a strong rise in prices. The EU introduced numerous policies (CAP) in which it applied the contractual-dispositive principle and the administrative-imperative regulation of agricultural processes. The EU has left member states to regulate their markets for production factors relevant to agriculture, intervening only where EU law is breached

On the other hand, to increase competition, regulations related to commodity markets (food markets) (*EU Regulation 1308/2013 on competition in agricultural markets*) [29] were introduced, as well as special mechanisms for these markets to function through more effective contractual forms (*Regulation EU 1151/2012 on food quality scheme)* [30].

Along with standard contractual forms such as: lease, rent, donation, division, establishment of the right to use land, agricultural lands, special hybrids were created, such as: *(a) official establishment of servitudes in the sense of Art. 24 para. 13 and Art. 25 Art. 4 of Law on Ownership and Use of Agricultural Land (LOUAL), 1991* [44]*; (b) the agreements under Art. 37c, LOUAL, 1991 as well as a number of mechanisms such as the one for the conversion of transactions (Resolution of the Cassation Court, 2015)* [59], *with which they facilitated horizontal integration. Similar were the motives for building type-specific contracts for agricultural goods and food, such as the quality "schemes": (a) for the protected designation of origin (PDO); (b) the protected geographical indication (PGI); (c) food with a traditionally specific character (HTSC), etc.*

To these agricultural contracts, we should also add some classic organizational forms for doing agriculture, such as agricultural cooperatives [63], food production companies and trusts for the management of agricultural lands - under the Law on companies with a special investment purpose and securitization - most often functioning as companies, as well as some specific entities from the sector, working as Agricultural Associations with registration under the Law on Non-Profit Legal Entities (NLA) [45]. Mainly for these organizations, their management structure, like other relationships, is a complex mixture of other bilateral relationships and increasingly - it would easily fit through their analysis, as the contract organization, which is a kind of hybrid.

Along with them, almost a whole range of types of employment contracts are used, including one-day contracts under *Art. 114a Labour Code (LC), 1987* [42], some of them combined with other contracts even aleatory insurance contracts and others.

Insurance contracts for agricultural produce, livestock and other property are characterized by premiums that are paid for higher risk than other sectors. Neither the random event nor the payment of the premium has anything to do with the duration of the contract. These contractual frameworks are often combined with contractual alternatives for financing agricultural production or project forms for participation in the process of subsidizing from EU funds. Table 3 presents the subordination between institutions and contracts in agriculture. The interaction between legal formal institutions and contractual forms is shown in gray. In practice, this means representations of the hierarchy of legal sources and the corresponding use of legal forms with which rights are transferred and contracts are implemented. In the northern part of the table, contracts with classic legal forms known from the law are shown in part. From the perspective of governance structure theory, these agricultural contracts are market-based. In the northwest corner, administrative and other processes are represented, which according to the governance structure theory are hierarchies. In many cases, these processes do not exist separately, but as part of market processes. In the southeast corner are represented the different types of companies, which are implemented another type of hierarchy. At the same time, the modern agrarian company is a real mixture of different functionality and can also be considered as a hybrid contract. In the southern part of the table are the typical hybrids. In the western part are the institutions.

Table 3. Contracts in agriculture – NIE perspective (examples from Bulgaria)

	Classical	Neoclassical	Behavioral	Hybrids
Law (perspective)	Unilateral transactions (refusal of inheritance, will, power of attorney)	Purchase and sale. Agricultural land lease Insurance contracts[1]	Employment contract. Tolling agreement[2]. Loan for service between relatives. Membership in an organization of agricultural producers.	Procedures: Art. 37c of the LOUAL (1991) [44] Organizations under Regulation 1308/2013 (EU Law) [29] EU Law (infringement procedure)[3][28] Other Procedures[4]
Process (perspective)	Processes and administrative proceedings for extracting documents. Registration and entry processes.	Trades on the commodity exchange. Bargaining. Futures and forward contracts, Options, etc.	Opportunism in contracts of any type. Transactions in shares of agricultural enterprises Lawsuits	Common trademarks. Common property (resources). Virtual organizations (hubs). Electronic systems for applying for a given measure (for example a measure under the National program "Beekeeping") "Quality" schemes (EU Law) [30] Virtual organizations(hubs). Judicial process: Art. 108 of the Property Act (1951) [72] Art. 14 (3) of the LOUAL (1991) [44] .
Actors (perspective)	Holders of subjective property rights: Administrative services. Notaries. Lawyers. Intermediators[6]	Holders of subjective property rights: Institutional Intermediaries: Stock Exchanges. NLA(NGO). Associations.	Holders of subjective property rights: Institutional Arbitrators. BG Courts. EU Court of Justice. Other type jurisdictions: testing laboratories and CIRAD[6].	Holders of subjective property rights: All

[1]*See* aleatory - an uncertain, random event.
[2]These contracts can also be considered as manufacturing contracts (See Art. 258-269, Law of Obligations, 1951) [43].
[3]French Agricultural Research Centre for International Development (CIRAD).
[4]*See* the agreements under Art. 9 of the APC, 2006, which substituted the commencement. On the basis of Art. 20 of APC, 2006, administrative bodies may enter into agreements. See also the possibilities for agreements under Art. 16 of the Administrative Procedural Code (APC) [69], carried out by the Prosecutor. Agreements are also concluded by the financial authorities, as well as by virtue of membership in international organizations (Articles 134e-134g of Financial Tax Procedure Code, FTPC 2006); between the financial authorities Code FTPC, 2006). between the financial authorities of the state (art. 143 para. 6, para. 7 of (FTPC, 2006) and by virtue of a legal relationship occurring between the financial authority and the addressee - subject of obligations (Art. 154 of FIPC, 2006). Such are also the substitutions for the agreements, which terminate the process and operate with the force of res judicata, replacing the legal dispute (Art. 140a and 140b; Art. 330 of the Penal Procedure Code (PPC, 2006) and Art. 384 para. 2 of the CPC, 2008; art. 24 paragraph 3 of PPC, 2006 and art. 330 of PPC, 2006).
5*See* the parties to the agreements Art. 145 of the Code of Civil Procedure (CPC, 2008) [70] , part 149 of the CPC, 2008 Art. 384 par. 1 of CPC, 2008; to settlement by arbitration agreement (Art. 19 of CPC, 2008), referral to mediation (Art. 143 b of CPC, 2008)).
[6]Procedure for agricultural lands against 5 countries including Bulgaria.

Source: Own research.

In the event that their subordinate character is accepted, the impact of imposing some order on the other forms - that is, the institutions can be considered both as a prerequisite and as a continuation of the listed contracts. In the lower, southern part of the figure, the effect of part of the integrated contractual frameworks - the transaction costs - is placed.

Such an approach combining agricultural institutions, simultaneously with contractual forms, which in turn are woven into markets, hybrids, and hierarchies, allows the deployment of a systematic analysis of agricultural contracts.

Agricultural contracts and transaction costs.

Transaction costs are dependent on the degree of integration in the contract [64, 50]. On the other hand, the degree of integration in the contract is always determined by its uncertainty [56, 60]. According to such a paradigm, market contracts will impose the highest transaction costs, which will decrease in hybrid contracts and will be lowest in

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hierarchies [51]. However, the latter should be true only in a classical analytical framework that does not include the time factor in which a given contract unfolds. We do not see an obstacle when switching from one contract form to another, that is, in the case of "plural forms" [52, 53], some forms such as those of hybrid contracts have higher transaction costs than market contracts.

Transaction costs in agricultural contracts provide information about the price of different contract alternatives. Their discrete structural analysis directs the types of contract forms - how to use a contract, and how to plan the overall economic activity [12, 32].

Table 4. Governance between institutions and contract forms = Effects = Transaction costs

	North																
West		CONTRACTS Examples:	Purchase and sale	Rent	Lease	Donation	Division of agricultural land	Easement of property	Right of use	Notarial deed on Circumstantial verification	Bequest of property/agricultural land	Disinheritance	Mortgage in consequence loan	Inheritance	others		*East*
	INSTITUTIONS Examples:		a	b	c	D	e	f	g	h	i	j	k	l	m	HIERARCHIES Examples:	
	PA(1951)[1][72]	1														Procurement of documents	
	LOUAL (1991) [44]	2														Acquisition of information	
	CPC (2008)[3][70]	3														Agricultural farm - household	
	SPL (1996)[4] [66]	4														Ltd.	
	MPA (1996)[5] [54]	5														General partnership	
	IA (1949)[6] [38]	6														Joint-stock company	
	EU Law[7][26]	7														Non-profit legal entity (NPE)	
	Tariffs[8] [71]	8														Agricultural cooperatives	
	DCC, 2014[9] [21]	9															
			Procedure / Agreement Contract													HYBRIDS Examples:	
			EU Quality schemes Digital forms Law Disputes														
Transaction costs																	
	South																

[1]Property Act, 1951 [72].
[2]Law on Ownership and Use of Agricultural Land, 1991 [44]
[3]CPC, 2008 - Civile Procedure Code [70]
[4]State Property Law [66]
[5]Munsipal Property Act 1996 [54]
[6]Inheritance Act, 1949 [38]
[7] EU Law – EU Regulation 1308/2013 (Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013 [29] establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007
[8]Tariff for Notary Fees under the Law on Notaries and Notarial Activities, 1998 [71].
[9] DCC, 2014 -See Decision No. 1 of January 28, 2014 of the Constitutional Court in Constitutional Case No. 22 of 2013 [21], SG No. issue 10 of 4.2.2014 in connection with a violation of Art. 22 par. 1 of the Constitution and of § 3 "Free movement of capital", item 2 of Annex VI: The list under Article 20 of the Accession Protocol, Transitional Measures, Bulgaria from the Treaty of Accession of the Republic of Bulgaria and Romania to the European Union (TARBREU).

Source: Own research.

Sometimes it would be more profitable to use activities with completed contracts (sales) and in other cases - unfinished (leases), but this is only one side of the question [7, 16]. Transaction costs can be used to justify a decision in choosing the most appropriate legal form of a company (Ltd.; SA) that will carry out a certain activity (Table 4). Their measurement would make more effective both the decisions to start a business (regulation entry) and the costs of (exit) - the exit of a given economic entity from a certain agricultural market or the economic system upon termination of the activity of an agricultural company [24]. The amount of transaction costs can be the reason for the existence or the transition from one to another contractual form [47].

CONCLUSIONS

A contract can be thought of as an institution and a system of rules of conduct. On the other hand, it can be like a legal form, but also a social technology (mechanism) through which process alternatives are measured. Firms and other hierarchical structures can be analyzed in a bilateral context, as a special type of contract. Agricultural contracts can be considered as a hybrid, and their analysis takes into account:

(1) Specificity of resources. For example, contracts for the lease of agricultural land, which have a strictly separate subject, which, despite the analogy, are different from similar contracts for the use of property in other spheres. They should combine an administrative approach and the dispositive principle (see again the procedure under Art. 37c, LOUAL, 1991) [44] . The situation is similar with quality schemes and others. The hybrid contract is suitable for the analysis of cases with common ownership or a mixture of standard and e-technologies.

(2) Employment contracts. Of particular importance are family and farm employment contracts, the latter of which can be considered in a bilateral context but taking into account the differences from typical firms and seasonal activities in the sector. Contracts serving to reduce risk - cannot be applied, such as contracts for insurance of agricultural inventory and agricultural production but can be part of a system of a general alternative framework with financing contracts or labor contracts.

(3) Market agricultural organizations, as well as their accompanying hierarchies, can be analyzed as a system of steps and procedures. At the same time, they can combine administrative, judicial processes and market mechanisms in a common framework. The situation with organizations registered as companies is similar. They can be part of a system of contracts with a market and a non-market element, in which ordinary bargaining and an administrative hierarchical approach to problem solving can "coexist" in parallel.

(4) Transaction costs are influenced by the form of the agricultural contract. They are consequences of the chosen legal forms but can determine the decisions related to the use of certain types of contracts. There is a lack of indisputable evidence, including empirical evidence, that a given legal form leads to lower or, on the contrary, to higher transaction costs.

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AQUACULTURE IN TRANSITION: PREDICTIVE INSIGHTS INTO ROMANIAN AQUACULTURE PRODUCTION

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Abstract

The significance of aquaculture in contributing to global food security is well-established, especially as traditional fishery yields plateau. Recognizing the essential role of hatcheries and nurseries in sustainable development, this paper examines Romanian aquaculture, predicting production trends until 2034. Employing time-series analysis via Microsoft Excel, it forecasts production at various life cycle stages, from eggs to juveniles, excluding mature aquaculture outputs. The study highlights expected outputs alongside their associated confidence intervals, pinpointing potential fluctuations. The forecasted trends in Romanian aquaculture highlight the potential for growth in the sector, reflecting an industry poised to meet future demands. However, the variability encapsulated within the confidence intervals suggests that stakeholders should remain adaptable to changes. Strategic planning should therefore incorporate these forecasts while also considering environmental, economic, and technological developments that could influence production. The findings underscore the need for ongoing research and adaptive management to maintain and enhance the contribution of aquaculture to food security and economic development in Romania and beyond.

Key-words: *aquaculture forecasting, fish production, hatcheries and nurseries, food security*

INTRODUCTION

Aquaculture holds a pivotal position in bolstering global food security, particularly as the demand for high-quality animal protein escalates in parallel with the world's population growth [13, 7, 9, 1]. This surge in aquaculture has been crucial in offering a sustainable seafood source, notably in low and middle-income countries, where it plays a significant role in enhancing food and nutrition security [15, 18]. Recognized as one of the most efficient methods of animal protein production, aquaculture is instrumental in mitigating food shortages and augmenting human nutrition [24, 12]. Hatcheries, nurseries, and fish egg production emerge as essential components within the aquaculture development framework, facilitating the consistent supply of high-quality fish for human consumption. These infrastructures are vital for advancing biotechnology research and applications in aquaculture, thereby ensuring sustainable practices and efficient fish production management. Leveraging best practices and innovative techniques, such as genome editing, the aquaculture sector can enhance breeding and production processes to cater to the escalating global seafood demand [13].

Beyond merely supplying food, aquaculture significantly contributes to income generation, social development, and poverty reduction across various regions. Its expansion and intensification are imperative for satisfying the growing food demand and securing a stable supply of aquatic products [6, 2, 5, 8]. Integrating aquaculture into food systems and policy frameworks enables countries to bolster food and nutrition security, particularly for vulnerable populations.

The EU financially sustains the development of fishery aquaculture and fishery. In Romania the Operational Program for

Fisheries and Maritime Affairs (AM-POPAM) is destined to put in practice the absorption of European funds for the period 2014-2020 [11].

However, global fisheries confront numerous challenges that threaten their sustainability and marine ecosystems' health. Characterized by overexploitation, dwindling fish stocks, and inadequate management practices, the current state of global fisheries demands urgent attention [22, 14].

The underreporting and neglect of small-scale fisheries exacerbate these issues, leading to misinformed management and conservation strategies [20].

Moreover, illegal, unreported, and unregulated (IUU) fishing further complicates sustainable fisheries governance, necessitating enhanced management practices to ensure fish stocks' longevity [4, 21].

Acknowledging aquaculture's role in economic and social development, it is evident that the sector harbors significant growth potential and societal impact. Aquaculture's contribution extends beyond economic benefits, fostering social capital and networks that underpin community resilience and sustainable development [19, 3].

Despite these contributions and potential, there exists a notable research gap in forecasting and understanding the full scope of aquaculture's impact, particularly in specific regions like Romania.

This study aims to bridge that gap by providing detailed forecasts of Romanian aquaculture production, encompassing various life cycle stages and examining the implications for food security, economic growth, and policy development.

By offering these insights, the study contributes significantly to aquaculture research and informs policy-making processes, ensuring that aquaculture continues to play a vital role in global food security and socio-economic advancement.

MATERIALS AND METHODS

Data Collection

Data on Romania's aquaculture production, spanning various stages of the life cycle, was collected from the European Statistical Office (EUROSTAT) database[6]. The dataset includes annual production figures from 2013 to 2022 and encompasses:

(i)Production from aquaculture excluding hatcheries and nurseries.

(ii)Production of fish eggs for human consumption from aquaculture.

(iii)Production of hatcheries and nurseries at the egg stage.

(iv)Production of hatcheries and nurseries at the juveniles stage.

Data for the latter two categories is limited, with some years presenting no recorded production, reflecting either a lack of production or unreported data.

Forecasting Methodology

The forecasting model was constructed using Microsoft Excel's suite of data analysis tools. The data was subjected to time series analysis, with the following statistical forecasting models applied:

-Exponential Smoothing: Used for forecasting aquaculture production while accounting for trends and seasonal variations where data was sufficient.

-Linear Regression Analysis: Applied to identify trends in the data over time and to project future values.

Confidence intervals were computed to gauge the potential range of the forecast values,providing upper and lower bounds for the predictions.

Statistical Measures

The forecast's accuracy was assessed using several statistical measures:

-Alpha (α): The smoothing constant for the level in the Exponential Smoothing model.

-Beta (β): The smoothing constant for the trend in the Exponential Smoothing model.

-Gamma (γ): The smoothing constant for the seasonality in the Exponential Smoothing model.

-Mean Absolute Scaled Error (MASE): A measure of the accuracy of forecasts in a time series.

-Symmetric Mean Absolute Percentage Error (SMAPE): A measure of percentage errors between forecasted and actual values.

-Mean Absolute Error (MAE): The average of the absolute errors between forecasted and observed values.
-Root Mean Square Error (RMSE): The square root of the average of squared differences between forecasted and observed values.
These metrics were utilized to evaluate the performance of the forecasting models and the reliability of the predictions.

Software

The entire analysis was conducted using Microsoft Excel (version 2024), which provided the necessary computational tools for the statistical forecasting and regression analysis.

RESULTS AND DISCUSSIONS

The forecast of fishery production in Romania, specifically considering aquaculture excluding hatcheries and nurseries, indicates a steady increase in production over the forecast period extending to 2034 (Figure 1). According to the collected data, the actual recorded production from 2013 to 2022 shows fluctuations with a slight downward trend until 2020, after which an uptrend is noticeable. The forecasted values suggest a gradual increase in production starting from 11,212 thousand units in 2022 to an estimated 12,758 thousand units by 2034.

The forecasts also include lower and upper confidence bounds, which represent the range within which the actual values are expected to lie with a certain probability. These bounds suggest a degree of uncertainty in the forecast, with the lower bound indicating a minimum expected production and the upper bound suggesting a maximum expected production. For 2022, the lower and upper confidence bounds are approximately 10,123 and 12,678 thousand units, respectively, illustrating the potential variability in the production levels.

The linear trend line displayed in the graph, characterized by the equation y = 123.4x + 11,008, with an R-squared value of 0.1702, indicates that only a small portion of the variability in the fishery production data can be explained by this linear trend.

The wide range between the lower and upper confidence bounds indicates substantial uncertainty, which could stem from various factors such as environmental changes, economic conditions, and policy changes affecting the aquaculture industry.

The statistical metrics provided include a high Alpha value of 0.90, suggesting a strong level of confidence in the current trend continuing into the future. However, the Beta and Gamma values are zero, indicating no trend or seasonal adjustments are considered in this forecast. This could be a limitation if there are indeed underlying trends or seasonal patterns in the fishery production data.

The Mean Absolute Scaled Error (MASE) of 0.92 and the Symmetric Mean Absolute Percentage Error (SMAPE) of 0.04 suggest a good fit of the forecast model relative to the mean model and the magnitude of the errors in percentage terms, respectively. The Mean Absolute Error (MAE) of 501.37 and the Root Mean Square Error (RMSE) of 651.68 provide measures of the average error magnitude and the standard deviation of the forecast errors, respectively. These values are relatively low, which generally indicates a reasonable accuracy of the forecast model, although these errors should still be considered when making decisions based on these forecasts.

Our analysis of production from aquaculture excluding hatcheries and nurseries aligns with global expectations of significant growth in the aquaculture sector over the coming decade. Our data support the notion that freshwater aquaculture will continue to be a pivotal contributor, as it already constitutes a substantial share of worldwide edible aquaculture output, corroborating the observations made by [23].

Consistent with the broader trends identified by [24], the aquaculture sector is poised for expansion to satisfy the escalating demand for seafood. This growth trajectory is not isolated but parallels the development seen in terrestrial crop and livestock production sectors, highlighting aquaculture's critical role in the global food system as emphasized by [16].

Despite these optimistic trends, the sector faces hurdles, notably the pressure to supply high-quality fish products sustainably. Addressing these challenges necessitates a concerted focus on sustainable production practices. This approach not only aligns with the recommendations of [17] but is also essential for the sector's ability to meet the growing seafood demand responsibly.

In the context of Romanian aquaculture, our findings suggest that while the sector is on a growth path, mirroring global trends, it mustnavigate the complexities of sustainable expansion. The emphasis on sustainable practices will be critical for the industry to not only increase production but also ensure that such growth is environmentally sustainable and economically viable, contributing to long-term food security and societal well-being.

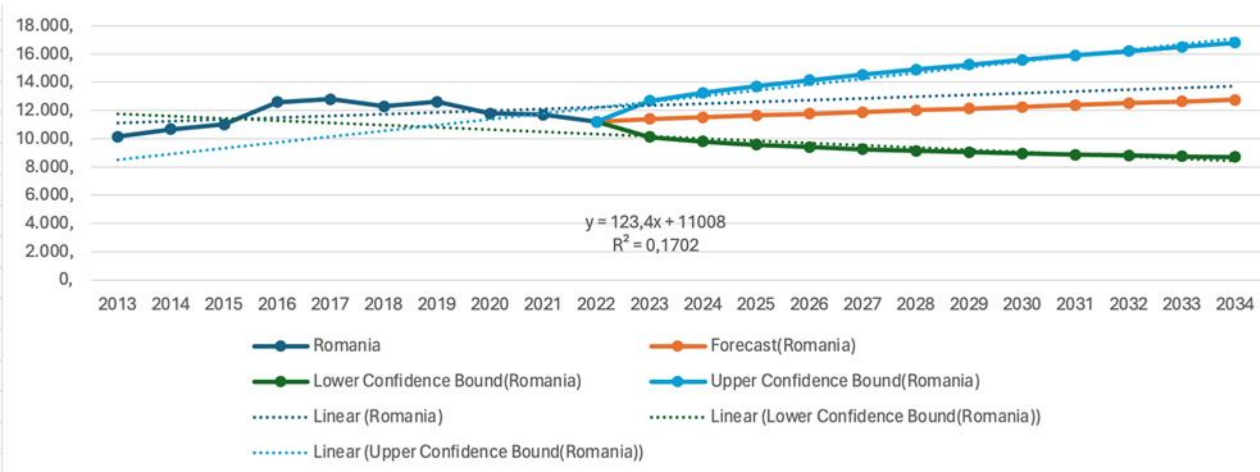

Fig. 1. Production from aquaculture excluding hatcheries and nurseries
Source: EuroSTAT [6].

The data regarding the production of fish eggs for human consumption from aquaculture in Romania displays an exponential growth based on a limited dataset that includes only the years 2021 and 2022 (Figure 2). According to the information provided by EUROSTAT, the actual production in 2021 was 0.421 thousand units, which then forecasted an exponential increase to 1,287 thousand units in 2022. The forecast projects a continuation of this rapid growth, reaching an estimated 16,725.948 thousand units by 2034.

The forecast model is defined by a linear equation y = 1,286.6x - 1,286.2 with an R-squared value of 1, indicating a perfect fit of the model to the data points. However, given the limited data points available, this high R-squared value may not be indicative of actual future trends but rather a result of overfitting to the very limited historical data.

The lower and upper confidence bounds are identical to the forecast values, suggesting no variation in the forecasted model. This is an artifact of the limited data and the statistical model applied, which does not account for any potential variability in future outcomes.

The exponential increase reflected in the forecast suggests a very optimistic outlook for the industry; however, the dataset is highly limited, with only two years of actual data, which severely constrains the robustness and reliability of the forecast.

The statistical parameters provided in the model (Alpha = 1.00, Beta = 0.75, Gamma = 0.00) indicate that the model is highly sensitive to the level and trend but does not account for any seasonal variability, which may not be relevant in this particular context. Moreover, the MASE, SMAPE, MAE, and RMSE values are all zero, which in a real-world context is highly unlikely and again is indicative of overfitting due to the limited dataset.

The forecast should be used as a tentative projection of the industry's potential under the assumption that current growth trends continue unabated, which is unlikely in a real-world biological and economic context. The absence of variability in the confidence

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intervals and the perfect R-squared value highlight the need for caution in interpretation.

Given the exponential nature of the forecast, it is vital to consider the capacity of the environment, the aquaculture industry's infrastructure, market conditions, and potential biological constraints that could limit such growth. Future forecasts would benefit significantly from more comprehensive data over several years to provide a more reliable and nuanced projection that accounts for the complexities of aquaculture production.

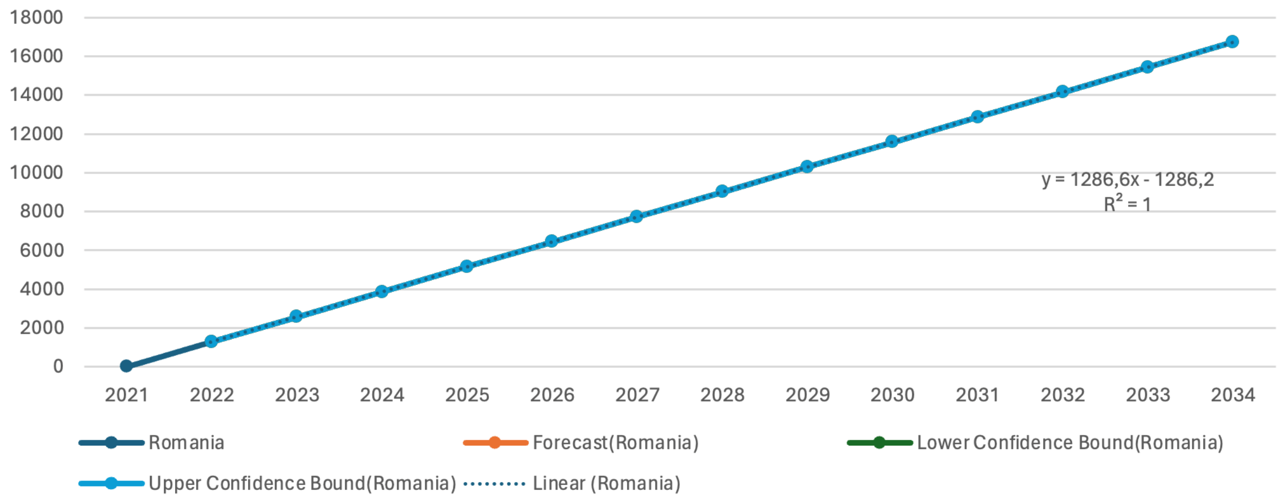

Fig. 2. Production of fish eggs for human consumption from aquaculture
Source: EuroSTAT [6].

The analysis of the production of hatcheries and nurseries at the egg stage in life cycle in Romania demonstrates notable variability from 2014 to 2021, with an overall increasing trend (Figure 3). The historical data shows fluctuations with values ranging from a low of 0.58 in 2016 to a high of 115.03 in 2014. Notably, there has been a substantial increase to 10.706 in 2021.

The forecasted data predicts a continuing upward trend with production expected to increase from 91.26 in 2022 to 69.81 in 2034. It is essential to observe that the lower confidence bounds are negative from 2023 onwards, whichis not feasible for actual production values and indicates a high degree of uncertainty in the forecast. Conversely, the upper confidence bounds suggest a potential for higher production, increasing from 173.708 in 2023 to 360.593 in 2034.

The linear regression model applied to the forecast has an equation of y = -1.0727x + 30.917 with an R-squared value of 0.0044, indicating that the linear model does not effectively explain the variance in the production data, and thus may not be suitable for making accurate predictions.

Statistically, the Alpha value of 0.90 suggests strong weighting on recent observations, while a Beta of 0.00 indicates that the model does not account for the trend component of the time series. A Gamma value of 0.00 means the seasonal component is also not considered. Given the MASE of 0.95, the model performs slightly better than a naïve benchmark model.

The SMAPE of 1.19, along with MAE of 24.80 and RMSE of 46.85, reflect the average percentage errors and absolute errors in the model, indicating that there is room for improvement in the forecast accuracy.

Given these insights, stakeholders and policymakers should treat the forecast as indicative rather than definitive. It would be prudent to consider additional factors and perhaps utilize more sophisticated time series analysis techniques that can account for the non-linear nature of the data.

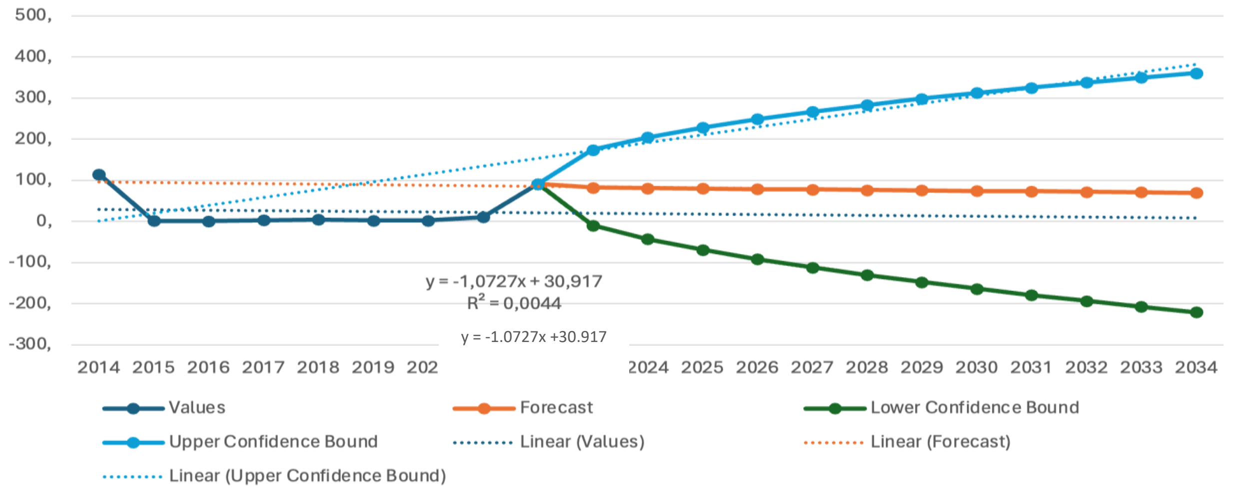

Fig. 3. Production of hatcheries and nurseries at eggs stage in life cycle
Source: EuroSTAT [6].

This approach would likely result in more reliable and actionable insights for planning and decision-making processes in the Romanian hatcheries and nurseries sector.

The projection of significant growth in the production of fish eggs for human consumption from aquaculture over the next decade aligns with our scientific findings. In this regard, [10] emphasize the sector's burgeoning role in supplying sustainable seafood sources, a trend that our analysis confirms for Romania. This growth is indicative of the broader expansion within aquaculture, underscoring its critical position in addressing the increasing global demand for fish products.

The data regarding the production of hatcheries and nurseries at the juvenile stage in the life cycle in Romania indicates a dramatic fluctuation in historical values, with a sharp peak in 2017 at 286.877, a significant drop in the subsequent years, and a low point of 0.9743 in 2022 (Figure 4).

The forecast suggests a decreasing trend over the period up to 2034, where production is expected to diminish to 15.1683999092.

Interestingly, the lower confidence bounds for the forecast are negative from 2023 onwards, which is not practical or possible for production values and indicates substantial uncertainty in the projection.

The upper confidence bounds, however, consistently remain in the positive range, suggesting that while there may be a decline, the potential for maintaining some level of production exists.

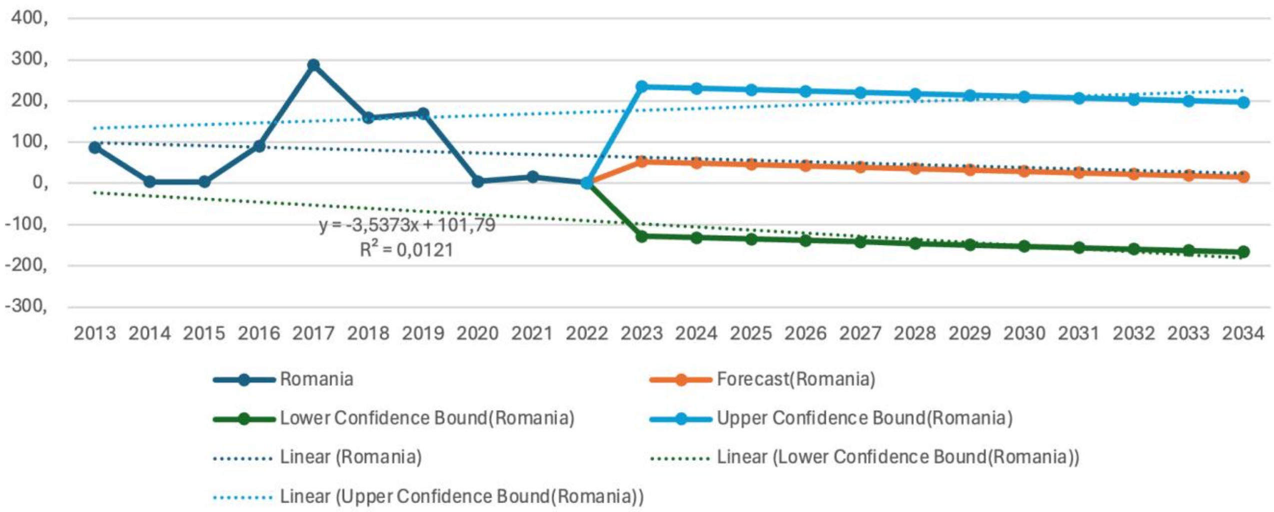

Fig 4. Production of hatcheries and nurseries at juvenile stage in life cycle
Source: EuroSTAT [6].

The linear regression model shows a decreasing trend line with the equation y = -3.5373x + 101.79 and an R-squared value of 0.0121, suggesting a very weak correlation between the time and the production values, indicating that the model does not adequately capture the factors influencing production levels.

The accuracy measures including MASE at 0.95, SMAPE at 1.15, MAE at 73.69, and RMSE at 92.51 indicate that the model's predictions are not very close to the actual data points. These metrics suggest that while the model's performance is slightly better than a naive model (as indicated by the MASE), there is a significant average percentage error (SMAPE) and substantial average and root mean square errors (MAE and RMSE, respectively).

Given the decreasing trend and the high level of uncertainty indicated by the negative lower confidence bounds, stakeholders in Romania'shatcheries and nurseries sector should be cautious.

CONCLUSIONS

This study offers a comprehensive forecast and analysis of the Romanian aquaculture sector, highlighting areas such as production from aquaculture excluding hatcheries and nurseries, and the production of fish eggs for human consumption, alongside hatcheries and nurseries outputs at different life stages. The findings underscore a sector poised for substantial growth, reflecting broader global shifts towards increased reliance on aquaculture to satisfy escalating seafood demand.

The projected expansion within Romanian aquaculture underscores the sector's burgeoning role in bolstering food security, both nationally and globally. This anticipated growth further emphasizes the imperative for sustainable production practices. As the sector evolves, prioritizing environmental stewardship and sustainable methodologies will be crucial for ensuring its longevity and mitigating impacts on ecosystems.

Notably, the expected increase in the production of fish eggs for human consumption represents a significant opportunity for Romania's aquaculture industry. This segment presents a pathway to high-value products within the global seafood market, necessitating a focus on innovation, quality, and sustainability in production processes.

The sector's journey forward is marked by both challenges and opportunities. Environmental concerns and sustainable resource management remain critical issues. However, these challenges also pave the way for technological advancements, research breakthroughs, and the implementation of best practices that can drive the industry forward.

Continuous research is vital for keeping pace with market dynamics and environmental changes, ensuring the Romanian aquaculture sector's resilience and success in the global arena.

In summary, the Romanian aquaculture sector is at a pivotal point, with sustainable growth and innovation key to its future success. By leveraging opportunities for high-value production, such as fish eggs, and committing to environmental and sustainable practices, Romania can enhance its contribution to global food security and assume a leading role in the international aquaculture landscape. Further research and adaptive strategies will be essential in navigating the challenges and seizing the opportunities that lie ahead.

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ANALYSIS OF SINGLE AREA PAYMENT SCHEME (SAPS) BENEFICIARIES. CASE STUDY IN TIMIȘ AND CARAȘ SEVERIN COUNTIES, ROMANIA

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Abstract

This study investigates SAPS (Single Area Payment Scheme) beneficiaries in Timiș and Caraș Severin counties, Romania, categorizing them by legal entity type (individual, authorized natural person, legal entity, and enterprise), gender, age, and the respective monetary values attracted in each jurisdiction. Findings in Timiș reveal a numerical preponderance of individual beneficiaries, yet a cumulative analysis across legal entities underscores their quantitative superiority. Conversely, in Caraș Severin, the cumulative count of all legal entities does not exceedt hat of individual beneficiaries. Gender distribution in Timiș manifests as 70.5% male and 24.5% female, while in Caraș Severin, it is 71.1% male and 28.9% female, with statistically comparable proportions at a significance level of α=0.01. Regarding age, beneficiaries uniformly exhibit a minimum age of 18 years, with noteworthy instances of advanced age, reaching 95 or 96 years. The rightward-skewed age distribution is explicable by a pronounced presence of elderly individuals within the cohort.

***Key words**: SAPS, European Agricultural Guarantee Fund (FEGA), European Fund for Agriculture and Rural Development (FEADR), subsidies, finance*

INTRODUCTION

The Western Region of Romania was established in 1998, comprising four counties, including Timiș and Caraș-Severin. The primary functions of the region are the coordination of regional development projects and the absorption of funds from the European Union (PNDR 2021-2027). The Western Region has vast agricultural lands, and the local pedoclimatic conditions offer multiple possibilities for agricultural development [1]. Compared to other regions in Romania, the Western Region has significant competitive advantages [10,16]. There is also a high interest from European Union investors in the region's agricultural lands, which are of superior quality and have not been treated with pesticides, as foreign investors cultivate organic and ecological agricultural products intended for export. Consequently, attracting European funds in the field of agriculture has brought significant benefits to companies in Timiș and Caraș-Severin counties. From an economic efficiency perspective, there are two main effects. Attracting over 450 million EUR (EAGF, EAFRD, and National Budget funds) to the county since 2007 has substantially increased the financial stability of the sector, with a strong decrease in the volatility of companies. In the last 13 years, the trend of land consolidation and the increasingly easy access to non-repayable funds have made agriculture attractive for many strong foreign investors and have allowed Romanian farmers to expand their businesses [3, 8,11].

Investments made through accessing European funding programs have increased the level of equipment of farms with state-of-the-art machines, equipment, and technologies, which have led to both a reduction in operating costs per unit of product obtained and an increase in the yields per hectare. All these factors have contributed to increasing the economic efficiency of businesses in the field [13,15].

In recent years, due to the increasing occurrence of extreme weather phenomena and the increasingly pronounced changes in annual climate patterns, the need for environmentally friendly agriculture has become more and more evident [5, 6]. The new Common Agricultural Policy (2021 – 2027), along with the European Green Deal, aims to set a global standard in terms of safety, supply security, nutrition, and quality [9,14]. Transitioning to a sustainable food system can have social, health, and environmental benefits, as well as more equitable economic advantages [4, 7, 12].

The most significant difference between the two counties, Timiș and Caraș-Severin, is their geographical configuration, which directly impacts the favourability of agricultural production: while in Timiș, the relief is largely favourable to agriculture, extending over most of the western plain, the neighbouring county's terrain is much less conducive, given the presence of mountains with the specificity of mountainous areas. Culturally, however, the areas are quite similar. Both are part of the Romanian section of the Banat region (the rest being divided between Hungary – 5% and Serbia – 40%) [1]. Nonetheless, the concept of the family farm passed down from generation to generation is better preserved in Caraș-Severin. This can be partly explained by the mountainous nature of the terrain in this county, which has made the process of expanding farms in terms of area difficult, but also by the historical fact of mass nationalization of land sown by large landowners in Timiș and their forced deportation and relocation to Bărăgan. Although the region was known in the past as an intensive pork production area (even today, Timiș hosts one of the largest pig breeding and pork processing complexes), in recent years, farmers have focused more on sheep and cattle raising, including in mixed farms, especially from an economic standpoint, as the profit margins are significantly higher.

In this context, the purpose of the paper is to provide a detailed analysis of the Single Area Payment Scheme (SAPS) beneficiaries in Timiș and Caraș Severin counties in Romania, with a specific focus on understanding the distribution and characteristics of these beneficiaries by legal entity type, gender, age, and the monetary values attracted. Through this analysis, the paper aims to:

Evaluate the Impact of SAPS Funding: It seeks to assess how SAPS funding has been distributed among various categories of beneficiaries and to understand the financial impact of this support on the agricultural sector in the two counties.

Demographic Analysis: By categorizing beneficiaries based on legal entity type, gender, and age, the paper intends to provide insights into the demographic profile of those who are benefitting from SAPS, offering a glimpse into who is participating in and benefiting from EU agricultural policies.

Economic Efficiency and Technological Advancement: The study examines the economic efficiency and the adoption of advanced technologies and practices in agriculture as a result of SAPS funding. It discusses how investments made through European funding programs have enhanced the equipment level of farms, leading to reduced operating costs and increased yields.

Policy Implications and Recommendations: By providing a comprehensive analysis of SAPS beneficiaries and the broader agricultural context in Timiș and Caraș Severin, the paper likely seeks to inform policy decisions, contribute to the optimization of future funding schemes, and support the transition towards more sustainable and efficient agricultural practices in Romania and potentially in similar regions within the European Union.

MATERIALS AND METHODS

The research in this article was located in the Western Region, more precisely in Timiș and Caraș-Severin counties. The materials used for this study were provided by the Agency for Payments and Intervention in Agriculture, the National Institute of Statistics, and various bibliographic sources. The collected data were subject to observation, analysis, interpretation, and comparison. Additionally, graphical representations were made using the Past 4.03 software (Statistical analysis software). The centralization, processing, and interpretation of the data allowed for the formulation of the main conclusions regarding the situation of SAPS beneficiaries in the two studied counties.

RESULTS AND DISCUSSIONS

Regarding the number of SAPS beneficiaries [2] in Timiș county, there are 198,238, representing approximately 75% of the total for the two counties. For comparison, in Caraș-Severin County, there were 65,535 beneficiaries. The highest proportion of SAPS beneficiaries consists of individual physical persons, both in Timiș county and in Caraș-Severin. It is immediately noticeable that in Timiș county, even if the number of individual persons is higher than the other categories taken separately, a numerical comparison with the other categories of legal persons taken together indicates the latter's superiority. The same is not observed in Caraș-Severin County, where even if all categories of legal persons are combined, they do not exceed the number of physical persons. Specifically, in Timiș county, the distribution by legal form of the beneficiaries is 47% for individuals, 39.9% for legal persons, 6.3% for authorized persons, 5.8% for individual enterprises, and 0.2% for family enterprises. In Caraș-Severin County, this distribution is: 72.7% for individuals, 18.7% for legal persons, 4.3% for authorized persons, 3.3% for individual enterprises, 0.9% for family enterprises, and 0.1% for foreign citizens. The $\chi 2$ test of association indicates that the distribution by legal form differs significantly between the two counties, $\chi 2=1.3\times 104$, $p<0.001$. The data corresponding to this description are found in Table 1 and Figure 1.

Following the distribution of SAPS beneficiaries by gender, in Timiș county, 70.5% are men and 24.5% are women, while in Caraș-Severin County, 71.1% are men and 28.9% are women.

Table 1. Distribution of SAPS beneficiaries by legal form in Timiș and Caraș Severin counties

Legal_form		County		
		Timis	Caras Severin	Total
Individual	Count	94,598	47,666	142,264
	% within Legal_form	66.5%	33.5%	100.0%
	% within County	47.7%	72.7%	53.9%
	% of Total	35.9%	18.1%	53.9%
Legal person	Count	79,191	12,239	91,430
	% within Legal_form	86.6%	13.4%	100.0%
	% within County	39.9%	18.7%	34.7%
	% of Total	30.0%	4.6%	34.7%
Authorizedperson	Count	12,549	2,837	15,386
	% within Legal_form	81.6%	18.4%	100.0%
	% within County	6.3%	4.3%	5.8%
	% of Total	4.8%	1.1%	5.8%
Individual enterprise	Count	11,413	2,147	13,560
	% within Legal_form	84.2%	15.8%	100.0%
	% within County	5.8%	3.3%	5.1%
	% of Total	4.3%	.8%	5.1%
Familyenterprise	Count	407	565	972
	%Legal_form	41.9%	58.1%	100.0%
	% within County	.2%	.9%	.4%
	% of Total	.2%	.2%	.4%
Foreign citizen	Count	80	81	161
	% within Legal_form	49.7%	50.3%	100.0%
	% within County	.0%	.1%	.1%
	% of Total	.0%	.0%	.1%
Total	Count	198,238	65,535	263,773
	% within Legal_form	75.2%	24.8%	100.0%
	% within County	100.0%	100.0%	100.0%
	% of Total	75.2%	24.8%	100.0%

Source: Authors' calculation based on the data from APIA [2] and INS [11].

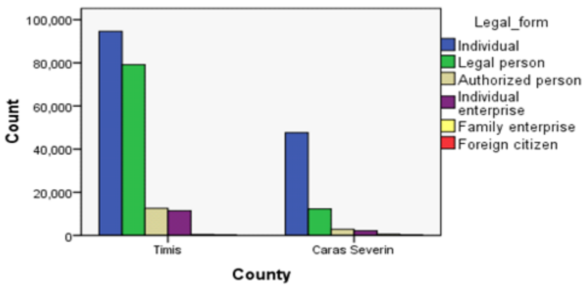

Fig. 1. Distribution of SAPS beneficiaries by legal form in Timiș and Caraș Severin counties
Source: Own design reflecting the results.

The proportions are close, and there are no statistical arguments at a threshold of α=0.01 regarding the existence of differences between them in association with the counties.

These conclusions were reached by applying the χ2 association test. The statistical data are presented in Table 2 and Figure 2.

Table 2. Distribution of SAPS beneficiaries by sex in Timiş and Caraş Severin counties

		County		
Sex		Timis	Caras Severin	Total
M	Count	66,666	33,903	100,569
	% within Sex	66.3%	33.7%	100.0%
	% within County	70.5%	71.1%	70.7%
	% of Total	46.9%	23.8%	70.7%
F	Count	27,884	13,759	41,643
	% within Sex	67.0%	33.0%	100.0%
	% within County	29.5%	28.9%	29.3%
	% of Total	19.6%	9.7%	29.3%
Total	Count	94,550	47,662	142,212
	% within Sex	66.5%	33.5%	100.0%
	% within County	100.0%	100.0%	100.0%
	% of Total	66.5%	33.5%	100.0%

Source: Authors' calculation.

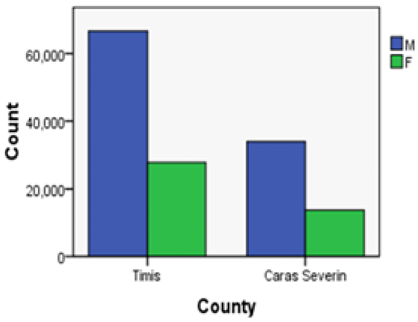

Fig. 2. Distribution of SAPS beneficiaries by sex in Timiş and Caraş Severin counties
Source: Authors' design of the results.

The age of SAPS beneficiaries is an useful subject for painting a picture of the future of agriculture in Romania. In the following discussion on age, only individual persons are considered, excluding any forms of legal entities and their representatives.

Table 3 provides information on direct numerical and percentage comparisons between the groups' volumes in the two counties (% within Age group). Moreover, consulting the columns on the percentage distribution of the volume in each county, we find that in Timiş, 0.1% of SAPS beneficiaries are under 20 years old, 3.8% between 20-29 years, 10% between 30-39 years, 19.4% between 40-49 years, 23.9% between 50-59 years, 24.4% in the 60-69 age group (being the largest age group in terms of volume), 14.3% in the 70-79 age group, 3.9% in the 80-89 age group, and even 0.2% in the 90-99 age group. On the other hand, in Caraș-Severin County, like in Timiș, 0.1% are under 20 years old, 3.7% between 20-29 years, with a similar value close to that of Timiș county, 10.6% between 30-39 years.

However, only 18.1% of SAPS beneficiaries in Caraș-Severin are in the 40-49 age group, a value observed to below compared to Timiș county where the proportion of SAPS beneficiaries is higher in this age group.

The same phenomenon is observed in the 50-59 age group where there are 21.7% of the beneficiaries in Caraș-Severin, a lower value compared to Timiș county.

The two age groups, 40-49 and 50-59 years, constitute very efficient periods when characterizing the results of human resources in the field of agricultural management.

It is note worthy that in the 60-69 age group in Caraș-Severin County, the proportion of SAPS beneficiaries is 26.4%, a value higher than the same age group in Timiș county. Similarly, in the 70-79 age group, the proportion is 15.4%, a higher value in Caraș-Severin compared to Timiș.

The fact that these groups have a higher proportion in Caraș-Severin compared to Timiș can be attributed to the aging population phenomenon, particularly due to the migration of the youth for educational purposes to the neighbouring county of Timiș, among other reasons.

Moreover, the well-developed industry in the past in Caraș-Severin County has resulted in many individuals from these age groups being settled in this county, who are now retired but still active in the agricultural sector.

From a statistical significance perspective, an association of the values corresponding to the age groups with the counties is noted, applying the χ2 association test, χ2=199.2, p<0.001.

Table 3. Frequency distribution of SAPS beneficiaries by age group in Timiş and Caraş Severin counties

Age group		County Timis	Caras Severin	Total
<20 years	Count	82	31	113
	% within Age group	72.6%	27.4%	100.0%
	% within County	.1%	.1%	.1%
	% of Total	.1%	.0%	.1%
20-29 years	Count	3,558	1,743	5,301
	% within Age roup	67.1%	32.9%	100.0%
	% within County	3.8%	3.7%	3.7%
	% of Total	2.5%	1.2%	3.7%
30-39 years	Count	9,460	5,029	14,489
	% within Age group	65.3%	34.7%	100.0%
	% within County	10.0%	10.6%	10.2%
	% of Total	6.6%	3.5%	10.2%
40-49 years	Count	18,317	8,631	26,948
	% within Age group	68.0%	32.0%	100.0%
	% within County	19.4%	18.1%	18.9%
	% of Total	12.9%	6.1%	18.9%
50-59 years	Count	22,642	10,324	32,966
	% within Age group	68.7%	31.3%	100.0%
	% within County	23.9%	21.7%	23.2%
	% of Total	15.9%	7.3%	23.2%
60-69 years	Count	23,119	12,717	35,836
	% within Age group	64.5%	35.5%	100.0%
	% within County	24.4%	26.7%	25.2%
	% of Total	16.3%	8.9%	25.2%
70-79 years	Count	13,532	7,320	20,852
	% within Age group	64.9%	35.1%	100.0%
	% within County	14.3%	15.4%	14.7%
	% of Total	9.5%	5.1%	14.7%
80-89 years	Count	3,693	1,776	5,469
	% within Age group	67.5%	32.5%	100.0%
	% within County	3.9%	3.7%	3.8%
	% of Total	2.6%	1.2%	3.8%
90-99 years	Count	195	95	290
	% withinAgegroup	67.2%	32.8%	100.0%
	% withinCounty	.2%	.2%	.2%
	% of Total	.1%	.1%	.2%
Total	Count	94,598	47,666	142,264
	% withinAgegroup	66.5%	33.5%	100.0%
	% withinCounty	100.0%	100.0%	100.0%
	% of Total	66.5%	33.5%	100.0%

Source: Authors' calculation.

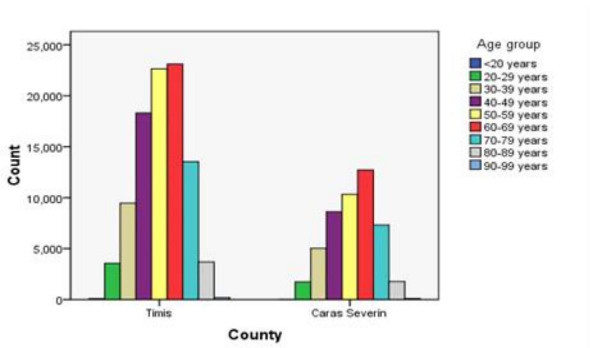

Fig. 3. Frequency distribution of SAPS beneficiaries by age group in Timiş and Caraş Severin counties
Source: Authors' design of the results.

In both counties, the age distribution of SAPS beneficiaries has some similarities with the normal distribution, in that the extreme values, namely the age groups corresponding to the very young and the elderly, are quantitatively lower and there is also a tendency towards symmetry around the average age of approximately 55.78 years in Timiş county and 56.3 years in Caraş-Severin. However, the Kolmogorov-Smirnov test yields values of D (94,598) = 0.049 and D (47,666) = 0.067 with $p<0.001$ in both cases. Therefore, the total number of cases deviating from the normal distribution is statistically significant, suggesting that neither group follows a normal distribution.

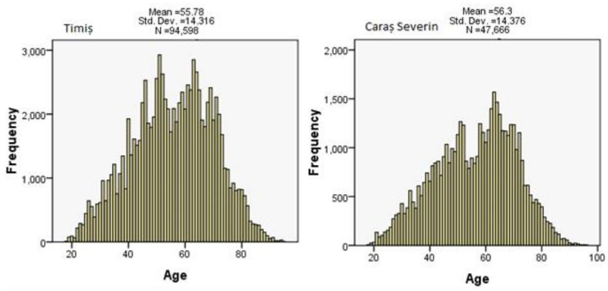

Fig. 4. Histograms related to the age distribution of SAPS beneficiaries in Timiş (a) and Caraş Severin (b) counties.
Source: Authors' design.

For characterizing the statistical populations of SAPS beneficiaries in terms of age in the two counties, data from Table 4 were presented.
The minimum age is 18 years in each case. However, it's note worthy that the maximum age is very advanced, at 95 and 96 years, for some SAPS beneficiary individuals. Negative skewness in both situations, albeits light, indicates an asymmetry in the distributions. The curve is shifted to the right, a phenomenon explained by a high number of older individuals.
Negative kurtosis values for the populations of both counties indicate flattened distributions.
This is related to the same phenomenon of the aging population engaged in agriculture and the reduced number of individuals with an average age. The average age of individuals in Timiş county is 55.78 years, while in Caraş-Severin County, it is slightly higher, at 56.3

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years. This difference is statistically significant, t=-6.4 with p<0.001. The median values are 56 years for the group from Timiș and 58 years for that from Caraș-Severin.

Table 4. Statistical summary for describing the age of SAPS beneficiaries in Timiș and Caraș Severin counties

Timiș			Caraș Severin		
Mean		55.78	Mean		56.3
95% Confidence Interval for Mean	LowerBound	55.69	95% Confidence Interval for Mean	LowerBound	56.17
	UpperBound	55.87		UpperBound	56.43
5% TrimmedMean		55.91	5% TrimmedMean		56.48
Median		56	Median		58
Variance		204.935	Variance		206.674
Std. Deviation		14.316	Std. Deviation		14.376
Minimum		18	Minimum		18
Maximum		95	Maximum		96
Range		77	Range		78
Interquartile Range		21	Interquartile Range		21
Skewness		-0.142	Skewness		-0.218
Kurtosis		-0.567	Kurtosis		-0.601

Source: Authors' calculation.

The requests for organic agriculture vary in proportion between the two counties.
There was a statistically significant association between organic requests and the counties studied, applying the $\chi2$ association test, $\chi2=3157$, $p<0.001$.
In Timiș county, 7.2% of the applications are for organic farming, and 92.8% are not, while in Caraș-Severin County, the proportion is higher, with 14.4% being organic and 85.6% not. However, in absolute numbers, the number of organic applications is higher in Timiș county.
The data indicating these conclusions are presented in Table 5 and in Figure 5.

Table 5. Distribution of the number of applications for organic farming in Timiș and Caraș Severin counties

County		Ecological		
		No	Yes	Total
Timis	Count	184,036	14,202	198,238
	% withinCounty	92.8%	7.2%	100.0%
	% withinEcological	76.6%	60.1%	75.2%
	% of Total	69.8%	5.4%	75.2%
Caras Severin	Count	56,101	9,434	65,535
	% withinCounty	85.6%	14.4%	100.0%
	% withinEcological	23.4%	39.9%	24.8%
	% of Total	21.3%	3.6%	24.8%
Total	Count	240,137	23,636	263,773
	% withinCounty	91.0%	9.0%	100.0%
	% withinEcological	100.0%	100.0%	100.0%
	% of Total	91.0%	9.0%	100.0%

Source: Authors' calculation.

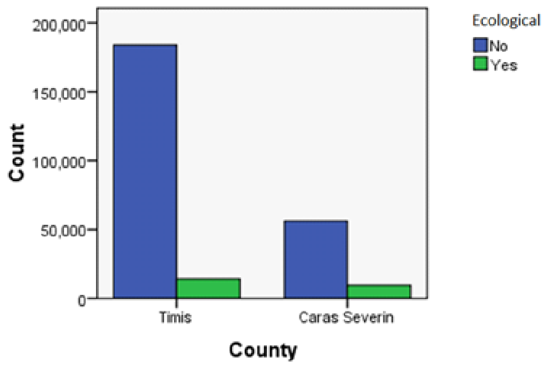

Fig. 5. Distribution diagram of the number of applications for organic farming in Timiș and Caraș Severin counties
Source: Authors' design.

CONCLUSIONS

The mobilization of European funds in the agricultural sector has significantly benefited both farmers and companies in Timiș and Caraș-Severin counties. This influx has played a pivotal role in both consolidating and stabilizing agricultural enterprises, thereby enhancing overall business profitability. Such financial support has been instrumental in fostering a more resilient and economically viable agricultural landscape within these regions.
An examination of the farm structures and subsidy applicants in both counties up to 2021 reveals a closely matched scenario, with Timiș recording 17,584 beneficiaries and Caraș-Severin slightly higher at 18,694. This parity underscores a widespread engagement with SAPS across both counties, reflecting the scheme's relevance to the agricultural community.
The distribution analysis of SAPS beneficiaries unveils a dominant presence of individual farmers in both counties, constituting the majority. Specifically, Timiș County reported 198,238 beneficiaries, about 75% of the total for both counties, with Caraș-Severin accounting for the remaining 65,535 beneficiaries. This distribution pattern emphasizes the critical role of individual farmers in the region's agricultural economy.
Gender distribution among SAPS beneficiaries reveals a notable male predominance, with 70.5% male beneficiaries in Timiș and 71.1% in Caraș-Severin. However, the significant representation of

women, 24.5% in Timiș and 28.9% in Caraș-Severin, highlights an encouraging trend towards gender diversity in agricultural participation.

Age demographics of SAPS beneficiaries present insightful trends for the future of agriculture in Romania. In both counties, the distribution spans from youths under 20 to seniors in their 90s, with the largest concentration in the 60-69 age group. This age diversity not only reflects the broad appeal and accessibility of farming across generations but also signals potential challenges and opportunities in encouraging younger entrants to agriculture, ensuring sustainability and continuity.

These findings collectively illustrate the substantial impact of European funding on the agricultural sectors of Timiș and Caraș-Severin counties. They underscore the importance of continuous support and tailored policies to sustain growth, encourage inclusivity across gender and age, and ultimately, secure the future of agriculture in Romania.

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EGG QUALITY RESEARCH ON CONTAMINATION IN VARIOUS SEASONAL CONDITIONS

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Abstract

The scientific research reflected in this study aimed to identify the quality of chicken eggs regarding bacterial contamination in different seasonal conditions. The scientific researches were performed using the following research methods: microscopic visualization, qualitative and quantitative analysis, induction, deduction, the graphics method, the chronological series method. The results of the research highlighted the general prevalence of microbial germs on the eggshell surface during the autumn season, followed by the spring season and finally a lower prevalence during the winter season. Salmonella species were not identified. In the scientific research are analysed the egg production per region, revenue in the egg market of Moldova, sales channels of eggs and egg quality in different seasonal conditions. In the same time the research finishes with conclusions/recommendations related the egg quality assurance and bacterioscopic results.

Key words: *hen eggs, bacteriology, bacterioscopy, egg shell, microflora*

INTRODUCTION

The production, processing and consumption of eggs and derived products has seen a constant increase in the last decades, and the obtaining and industrialization of eggs for consumption can be considered as some of the most dynamic activities in the agri-food chain, that is why the idea of increasing the shelf life of eggs and their superior valorization in correlation with consumer market preferences have become current and of particular importance [4, 10, 12].
Food safety, quality and taste are important attributes for both producers and consumers. The increased demand for food products with a long shelf life that maintain their nutritional and sensory characteristics has required the development of appropriate preservation methods. For consumers, the quality of food products is correlated with shelf life and sensory characteristics [2, 5, 8].
In order to meet the needs of the modern human factor in relation to the quantity and quality of food products, a sustained effort is required to increase agricultural and livestock production, for a higher consumption of natural products at the expense of processed ones [1, 3, 5].
Currently, worldwide, it can be observed that the scientific evolution of recent years has visibly influenced the way of life of the modern population. This is reflected in the daily diet, through the food consumed that is processed and concentrated, so that it is as easy as possible to cook but also to produce the feeling of satiety, but without taking into account the needs of the human body and the effects in the long term on his health [6, 7].
From this point of view, the main objective of this research is the investigation of the quality of some varieties of eggs in various seasonal conditions.

MATERIALS AND METHODS

The contamination research on egg quality was carried out on different varieties of hen's eggs sold at the market and store, in Chisinau municipality, in different periods of the commercialization season: autumn, winter, spring.
The investigations were carried out according to the laboratory methods regarding the

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superficial investigation of the eggshell microflora. The researches were carried out in the presence of the characteristic indices of the total number of germs (NTG), pathogenic microorganisms frequently involved in the contamination of eggs, fungi and yeasts.
The development of microbial cultures on culture media and their study was carried out by native and microscopic visualization. During the laboratory research, bacterioscopic, bacteriological, organoleptic investigations were carried out, the morphology of the microscopic microorganisms was determined and their differentiation was resorted to according to laboratory methods regarding the quality of food products.
The research to highlight the quality of the eggs was carried out in accordance with the regulated requirements for the investigation of food products in the laboratory of microbiological investigations of food products within the Diagnostic Center in Veterinary Medicine in Chisinau.

RESULTS AND DISCUSSIONS

Production (growth) of animals (in live weight) in households of all categories in January-September 2023 compared to January-September 2022 decreased by 4.5%. The decrease in production was generated by the decrease in production in households (-5.5%) and in agricultural enterprises (-3.6%).
Despite the fact that milk production in agricultural enterprises increased by 16.0%, in households of all categories production decreased insignificantly - by 0.1% as a result of its decrease in households by 2.5%.
Egg production in households of all categories decreased by 3.3% due to the decrease in production in households by 9.0%. At the same time, egg production in agricultural enterprises increased by 5.2%.
Distribution of egg production by region in the Rpublic of Moldova in the year 2022 is presented in Figure 1.
Mostly, eggs are produced in household of the population, namely, in January-September, 2023, were produced 281.4 million pieces (56.5%) being followed by agricultural enterprises where were produced 216.6 million pieces (%).
According to Fig. 1, in 2022 the highest average annual production per region, was registered in North Region – 28%, being followed by Chisinau Municipality – 27%, after South Region 25% and Centre Region with 20%.

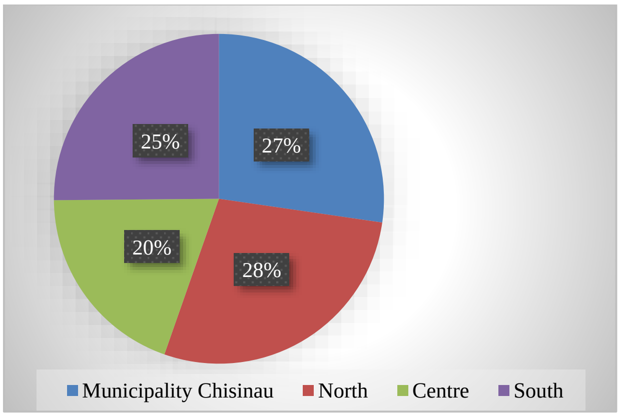

Fig. 1. Distribution of average annual production of eggs per region, Republic of Moldova, 2022
Source: elaborated by the author.

According to the data from Fig. 2, in 2023 the revenue in the eggs market of Moldova constituted 71.84 mln USD. The percent of market growing is expected to be 11.32% annually.

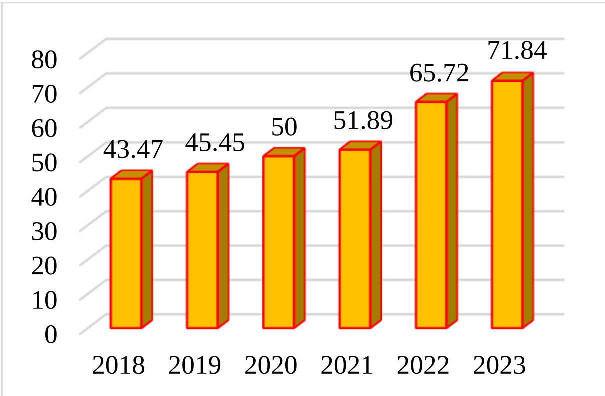

Fig. 2. Revenue in the eggs market of Moldova for 2018-2023, mln. USD
Source: elaborated by the author.

According to Figure 3, eggs are sold mostly offline. In 2023, 98.5% of eggs were sold offline and 1.5% of eggs were sold online.
Livestock production by main types in the period January-September 2023 is shown in Table 1.

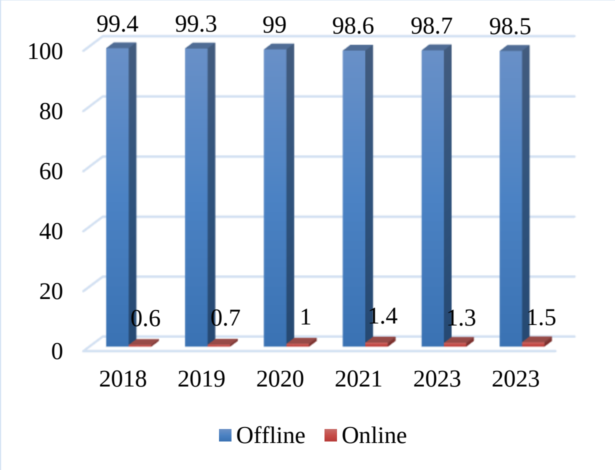

Fig. 3. Sales channels of eggs for the period 2018-2023
Source: elaborated by the author.

Table 1. Livestock production by main types in January-September 2023

	Total	In % compared to January-September 2022	Share (in % of the total)
Production (breeding) of animals			
(in live weight) – total, thousands of tons	**130.0**	**95.5**	**100.0**
out of which:			
-Agricultural enterprises	69.7	96.4	53.6
-Households of the population	60.3	94.5	46.4
Milk - total, thousands of tons	**221.4**	**99.9**	**100.0**
out of which:			
-Agricultural enterprises	33.4	116.0	15.1
-Households of the population	188.0	97.5	84.9
Eggs - total, million pieces	**498.0**	**96.7**	**100.0**
out of which:			
-Agricultural enterprises	**216.6**	**105.2**	**43.5**
-Households of the population	**281.4**	**91.0**	**56.5**

Source: adjusted by the author based on [9].

Based on the study of the quality of some egg assortments, regarding superficial contamination depending on the season, we allowed ourselves to appreciate them through the values obtained as a result of counting microbial colonies.

According to the bibliographic references, it is known that the superficial germs of the eggshell are often of faecal origin, bedding, machinery, etc.

These bacteria can represent saprophytic and pathogenic bacteria and are significant in egg quality evaluations.

The data from Figure 4 regarding the bacteriological investigations of the load of germs on the shell of chicken eggs studied under market conditions depending on the season determine a greater number of colonies in the autumn season-10, compared to the spring-4 and winter seasons- 2 colonies highlighted on agar medium. A higher number of colonies were recorded on Endo media in spring-3 colonies, compared to autumn-2 colonies and winter-1 colony. Regarding the Saburov environment, regarding the results obtained, colonies were registered in a larger quantity during the autumn season - 3 colonies, compared to the winter season - 1 colony and spring - 2 colonies.

These results confirm to us that the pollution of the eggshell surface shows higher values during the autumn season, which justifies data of more intense multiplication of pathogenic germs regarding the surface microflora of market eggs.

The results of bacteriological investigations of the load of germs on the shell of chicken eggs studied in store conditions, depending on the season, confirmed that in these food products the number of colonies compared to the research of eggs studied in market conditions is lower, constituting a number of 8 in autumn colonies on agar medium, compared to spring periods with 3 developing colonies and winter 1 microbial colony.

Microbiological investigations were also carried out on special media for the determination of mycete and E.coli microorganisms.

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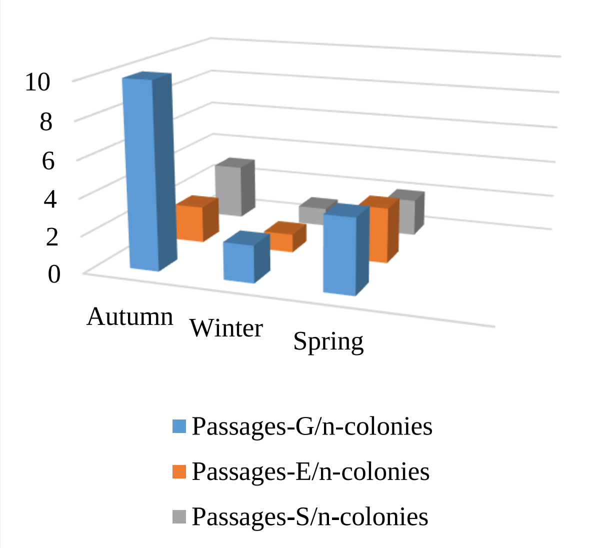

Fig. 4. Bacteriological investigations of the germ load on the shell of chicken eggs studied under seasonal market conditions
Source: elaborated by the author.

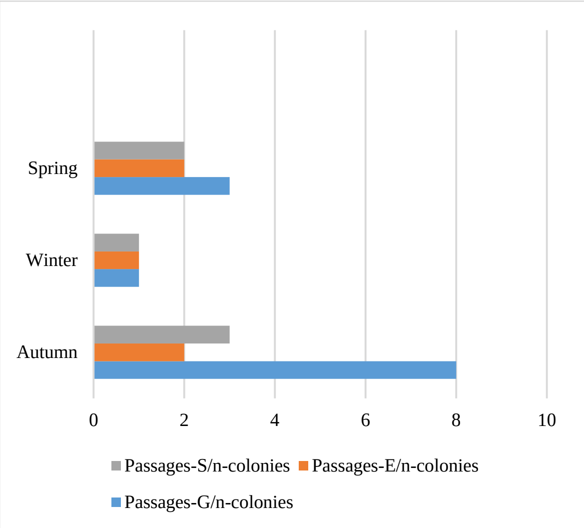

Fig. 5. Bacteriological investigations of the germ load on the shell of hen eggs studied under store conditions depending on the season
Source: elaborated by the author.

Values of 3 microbial colonies on the Saburov medium during the autumn season, 2 microbial colonies in the spring and 1 microbial colony in the winter season were determined. 2 microbial colonies were determined on the Endo medium in the fall, 2 microbial colonies in the spring and 1 microbial colony in the winter. Analyzing these values in a comparative aspect, we deduce that the shell of the eggs sold in the store is less contaminated with microorganisms. Therefore, the incidence of microorganisms on eggshell in this study was slightly lower than that of the eggs in the previous study, but the incidence on these eggs is not dangerous for sale.

Other research after microbiological laboratory conduct is reflected in Figure 5, where the results of the bacterioscopic determination of the load of germs on the shell of hen's eggs studied under market conditions depending on the season are shown. Bacterial load, where NTG/cocci are reflected, the number of yeasts present, etc. was determined. The bacterioscopic investigations were carried out by making smears from the microbial colonies, which were carried out on sterile slides and stained according to the Gram method, using gentian violet dyes, fuchsin, Lugol's solution, fixing with ethyl alcohol. Based on the bacterioscopy study, it was revealed under microscopy that the bacterial load of the eggshells in the fall constituted 42 eggs, compared to the period of spring, where the number of cocci was 35 cocci microbial cells and in winter, where this NTG index constituted a smaller amount corresponding to 10 cocci under microscopy.

The microbial species Salmonella was not identified on the eggshell surface. The bacterioscopic research of the shell of chicken eggs studied under market conditions revealed a number of 5 yeasts during the autumn season, compared to the spring season, where the number of yeast cells constituted 3 yeast cells and in the winter, where this number constituted 1 yeast cell. These reports infer the fact that the microbial contamination of the eggshell from a bacterioscopic point of view is higher in the fall, followed by the spring season and respectively at the end, a mixing of the number of cocci microorganisms is observed in the winter, regarding the contamination of the eggshell traded on the market.

The bacterioscopic study of the load of germs on the shell of chicken eggs studied in store conditions depending on the season shown in Figure 6 shows important aspects regarding this bacterial microflora shown by the number of yeasts, escherichia, NTG. Salmonella species is absent.

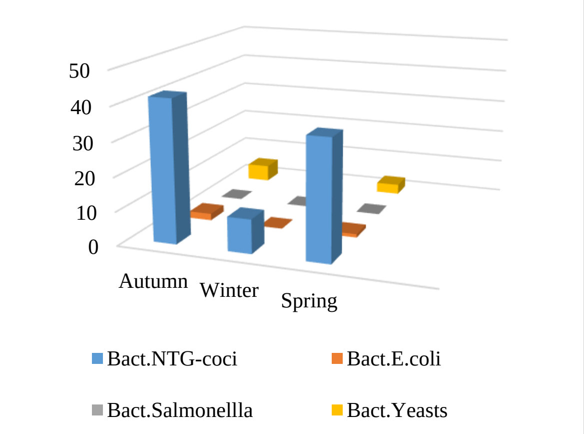

Fig. 6. Bacterioscopic investigations of the germ load on the shell of hen eggs studied under seasonal market conditions
Source: elaborated by the author.

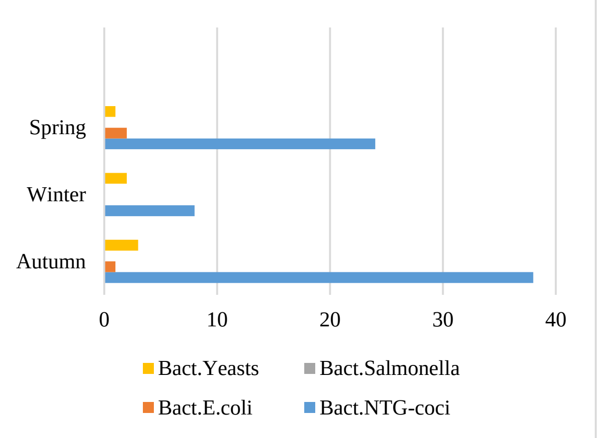

Fig.7. Bacterioscopic investigations of the germ load on the shell of chicken eggs studied under store conditions depending on the season
Source: elaborated by the author.

The values of Figure 7 reveal that the shell of the eggs sold in the store during the autumn season recorded 38 microbial cells, compared to the spring where 24 cocci microbial cells were microscopically observed and in the winter where the number of cocci cells showed 8 cocci.

The yeast cells presented a number of 3 cells during the autumn period, compared to the spring season - 1 cell and in the winter 2 microbial cells presented on the surface of the eggshell.

Therefore, the indices obtained reveal that the pollution of eggs sold in the store in various periods of the season presents lower quantitative aspects, compared to the indices obtained by microscopy as a result of investigations of the shell of eggs sold in market conditions in various periods of the season.

The quality of the evaluated eggshell presents, in our opinion, the development of a strategy to reduce the risk of pathogens from the outside, because the eggshell presents from a practical and scientific point of view a risk of the penetration of pathogenic species inside the eggs and at the same time offers a greater resistance good at penetration of pathogens and contamination of internal contents.

The National Agency for Food Safety (ANSA) warns consumers to purchase fresh eggs only from authorized places and in original packaging.

According to ANSA the eggs for human consumption are classified in the following quality categories:

a) category A or "fresh eggs";

b) category B which are delivered only to the food and non-food industry.

Category A eggs are classified according to the following weight categories:

a) XL – very large: at least 73 g;

b) L – large: from 63 to 73 g exclusively;

c) M – average: from 53 to 63 g exclusively;

d) S – small: less than 53 g.

Category A eggs must have the following quality characteristics:

a) whole, hard, uncracked, clean, matte, rough peel, without visible spots or pores;

b) cuticle: whole, clean, intact;

c) air chamber: the height should not exceed 6 millimeters, immovable; however, for eggs marketed with the mention "extra", it must not exceed 4 millimeters;

d) the yolk: visible in the light beam only in the form of a shadow, without a precise outline, without visibly moving away from the central position, in case of turning the egg;

e) white: clear, transparent;

f) without foreign bodies;

g) no foreign smells.

Category A eggs are not refrigerated in premises or installations where a temperature lower than 5°C is artificially maintained.

Eggs that have been kept for less than 24 hours at a temperature lower than 5°C, during a transport operation, or kept in the premises where the retail sale is practiced or in its dependencies for maximum 72 hours.

Category A eggs bear the manufacturer's code and the laying date, they are classified, marked and packed within ten days of laying.

The minimum validity date is marked at the time of packaging and announced by the mention:

a) "to be consumed before...", if the date contains the indication of the day;

b) "to be consumed before the end...", in the other cases.

The consumption limit date cannot exceed 28 days from laying the eggs. If the laying period is indicated, the minimum validity date is established starting with the first day of the respective period.

On the packages containing category A eggs, until the ninth day after laying, the words "extra" or "extra fresh" can be used as additional quality indications. In this case, the laying date and the nine-day period appear on the packaging and are visible.

It is important not to forget that before consumption, eggs must be washed, because microorganisms harmful to health can enter food from the shell.

Details about the egg marking requirements are presented in Figure 8.

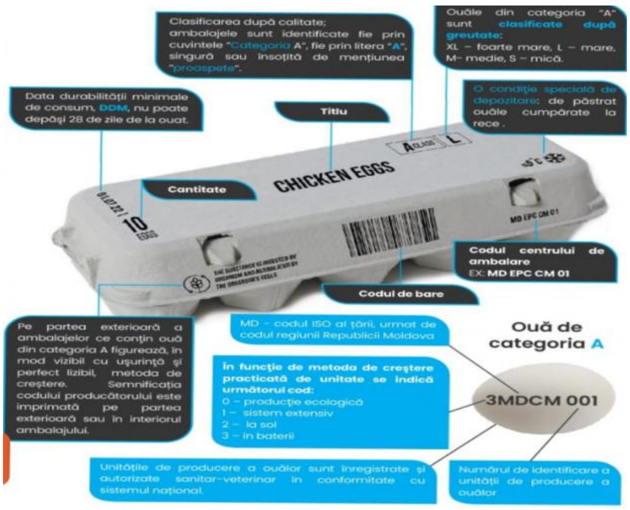

Fig. 8. Egg marking requirements
Source: [11].

CONCLUSIONS

Bacteriological investigations of the load of germs on the shell of eggs sold in market and store conditions in various periods of the season determined values of the number of colonies between 8-10/autumn; 3-4/spring and 1-2/winter.

The bacterioscopic evaluations of the total number of germs investigated on the surface of the eggshell revealed values of the number of shells between 38-42/autumn; 24-35/spring and 8-10/winter.

The research results in the conducted study demonstrated the general prevalence of microbial germs on the eggshell surface during the autumn season, followed by the spring season and finally a lower prevalence during the winter season. Salmonella species were not identified.

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RESEARCH ON SOME ASPECTS OF POULTRY MEAT QUALITY DEPENDING ON STORAGE

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Abstract

The study of current research is of interest regarding the assessment of the quality of poultry meat depending on the storage conditions. The scientific researches were performed using the following research methods: microscopic visualization, bacterioscopic and bacteriological methods qualitative and quantitative analysis, induction, deduction, the graphics method, the chronological series method. The results of the researches on the quality of poultry meat assortments demonstrated aspects of the quality of poultry meat assortments after 24 hours of refrigeration with a higher weight in the sample of poultry meat of the assortment purchased from the market - 3 isolated bacterial colonies, followed by the poultry meat of domestic origin-2 colonies and 1 bacterial colony determined in store-bought poultry meat depending on various storage conditions. In the scientific research are analyzed the consumption of meat by different categories, the origin of poultry meat sold on markets from Moldova, the analysis of quality based on storage and proposed recommendations related the improving the quality of the poultry meat.

Key words: *poultry, meat quality, bacteriology, bacterioscopy, refrigeration, freezing, storage*

INTRODUCTION

In the last decade in the Republic of Moldova, there is a significant increase in the volume of poultry breeding in peasant households and in the industrial way with the use of intensive technologies. The Statistical Yearbook of the Republic of Moldova notes a significant increase in the production of poultry meat. This advancement in the production of poultry meat is conditioned by the short period of growth of birds (broiler chickens reaching the mass required for slaughter at 40 days of growth) [2; 6; 8].

Poultry meat is part of the white meat category, it has dietary properties, being very welcome in the diet of children of all ages, adults and the elderly. The population all over the world prefers to eat poultry meat in its natural state, which represents about 80-85% of the weight of the bird's carcass and only 10-12% is directed to the manufacture of minced poultry meat products. Poultry meat processing represents a complex set of processes closely related to biology, meat chemistry, processing technique and technology, marketing and trade [1; 3; 7; 11].

In the last 20-30 years, poultry processing technology has been developing in the direction of increasing productivity, the main problem of poultry meat processing technologies being the relatively short storage time of finished products both in refrigerated and frozen states. From these considerations, it was found that different bacterial species from the genera Pseudomonas, Clostridium, bacillus, Listeria monocytogenes, Streptococcus, Lactobacillus, Enterobacter usually persist on the surface of refrigerated poultry meat [4, 6, 9; 10; 11]. Also, working on rabbit meat, we found a large diversity of bacterial species [5].

Food poisoning often has possible causes transmitted through meat, given the fact that live birds are carriers of Salmonella and Campylobacter type microorganisms opposite of which there are currently no effective means to reduce their spread [10; 12, 13].

For these reasons, the main objectives of these researches are to investigate the quality of poultry meat in various storage conditions.

MATERIALS AND METHODS

Practical laboratory research on the quality of poultry meat of different categories from home conditions, market and store after 24 hours of refrigeration and 24 hours of freezing was carried out according to laboratory bacteriological methods by making microbial preparations and cultivation from samples on culture media intended for the identification of microorganisms, regarding its quality.
For the investigations, samples of poultry meat were collected and investigated by the basic methods used: bacterioscopic and bacteriological. Through these basic methods of investigation, quality indices were determined regarding the aspects of determining the number of colonies and cells of the developed microbial species.

RESULTS AND DISCUSSIONS

Analysing the production of meat for the period 2018-2022, we can reveal that the total meat production is approximately 120 thousand tons. In 2022, was produced 45 tons of poultry meat, registering an increase compared to 2021 by 5 tons, but analysing the dynamics of meat production for the period 2018-2022, was registered that the production of poultry meat constitutes aproximately 45 thousand tons per year (Fig. 1).
According to the Fig.2 the consumption of poultry meat in Republic of Moldova per inhabitant registered an increase in the period 2020-2022, from 25 kg/pers in 2020 to 27 kg/pers in 2022.
During the period Jan-Nov. 2023, in the Republic of Moldova was imported 25,556 tons of poultry meat (Fig. 3). Analysing the imports of poultry meat, was identified that prevails Ukraine with 49% imports or 12,641. A significant share in imported poultry meat in Moldova owns Poland – 19% and Hungary – 14%.
Investigations of poultry meat samples of different varieties confirm our data regarding superficial quantitative indices on the culture media of poultry meat varieties of different categories after 24 hours of refrigeration, Figure 4.
These varieties of poultry meat evaluated for the number of colonies developed demonstrate to us the characteristics of the study of the bacterial bacteriological microflora.
During the analysis of the study, it was found with regard to the bacteriological behaviors regarding the number of colonies after 24 hours of refrigeration in different types of meat, that on the gel medium depending on the nature of the analyzed samples, it can be observed that the sample had the largest share of poultry meat of the variety purchased from the market – 3 bacterial colonies isolated, followed by poultry meat of domestic origin – 2 colonies and 1 bacterial colony determined in poultry meat purchased in the store.
The research focused on the quality and quantity of the food product pollution, the bacterioscopic and bacteriological behavior, which allowed the specific characteristics of the bacteria. As a result of the research, simple, classic methods were used to determine the characteristic colonies of bacterial cultures, obtained on selective isolation media, which, in a first stage, were highlighted on nutrient agar, and later on Endo selective media, Levine and Saburov for highlighting the pathogenic characteristics. Within the work methodology, the identification of enterobacteriaceae in general, and species belonging to the Salmonella genus in particular, by microbiological tests were not confirmed.
In the conducted experiments, we used standardized examination methods, first of all, classic bacteriological examinations (bacterioscopic, cultural examinations, isolation and identification of germs) from raw poultry meat refrigerated after 24 hours.
The results obtained using the classical bacteriological methods ensure, in addition to the isolation of the bacteria, the identification of different morphological and cultural characters, on the basis of which the strains can be classified into species. In addition, the bacteriological examination also provides

clues about the source of the infection, thus making it possible to eliminate it.

Figure 5 represents the behavior of testing the bacteriological quantitative indices from the depth on the culture media of the poultry meat assortments of different categories after 24 hours of freezing, where it is found that the number of colonies constituted in the frozen meat denotes lower values compared to the values obtained from following investigations of refrigerated meat samples.

Thus, the values obtained regarding the number of colonies in the samples from the chicken meat sold on the market constituted 2 microbial colonies, compared to the values of the samples of the poultry meat from the domestic and store-bought varieties, where the number of colonies was 1 colony from both types of meat of investigated bird.

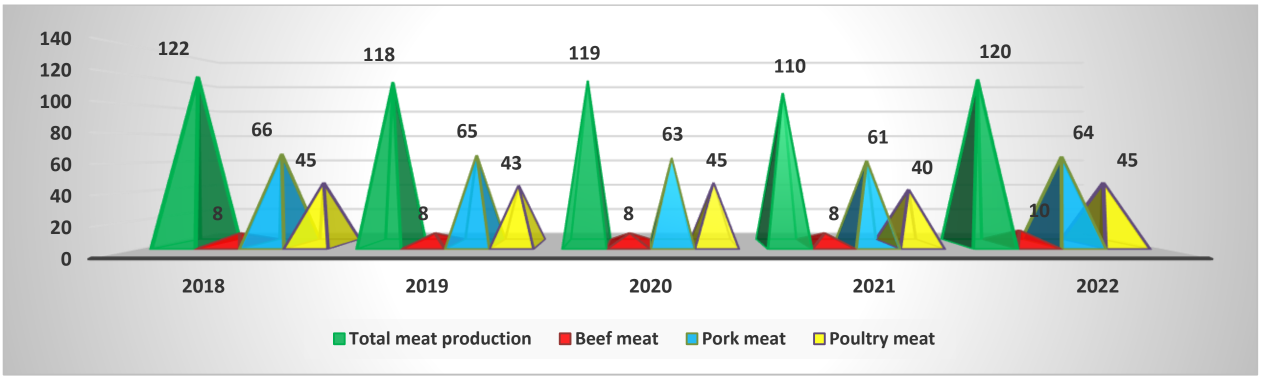

Fig.1. Meat production in the Republic of Moldova for 2018-2022, thousand tons
Source: elaborated by the author

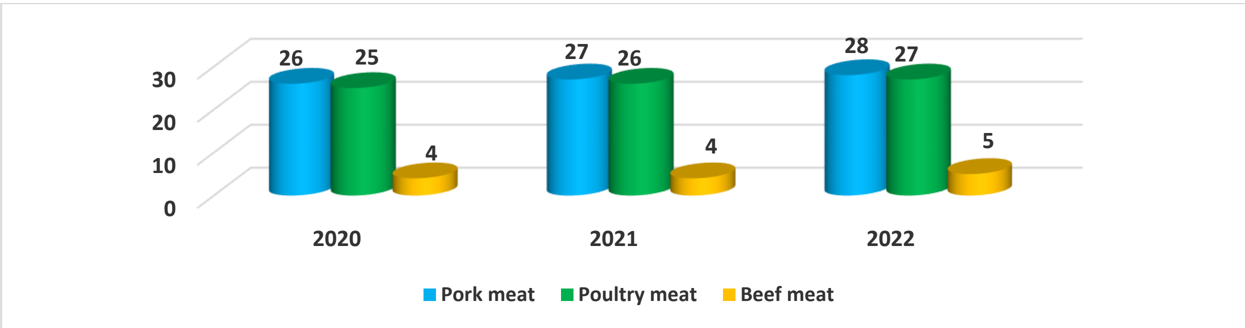

Fig. 2. Meat consumption per inhabitant for 2020-2022, kg/pers
Source: elaborated by the author

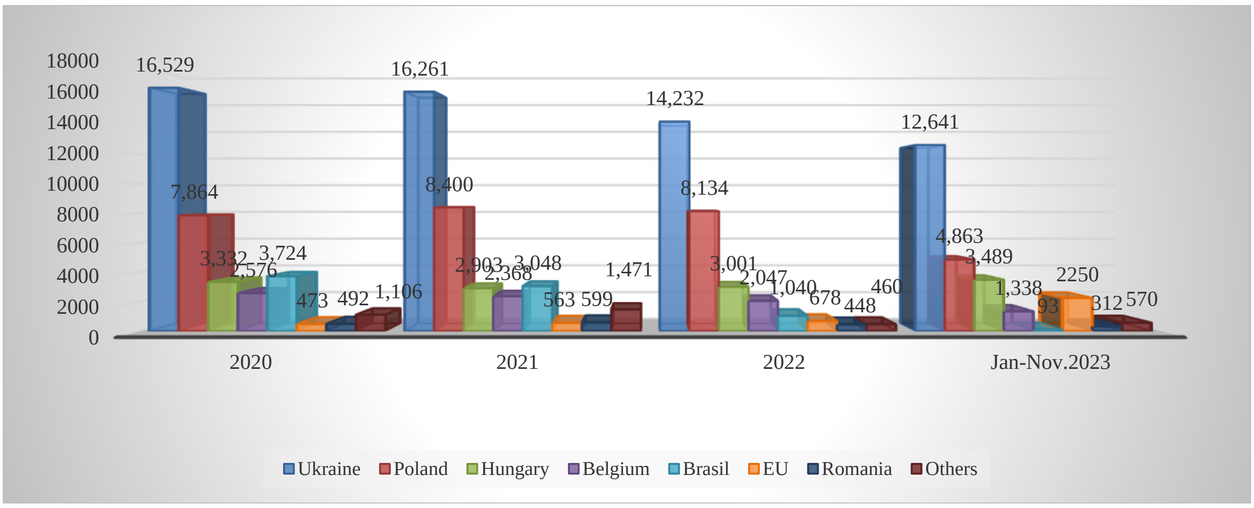

Fig. 3. The origin of poultry meat (and of edible meat) imported in the Republic of Moldova for 2020-Jan/Nov 2023, tons
Source: elaborated by the author.

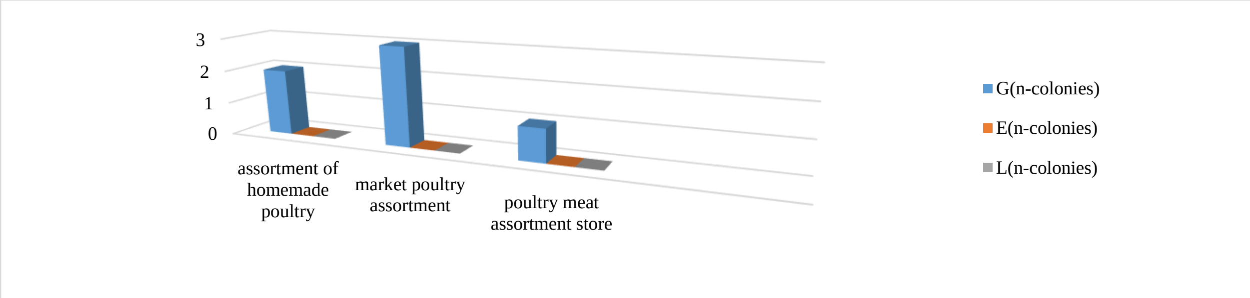

Fig. 4. Quantitative superficial bacteriological indices on the culture media of poultry meat assortments of different categories after 24 hours of refrigeration
Source: elaborated by the author.

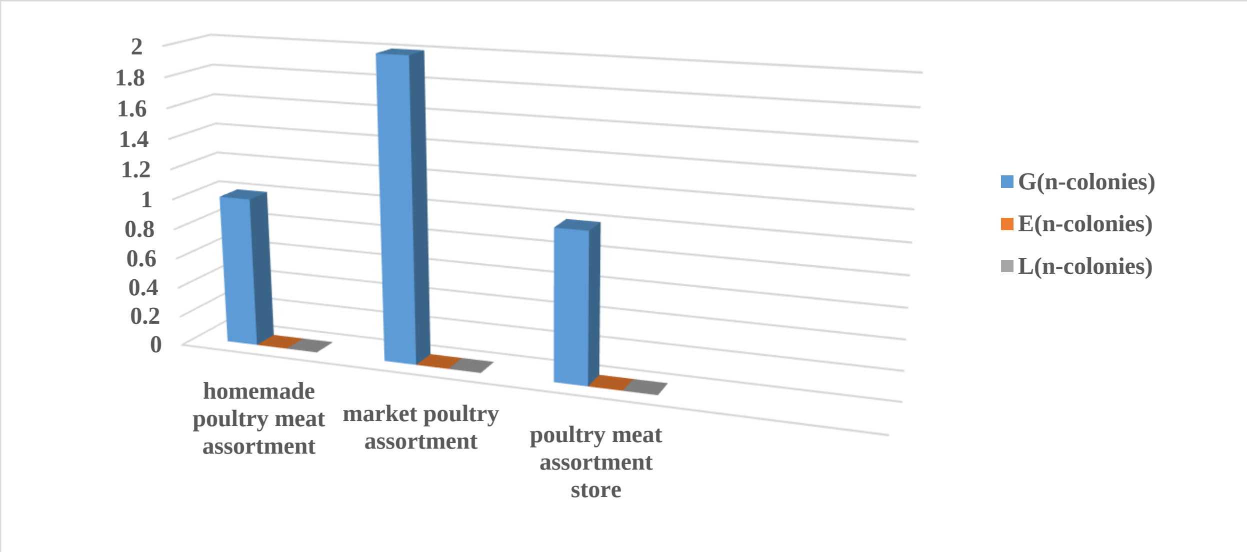

Fig. 5. Quantitative bacteriological indices from depth on the culture media of poultry meat assortments of different categories after 24 hours of freezing
Source: elaborated by the author.

The data presented are important in the context in which, as a result of the investigations, these colonies were detected, which under microscopy showed saprophytic cocci, confirming a normal bacterial microflora.

Considering these aspects, we conclude that food poisoning through these types of meat is excluded.

It is important to include complex measures for this purpose, aimed both at educating those who handle food to maintain proper hygiene in slaughtering, preparation and marketing units, but also at the proper preparation of food, its correct refrigeration and the prevention of cross-contamination, measures of personal hygiene and reducing the contamination of carcasses in slaughterhouses, sales conditions in the store or at the market.

From this point of view, the aspects regarding the conditions for obtaining and marketing food, especially poultry meat, which is frequently used in human nutrition, are very important. In the framework of our study carried out in samples of poultry meat of different categories, the bacterioscopic quantitative indices shown in Figure 6 confirm some important values obtained.

According to the bibliographic sources, the bacterioscopic microbiological study of meat investigation involves the division of marketed meat into three categories: fresh meat-10 cocci/microscopy; less fresh-30 cocci/microscopy; relatively fresh-more than 30 cocci/microscopy.

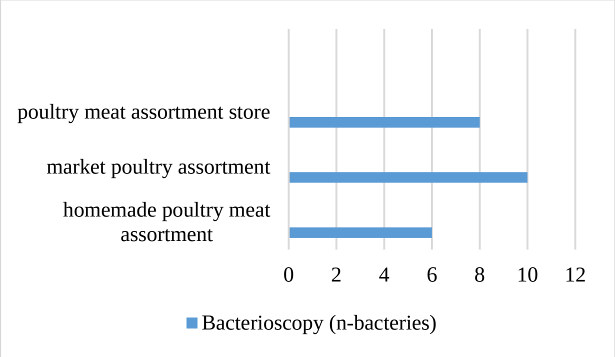

Fig. 6. Quantitative bacterioscopic indices from the depth of poultry meat of different categories after 24 hours of freezing
Source: elaborated by the author.

The bacterioscopic study was the stage after which cocci microorganisms were isolated from the depth of the poultry meat carcass, which confirmed important characteristic values observed in the result of microscopic research.

According to the data in Figure 6, it can be observed that in the samples of meat sold at the frozen market, the number of buns was 10 cocci microscopy cocci in the samples from the depth of the meat compared to the samples of chicken meat sold in store conditions where the number of buns in bacterioscopy was 8 cocci bacterioscopy and the peels homemade meat, where under microscopy the number of lumps constituted 6 cocci under microscopy.

Therefore, a preponderance of the number of chickens sold at the market is observed, possibly this preponderance is explained by some less hygienic marketing conditions compared to the poultry meat sold in the store and that of domestic origin.

The importance of these reports from a practical point of view is of interest in that these characteristics were detected, which upon viewing confirmed a normal bacterial microflora characteristic of saprophytic cocci.

These reports guide us towards complex measures, which aim towards a correct commercialization of poultry carcasses, refrigeration, freezing and prevention of contamination with various species of microorganisms.

The study revealed in Figure 7 shows quantitative superficial bacterioscopic values of poultry meat of different categories after 24 hours of refrigeration, where it is observed that the bacterioscopic microflora is more abundant in the samples of meat sold on the market - 14 cocci cells under microscopy, compared to the samples sold in the store with 10 cocci under microscopy of chilled meat and 8 cocci of bacterial cells characteristic of home-grown meat.

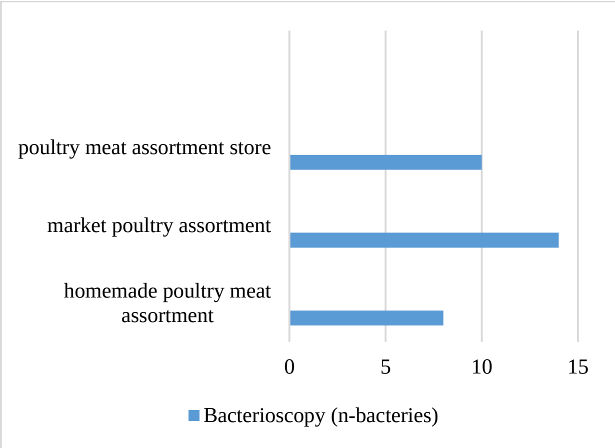

Fig. 7. Quantitative superficial bacterioscopic indices of poultry meat of different categories after 24 hours of refrigeration
Source: elaborated by the author.

On Endo, Levine and Saburov microbial pathogenic species detection media, no pathogenic colonies characteristic of pathogenic species were detected by culture and microscopic visualization after Gram staining. Salmonella and Escherichia species after bibliographic studies remain the main cause of foodborne bacterial diseases reported in China, USA and other countries of the world. Meat products are recognized as one of the major sources of human salmonellosis; however, there is a lack of comprehensive and quantitative data on Salmonella contamination of these foods. Therefore, the objectives of this study were also focused on investigating the prevalence, bacterial load of different varieties of poultry meat for sale. The analysis of the most likely number of microbial colonies and cocci microorganisms detected showed us that the contamination was quite low.

CONCLUSIONS

-The indicators of the study found aspects of the bacteriological behaviors regarding the quality of the poultry meat assortments after

24 hours of refrigeration with a greater weight in the poultry meat sample of the assortment purchased from the market - 3 isolated bacterial colonies, followed by the poultry meat of origin housewife-2 colonies and 1 bacterial colony determined in store-bought poultry meat.

-The behavior of testing the bacteriological quantitative indices regarding the quality aspects from the depth on the culture media of the poultry meat assortments of different categories after 24 hours of freezing showed a number of colonies constituted in the frozen meat lower values compared to the values obtained from the investigations refrigerated meat samples.

-The samples of meat sold at the frozen market confirmed a number of cocci consisting of 10 microscopic coci in the samples from the depth of the meat compared to the samples of chicken meat sold in store conditions where the number of cocci at bacterioscopy was 8 cocci bacterioscopy and the home meat samples, where on microscopy the number of cocci constituted 6 cocci on microscopy.

-A more obvious preponderance of the number of chickens sold at the market confirms a possible less hygienic sales condition compared to the poultry meat sold in the store and that of domestic origin.

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ADAPTATION OF THE FARMERS' SKILLS TO THE REQUIREMENTS OF THE FUTURE AGRICULTURE

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Abstract

This research explores the evolving skill requirements in the agricultural sector, driven by changing business environments and technological advancements in the labour market. As agriculture undergoes significant transformation with the integration of technologies like drones, soil sensors, and data analytics, the role of farmers is shifting towards that of data-driven, business-savvy professionals. To assess modern agriculture's skill needs, the study employed a multi-faceted approach. Firstly, we utilized the European Skills/Competences, Qualifications and Occupations (ESCO) classification to identify agriculture-related skills. Secondly, we analysed job advertisements from Romanian profile websites to compare the skills mentioned in job postings with the ESCO taxonomy. Lastly, we administered questionnaires to agronomy students and practicing farmers to gauge their perspectives on necessary skills. The study revealed a comprehensive skill set relevant to agriculture, with a strong emphasis on information skills, effective communication, and management abilities. These findings highlight the multifaceted nature of contemporary agriculture careers, which require technical expertise, sales acumen, analytical skills, and adaptability to navigate the evolving landscape.

Key words: *agriculture skills, technological transformation, contemporary farming, skill gap analysis*

INTRODUCTION

In recent years, changes in the business environment, new technologies, an increasingly competitive level, and dynamism have contributed to the need for acquiring new skills. (Mulder et. al., 2007; Dolce et al., 2019) [16, 7]. Maybe now more than ever, the labour market is deeply influenced by VUCA characteristics (Volatile, Uncertain, Complex, and Ambiguous) (Cedefop, 2022; Howard et. al., 2022) [5, 13].

In this context, even the profession of farming is on the verge of undergoing radical changes which requires updated and new skills [1, 2]. The use of drones has already become common for monitoring fields and treating them with herbicides or spray fertilizers. The future image of agriculture is realized through a combination of soil sensors, weather prediction apps, satellite imagery, and tractors controlled by joysticks.

Of course, this transformation does not lead to the disappearance of the farmer's profession, but it does radically change it. The farmer of the future will work in a completely different way compared to the present (Erickson et. al., 2018; Sorensen et al., 2021) [9, 17]. "They will coordinate machines, give commands to drones from a computer, analyse data, and make decisions based on this data." (INACO - Inițiativa pentru Competitivitate, 2021) [14].

Furthermore, according to INACO experts, future farmers will need skills more akin to those of business people. Their time will be much more valuable if spent creating connections and finding markets for their products rather than working the land. They will need to study demand in order to adapt their offerings to consumer needs. Successful farmers will be those who attend conferences to stay connected with the latest technological developments in the field. Those who want to remain relevant will test new, more resilient seeds with higher production capacities (INACO - Inițiativa pentru Competitivitate, 2021) [14].

This study aims to conduct a comprehensive assessment of the extent to which there is alignment between the competencies that entrepreneurs in the agricultural sector expect from their employees and the skills that students pursuing education in agriculture identify as essential for their future employment [6]. By analyzing the perspectives of both agricultural entrepreneurs, who represent the employer's viewpoint, and students, who are potential future employees, this research seeks to identify commonalities and discrepancies in the expectations and perceived necessities of skills and knowledge in the agricultural job market [4, 7, 11, 15].

This investigation is intended to contribute to a deeper understanding of the educational and training needs in the agriculture sector, facilitating better preparation of students for their professional careers and assisting employers in aligning their expectations with the emerging workforce's capabilities

MATERIALS AND METHODS

In order to assess the skills needed by farmers nowadays we took a number of important steps.

First, we assessed and extracted all the skills labelled as dealing with agriculture in the European Skills/Competences, Qualifications and Occupations/ESCO classification of the European Commission (European Commission, 2023) [10].

Second, using scraping and crawling tools, we extracted a series of job advertisements available on Romanian profile websites and compared the skills mentioned in them to the skills from the ESCO taxonomy.

The data was collected dated from the 2022 – 2024 timeframe.

Third, we created a questionnaire which we applied both to students in the agronomy field, as well as to present farmers, trying to assess which skills the future and present farmers believe they need for succeeding in this field of work.

RESULTS AND DISCUSSIONS

In December 2023 the following 26 skills were connected to the agriculture field in the ESCO taxonomy (Table 1).

Table 1 not only categorizes 26 distinct skills but also aligns them with their respective ESCO level 1 categories, offering a structured overview of the competencies deemed essential in agriculture. These skills range from managerial tasks, such as assigning duties to agricultural workers and developing agricultural policies, to more technical abilities like maintaining agricultural machinery and operating agricultural or forestry equipment.

A noteworthy aspect of this classification is its emphasis on a diverse skill set that spans management, information skills, assisting and caring, working with machinery and specialized equipment, working with computers, communication, collaboration and creativity, handling and moving, and organizing, planning, and scheduling work and activities. This diversity reflects the multifaceted nature of the agricultural industry, which requires professionals to possess a blend of technical, managerial, and interpersonal skills to effectively address the challenges and demands of modern agriculture.

The inclusion of skills related to the development and implementation of agricultural policies and production plans underscores the sector's strategic importance and its need for forward-thinking leadership. Furthermore, the focus on operating machinery and specialized equipment highlights the technological advancements in agriculture, such as precision farming and the use of agricultural information systems and databases, which are critical for enhancing productivity and sustainability.

The classification also acknowledges the importance of soft skills, such as teamwork and the ability to provide advice to farmers, indicating that successful agricultural professionals must be able to communicate effectively and work collaboratively. Additionally, the attention to compliance with agricultural codes of practice and farm regulations reflects the growing emphasis on sustainable and ethical farming practices.

Overall, the ESCO taxonomy's detailed mapping of agriculture-related skills provides valuable insights into the competencies that are currently prioritized in the agricultural sector. This information is crucial for educational institutions, policymakers, and industry stakeholders aiming to develop training programs and policies that align with the evolving needs of the agriculture industry, ensuring that the future workforce is well-equipped to meet these challenges.

Table 1. Agriculture-related skills identified in the ESCO classification

Skills	ESCO level 1 category they belong to
Assign duties to agriculture workers	Management skills
Develop agricultural policies	
Develop agricultural production plans	
Carry out work related calculations in agriculture	Information skills
Maintain agricultural machinery	
Inspect agricultural fields	
Strive for nutritional improvement of food manufacturing	
Supervise hygiene procedures in agricultural settings	Assisting and caring
Comply with agricultural code of practice	
Comply with farm regulations	
Drive agricultural machines	Working with machinery and specialised equipment
Operating agricultural or forestry equipment	
Diagnose fuel systems	
Maintain air conditioning systems	
Operating mobile plant	
Apply precision farming	
Use agricultural information systems and databases	Working with computers
Promote agricultural policies	Communication, collaboration and creativity
Provide advice to farmers	
Working in teams	
Work in a land-based team	
Advise on weather-related issues	
Cultivating land and crops	Handling and moving
Harvest crop	
Manage time in agricultural production	Organising, planning and scheduling work and activities

Source: ESCO taxonomy [10].

Following the extraction of 78 job ads related to the agriculture field found on specific Romanian internet websites (BestJobs, 2023; eJobs, 2023; Hipo, 2023) [3, 8, 12].

The agriculture-related jobs we identified during this endeavour include:

Agronomist (Responsibilities: Providing agronomic consultancy, conducting market research and offering technical support to clients, helping them optimize their agricultural practices)

Agribusiness Sales Representative/ Consultant (Responsibilities: Promoting and selling agricultural equipment and products)

Key Account Manager (Responsibilities: Working closely with major clients, negotiating contracts and aiming to increase sales and client satisfaction)

Automation Engineer (Responsibilities: Monitoring and improving industrial control systems, ensuring their proper functioning)

Utilities Engineer (Responsibilities: Coordinating activities related to environmental protection, waste management, water and air quality, and maintaining utility systems)

Contract Administrator - Agribusiness (Responsibilities: Registering and managing sales and purchase contracts, maintaining master data, and ensuring compliance with internal procedures)

Depot Manager - Vegetable/Fruit Warehouse (Responsibilities: Efficiently managing warehouse activities, stock monitoring, team coordination, and problem-solving)

Business Development Manager (Responsibilities: Expanding the company’s business, identifying new clients and forming strategic partnerships)

Assistant Manager – Warehouse (Responsibilities: Assisting with warehouse management, including order processing, inventory control, and logistics coordination)

Technical Support and Training Roles (Responsibilities: providing specialized training to clients on the use and maintenance of agricultural equipment or technology, ensuring customer satisfaction and addressing technical issues)

Additional Roles (Responsibilities: management positions or roles in the automotive industry related to agriculture)

Further, we cleaned the data, translated it in English and analysed the specific skills required from the candidates, categorizing them according to the ESCO taxonomy.

Table 2 presents a detailed analysis of agriculture-related skills as identified in job advertisements (ESCO taxonomy Level 2).

Table 2. Agriculture-related skills identified in the job ads, classified according to the ESCO taxonomy

Category according to ESCO Level 2	No. of mentions
S2.3 - managing information	223
S2.9 - monitoring developments in area of expertise	150
S2.2 - documenting and recording information	150
S2.7 - analysing and evaluating information and data	132
S4.2 - organising, planning and scheduling work and activities	105
S1.2 - liaising and networking	95
T4.1 - communicating	94
S4.6 - building and developing teams	92
S2.8 - monitoring, inspecting and testing	87
S4.5 - leading and motivating	86
S4.9 - making decisions	81
S3.4 - providing information and support to the public and clients	77
T2.2 - planning and organising	74
S3.3 - protecting and enforcing	74
S4.1 - developing objectives and strategies	72
S4.8 - supervising people	65
S1.0 - communication, collaboration and creativity	60
S1.8 - working with others	59
T3.2 - taking a proactive approach	57
T4.2 - supporting others	49
T2.1 - processing information, ideas and concepts	49
S4.3 - allocating and controlling resources	45
S1.6 - promoting, selling and purchasing	42
S1.5 - advising and consulting	39
T3.3 - maintaining a positive attitude	37
T3.1 working efficiently	34
S2.1 - conducting studies, investigations and examinations	34
T3.4 - demonstrating willingness to learn	32
T6.3 - applying civic skills and competences	32
S1.11 - designing systems and products	29
S4.0 - management skills	28
T4.5 - following ethical code of conduct	26
S1.15 - using more than one language	26
T1.1 - mastering languages	26
T6.1 - applying health-related skills and competences	22
S1.1 - negotiating	21
S3.1 - counseling	19
S3.0 -assisting and caring	19
T6.5 - applying entrepreneurial and financial skills and competences	18
T6.6 - applying general knowledge	16
S1.9 - solving problems	15
S1.4 - presenting information	15
S2.0 - information skills	14
S2.4 - processing information	14
T2.4 - thinking creatively and innovatively	10
T2.3 - dealing with problems	10
T6.2 applying environmental skills and competences	10
S1.7 - obtaining information verbally	10
T1.3 - working with digital devices and applications	10
S4.4 - performing administrative activities	9
S2.6 - calculating and estimating	4
S3.2 - providing health care or medical treatments	4
S3.6 - providing general personal care	4
T1.2 - working with numbers and measures	2

Source: ESCO taxonomy [10].

This analysis provides a quantitative overview, showcasing the frequency of mentions for each skill category, which offers insightful data on the current demand for specific competencies within the agricultural sector.

The most valued skills according to our analysis are the ones belonging to **S2 – information skills** (with a total of 383 mentions). These include skills in using various software tools, including MS Office, ERP systems, and industry-specific software like Autocad, drafting bills of materials, filing documents, preparing financial documents and records, reports or budgets, handling e-mail, analysing information and data as well as technical knowledge and experience in the agriculture domain.

The second most valuable set of skills belongs to the **S1 – communication, collaboration and creativity** category (a total of 370 mentions). These include effective communication, both verbal and written, often in more than one language (especially English), coordinating with teams, working with others and dealing with clients.

The third set of skills belongs to the **S4 – management skills** category (a total of 340 mentions). This includes team leadership, project management, the ability to face constant change or the ability to delegate and supervise tasks, as well as the ability to plan events and programmes, directing, to supervise and coordinate projects, manage transport and logistics activities and plan production processes.

Fourth are the skills belonging to the **T4 – social and communication skills and competences** (a total of 169 mentions). Besides communication, support, customer orientation and the ability to sell, these transversal competences also include integrity, respect, loyalty and ethics.

Fifth are the skills belonging to the **S3 – assisting and caring** category (153 mentions). These involve customer orientation, friendliness, support, as well as a preoccupation for the environment and compliance with regulations. Understanding of local and international regulations and standards, including environmental and safety regulations, is important, especially in roles related to compliance and quality control.

Sixth are the **T6 – life skills and competences** (148 mentions). These include critical thinking, quick reactions, assuming responsibility, as well as assessing risk, the ability to analyse market trends, customer needs, and technical problems, and then develop effective solutions.

Seventh are **T3 – self management skills and competences** (123 mentions). These include curiosity and willingness to learn, attention to detail, determination and initiative. Especially for roles that involve fieldwork or visiting different sites, having a driving license and being open to travel is often a prerequisite.

Eighth come **T2 – thinking skills and competences** (109 mentions). These are skills such as planning and organising, positive attitude, ability to work under pressure and in stressful environments, creative thinking and improvisation.

Ninth and last place are **T1 – core skills and competences** (38 mentions), which include languages, calculations and programming skills.

In summary, a career in agriculture today requires a blend of technical expertise, sales and customer service skills, analytical abilities, and strong communication, along with computer proficiency and management capabilities. Adaptability and a solid educational foundation also play significant roles in this field.

Interestingly, we haven't found any mentions of skills such as inspiring, encouraging, being a role model, deciding, interpreting, dealing with frustrations, ability to concentrate, patience, negotiation skills, entrepreneurial skills, innovative thinking, the ability to listen, the ability to express through visual materials, or teaching skills.

In the third stage of our research, we created two sets of questionnaires: one dedicated to students from the University of Life Sciences" Regele Mihai I" from Timișoara (students in the agriculture field), and one dedicated to farmers.

54 students answered the first questionnaire. Most of them were enrolled for obtaining a bachelor degree, but there were several enrolled into masters or doctoral studies.

Most were aged 20-25 years old and declared they had previous experienced with working in the agronomy field, mostly within the family farm. On the other side, 12 farmers answered the second questionnaire.

5 of them were 20-35 years old, while 7 were 35-50 years old. Most of them had formal degrees in the agronomy field, and ran farms of different sizes (from under 10 ha to over 500 ha).

Each of the respondents was asked to rank the 54 soft skills identified in the job ads, using a scale from 1 to 10, according to their perceived relevance in succeeding in the agronomy field.

Table 3 offers an insightful perspective on the importance of various soft skills in the agronomy field, as ranked by students. This ranking is predicated on their perceived relevance for success in this domain, with ratings on a scale where a higher value indicates greater importance.

Notably, "S1.6 - promoting, selling and purchasing" and "S4.9 - making decisions" both received the highest importance rating of 9.57, highlighting the critical role of marketing and decision-making skills in the agronomy sector. These competencies are deemed vital for navigating the complexities of agricultural markets and making strategic decisions.

Close behind, with ratings above 9.5, are "S1.9 - solving problems," "S4.3 - allocating and controlling resources," "T2.3 - dealing with problems," "T3.1 working efficiently," and "T4.5 - following ethical code of conduct." These skills underscore the necessity for problem-solving abilities, resource management, efficiency in work, and adherence to ethical standards, reflecting the multifaceted challenges faced in agronomy.

Organizational skills, as represented by "S4.2 - organising, planning and scheduling work and activities," along with effective communication ("T4.1 - communicating"), are also highly valued, each with a rating of 9.48. These competencies are essential for managing complex agricultural operations and ensuring clear, effective communication within the field.

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Table 3. Agriculture-related skills identified in the job ads, ranked by students in the agronomy field according to their relevance for succeeding in this field

Soft skills according to ESCO Level 2	Imp. acc. to students
S1.6 - promoting, selling and purchasing	9.57
S4.9 - making decisions	9.57
S1.9 - solving problems	9.52
S4.3 - allocating and controlling resources	9.52
T2.3 - dealing with problems	9.50
T3.1 working efficiently	9.50
T4.5 - following ethical code of conduct	9.50
S4.2 - organising, planning and scheduling work and activities	9.48
T4.1 - communicating	9.48
T2.4 - thinking creatively and innovatively	9.46
T4.2 - supporting others	9.46
S4.0 - management skills	9.44
S4.1 - developing objectives and strategies	9.44
S4.6 - building and developing teams	9.44
T6.6 - applying general knowledge	9.44
T2.2 - planning and organising	9.43
T3.4 - demonstrating willingness to learn	9.39
S2.6 - calculating and estimating	9.37
T6.5 - applying entrepreneurial and financial skills and competences	9.37
S4.5 - leading and motivating	9.35
S1.1 - negotiating	9.31
S1.5 - advising and consulting	9.31
S2.2 - documenting and recording information	9.31
T1.3 - working with digital devices and applications	9.31
T6.3 - applying civic skills and competences	9.31
S2.8 - monitoring, inspecting and testing	9.30
S1.8 - working with others	9.28
S4.8 - supervising people	9.28
T2.1 - processing information, ideas and concepts	9.28
T3.3 - maintaining a positive attitude	9.28
S1.4 - presenting information	9.26
S2.4 - processing information	9.24
S2.9 - monitoring developments in area of expertise	9.24
T6.2 - applying environmental skills and competences	9.24
S4.4 - performing administrative activities	9.22
T1.2 - working with numbers and measures	9.22
T6.1 - applying health-related skills and competences	9.22
S2.7 - analyzing and evaluating information and data	9.20
S3.0 -assisting and caring	9.20
S3.3 - protecting and enforcing	9.20
S2.1 - conducting studies, investigations and examinations	9.19
S2.0 - information skills	9.15
S2.3 - managing information	9.13
S1.7 - obtaining information verbally	9.11
S3.1 - counseling	9.11
S3.2 - providing health care or medical treatments	9.11
S1.0 - communication, collaboration and creativity	9.09
S1.11 - designing systems and products	9.07
S3.6 - providing general personal care	9.07
T3.2 - taking a proactive approach	9.06
S3.4 - providing information and support to the public and clients	9.02
S1.2 - liaising and networking	8.98
T1.1 - mastering languages	8.76
S1.15 - using more than one language	8.74

Source: original research. Students' answers.

Innovative thinking and support for others, indicated by "T2.4 - thinking creatively and innovatively" and "T4.2 - supporting others," with ratings of 9.46, emphasize the importance of creativity and teamwork in addressing the dynamic challenges of agronomy.

Management and leadership skills, including "S4.0 - management skills," "S4.1 - developing objectives and strategies," and "S4.6 - building and developing teams," each rated at 9.44, highlight the demand for leadership qualities that can drive strategic direction, team development, and organizational success in the agricultural sector.

This ranking vividly illustrates the broad spectrum of soft skills that students in agronomy perceive as crucial for their future success. It underscores the importance of not only technical knowledge but also of interpersonal, managerial, and ethical competencies in the agricultural profession. This insight can guide educational institutions in tailoring their curriculum to better prepare students for the challenges and opportunities in the field of agronomy, ensuring they are well-equipped with the skills necessary to thrive in their future careers.

Table 4 illustrates the prioritization of agriculture-related soft skills as ranked by farmers, reflecting their assessment of what is most relevant for success in the field. This evaluation provides a practical perspective on the competencies valued by those actively engaged in farming operations.

At the top of the list, "S4.3 - allocating and controlling resources" is considered most critical, with a rating of 9.58, emphasizing the importance of efficient resource management in farming. Skills in "S1.4 - presenting information," "S1.9 - solving problems," "S2.6 - calculating and estimating," and "T2.3 - dealing with problems" are all highly valued, each with a rating of 9.41. These skills underscore the necessity for effective communication, problem-solving capabilities, and analytical thinking in the agriculture sector.

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Table 4. Agriculture-related skills identified in the job ads, ranked by farmers according to their relevance for succeeding in this field

Soft skills according to ESCO Level 2	Imp. acc. to students
S4.3 - allocating and controlling resources	9.58
S1.4 - presenting information	9.41
S1.9 - solving problems	9.41
S2.6 - calculating and estimating	9.41
T2.3 - dealing with problems	9.41
S1.0 - communication, collaboration and creativity	9.33
S4.5 - leading and motivating	9.33
T3.1 working efficiently	9.33
S2.7 - analysing and evaluating information and data	9.25
S4.2 - organising, planning and scheduling work and activities	9.25
S4.8 - supervising people	9.25
S1.1 - negotiating	9.16
S2.0 - information skills	9.16
S4.0 - management skills	9.16
S4.6 - building and developing teams	9.16
S4.9 - making decisions	9.16
T2.2 - planning and organising	9.16
T4.1 - communicating	9.16
S2.3 - managing information	9.08
S2.8 - monitoring, inspecting and testing	9.08
T3.2 - taking a proactive approach	9.08
S1.2 - liaising and networking	9
S2.1 - conducting studies, investigations and examinations	9
S2.9 - monitoring developments in area of expertise	9
T2.1 - processing information, ideas and concepts	9
S4.1 - developing objectives and strategies	8.91
T3.4 - demonstrating willingness to learn	8.91
T4.5 - following ethical code of conduct	8.91
S1.8 - working with others	8.83
S2.2 - documenting and recording information	8.83
S2.4 - processing information	8.83
T1.3 - working with digital devices and applications	8.83
T2.4 - thinking creatively and innovatively	8.83
T3.3 - maintaining a positive attitude	8.83
S3.3 - protecting and enforcing	8.75
T1.2 - working with numbers and measures	8.75
T6.6 - applying general knowledge	8.66
S1.5 - advising and consulting	8.58
S3.0 -assisting and caring	8.58
S4.4 - performing administrative activities	8.58
T4.2 - supporting others	8.58
T6.1 - applying health-related skills and competences	8.58
T6.5 - applying entrepreneurial and financial skills and competences	8.5
S1.6 - promoting, selling and purchasing	8.41
S1.7 - obtaining information verbally	8.41
S1.11 - designing systems and products	8.41
T1.1 - mastering languages	8.41
T6.2 - applying environmental skills and competences	8.41
T6.3 - applying civic skills and competences	8.41
S3.1 - counseling	8.33
S1.15 - using more than one language	8.25
S3.4 - providing information and support to the public and clients	8
S3.6 - providing general personal care	7.91
S3.2 - providing health care or medical treatments	7.83

Source: Original research. Farmers' answers.

"Communication, collaboration and creativity" (S1.0), along with "leading and motivating" (S4.5) and "working efficiently" (T3.1), each receive a rating of 9.33, highlighting the essential role of teamwork, leadership, and productivity in agricultural success.

"Analysing and evaluating information and data" (S2.7), "organising, planning and scheduling work and activities" (S4.2), and "supervising people" (S4.8) are also considered important, with ratings of 9.25. These skills reflect the need for analytical capabilities, strategic planning, and effective supervision in managing farm operations.

Negotiation, information management, and decision-making skills, along with the ability to build and develop teams, are further identified as key competencies, with ratings ranging from 9.16 to 9.25. This indicates a recognition of the multifaceted nature of farming, which requires a blend of managerial, interpersonal, and technical skills.

Skills related to "managing information" (S2.3), "monitoring, inspecting and testing" (S2.8), and taking a "proactive approach" (T3.2) are also ranked highly, with ratings around 9.08, pointing to the necessity for continuous monitoring, quality control, and proactive management in agricultural practices.

This ranking by farmers sheds light on the practical skills deemed essential for navigating the complexities of modern agriculture. It underscores a blend of managerial, technical, and interpersonal skills, reflecting the dynamic and challenging nature of the sector. This insight can inform educational and training programs aimed at preparing individuals for successful careers in agriculture, ensuring they are equipped with the competencies valued by industry practitioners.

Several interesting aspects surfaced from the three stages of our research when the results were compared

For instance, S2.3 - managing information, the soft skill which ranked first in the job ads with no less than 233 mentions, only ranked in the 43rd place in the students' hierarchy and on the 19th place in the farmers' hierarchy. (Fig.1; Fig 2; Fig. 3)

The soft skill which ranked first in the students' hierarchy, S1.6 - promoting, selling and purchasing, only ranked on the 23rd place in the job ads and on the 44th place in the farmers' hierarchy.

The soft skill which ranked first in the farmers' hierarchy, S4.3 - allocating and controlling resources, only ranked on the 22nd place in the job ads, but ranked on a close 5th place in the students' hierarchy.

The students graded the importance of soft skills higher than the farmers. The highest average score given by the students was 9.57, and the lowest one was 8.74. The highest average score given by the farmers was 9.58, while the lowest one was 7.83.

Soft skills such as providing health care, medical treatments or personal care scored the lowest in all the created rankings.

Also, applying environmental skills and competences ranked extremely low in the job ads and the farmers' hierarchy, but much higher, on the 34th place, in the students' hierarchy.

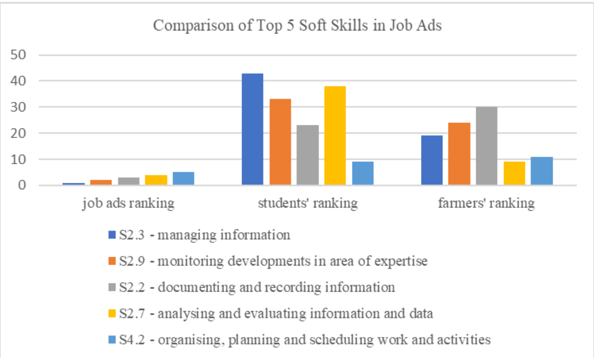

Fig. 1. Comparison of Top 5 Soft Skills in Job Ads
Source: Original research.

The top 5 soft skills ranked by the farmers seem to most align with their according ranking done by the students. However, they are not reflected in the job ads mentions.

In fact, it appears that more often than not, the job ads in the agriculture domain do not reflect the real needs of the farmers or the beliefs of the students when it comes to mentioning soft skills needed for jobs in the field.

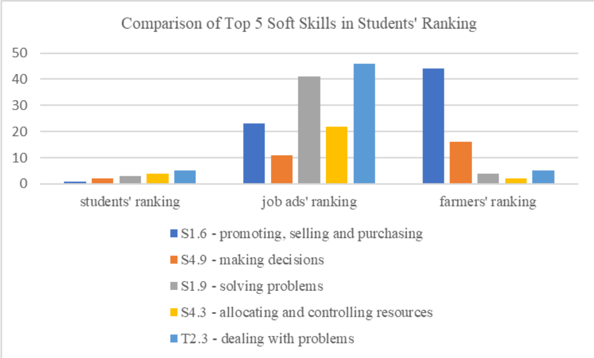

Fig. 2. Comparison of Top 5 Soft Skills in Students' Ranking
Source: Original research.

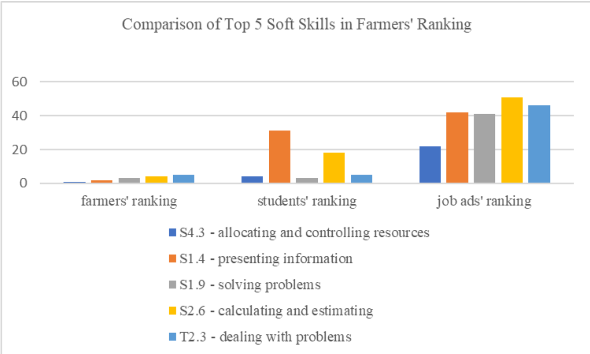

Fig. 3. Comparison of Top 5 Soft Skills in Farmers' Ranking
Source: Original research.

CONCLUSIONS

In conclusion, the agriculture sector is undergoing a profound transformation driven by technological advancements, changing market dynamics, and the need for greater sustainability. This transformation is reshaping the skills and competencies required of farmers and agricultural professionals. The study conducted a comprehensive analysis of the skills demanded in contemporary agriculture-related job advertisements and identified key skill categories.

The most valued skills in the agriculture sector according to the job ads are information skills, emphasizing the importance of digital literacy and data analysis in modern farming practices.

According to the farmers, the most important skills to have in this domain are the ones related to allocating and controlling resources, presenting information, solving problems, calculating and estimating and dealing with problems.

According to the students, the most valuable skill involves promoting, selling and purchasing, followed by making decisions, solving problems, allocating and controlling resources and dealing with problems.

Effective communication, collaboration, and creativity skills also rank high, reflecting the need for farmers to work in diverse teams and engage with clients and stakeholders. Management skills, including leadership and project management, are essential for overseeing complex agricultural operations.

Furthermore, the job ads highlighted the importance of social and communication skills, caring for the environment, and compliance with regulations in the agriculture industry. Life skills such as critical thinking, risk assessment, and self-management are crucial for addressing challenges and seizing opportunities in this dynamic field.

Overall, a successful career in agriculture today requires a diverse skill set that combines technical expertise, sales and customer service skills, analytical abilities, and strong communication, along with computer proficiency and management capabilities. Adaptability and a solid educational foundation are also key factors in thriving in the evolving agricultural landscape. However, there is a notable absence of certain skills, such as negotiation, innovation, and teaching skills, which may become increasingly important as the agriculture sector continues to evolve.

The farmers and the students seem to be much more aligned when it comes to predicting the soft skills that lead to success in the agriculture domain than the job ads.

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ANALYSIS OF THE EFFICIENCY OF THE IMPLEMENTATION OF FINANCING PROGRAMS FROM THE EUROPEAN SOCIAL FUND ON EDUCATION IN THE RURAL ENVIRONMENT IN ROMANIA

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Abstract

The objective of this article is to achieve a centralization of educational units with a specific focus on the trend of student enrolled in different forms of education versus the number of graduates since 1990. The importance of this article is given both by the historical context of this period, being characterized by the fall of the communist regime and the start of the reform processes in all fields, including education, following that from 2007, with Romania's accession to the European Union, the education system should benefit the implementation of funding programs from the European Social Fund (ESF), placing more emphasis on education in rural areas in Romania. It was also aimed at analyzing the results recorded in reducing educational gaps between rural and urban environments, as well as the impact on the socio-economic development of rural communities. In conclusion, recommendations will be proposed to optimize the efficiency of the implementation of ESF financing programs, for the purpose of rural education and supporting sustainable rural development.

Key words: *education, graduates, education, financing, rural, Romania*

INTRODUCTION

The educational level represents a stage of the education system that provides basic, intermediate, or higher education according to educational programs [1]. According to the methodology of the National Institute of Statistics, the post-1990 educational system includes all units and educational institutions of various types, levels, and forms of organization, which facilitate the development of the education and training process for the school population at all levels of education, for its professional training [8]. The school population represents the set of children in kindergartens and nurseries, pupils and students involved in the learning and education process in a school/university year within the framework of formal education, regardless of the types of education followed, the study program and age [7, 3]. According to law 198/04.07.2023 published in the Official Gazette of July 5, 2023 Article 13(1) Compulsory education includes pre-school education, primary education, middle school education and high school education, with the exception of the provisions of paragraph 1, students from the technological stream, who do not opt for continuing high school studies after obtaining a level 3 qualification certificate, is considered that they completed the compulsory education, without reaching a level 4 qualification.

Starting with 2013, the International Standard Classification of Education (ISCED 2011) categorizes the levels in the National Education System: preschool education (ISCED level 01); preschool (ISCED level 02), primary (ISCED level 1); secondary school (level 2 ISCED); high school and vocational (ISCED level 3); post-secondary and foremen (ISCED level 4); and higher (tertiary) (ISCED levels 6, 7 and 8) [2].

In Figure 1, it is presented the structure of the education system in Romania.

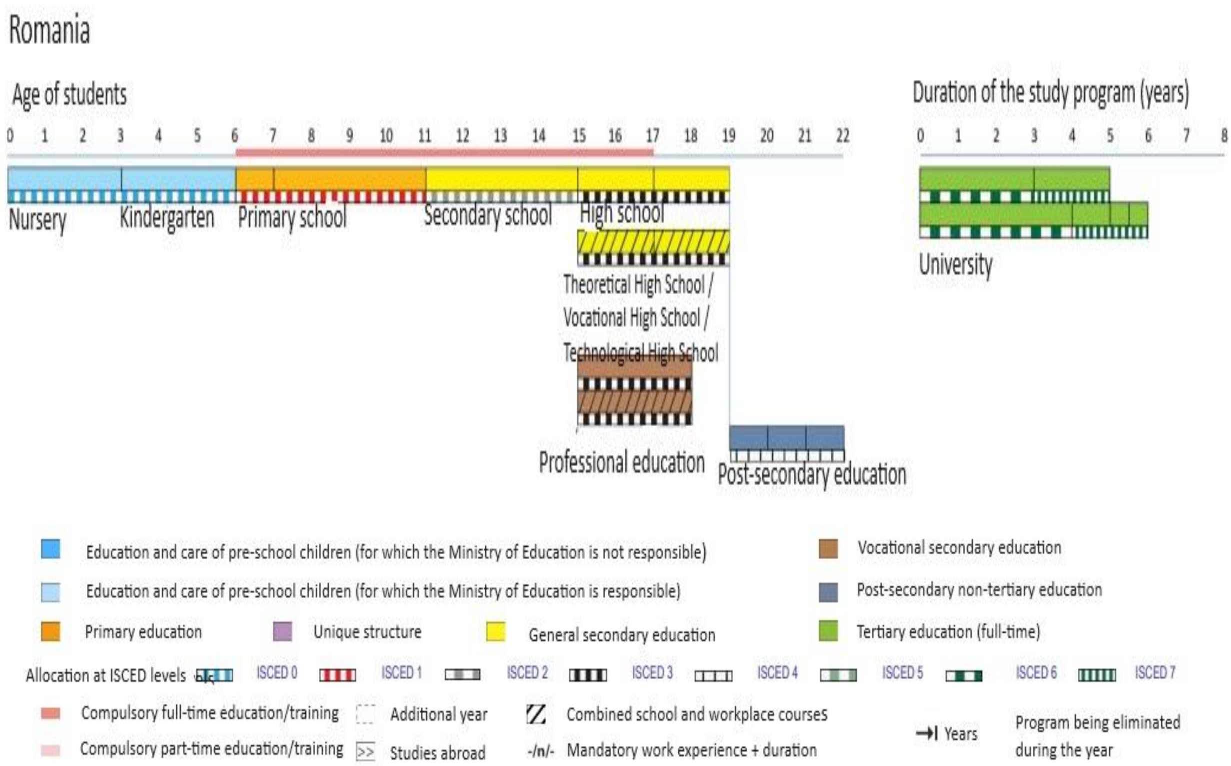

Fig. 1. The structure of the education system in Romania
Source: http://eacea.ec.europa.eu/education/eurydice [17].

MATERIALS AND METHODS

The study involved researching, analysis and interpreting statistical data collected from the National Institute of Statistics in Romania, regarding the number of educational institutions and the quantity of students enrolled in a form of mainstream education in the pre-accession and post-accession period (Romania to the European Union).

These data, superimposed with the theoretical aspects from the specialized literature, facilitated the identification of the dynamics and results of the education system in Romania.

The methodology included descriptive data analysis and comparative analysis, the results being presented in the form of tables.

RESULTS AND DISCUSSIONS

According to the methodology of the National Institute of Statistics, the educational system after 1990 represents the set of educational units and institutions of different types, levels and forms of organization of education and training activities, which ensure the educational process of the school population from all levels of education, in order to its professional training [6].

According to the data provided by the National Institute of Statistics, an interesting fluctuation can be observed in the number of educational units in the categories presented in Table 1. For example, the number of kindergartens started at 12,529, and remained approximately at this level until the year 2000, then a sudden decrease in their number began, reaching 1,241 in the year 2022. There is also a decrease in the number of primary and secondary education schools, starting from 13,511 school units in the year 1990, reaching the year 2022 to only 3,988 units [4]. Regarding high school education, the situation is better, in the sense that in 1990 there were 1,198 such units, their number following an upward trend until 2007, reaching 1,426, an increase that continued until 2011, followed by a slight decrease, situation which means that in 2022 there will be 1,462 secondary education units in Romania, cycle 2 [15]. The most important thing to mention is the fact that vocational schools have almost disappeared, and in recent years there has been a concern to bring them back to the attention of students [16].

Table 1. The progress of the number of school units across different levels of schooling since 1990

Categories of educ. units	**1990**	**2000**	**2007**	**2008**	**2011**	**2012**	**2013**	**2020**	**2021**	**2022**	**Dif. 1990 vs.2000**	**Dif. 2007 vs. 2022**
School units for preschool education	12,529.	10,080	1,731	1,718	1,367	1,222	1,187	1,153	1,200	1,241	-11,288	-10,978
Primary and secondary school (including special education)	13,511	12,709	4,737	4,727	4,022	4,024	4,045	3,998	4,002	3,988	-9,523	-8,874
High school-secondary education cycle 2	1,187	1,367	1,426	1,444	1,615	1,606	1,605	1,461	1,459	1,462	264	228
Schools of vocational education - secondary education cycle 2	707	93	147	147	6	9	7	83	85	84	-623	-560
Higher education institutions	48	126	106	106	108	107	103	89	88	87	39	58
Total	27,993	24,375	8,147	8,142	7,118	6,968	6,947	6,784	6,834	6,862	-21,131	-19,846

Source: Processing, NIS database [12].

The evolution of the number of educational units in the years 1990-2007-2022 is shown in Figure 2.

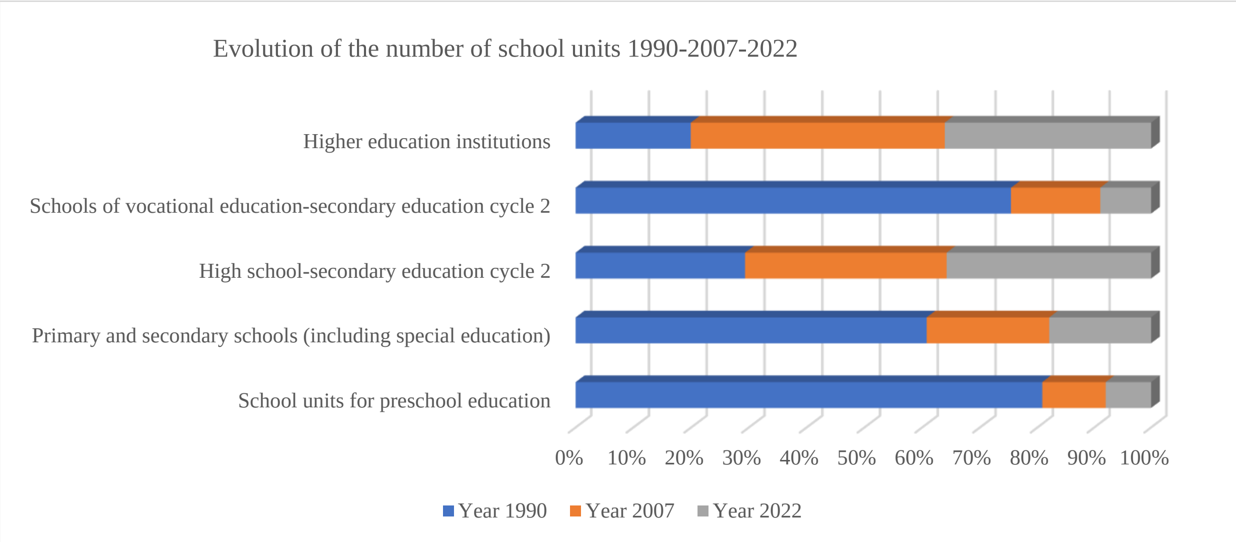

Fig. 2. The progress of the number of educational units in the years 1990-2007-2022.
Source: Data processing Table 1.

The present centralization presents the situation recorded in the case of pre-university and university undergraduate education and considers the following dimensions: human resources and the number of participating pupils and students enrolled at different levels of education (preschool, primary and secondary, high school, vocational and higher education) [10]. For the statistical analysis, databases generated by the National Institute of Statistics were used and processed to obtain a clear picture of the evolution of the human resource and the total number of people registered in the educational system on the International Standard Classifications of Education ISCED 11, in the present case reporting - us from ISCED 0 to ISCED 6, within the pre-accession length, respectively the years 1990 and 2000, the year 2007 which marks Romania's accession to the European Union, and the post-accession years 2008, 2011, 2012, 2013, 2019, 2020, 2021 and 2022. The analysis of the data shows the evolution of the staff numbers in pre-university and undergraduate education shows a fluctuation in them, in conclusion, there is an increase in teaching staff. In the length 1990-2022, in Romania, the evolution of teaching staff and the number of students was influenced by various social, economic and educational factors. Compared to the year 1990, in 2022 the number of teaching staff related to preschool education increased by 157 teachers, there was an exponential grow in the number of teaching staff also among higher education undergraduate program, the year 2022 registering a number of 26,649 thousand teaching staff, more by 12,722 thousand more than in 1990 [11]. In line with the selected sample, after 2013 the number of students included in the Romanian pre-university education system was declining from year to year [5]. The decreasing in the number of students manifests itself differently depending on the level of education at which it is enrolled. According to the level of study, the lowest ratio (students/teachers) is recorded in the case of high school education [1, 7] (Table 2).

Table 2. Evolution of teaching staff and students in preschool, primary and secondary education (including special education), high school, professional and higher education institutions (Number of people)

Education level	**1990**	**2000**	**2007**	**2008**	**2011**	**2012**	**2013**	**2019**	**2020**	**2021**	**2022**	**Dif. 1990 &2022**	**Dif. 2007 & 2022**
Children enroled in kinder gartens	753,141	611,036	650,324	652,855	673,641	581,144	568,659	526,216	505,179	517,898	521,826	-230,315	- 128,498
Teaching staff for preschool	37,007	34,023	37,348	38,253	37,391	35,071	35,433	34,897	35,143	36,266	37,164	157	-184
No. of students per teaching staff	20.32	17.96	17.41	17.06	18.02	16.57	16.05	15.08	14.37	14.28	14.04	-6.28	-3.37
Pupils enrolled in primary and secondary education (including special education)	2,730,306	2,411,505	1,789,693	1,752,335	1,629,405	1,744,192	1,743,254	1,622,641	1,589,432	1,609,941	1,606,975	- 1,123,331	- 182,718
Teaching staff in primary and secondary education (including special education	163,865	162,606	138,972	138,560	120,927	123,640	125,454	115,761	116,603	118,067	118,985	-44,880	- 19,887
No. of studnets/ teaching staff	16.66	14.83	12.88	12.65	13.47	14.11	13.90	14.02	13.63	13.64	13.51	-3.15	+0.63
Studenst enrolled in the second cycle secondary high school education	995,689	687,919	791,348	784,361	888,768	831,810	776,616	618,275	620,625	597,789	595,252	-400,437	- 196.096
Teaching staff in high school education	51,731	64,729	61,620	60,647	59,380	57,080	56,843	53,454	53,569	52,714	52,720	989	-8,900
No. of students per teaching staff	19.25	10.63	12.84	12.93	14.97	14.57	13.66	11.56	11.59	11.34	11.29	-7.96	-1.55
Students enrolled in the cycle 2 secondary vocational education	365,860	239,550	220,335	189,254	12,382	19,734	26,493	100,775	109,721	104,986	96,263	-269,597	- 124,072
Teaching staff in vocational education	4,209	5,576	5,939	5,129	64	150	142	1,499	1,566	1,430	1,469	-2,740	-4,470
No. of students per teaching staff	86.92	42.96	37.10	36.90	193.47	131.56	186.57	67.23	70.06	73.42	65.53	-21.39	-28.43
Students enrolles undergraduate university education	192,810	533,152	907,353	891,098	539,852	464,592	433,234	407,373	418,346	415,839	410,181	217,371	- 497,172
Teaching staff in university education	13,927	28,674	31,964	31,973	28,365	27,555	28,211	26,429	25,991	26,555	26,649	12,722	-5,315
No. of students per teaching staff	13.84	18.59	28.39	27.87	19.03	16.86	15.36	15.41	16.10	15.66	15.39	-1.55	-13

Source: Processing, NIS database http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-tableAccessed on April 15, 2024.[12].

Based on the data from Table 2, the share of teachers in pre-university education was calculated. Of the complete workforce in pre-university education, over half work in primary and secondary schools, almost 25% in high school, while about 16% in preschool education. Vocational education has the smallest proportion of teachers, less than 1% of the total [14].

Table 3. Share of teaching staff by education level

	Year 1990	Year 2000	Year 2007	Year 2008	Year 2011	Year 2012	Year 2013	Year 2019	Year 2020	Year 2021	Year 2022
Subtotal pre-univerity	256,812.00	266,934.00	243,879.00	242,589.00	217,762.00	215,941.00	217,872.00	205,621.00	206,881.00	208,477.00	210,338.00
Preschool share of total teaching staff	14.41%	12.75%	15.31%	15.77%	17.17%	16.24%	16.26%	16.97%	16.99%	17.40%	17.67%
Share in primary/secondary school out of total teaching	63.81%	60.92%	56.98%	57.12%	55.53%	57.26%	57.58%	56.30%	56.36%	56.63%	56.57%
Share in high school out of total teaching staff	20.14%	24.25%	25.27%	25.00%	27.27%	26.43%	26.09%	26.00%	25.89%	25.29%	25.06%
Professional share of total teching staff	1.64%	2.09%	2.44%	2.11%	0.03%	0.07%	0.07%	0.73%	0.76%	0.69%	0.70%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Data processing Table 2.

Table 4. Share of the number of students by education level (%)

	1990	2000	2007	2008	2011	2012	2013	2019	2020	2021	2022
Effective subtotal of preuniversity students	4,843,996	3,950,010	3,451,700	3,378,805	3,204,197	3,176,880	3,115,022	2,867,907	2,824,957	2,830,614	2,820,316
Preschool share of total students	15.53	15.47	18.84	19.32	21.02	18.29	18.26	18.35	17.88	18.30	18.50
Share in primary/secondary school of total students	56.38	61.05	51.85	51.86	50.85	54.90	55.96	56.58	56.26	56.88	56.98
Share in high school out of total students	20.56	17.42	22.93	23.21	27.74	26.18	24.93	21.56	21.97	21.12	21.11
Professional share of total students	7.55	6.06	6.38	5.60	0.39	0.62	0.85	3.51	3.88	3.71	3.41
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Data processing Table 2.

Of the actual total of students registered in pre-university education, more than half are registered in the primary/secondary cycle, almost 23% at the high school level, 18% preschoolers and a share of less than 4% at the professional level.

It can be concluded that the ratio between the number of teaching staff and students remains consistently steady, in the years under analysis. This ratio provides better understand the distribution of the number of graduates by region, the composition of the macroregions by development region is mentioned: Macroregion One includes the North West Region and the Central Region; Macroregion Two includes the North East Region and South East Region, Macroregion Three includes South Muntenia Region and Bucharest Ilfov Region; Macroregion four includes the South West Oltenia Region and the West Region [13] (Table 5).

After we have interpreted and presented the data on the existing school population in Table 3, it is normal to refer further to the evolution of the number of graduates by education levels, we will have as a reference period, 2000-2021, so that the data is easy comparable. Thus, in the year 2000 the total number of graduates was 617,700, of which 301,695 in secondary education, 239,775 students in secondary, second cycle, high school and professional education and 76,230 students with a bachelor's degree. The number fluctuated and the situation reached, at the end of 2021, 430,212 graduates, of which 170,607 in secondary school studies, 177,151 in high school and professional courses and 82,454 graduates of undergraduate university studies [6]. Starting from the data in the previous Table, the number of graduates was broken down by means of residence, keeping the same reference period. The analysis of graduates by environment (urban and rural), shows the special share of people from the urban environment. In high school education, the share of students from rural areas is very small, 6.33% in 2000 and 5.87% in 2021. With Romania's accession to the European space, special emphasis was placed on increasing the quality and efficiency of the educational system by building an offer in line with the indicators imposed by the European Union. Programs with funding from the European Social Fund (ESF) were accessed.

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For example, the Human Capital Operational Program (POCU) 2014-2020 establishes Romania's intervention priorities in the field of employment, social inclusion, and education [10].

Table 5. Graduates by education levels and macro-regions

Tabel 3. Absolventi pe niveluri de educatie şi macroregiuni										
Education levels	Macroregions, development regions and counties	Year 2000	Year 2007	Year 2008	Year 2011	Anul 2012	Year 2013	Year 2019	Year 2020	Year 2021
		Number of people	Number of people	Number of people	Number of people	Number of people	Number of people	Number of people	Number of people	Number of people
Primary and secondary education (including special education)	MACROREGION ONE	72737	49704	49228	44942	44688	44794	45438	35610	42317
	MACROREGION TWO	96929	66592	65967	59690	59623	60560	56809	46227	53766
	MACROREGION THREE	74354	48862	47824	43965	43144	43456	46559	36628	44874
	MACROREGION FOUR	57675	42640	40999	36002	35295	35236	32511	24495	29650
	TOTAL	**301695**	**207798**	**204018**	**184599**	**182750**	**184046**	**181317**	**142960**	**170607**
Secondary high school education cycle 2	MACROREGION ONE	41239	53464	51333	47787	49749	42409	34781	34082	34348
	MACROREGION TWO	43471	61497	56729	53317	58353	50722	44642	43600	43883
	MACROREGION THREE	43526	58068	50629	46365	49226	42975	38622	37655	38455
	MACROREGION FOUR	32870	45176	43422	40052	42676	36507	29960	28876	29412
	TOTAL	**161106**	**218205**	**202113**	**187521**	**200004**	**172613**	**148005**	**144213**	**146098**
Secondary vocational education cycle 2	MACROREGION ONE	21190	30233	26937	1903	1937	3705	7351	7458	8317
	MACROREGION TWO	26836	35941	31972	1707	2207	4671	8993	8932	11405
	MACROREGION THREE	17267	24919	22616	445	812	1766	3483	3923	5444
	MACROREGION FOUR	13376	21991	19376	515	687	1773	4124	4363	5887
	TOTAL	**78669**	**113084**	**100901**	**4570**	**5643**	**11915**	**23951**	**24676**	**31053**
University education - graduates with a bachelor's degree	MACROREGION ONE	19630	53799	48904	33296	29125	25062	24075	23881	23046
	MACROREGION TWO	13790	38997	35152	27408	21705	19416	17121	16907	16345
	MACROREGION THREE	28877	103829	96936	51148	39352	33546	30719	30937	29371
	MACROREGION FOUR	13933	36260	33834	24819	20846	16998	13864	13940	13692
	TOTAL	**76230**	**232885**	**214826**	**136671**	**111028**	**95022**	**85779**	**85665**	**82454**

Source: Processing, NIS database http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, Accessed on April 15, 2024 [12].

The POCU program supports operations included in 7 priority Axes, Axis 6 being "Education and skills". We list 2 specific objectives of this axis specifically dedicated to improving the educational offer in the rural environment: Objective 6.2 "Increasing participation in pre-school and school education, especially of groups at risk of leaving school early, with an emphasis on children belonging to the Roma minority and those from rural areas"; [6] Objective 6.2 "Reducing early school leaving through integrated prevention measures and ensuring equal opportunities for students belonging to the Roma minority and students from rural areas/socio-economically disadvantaged communities" [6].

Table 7. Total funds allocated on Axis 6 of the POCU

Priority Axis	Fund	Categ. Reg.	EU contribution (EUR)	RO contribution (EUR)	Total finanțare (EUR
AP 6	FSE	Less developed region	1,184,587,170	209,044,795	1,393,631,965
AP 6	FSE	Bucharest-Ilfov region	68,003,263	17,000,816	85,004,079

Source: Processing, Ministry of European Projects Implementation database https://mfe.gov/contracte-in-implementare/ Accessed on April 15, 2024 [9].

Investments from POCU will finance operations in all 8 development regions. Of these, 7 fall into the category of less developed regions (whose GDP per capita is less than 75% of the average GDP of the EU-27), respectively North-East, South-East, South Muntenia, South West Oltenia, West, North West and Center. The Bucharest-Ilfov region falls into the category of developed regions (whose GDP per capita is higher than 90% of the average GDP of the EU-27).

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At the POCU level, differentiated financial allocations are established according to the categories of regions, respectively between developed regions and less developed regions.

Within each request for project proposals, the financial allocations according to the two categories of regions will be clearly indicated.

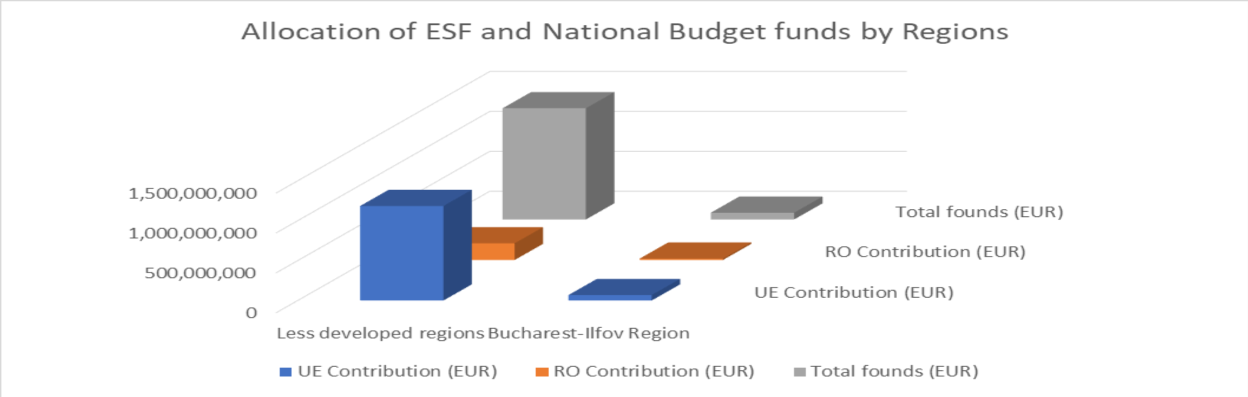

Fig. 3. Allocation of ESF and National Budget funds by Regions
Source: Data processing Table 7.

Table 8. Implementation by intermediate bodies of projects financed by AXA 6 in the period 2018-2022

AM/OI/OIR POCU	The eligible value of the project (RON)			Private contribution	Ineligible expenses	Total project value	Payments to beneficiaries (RON)	
	Funding awarded		Beneficiary's own contribution Partnership Leader/Partners				EU funds	tional contribut
	EU funds	National buget						
OIR South East	279.110.304	44.445.814	9.017.760	0	0	332.573.878	205.022.575	32.398.256
OIR South West Oltenia	414,193,531	65,827,944	11,349,436	0	110.492	491,481,404	331,044,884	52,648,334
OIR North West	250,736,406	42,460,966	6,207,995	0	342.009	299,747,375	200,877,065	32,792,196
OIR NE Total	310,773,692	49,230,471	8,228,665	0	254.474	368,487,302	272,430,783	41,723,616
OIR Bucharest Ilfov	45,985,252	6,830,818	4,298,446	0	0	57,114,516	26,668,701	4,468,049
OI POCU ME Total	2,410,789,696	291,473,318	149,591,481	0	2,692,167	2,854,546,662	1,670,450,367	201,818,755
OIR Center	333,296,355	50,514,698	16,076,299	0	128.373	400,015,726	263,514,144	38,077,174
OIR South Muntenia	334,267,569	50,633,822	13,739,206	0	59.777	398,700,374	231,347,469	32,972,581
OIR West	241,978,040	37,956,805	9,424,587	0	240.305	289,599,737	191,168,094	29,954,418
Total	4,621,130,845	639,374,656	227,933,876	0	3,827,597	5,492,266,973	3,392,524,081	466,853,378

Source: Processing, Ministry of European Projects Implementation database https://mfe.gov/contracte-in-implementare/ Accessed on April 15, 2024 [9.]

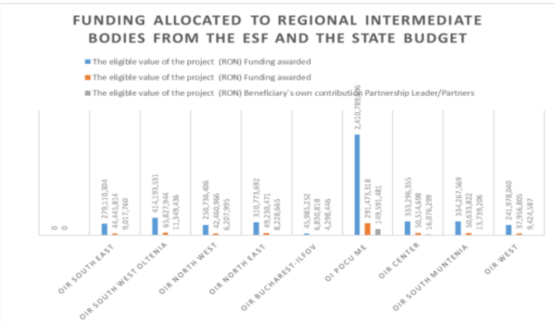

Fig. 4. Funding allocated to regional intermediate bodies from the ESF and the State Budget
Source: Data processing Table 8.

CONCLUSIONS

Drastic decrease in the number of school units for preschool education in 2022 compared to 1990 may be due to demographic changes, in the course of more than 30 years, the population of Romania and the demographic structure of the country have undergone significant changes, with a decrease of approximately 4.15 million of inhabitants, from 23.2 million in 1990 to 19.05 million inhabitants in 2022, we can say that this can influence the need and number of preschool education units.

Population migration to urban areas, changes in preferences and demand on the labor market, and last but not least, changes in educational policy have led to a drastic decrease in the number of vocational schools.

Therefore, the significant difference in the number of pre-school education units between 1990 and 2022 reflects the changes and developments that have taken place in society, in education and in public policies during these years.

The analyzed data highlight the need for continuous support of the rural environment, through specific projects and measures regarding the development of the network of preschool education units and the support of participation in early education.

This situation of disadvantage in the rural environment is the consequence of the increase in school dropouts and leaving early after completing primary education, as well as the phenomenon of external migration. Discrepancies in residential environments are growing significantly in the last five years and require ameliorative interventions specifically aimed at the rural environment.

Participation in education is the first condition for the development of a nation.

Only through training a nation becomes more civilized and more productive.

If the demographic evolution is strongly downward overlaps with a reduced degree of inclusion in education of the school-age population, then the situation becomes alarming from the perspective of the future.

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INSIGHTS OF ROMANIAN WINE PRODUCERS' BUSINESS AND THEIR INVOLVEMENT IN WINE TOURISM

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Abstract

The aim of this research paper is to explore the business framework of the Romanian wine making sector. In the analysis were considered factors that have an influence on the performance of the legal entities such as the professionals working in the sector, winery profile, the dimension of the vineyards holding etc. The research was conducted using the survey method divided in three sections, first was to point out the profile of the winery's employees, while the second part reveals data regarding the winery and organization. Finally, the third part is focused on the wine tourism activities that are performed within the wine cellar. The results of this study were analysed with the cross tabulation method for nominal variables that showed the dependence between winery type and dimension of the vineyards holdings. Moreover, the wineries perspective has been investigated in regard to the main reasons that encourage them to expand the wine making business to wine tourism. Finally, in the last part of the analysis the reasons that restrain the producers from expanding their wine making business to wine tourism were revealed.

Key words**:** *wine tourism, wine tourism turnover, wine producers' business, wine tourism activities*

INTRODUCTION

In many regions wine producers do not see themselves as part of tourism sector.

Often due to the fact that producers do not have the openness to see the opportunity to converge the wine sector with tourism and the synergy is set to failure [15].

The key success is that wine producers should understand tourism as a product that can be offered at the winery and its benefits. Also, [9] reinforces the need for wine producers to understand the tourism sector and how it can be integrated in their business, but at the same time tourism operators lack in understanding winemaking industry and viticulture [11]. The added value of wine tourism for the viticulture sector is unquestionable. Customer and market knowledge are two of the many factors that wine producers should be focused on learning when deciding to expand their business and open their winery doors to the visitors, whereas further the stages of development should be based on cooperation between the sector stakeholders and planning for the future.

The economic benefits of the association between wine industry and tourism are generally recognized [14] for instance increased winery sales [18], work places creation [16] and wages for the community [24], easier access to associations with the purpose of creating a common image and publicity for the specific region where all the interested parties from the area can benefit [17].

However, on the other side there are also challenges that the industries are needed to face such as lack of information and research in this domain, lack of experience and skills, staff training, lack of infrastructure, costs increase etc. [9].

The fore mentioned challenges might be overcome through a formation of a collective identity that can define the region [23], development of wine tourism related products such as considering the local cultural and agricultural resources [6], combining wine tourism with art [22] or gastronomy and wine routes development [7].

Promotion and effective marketing strategies are important factors that are influencing the success of both tourism sector and wine sector. In general wine tourism is often associated as being part of agrotourism, rural tourism, ecotourism, gastronomic tourism [21], reinforcing what was mentioned above where one of the success factors of developing wine tourism is to be associated with something or as being part of something. In this case association of tourism and viticulture sector should be advertised with effective marketing strategies and to create a branding image of the whole wine region in order to create awareness and to promote the unique features of the area [4].

When it comes to marketing and promotion the most used tools are social media, online platforms, partnerships or the winery website.

Additionally, the experiences that wine tourists have at the winery are fundamental [2] facilities, tasting experiences, entertainment activities, information provided may significantly impact tourists' satisfaction. Also, the accommodation options, restaurants, transportation and overall touristic infrastructure are critical for the development of the wine tourism services. [3] present in their paper the main factors that influence wine region destination image, as follows: wine product and consumption experience, general winescape features, entertainment and events, natural environment and rural landscape, relaxation and recreation, customer service, socializing and wine clubs and other tourism and hospitality services. These factors are a consolidation from different papers related to wine tourism that focus on the development of this tourism type. Some of these factors are also mentioned by other authors as [10], where they represent elementary attributes for the development of a winery business. Thus, based on research literature the data should be relevant and integrated as a business plan for the development of Romanian wine cellars activity.

Romanian wine tourism has become popular in recent years, as the country has a rich history of winemaking and viticulture. In terms of wine production, Romania ranks as 14th worldwide [13]. Furthermore, Romania also has significant vineyard surface meaning that it has a great potential for wine tourism development [12].

With reference to the wine regions there are seven regions that are spread across country, and classified as areas with Designation of Origin (DOC) and regions with geographical indication (IG). Moreover, Romania has the advantage of being recognized for its indigenous grape variety such as Tamâioasă românească, Busuioacă de Bohotin, Negru de Dragășani, or Fetească Regală are only a few from a diverse variety [19].

When it comes to wine tourism infrastructure there are more than 400 legal entities that produce wine [26], while part of the wineries have the proper facilities for wine tourism services.

The main objective of the paper is to gather data and information regarding the current state of the wine and tourism market representing an incipient study from wineries point of view. The paper is structured as follows: in the first section data about the wineries representative are revealed in order to see who the professionals working in this field are. The second section of the study presents the profile of the wineries and business insights, while in the third section wine tourism activities performed at the wineries are exposed. Therefore, the following analysis is an overview focused on Romanian wineries engagement in wine tourism activities.

MATERIALS AND METHODS

The research was designed to show an overview of the Romanian wine business and where it stands in terms of the development of wine tourism. Thus, in the first stage the data was collected on site during the annual spring wine festivals from Bucharest, Revino and RO-Wine in May 2023. The discussion with the wineries started with a presentation of the wines, while afterwards they were asked if they are offering wine tourism services at the wine cellar, and the discussion transited to introducing the purpose of the study and if they are willing to participate. The overall interest in participating to the study was low, only few wineries accepted to fill the survey

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on spot, while others were requesting the survey via e-mail, and some were not willing to participate at all. Considering the low-rate of responses received, other wineries that were not participating at the two festivals were contacted via e-mail in the month of June and the survey remained open until the end of the month.

In total 63 wineries were invited to participate to the study, where only 19 have filled the survey.

The responses were analysed using the SPSS statistical package, cross tabulation method and Microsoft Excel for the design of the graphs.

The survey had an introductory part where data about the winery representative was collected,

while the second part was focused on collecting data about the business activities and the perspective in respect to the wine tourism.

RESULTS AND DISCUSSIONS

The total response rate was 30.2%, if compared with other studies related to wine tourism, the response rate is below the general average that is around 40%. However, considering that the period for collecting the data was limited only to a series of events the response rate might be considered acceptable.

In the first stage of the survey a profile of the wineries representatives was designed. The people working in this sector are young professionals, between the range of 31 – 40 years old (31.6%) and 41 – 50 years old (31.6%).This confirms findings of other research made by Australian Government (2021) that state wine makers average age is 35 to 44 years old. The younger generation - the group below 30 years old consisted of 21.1% and the rest are above 50 years old (15.8%). Surprising or not there are more women (52.6%) than men (47.4%) working in the field. In reference to their assignments at the winery, the roles are various and not significantly different between genders. For instance, there are both male and females that are winey owner, administrator, oenologist, sales representative or working in the marketing department. Other roles that they have are event managers, operations manager or sommelier, these jobs are mentioned on [25] official website in the career paths section from wine industry sector.

In regards to the experience, most of the respondents are working in the viticulture and wine business for more than 7 years (47.4%), while 42.1% have between 1-7 years' experience, and 10.5% are new comers in the field. In the next part of the survey, the respondents were asked about the winery attributes in order to have a clear profile of the wineries included in this study.

In Figure 1 it can be seen that the wineries are located across country coming from 5 out of 7 wine regions of Romania. Also, taking into consideration that the wine festivals were held in Bucharest it can be explained why most of the wineries are coming from Muntenia and Oltenia, that this region has the advantage of being in the proximity of the country capital.

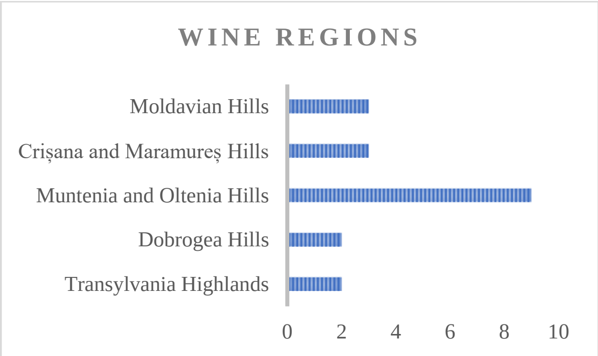

Fig. 1. Representation of the wine regions participating in the study
Source: Result of survey, 2023.

Couple with the location, it is equally important to show when the wineries started their activity in the wine business. As is known the Romanian wine making industry has been impacted by the communism period where state-owned wineries were returned to the initial owners after 1989 [1]. Thus, only few wineries re-entered the business after that period, whereas it is revealed in this study that the majority 52.6% have started their wine making business only after the year of 2000. It is important to mention that 15.8% are wineries established in the last couple of years (after 2015).

When it comes to the structure of a wine making business there are two options, one is that the winery is growing their own grapes, handle all the stages of the grape cultivation and finally produce the wine; or only produce wine with grapes coming from outside sources. In this specific study 21.1% of the respondents are only wine producers, meaning that they have external resources for the grapes, whereas the rest are growing grapes on their own vineyards for the wine production.

Eurostat (2024) [8] has made an analysis where it shows the overall vineyard holdings in Europe, this study is positioning Romania as first one, although in referralto average area of vineyards it is the last one (0.2 ha per vineyard holding).

However, in this research in terms of vine holding, the wineries that were included in the study own around 51-100 ha of vine (40.0%), while 13.3% have more than 500 ha and the rest less than 50 ha of vine (Figure 2). Correspondingly that Romania has a large dimension of cultivated vine, the dimension of the winery holdings is significant.

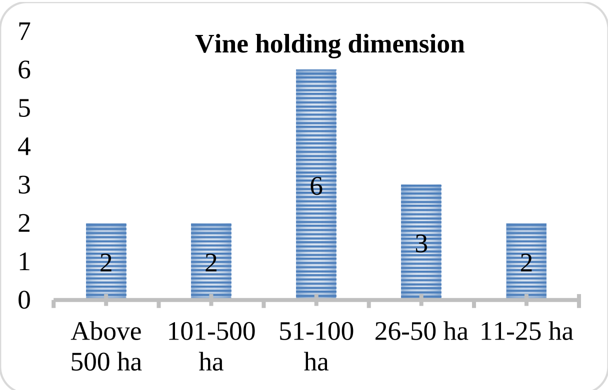

Fig. 2. Vine holding dimension
Source: Result of survey, 2023.

Before going further with the results a cross tabulation analysis was performed for a deeper understanding of the collected data.

In Table 1 it can be seen that within the wine makers that grow their own grapes the dimension of vine holding varies, for instance there are only 13.3% that have 11 – 25 ha or 101 – 500 ha, while the majority holds between 51 – 100 ha (40.0%). On the opposite side, the wine makers that detain more than 500 ha are only 10.5%.

For the wine producers that buy the grapes to produce wine 50% of them mentioned that they purchase around 26 – 50 ha. At the same time, 25% of them are buying grapes for even bigger productions such as more than 100 ha, or even more than 500 ha depending on the producing capacity.

Furthermore, a Pearson Chi-Square Test was performed in order to see if there is a statistical significance between the two variables. Considering that the p-value (Asymptotic Significance) is less than 0.05, this result is statistically significant, meaning that the relationship between the winery type and dimension of vine holdings is considerable.

In addition to the overview of the wine makers business details that were revealed, the respondents were asked if they had available any wine tourism services at their winery. 94.7% of the wine cellars that responded to the survey answered affirmatively and confirmed the availability of wine tourism activities and facilities at their property.

In regard to the type of services that are offered, the experiences mentioned by [2] in his study are also found in the Romanian wineries offer. However, depending on each winery the facilities and infrastructure available varies. As Figure 3 shows wine tasting and winery tour are the main activities that are performed by all the analysed wineries, while 38.9% of them are offering only these two services at the moment and 11.1% only wine tasting. On the other side, some of the respondents confirmed that they had available at the winey full services, including accommodation and restaurant and other entertainment activities or even sports facilities. Despite that, 16.7% of them have full services and 5.6% have full services and extra leisure activities. Compared with the study of [20] that was made on case of wineries from Slovakia on the wine tourism activities available at the wine cellar, it seems that overall,39% of them carry at least one wine tourism activity which is similar with our case, while there are around 17% of the wineries that provide three up to five activities.

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Fig. 3. Wine tourism services
Source: Result of survey, 2023.

Table 1. Winery type * Dimension of vine holding Cross tabulation

			Dimension of vine holding						
			0	101-500 ha	11-25 ha	26-50 ha	51-100 ha	Over 500 ha	Total
Winery type	Wine producer	Count	4	0	0	0	0	0	4
		% within Winery type	100.0 %	.0%	.0%	.0%	.0%	.0%	100.0%
		% within Dimension of vine holding	100.0 %	.0%	.0%	.0%	.0%	.0%	21.1%
		% of Total	21.1%	.0%	.0%	.0%	.0%	.0%	21.1%
	Wine producer and vine farmer	Count	0	2	2	3	6	2	15
		% within Winery type	.0%	13.3%	13.3%	20.0%	40.0%	13.3%	100.0%
		% within Dimension of vine holding	.0%	100.0%	100.0%	100.0%	100.0%	100.0%	78.9%
		% of Total	.0%	10.5%	10.5%	15.8%	31.6%	10.5%	78.9%
Total		Count	4	2	2	3	6	2	19
		% within Winery type	21.1%	10.5%	10.5%	15.8%	31.6%	10.5%	100.0%
		% within Dimension of vine holding	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	21.1%	10.5%	10.5%	15.8%	31.6%	10.5%	100.0%

Source: Authors' own research, 2023.

Table 2. Pearson's chi-squared test Winery type* Dimension of vine holding

Chi-Square Tests			
	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	19.000	5	002
Likelihood Ratio	19.557	5	002
N of Valid Cases	19		

Source: Authors' own research, 2023.

Additionally, the wine cellars representatives were asked how long they had been offering wine tourism services.

Figure 4 confirms the statement from other studies that say wine tourism is a relatively new practice in Romania. 38.9% expanded their wine making business to wine tourism in the last 3 years, while the rest have more than three years' experience on performing this type of tourism.

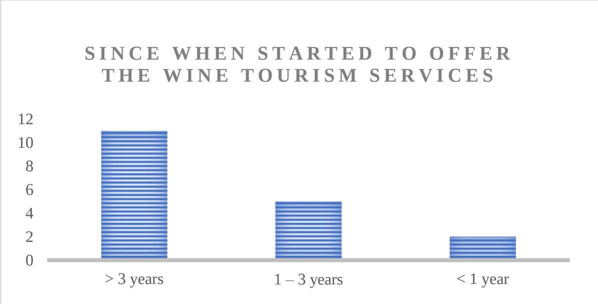

Fig. 4. Wine tourism services
Source: Result of survey, 2023.

If it is to compare the time since the wineries started to perform wine tourism with the services that they offer, there is indeed a wider offer at the wineries that have more than 3 years' experience in this sector; whereas the wineries that are in the incipient phase of development of wine tourism services, they are currently limited to wine tastings and winery tours.

The number of tourists that are visiting a winery is a key success factor that counts when it comes to tourism. Thus, based on the received responses 44.4% welcome at their winery less than 1,000 people, while 38.9% between 1,000 – 5,000 people. The rest of the wineries that stated they received more than 5,000 guests per year at the winery are located in the wine region of Moldova and Dobrogea, and they have been offering wine tourism services for more than 3 years (Figure 5). Also, these wineries have available only wine tasting and winery tours as activities, where the main facility is the restaurant, that explains the high number of visitors compared with the other wineries.

Fig. 5. Average number of tourists per year
Source: Result of survey, 2023.

Turnover is another key performance indicator when it comes to a business and its profitability. Overall, in case of the Romanian wineries 66.7% states that the turnover from wine tourism is less than 5% (Fig. 6).

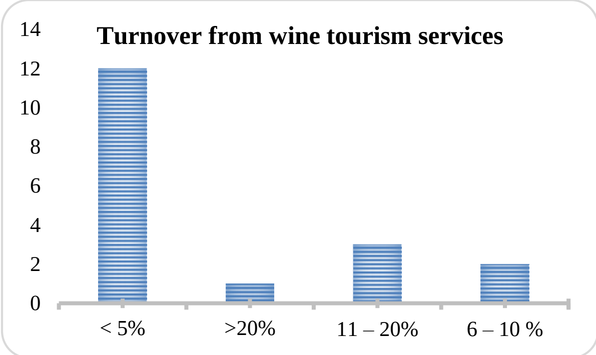

Fig. 6 % turnover of the wineries that comes from tourism services
Source: Result of survey, 2023.

Table 3. Pearson's chi-squared test Average number of tourists*Turnover from wine tourism services

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.375	6	.761
Likelihood Ratio	4.495	6	.610
N of Valid Cases	18		

Source: Authors' own research, 2023.

On top of this, within wineries that receive 1,000 – 5,000 people per year as Table 3 shows, the average turnover from wine tourism services is less than 5%, and for 11.1% of wineries that receive less than 1,000 people per year, the total turnover is on average between 11 -20%.This reveals that wine tourism might not have a significant impact when it comes to the financials of the winery, but it might help to overcome slow sales periods. On the other side, similar research to compare this data with other countries was not found at the time of the study.

The Pearson Chi-Square test p-value is greater than 0.05 significance level, meaning that there is not a statistically significant relationship between the number of tourists per year and the turnover that comes from wine tourism services. If the dimension of the winery or the activities available are taken into consideration, the relationship between the variables is still not statistically significant. Average number of tourists and turnover from wine tourism cross tabulation are presented in Table 4.

Table 4. Average number of tourists * Turnover from wine tourism services Cross tabulation

			Turnover from wine tourism services				
			< 5%	>20%	11 – 20%	6 – 10 %	Total
Average number of tourists	< 1,000 persons	Count	4	1	2	1	8
		% within Average number of tourists	50.0%	12.5%	25.0%	12.5%	100.0%
		% within Turnover from wine tourism services	33.3%	100.0%	66.7%	50.0%	44.4%
		% of Total	22.2%	5.6%	11.1%	5.6%	44.4%
	>5,000 persons	Count	3	0	0	0	3
		% within Average number of tourists	100.0%	.0%	.0%	.0%	100.0%
		% within Turnover from wine tourism services	25.0%	.0%	.0%	.0%	16.7%
		% of Total	16.7%	.0%	.0%	.0%	16.7%
	1,000 – 5,000	Count	5	0	1	1	7
		% within Average number of tourists	71.4%	.0%	14.3%	14.3%	100.0%
		% within	41.7%	.0%	33.3%	50.0%	38.9%
		% of Total	27.8%	.0%	5.6%	5.6%	38.9%
TOTAL		Count	12	1	3	2	18
		% within Average number of tourists	66.7%	5.6%	16.7%	11.1%	100.0%
		% within Turnover from wine tourism services	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	66.7%	5.6%	16.7%	11.1%	100.0%

Source: Authors' own research, 2023.

In addition to the numerical data that was provided by the respondents, other factors were considered when discussing business insights, therefore they were asked which were the preferred approaches when it comes to marketing and promotion. The responses received were in majority the same, as follows:

Winery website, social media platforms, such as Facebook, Instagram, Tik-Tok; as well as the presence on the online booking platforms (Booking, Airbnb, Agoda etc. – only for the ones that have accommodation) or TV commercials and press.

Moreover, the perspective of the wine cellars was requested in question to which are the main reasons for expanding their wine making business to tourism. Afterwards, based on the chosen options an average of the answers was made and the identified reasons were placed in their order of importance as it turned out from the survey.

The below results are sustained by [14] study from the Stellenbosch wine routes where the management of the wineries was asked about the perspective regarding wine tourism at their wine cellars. The results obtained in the current study are similar. Therefore, the below sumsup wine tourism advantages that

Romanian wineries representatives identified as follows:

-Wine tourism contributes to better advertising of the wine/wine cellar – 88.2%

-Wine tourism has a positive impact on wine sales – 82.4%

-Wine tourism is an opportunity to educate customers – 70.6%

-Wine tourism fosters loyalty to the winery's wines – 47.1%

-Visitors buy larger quantities of wine directly from the winery – 35.3%

-Wine tourism is an opportunity to test new products (wine) – 29.4%

-Wine tourism helps me differentiate myself from my competitors – 23.5%

-Wine tourism helps overcome periods when wine demand is low – 17.6%

Extra comments provided by the wineries: *wine tourism promotes the wine region and the landscapes together with local wines and it keeps the traditions alive.*

On the other hand, on the subject of the reasoning why wine makers are reluctant to be involved in wine tourism, they consider the involvement in this type of activity too challenging. [20] state that the wineries are seeing wine tourism not so beneficial when it comes to incomes as it requires high investments, or as per [5] wine producers get stuck into development of the proper facilities for wine tourism. On the current analysis, the respondents agreed on the below statements:

-Wine tourism requires high capital investment – 50%

-There is not enough labour for wine tourism – 30%

-Lack of support and development programs for this type of tourism – 30%

-Wine tourism increases the cost of maintaining the winery – 20%

-I am not interested – 20%

-Lack or low demand for wine tourism services – 10%

CONCLUSIONS

Romanian wineries business is currently in a stage of progress and development when it comes to wine tourism integration. Even though, the relationship between wine sector and tourism has demonstrated it is beneficial for both parties, there are still efforts needed for a better synergy.

In the first stage, the structure of the winery is significantly important not only in terms of dimension, but as well as regards the variety of wine tourism infrastructure and facilities available. Overall, 94.7% of interviewed wineries are offering wine tourism services, to note that the wineries established starting with 2010 are offering more facilities and services than the ones established after the communism period. Also, it might be discussed the wine producers that hold the vines and that have the vineyards in the proximity of the wine cellar are receiving more tourists (more than 1,000 people per year) compared with the ones that only have wine producing facilities. This could be explained by the fact that tourists are looking for a complete experience, meaning to see the winemaking process, but also to enjoy the winescape and to walk among the vines during the same visit.

At the moment, in general the wine tourism offer is limited, and this is proven by the turnover percentage of wine tourism (less than 5%) from the total wine making business. Concerning the number of tourists, the study reveals the importance of having a restaurant on the winery property; as showed the wine cellars with restaurants receive more than 5,000 persons per year.

On the other side, the alleged dependency between the number of tourists per year and turnover percentage from wine tourism services that consisted in a non-significantly might be motivated by the fact that only few wineries have restaurants on the property. Thus, this means that people are more likely to visit the place for the restaurant, not to visit the winery.

Finally, with respect to the pros and cons for wine tourism activities at the winery, the received responses acknowledge the importance of implementing such type of facilities and activities, for instance increased and direct wine sales, brand awareness and gaining customers loyalty, while the main disadvantage is the high costs of investments needed.

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CONSUMERS' PERCEPTION OF "GEZO" IN ROMANIA: A TRADITIONAL PRODUCT FROM KURDISTAN

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Abstract

The paper aimed to analyse Romanian consumers' perception towards a traditional product from Kurdistan. For this purpose a research was conducted among consumers of traditional products from Cluj-Napoca City. To achieve the purpose of the study a face to face survey was conducted. The research instrument was divided into 3 main parts: (i) expectation regarding the attributes of traditional product; (ii) perception of "Gezo" a traditional sweet product from Kurdistan; (iii) socio-demographic profile of the respondents. To determine if there are any differences between the perception and expectations regarding the traditional analysed product, a set of 13 items related to product attribute were evaluated on a scale from 1 to 5. The results indicated that the analysed product did not meet the Romanian consumers expectations especially in terms of taste (-1.1) and flavour (-0.22), but were positively appreciated the low content of fats (0.45) and sugars (+0.28). This study represents a first step in analysing the possibility of exporting traditional products outside of Kurdistan, and offers valuable information to adapt future development product strategies.

Key words: *Romanian consumers, expectations, product attributes*

INTRODUCTION

Traditional food products have their origins in an area, region, country, or geographical location, just like the majority of foods. as a result, it is difficult to pinpoint traditional food products due to the wide range of paradoxical characteristics linked to the concept [7].
In Europe, traditional foods compose a specific category of the food market and play an important part in everyday dietary consumption. They have historically had a significant influence on the customs of many nations and areas, enhancing their sense of pride and identity [12].
Product qualities have drawn a lot of attention in the literature on food marketing since it has been recognised that they are important in how products are chosen for consumers. However, there is a limitation in the literature on food product characteristic measuring, but not much on which qualities ought to be measured. The characteristics of food might vary across ethnic foods [3].
Consumers' decisions made by (individual, household, and societal levels to use and dispose of food and feed others, with the consideration of gender, age, and social factors; as well as actions to promote changes in their food environments [2].
Consumers' decision making process is influenced by a set of factors related to socio-demographic profile of the consumers such as: gender, education, age, family status [14, 6].
The objectives of the paper were to identify Romanian consumers' expectation towards traditional products, and the perception of "Gezo", a traditional product from Kurdistan.

MATERIALS AND METHODS

The product is known locally as Gezo and internationally as Manna [11, p. 423]. "Gezo"is gathered from oak trees in the Penjween and Sharbazher regions of the Sulaimani governorate, particularly those of the genus Fraxinusornus ("Manna Ash"). To extract the mixture of sugars on the surface of leaves, gather them and boil them in water [9].

To identify the Romanian consumers' perceptions towards "Gezo", a pilot study was conducted among 112 consumers of traditional products from Cluj-Napoca city. The collected data were divided into three main categories: (i) expectations regarding the attributes of the traditional products; (ii) perceptions regarding "Gezo" a traditional sweet product from Kurdistan; (iii) the socio-economic characteristics of the respondents (gender, age, education, children in the family). Each of the used attributes to evaluate the expectations regarding the traditional products were evaluated on a 5 point type Likert-scale, where 1 means not important at all, and 5 means very important, while the same attributes were evaluated in the case of "Gezo" product, using a 5 point type Likert-scale, where 1 means very dissatisfied and 5 means very satisfied. For each of the 13 attributes a score was calculated, based on the difference between perceptions and expectations. Each of the participants in the survey, were first asked to express their expectations towards traditional products, secondly they taste a sample of the analysed products, and expressed their perceptions regarding analysed product. A positive score indicates that the analysed traditional product "Gezo" exceed the expectations of the consumers in terms of traditional products, a negative score indicates that the analysed traditional product "Gezo" does not meet the consumers' expectations, while a score equal to zero indicates that the perceptions meet the expectations of the consumers. The collected data were analysed using descriptive statistics analysis. Mann–Whitney U test was employed in order to test if there are statistical significant differences between different analysed groups.

RESULTS AND DISCUSSIONS

The analysis of the socio-demographic profile of the respondents revealed that 63.1% of the respondents were female, with an average age of 42.2±14.2 years, with university degree in 64% of the cases. From the total number of the participants of the study 40.5% declared that they have children in the family (Table 1).

Table 1. Socio-demographic profile of the respondents

Characteristics	Variables	Percentage
Gender	Female	63.1
	Male	36.9
Education	Less than university degree	36.0
	University degree	64.0
Children in the family	Yes	40.5
	No	59.5
Monthly average income	< 4,500 RON	53.2
	>4,500 RON	46.8

Source: Own results based on the data from the survey.

Furthermore descriptive statistics was used to analyse the expectations of the consumers towards traditional products. The results indicated that the higher expectations of the consumers of the traditional are related to the taste of the products (4.80±0.536), quality of the products (4.68±0.632) content of natural ingredients (4.65±0.722), lack of additives (4.37±1.128) (Table 2).

Table 2. Expectations towards traditional products

Product characteristics	Mean	SD
Taste	4.80	0.536
Texture	3.80	1.069
Special flavour	3.98	1.095
Natural colour	3.86	0.995
Pleasant appearance	3.93	0.983
Low content in fats	3.37	1.328
Low content in sugar	3.54	1.333
Lack of food additives	4.37	1.128
Natural ingredients	4.65	0.722
High nutritional value	3.61	1.215
Organic product	4.14	0.939
Freshness	4.20	0.980
Quality	4.68	0.632

Source: Own results based on the data from the survey.

Attributes that influences consumers' buying process of the traditional products are similar to other categories of products, such as organic ones. [8] revealed the fact that the Romanian consumers are very interested in the content of natural ingredients when they decide to buy an organic food product, no artificial ingredients, taste. Less important aspects when consumers are choosing a traditional product were noticed to be low content in fats (3.37±1.328), low content in sugar (3.54±1.333), high nutritional value (3.61±1.215) (Table 2), similar to the case ot organic products [8].

After the determination of the expected scores, were calculated the scores for perceptions of the analysed product (Table 3). As it may be observed the respondents highly appreciated the content of natural ingredients (4.59±0.667), lack of additives (4.44±0.794). At the same time respondents appreciated the product as being an organic one (4.22±0.836). Less appreciated were the texture (3.24±1.185),
which may be explained by the fact that the product is a bit sticky, taste (3.69±1.152) which may be lead to the combination between cardamom and pistachio, which are not necessary traditional flavours in the Romanian cuisine.

Table 3. Perceptions towards "Gezo"

Product characteristics	Mean	SD
Taste	3.68	1.152
Texture	3.24	1.185
Special flavour	3.76	1.177
Natural colour	3.94	1.073
Pleasant appearance	3.68	1.207
Low content in fats	3.82	1.130
Low content in sugar	3.83	1.167
Lack of food additives	4.44	0.794
Natural ingredients	4.59	0.667
High nutritional value	3.83	1.069
Organic product	4.22	0.836
Freshness	3.98	0.972
Quality	4.07	1.006

Source: Own results based on the data from the survey.

The next step was to calculate the scores for each of the attributes used to analyse the expectations and perceptions of the traditional products (Table 4). The results revealed the fact that the analysed product did not meet the expectations of the consumers in terms of taste (-1.11±1.248), texture (-0.55±1.456), quality (-0.61±0.964), appearance (-0.25±1.504), freshness (-0.21±1.082).

Table 4. Total scores

Product characteristics	Mean	SD
Taste	-1.11	1.248
Texture	-0.55	1.456
Special flavour	-0.22	1.346
Natural colour	0.07	1.379
Pleasant appearance	-0.25	1.504
Low content in fats	0.45	1.487
Low content in sugar	0.28	1.149
Lack of food additives	0.07	1.173
Natural ingredients	-0.06	0.887
High nutritional value	0.21	1.296
Organic product	0.08	1.079
Freshness	-0.21	1.082
Quality	-0.61	0.964

Source: Own results based on the data from the survey.

At limit of meeting the expectations were the attributes related to the content of natural ingredients (-0.06±0.887). The higher score was determinate for the low content in fats (0.45±1.487), low content in sugar (0.28±1.149) and high nutritional value (0.21±1.296).
Subsequently Mann–Whitney U test was run to test of there are statistically significant differences regarding the perceptions, expectations and registered scores between males and females, respondents with children and respondents without children, consumers' less than 40 years and over years. The results indicated that in general female had higher expectations regarding the traditional products compare with male respondents, but there were no statistical significant differences (p>0.05) (Figure 1). Females tend to be more concerned regarding the natural ingredients, nutritional value of the products [1, 8].

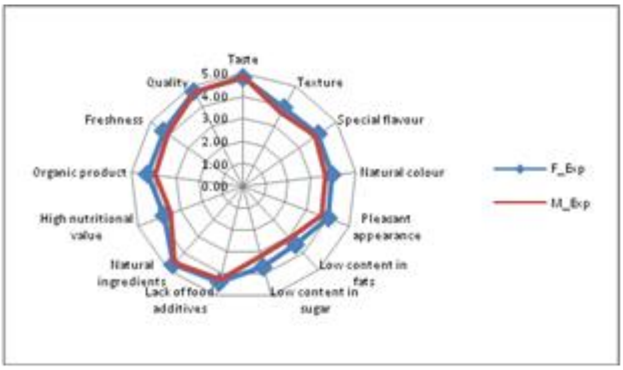

Fig. 1. Expectations distribution by gender
Source: Own results based on the data from the survey.

At the same time female respondents perceived more positively the analysed product compare with the male group.

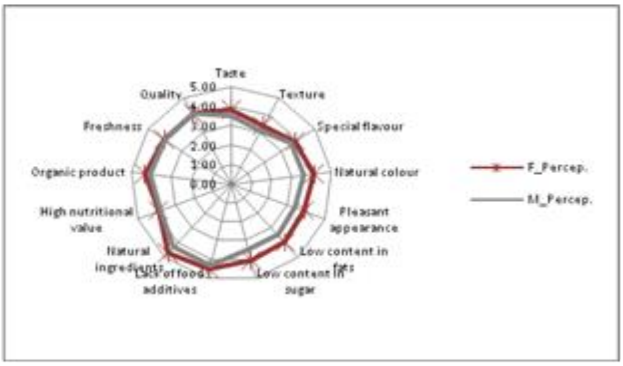

Fig. 2. Perceptions distribution by gender
Source: Own results based on the data from the survey.

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The differences being statistically significant for the natural colour (4.13 vs. 3.61), appearance (3.86 vs. 3.37), low content in fats (3.01 vs. 3.49) and sugar (4.04 vs. 3.46), and natural ingredients (4.71 vs. 4.37) ($p<0.05$) (Figure 2), similar to previous studies [13, 5].

The analysis by gender of the differences between perceptions and expectations regarding the traditional products revealed the fact that for both groups female and male, the lower score was for the taste (-0.97±1.285 vs. -1.36±1.156) (Figure 3), but with no statistical significant differences ($p>0.05$). In the case of the female group the higher score was obtained for low content in fats, this attribute exceeding their expectations (0.51±1.567), while for male was for the high nutritional value attribute (0.36±1.479). The Mann–Whitney U test revealed no significant differences between the scores registered by the two groups (female and male) for each of the analysed product attribute ($p>0.05$).

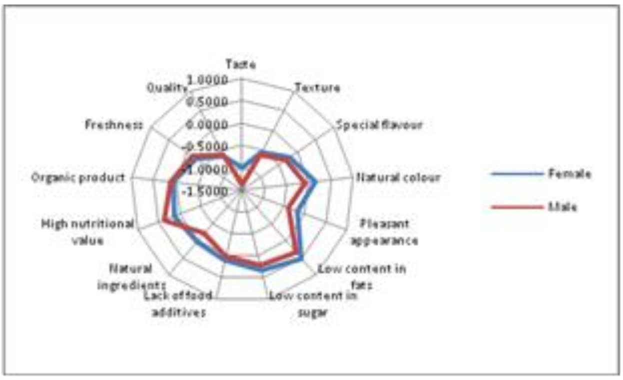

Fig. 3. Comparative analysis of scores by gender
Source: Own results based on the data from the survey.

A comparative analysis was conducted between the respondents with children, and respondents without children. The results indicated that for both of the groups the taste is the most important attribute (4.84±0.424 for the group with children vs. 4.77±0.602for the group without children), the content of natural ingredients is also important for both of the groups (4.76±0.609 vs. 4.58±0.786), while less important was the low content in fats (Figure 4). The results of Mann–Whitney U test revealed there were no statistically significant differences between the group with children and the group without the children regarding the expectations for traditional products towards the analysed attributes ($p>0.05$).

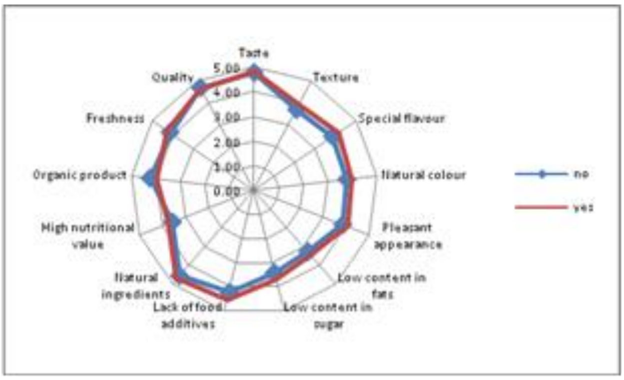

Fig. 4. Expectations distribution between respondents with children and without children
Source: Own results based on the data from the survey.

Regarding the perceptions of the attributes for the analysed traditional product both groups highly appreciated the content of the natural ingredients with an average of 4.78 for the group with children, and 4.45 for the group without children (Figure 5), reinforcing the results of [10] that pointed out that the presence natural indigents influence the decision making process for families with children. The difference recorded was statistically significant ($p<0.05$). Less appreciated by both groups was the texture of the analysed product (3.49±1.121 vs. 3.08±1.207), but with no statistically significant differences ($p>0.05$).

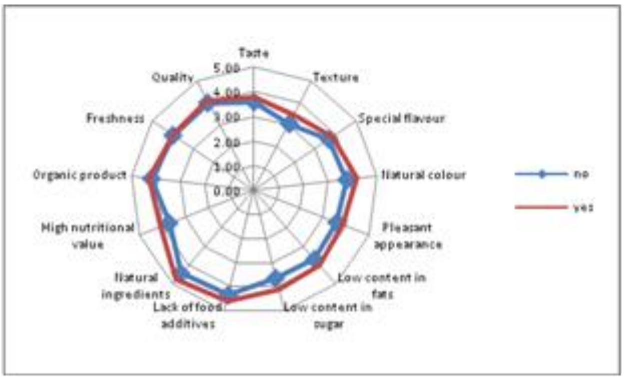

Fig. 5. Perceptions distribution between respondents with children and without children
Source: Own results based on the data from the survey.

Analysing the scores obtained by the group with children compared to the one without children was noticed that there were no significant statistically differences ($p>0.05$). Like for the entire sample, even in these cases, the lower score was obtained by the taste of the analysed product (with children: -1.04±1.086 vs. -1.16±1.354) (Figure 6).

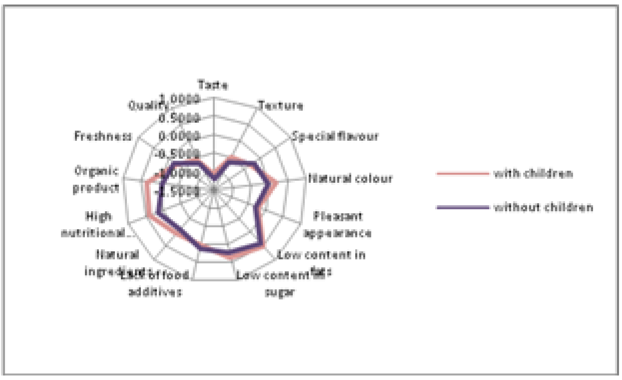

Fig. 6. Scores distribution of respondents with children and without children
Source: Own results based on the data from the survey.

Age represents another important variable that influence consumers' behaviour. To identify to which concern the respondents' age influence their expectations towards traditional products and perceptions regarding the analysed traditional products, and furthermore the recorded scores, the participants to the survey were grouped based their age into two groups: the first group was represented by respondents less than or 40 years (50.5%), and the second group represented by respondents over 40 years (49.5%).The higher expectations regarding the traditional products, for both groups, were for the taste (less than 40 years: 4.80±0.483 vs. 4.80±0.590 over 40 years), content of natural ingredients (less than 40 year: 4.69±0.711 vs. 4.60±0.735 over 40 years) and quality (less than 40 years 4.66±0.668 vs. 4.70±0.599 over 40 years), while less important were fats content (less than 40 years 3.37±1.369 vs. 3.36±1.296 over 40 years) sugar content (less than 40 years 3.41±1.359 vs. 3.67±1.306 over 40 years), and high nutritional value (less than 40 years 3.55±1.159 vs. 3.67±1.277) (Table 5), confirming the results of [4].

There were not statistically significant different between the group less than 40 years, and the group over 40 years, in terms of expectations towards traditional products (p>0.05).

Table 5. Comparative analysis by age

	Expectations		Perceptions		Scores	
Product characteristics	<40 years	>40 years	<40 years	>40 years	<40 years	>40 years
Taste	4.80±0.483	4.80±0.590	3.61±1.155	3.76±1.154	-1.19±1.197	-1.03±1.304
Texture	3.73±1.070	3.87±1.072	3.18±1.130	3.31±1.245	-0.55±1.400	-0.56±1.524
Special flavour	4.10±1.090	3.85±1.096	4.0±1.095*	3.51±1.215*	-0.10±1.316	-0.34±1.377
Natural colour	3.94±0.999	3.78±0.994	4.05±1.034	3.82±1.107	0.10±1.302	0.03±1.465
Pleasant appearance	3.81±1.002	4.03±0.962	3.54±1.334	3.82±1.056	-0.29±1.717	-0.21±1.272
Low content in fats	3.37±1.369	3.36±1.296	3.61±1186	4.04±1.036	0.23±1.439	0.67±1.516
Low content in sugar	3.41±1.359	3.67±1.306	3.59±.156*	4.07±1.136*	0.17±1.389	0.40±1.605
Lack of food additives	4.23±1.279	4.50±0.940	4.34±0.815	4.55±0.765	0.10±1.274	0.03±1.070
Natural ingredients	4.69±0.711	4.60±0.735	4.54±0.687	4.64±0.649	-0.16±0.910	0.03±0.859
High nutritional value	3.55±1.159	3.67±1.277	3.79±1.057	3.87±1.090	0.23±1.205	0.2±1.393
Organic product	4.14±0.943	4.12±0.944	4.09±0.859	4.35±0.799	-0.05±1.197	0.21±0.936
Freshness	4.00±1.128	4.40±0.760	3.79±1.091*	4.18±0.796*	-0.21±1.246	-0.21±0.896
Quality	4.66±0.668	4.70±0.599	4.16±0.949	3.98±1.063	-0.50±0.972	-0.72±0.951

*p<0.05.
Source: Own results based on the data from the survey.

The analysis of the perception regarding "Gezo" revealed statistically significant differences (p<0.05) for flavour, sugar content and freshness of the products. Respondents less than 40 years old were more satisfied with the flavour of the products (4.0±1.095), compared with the respondents over 40 years (3.51±1.215), which may indicate that the consumers less than 40 years are more open in trying now products, but still this was not above their expectations, the score recorded for this attribute was a negative one (-0.10±1.316). Consumers' over 40 years appreciated highly the low content in sugar (4.07±1.136) compared to consumers less than 40 years (3.59±.156). This could be explained by their preoccupation regarding the health. Also they (the consumers 40 years) appreciated the product as being more fresh (4.18±0.796) compared with the group below 40 years (3.79±1.091). There were also other aspects (eg. taste, appearance) for which the group over 40 years perceived the analysed product more higher compared with the group below 40 years, but the differences were not statistically significant (p>0.05). For both categories of consumers, in terms of age, the lower score was obtained by the taste attribute (less than 40 years: -1.19±1.197 vs. -1.03±1.304 over 40 years), followed by the texture and quality, respecting the same trend observed at the entire sample. The scores recorded were not statistically significant different between the two analysed groups (p>0.05).

CONCLUSIONS

Consumers' expectations are important in order to develop future product strategies. Attributes like taste, quality, and content of natural ingredients are important factors during the buying decision making process. In general female and consumers' with children have higher expectations regarding the attributes of the traditional products; this could be explained by the preoccupation for health higher in the case of female consumers, and families with children. The research offer valuable information for traditional producers regarding the consumers' expectations, which could be useful for development strategies. Future studies could focus on a comparative analysis, of the traditional product "Gezo", on the Romanian consumers and Kurdistan consumers of traditional products.

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RAPESEED CROP MANAGEMENT CONTRIBUTION TO YIELD INCREASE THROUGH SOIL WORKS SYSTEM AND FERTILIZING TREATMENTS

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Abstract

The study analyzed how elements of crop management can contribute to increasing the yield of the winter rape crop. Field research took place in the area of Satu Mare locality, Arad County, Romania, in the period 2022-2023. The field experiments were organized in farm conditions, with accessible agricultural technologies. Two soil working systems (Sws) were considered: a classic system of soil preparation by disc tillage (SwsA), and a system of soil preparation by direct seeding (SwsB). Four treatments (T) of nitrogen and sulfur fertilization (T1, T3 and T4) were applied to the background of each system, compared to a classic fertilization (T2). In the case of soil tillage SwsA system, rape yield average was $Y_{(AvgSwsA)}$ = 3,537.50 kg ha^{-1} (T4 treatment generated increase yield, ΔY = 380.50 kg ha^{-1}). In the case of soil tillage SwsB system, rape yield average was $Y_{(AvgSwsB)}$ = 3,795.00 kg ha^{-1} (T4 treatment generated positive growth, ΔY = 1,007.00 kg ha^{-1}). At the experiment level, the average yield was $Y_{(AvgSwsA\&B)}$ = 3,666.25 kg ha^{-1}. A significant yield increase was recorded only in the case of the T4 treatment, with $\Delta Y_{(SwsB-T4)}$ = 1,135.75 kg ha^{-1}. Multiparameter analysis (PCA, CA) facilitated distribution diagrams and classification of variants, under conditions of statistical safety (Coph.corr = 0.936). PC1 explained 40.35% of variance and PC2 explained 29.297% of variance. Mathematical models described the variation of yield (Y) in relation to biometric parameters of the plants ($p<0.001$, R^2 = 0.873 to R^2 = 0.989).

Key words: *crop technology management, mathematical models, rapeseed, soil works system, technological treatments, yield increase*

INTRODUCTION

Rapeseed (*Brasica napus* L.) is a crop plant with multiple values, cultivated primarily for oil production, being the second oleaginous plant worldwide, in this category of crop plants [5, 6, 13, 22].
Rapeseed is a plant with multiple values, from socio-economic and ecological perspectives. First of all, rapeseed is an oleaginous crop, and it is cultivated for the production of seeds, respectively oil.
Through its roots with a high absorption power, rape contributes to the absorption of heavy metals from the soil (e.g. cadmium) and has an important role in bioremediation techniques. Through the color of the flowers, they contribute to the color appearance of the agricultural lands, giving value to touristic objectives of an ecosystem nature. Through flowers, with a high content of nectar and pollen, it represents a main source of mellifera, but also of phytopharmaceutics (pollen used to extract some active principles - e.g. flavonoids, amino acids). The flour from the seeds is used to extract some active principles (e.g. istocyanates). The flour from the seeds and from the dry plants (secondary production from the harvest) is used in animal feed. Rape is also of interest in the biofuel industry (biodiesel).
Rapeseed can be cultivated for the purpose of protecting the soil, as a cover plant (especially for nitrogen retention), as well as for the purpose of green manure, with beneficial effects for the soil [6].
Some studies have looked at the utilization of seeds and oil cakes, but the utilization of rapeseed by-products such as straw has also been considered [8, 11, 18].
The content of bioactive substances in rapeseed is of increasing interest in recent

studies.

Laboratory studies have confirmed the functional role of rapeseed extracts in oxidative and metabolic processes, with perspectives for improved nutrition in animals and humans [1].

Based on a bibliographic study on the last decade, 2011 – 2021 (approx. 7617 scientific articles and reviews), it was found the increase in the number of articles and publications at the global level, the increase in cultivated areas, production and oil content in seeds [22].

In the analyzed studies and articles, aspects of the genetic nature of rapeseed plants, phylogeny, stress to abiotic factors, yield, oil content, seed meal, protein and fatty acid content, importance as biofuel, etc., were addressed [22].

Through studies of the rapeseed genome, aspects regarding genetic diversity were elucidated with implications in the traits of major importance of rapeseed plants [5]. Certain aspects regarding certain qualitative indices in rapeseed production (e.g. minimum erucic acid content, low level of glucosinolate), still require additional studies and research for certain clarifications [5].

Some studies have analyzed the oil yield and the protein content in the seeds, compounds with high importance for the food industry and animal feed. Aspects regarding the rapeseed culture technology were also analyzed, especially for the reduction of harvest losses [13].

The importance of rape in the structure of crop plants, as a component of agricultural rotations and rotations, for maintaining soil fertility and sustainable production, was considered and confirmed [5].

Rapeseed was studied in relation to the prevailing diseases and pests, with the formulation of crop rotation and placement schemes and the communication of farmers on these aspects, for ecological protection solutions, in the context of restrictions on the use of pesticides [21].

In the context of the EU, rape is a crop of high importance for oil, fodder, biodiesel, with a weight of about 63% in oil crops for the year 2017 [19]. Romania is among the largest rapeseed producers in the EU, after France, Germany and Poland [19].

Rapeseed is a crop with high nutrient requirements, which requires complex fertilization for high yields.

In an extensive study, nitrogen use efficiency (NUE) was evaluated in a large group of modern rapeseed genotypes, as a result of the importance of this nutrient in rapeseed production [17]. The authors of the study communicated the increase in NUE in relation to the increase in plant biomass until flowering, and the increase in primary yield components. The study authors also reported a negative correlation between high seed yields and seed oil content ($r = -0.49$ at high N level; $r = -0.39$ at low N level).

The importance of the rape crop, within agricultural crops, was analyzed from an ecological perspective, with a role in soil protection against erosion [9]. The authors of the study concluded that rapeseed, in comparative studies with other crops, had the best effects in soil protection against the erosion process, with ecological and economic benefits, and also with a positive impact on agricultural sustainability, under the study conditions.

Certain rapeseed genotypes were analyzed in relation to certain agricultural practices and categories of crop management inputs (e.g. dose of rapeseed at sowing, fertilization etc.) [12]. The study considered for the analysis a representative number of farms (100 farms, according to the authors), and the authors concluded which are the variables that showed high importance in relation to yield, and which can be improved for agricultural practices.

The profitability of rapeseed crop is variable, in relation to socio-economic and environmental factors, closely dependent on the management of farms and agricultural crops, and especially in relation to mechanization, according to some studies [6].

The present study analyzed the influence of the disc tillage system (SwsA) compared to the direct seeding system (SwsB), associated with four fertilization treatments, on the yield of the rape crop, and found models (mathematical, and graphic format) to rape yield estimate in relation to the biometric parameters of the plants.

MATERIALS AND METHODS

The study analyzed the influence of some crop technology elements management on yield and some plants biometric parameters in rapeseed. The research took place in the area of Satu Mare locality, Secusigiu Commune, Arad County, Romania, in the period 2022-2023. The field experiments were organized in specific farm conditions, with accessible agricultural technologies.

Two soil work systems (Sws) were considered; A, a classic soil preparation system through disc working - SwsA (two works, Case IH QUADTRAC 470hp tractor, Väderstand Spirit, 12.5 cm); B, a land preparation system by direct sowing - SwsB (direct sowing in stubble, John Deere, MZURI Pro Till, 33.3 cm).

Sowing was done on August 22 year 2022, for both systems, at a depth of 2-3 cm. The hybrid DK Expectation was cultivated.

During the growing season (year 2023), crop protection was done by treatments with Caramba (1 L ha^{-1}), Inazuma (0.14 kg ha^{-1}).

Fertilization was done when preparing the land and establishing the culture (in relation to the SwsA, SwsB systems) with complex fertilizers (NPK 15:15:15; DAP18:46:0) in a dose of 200 kg ha^{-1}. On September 25, sulphur (2 L ha^{-1}) was applied, and in the first decade of October, boron was applied (2 L ha^{-1}). In early November, complex fertilizer 1.5 L ha^{-1} (P, K, Mg, Zn) was applied. In February 2023, urea (N 46.6 %) was applied at a dose of 200 kg ha^{-1}, and in March, ammonium nitrate (N 34.4 %) was applied at a dose of 200 kg ha^{-1}. On March 25, sulphur was applied (1.5 L ha^{-1}).

The four treatments (T), on each tillage system, were represented as follows: T1 – sulphur treatment in spring (1.5 L ha^{-1}); T2 – autumn fertilizations; T3 – ammonium nitrate in spring (200 kg ha^{-1}); T4 – ammonium nitrate (200 kg ha^{-1}) and sulphur (1.5 L ha^{-1}) in spring. Aspects from the experimental field are presented in Photo 1.

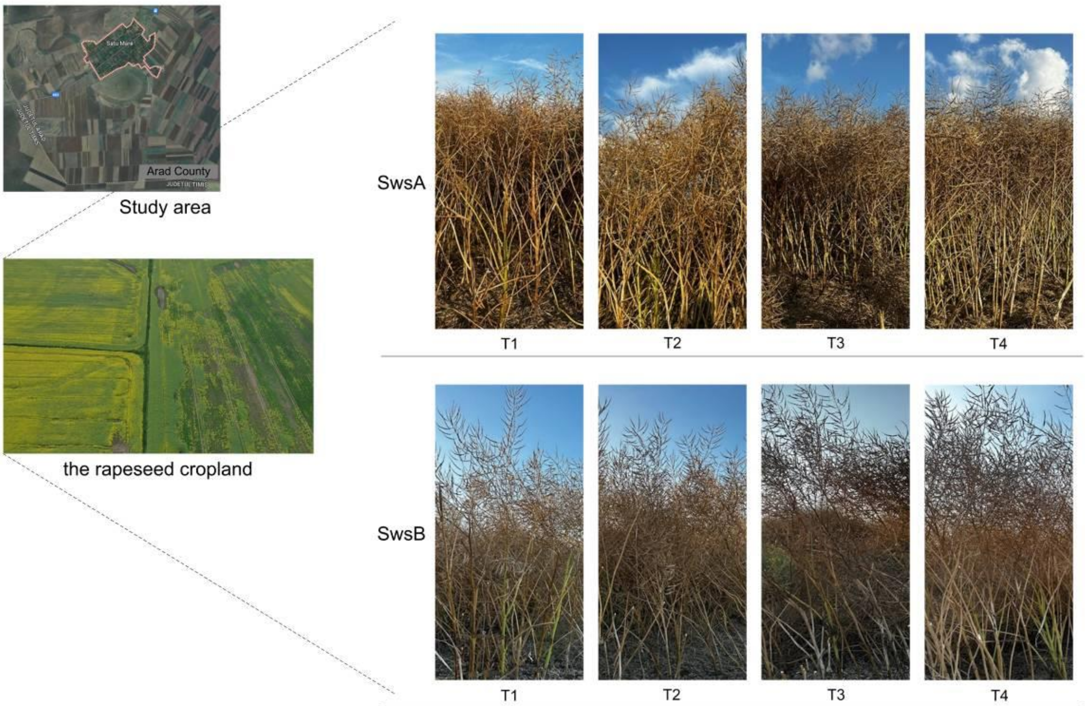

Photo 1. Aspects regarding the location of the study, the rape crop and the variants at the time of harvesting
Source: original photos taken by authors.

The influence of the two tillage systems (SwsA, SwsB) and the applied treatments on some plant biometric parameters, and rapeseed yield was analyzed. For this, the height of the plants (Ph, cm), the diameter of the stem (Sd, cm), the number of branches (Bn) were determined. At physiological maturity (BBCH 99) [10], the experimental variants were harvested. Depending on the degree of branching of the plants, the height of the branching and the insertion height of the siliques, harvesting was done at variable heights. Associated with the harvesting process, the harvesting height (Hh, cm) was determined. The yield was determined on each experimental variant. The surface of an experimental variant was 480 m^2 (20 x 24 m).

The production data were analyzed in relation to the biometric parameters of the plants, on the two tillage systems and applied treatments.

Relevant mathematical and statistical analyzes were made and appropriate analysis tools were used [7, 20].

RESULTS AND DISCUSSIONS

Rapeseed crop developed differently in the two systems of soil work and applied treatments. The variation of some biometric parameters of the plants was recorded, with importance in defining rapeseed yield. Thus, in the case of the SwsA work system (disc tillage), the height of the rapeseed plants (Ph) varied between Ph = 160 – 190±6.57 cm. The plant stem diameter (Sd) varied between Sd = 1.73 – 2.06±0.07 cm. The number of branches (Bn) varied between Bn = 8.00 – 16.00±1.71. In relation to the height of the plants and the position on the plant where the branches started, the harvesting height (Hh) varied between Hh = 18 – 25±1.49 cm. In the disc tillage variant (SwsA), the rapeseed yield was between Y = 3,119 – 3,918±163.47 kg ha^{-1}.

Corresponding to the SwsB work system (direct sowing), the height of the rapeseed plants (Ph) varied between Ph = 150 – 175±5.54 cm. The plant stem diameter (Sd) varied between Sd = 1.50 – 1.87±0.08 cm. The number of branches (Bn) varied between Bn = 12.00 – 15.00± 0.65. In relation to the height of the plants and the position on the plant where the branches started, the harvesting height (Hh) varied between Hh = 19 – 26±1.78 cm. Under the conditions of the SwsB system (direct sowing), rapeseed production varied between Y = 3,192 – 4802±352.26 kg ha^{-1}. The average values recorded for the biometric parameters of the plants, and for the rapeseed yield, in relation to the two tillage systems and the applied treatments, are presented accordingly in Table 1. The standard error (SE) values for each parameter and tillage system are also presented.

The experimental data showed statistical safety, and the presence of variance was confirmed in the data set (ANOVA Test, Alpha = 0.001), Table 2. The level of correlation between rapeseed yield and plant parameters was analysed, on the two tillage systems, Table 3.

Table 1. Experimental data recorded on rapeseed culture, DK Expectation hybrid

Crops technology elements		Ph	Sd	Bn	Hh	Y
Soil work system	Treatments	(cm)	(cm)	(no)	(cm)	(kg ha^{-1})
SwsA	T1	165	2.00	8	25	3,119
	T2	190	2.00	14	18	3,560
	T3	170	1.73	12	20	3,553
	T4	160	2.06	16	20	3,918
	SE	±6.57	±0.07	±1.71	±1.49	±163.47
SwsB	T1	150	1.50	12	24	3,192
	T2	160	1.87	14	19	3,471
	T3	170	1.80	13	19	3,715
	T4	175	1.73	15	26	4,802
	SE	±5.54	±0.08	±0.65	±1.78	±352.26

Source: original data from the experiment.

Table 2. ANOVA Test values

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	83798036	4	20949509	377.289	3E-28	5.8764
Within Groups	1943426	35	55526.45			
Total	85741462	39				

Source: original data.

Table 3. Correlation coefficient values

Soil works system SwsA					
	Ph	Sd	Bn	Hh	Y
Ph					
Sd	-0.058				
Bn	0.130	0.228			
Hh	-0.584	0.119	-0.833		
Y	-0.098	0.129	0.967	-0.730	
Soil works system SwsB					
	Ph	Sd	Bn	Hh	Y
Ph					
Sd	0.576				
Bn	0.757	0.611			
Hh	0.084	-0.636	0.218		
Y	0.868	0.259	0.840	0.536	

Source: original data.

In the case of the SwsA work system (disc tillage), there was a very strong, positive correlation between yield (Y) and plants branching number (Bn), r = 0.967, and a moderate, negative correlation between yield (Y) and harvest height (Hh), r = -0.730. Strong, negative correlation was recorded between plant branching (Bn) and harvesting height (Hh), r = -0.833. In the case of the SwsB work system (direct sowing), there was a strong, positive correlation between yield (Y) and plant height (Ph), r = 0.868, and between yield (Y) and branching number (Bn), r = 0.840. A moderate correlation was recorded between branches number (Bn) and the height of the plants (Ph), r = 0.757). In the case of both tillage systems, other correlations, of lower intensity, were recorded between the analyzed parameters, Table 3.
According to PCA, the diagram in Figure 1 resulted, in which the variants given by the tillage systems (SwsA, SwsB) and treatments (T1 to T4) were distributed according to the values of the considered parameters. PC1 and PC2 together explained 69.647% of variance.

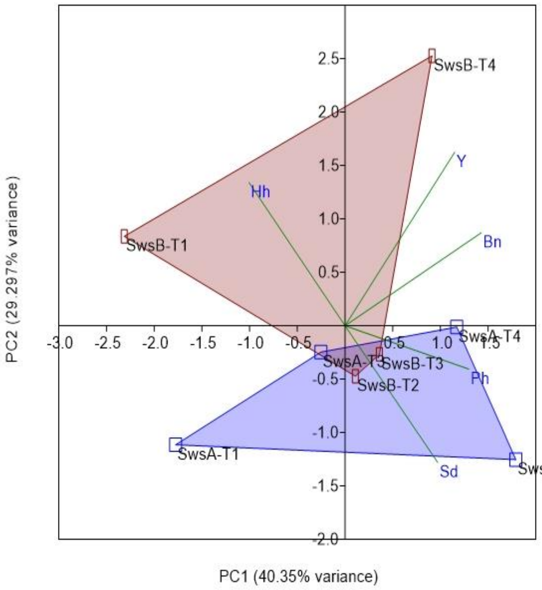

Fig. 1. PCA diagram regarding the distribution of the variants, in the experimental conditions, rape crop
Source: original figure.

Cluster analysis, based on yield (Y), led to the dendrogram in Figure 2, under conditions of Coph. corr. = 0.936.

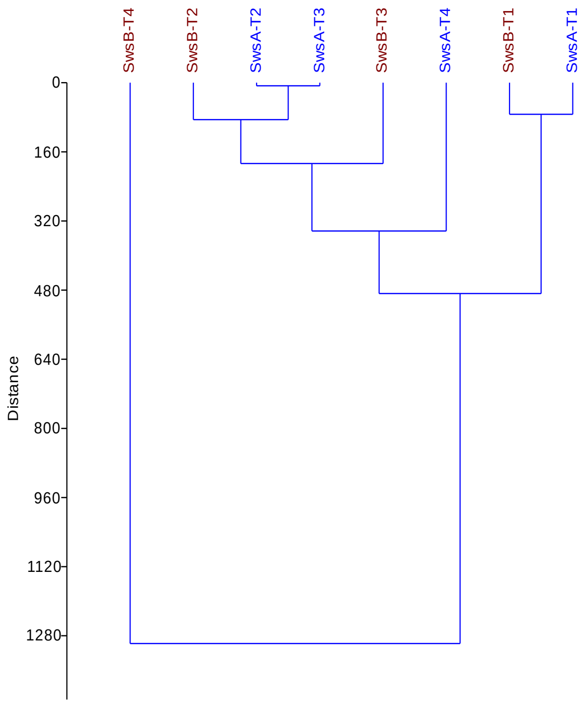

Fig. 2. Dendrogram for the classification of the experimental variants based on rape yield
Source: original figure.

The differentiated positioning of the SwsB-T4 variant was found, in the case of which the highest yield was recorded (Y = 4,802±352.26 kg ha^{-1}).

The other variants were grouped within a cluster, with several sub-clusters. A sub-cluster included some variants, in descending order of yield: the variant SwsA-T4 with the yield of 3,918 kg ha^{-1}, followed by the variants (((SwsA-T2, SwsA-T3), Swb-T2), SwsB- T3) with the yield between 3,471 - 3,715 kg ha^{-1}.

With a lower yield level, the SwsA-T1 and SwsB-T1 variants followed in the same sub-cluster, which presented yield levels between 3,119 - 3,192 kg ha^{-1}.

The SDI index values are presented in Table 4. According to the SDI values, the highest level of similarity was recorded between the SwsA-T2 and SwsA-T3 variants, with the SDI value SDI = 7.

Table 4. SDI values in relation to rapeseed yield

	SwsA-T1	SwsA-T2	SwsA-T3	SwsA-T4	SwsB-T1	SwsB-T2	SwsB-T3	SwsB-T4
SwsA-T1	0	441	434	799	73	352	596	1,683
SwsA-T2	441	0	7	358	368	89	155	1,242
SwsA-T3	434	7	0	365	361	82	162	1,249
SwsA-T4	799	358	365	0	726	447	203	884
SwsB-T1	73	368	361	726	0	279	523	1,610
SwsB-T2	352	89	82	447	279	0	244	1,331
SwsB-T3	596	155	162	203	523	244	0	1,087
SwsB-T4	1,683	1,242	1,249	884	1,610	1,331	1,087	0

Source: original data.

The regression analysis was used to estimate rapeseed yield, in relation to different biometric parameters determined in the plants, under the influence of soil work system, and applied treatments.

In relation to plant height (Ph) and stem diameter (Sd), the regression analysis led to equation (1), under conditions of R^2 = 0.873, F = 13.7946, p<0.001.

The graphic distribution of rape yield (Y, kg ha^{-1}) variation depending on plant height (Ph) and stem diameter (Sd) is presented in Figure 3 (3D format) and in Figure 4 (isoquants format).

$$Y = ax^2 + by^2 + cx + dy + exy + f \qquad (1)$$

where: Y – rapeseed yield (kg ha^{-1});
x – plant height (Ph, cm);
y – stem diameter (Sd, cm);
a, b, c, d, e, f – coefficients of the equation (1);
a= 5.22143419;
b= 6814.81614359;
c= -648.93998848;
d= 70377.62606243;
e= -591.87546601;
f= -4704.31790162

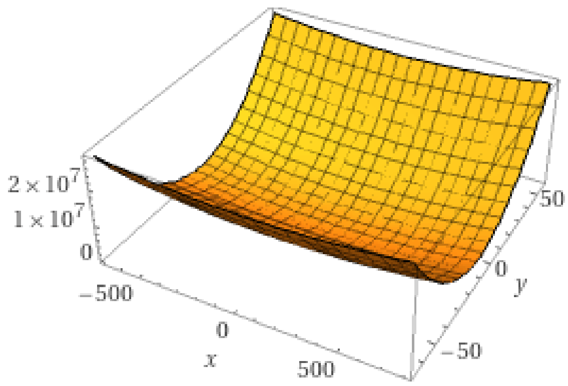

Fig. 3. 3D model of rapeseed yield variation (Y) in relation to Ph (x-axis) and Sd (y-axis)
Source: Original graph.

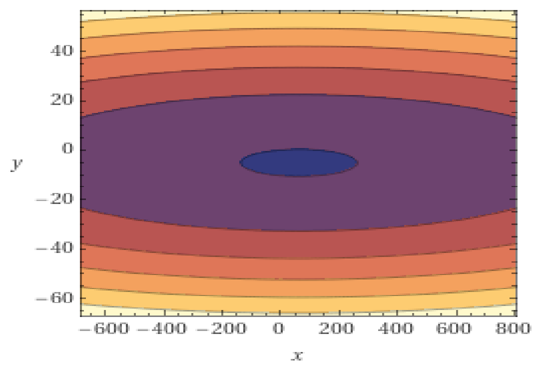

Fig. 4. Model in isoquants format, for rapeseed yield variation according to plant height (x-axis), and stem diameter (y-axis)
Source: Original graph.

The variation of rapeseed yield (Y, kg ha^{-1}), depending on the stem diameter (Sd) and harvesting height (Hh), was described by equation (2), under conditions of R^2 = 0.887, F = 15.7083, p<0.001.

The graphic distribution of rape yield (Y) according to Sd and Hh is presented in Figure 5 (3D format) and in Figure 6 (isoquants format).

$$Y = ax^2 + by^2 + cx + dy + exy + f \qquad (2)$$

where: Y – rapeseed yield (kg ha^{-1});
x – stem diameter (Sd, cm);
y – harvesting height (Hh, cm);
a, b, c, d, e, f – coefficients of the equation (2);
a= -23784.84282611;
b= -70.13126398;
c= 125677.09487622;
d= 6427.92449275;
e= -1733.66887783;
f= -183227.32967028

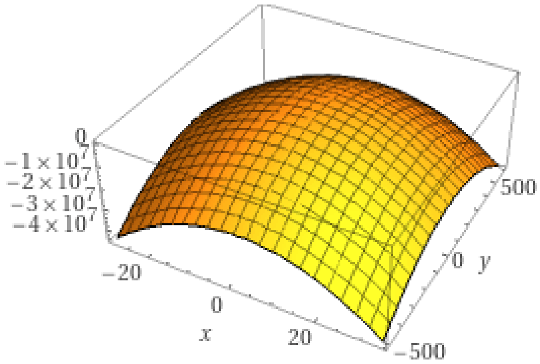

Fig. 5. 3D model of rape yield variation (Y) in relation to Ds (x-axis), and Hh (y-axis)
Source: Original graph.

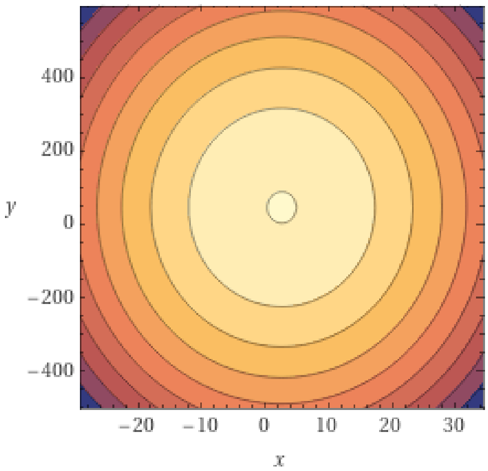

Fig. 6. Model in the form of isoquants of rape yield variation (Y) in relation to Sd (x-axis), and Hh (y-axis)
Source: Original graph.

The variation of rapeseed yield (Y, kg ha^{-1}), according to the harvesting height of the plants (Hh), and the number of branches per plant (Bn), was described by equation (3), according to R^2 = 0.989, F = 197.4476, p<0.001. Representation of yield variation (Y) depending on the harvesting height (Hh) and the number of branches (Bn) is presented in Figure 7 and Figure 8.

$$Y = ax^2 + by^2 + cx + dy + exy + f \qquad (3)$$

where: Y – rapeseed yield (kg ha^{-1});
x – harvesting height (Hh, cm);
x – branches number (Bn);
a, b, c, d, e, f – coefficients of the equation (3);
a= 17.92173538;
b= 62.79883259;
c= -1952.16941825;
d= -3446.49314339;
e= 88.10722297;
f= 46652.73146913

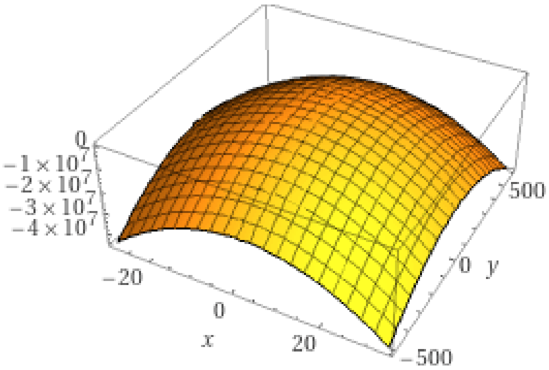

Fig. 7. 3D model of the rapeseed yield (Y) distribution, in relation to Hh (x-axis) and the Bn (y-axis)
Source: Original graph.

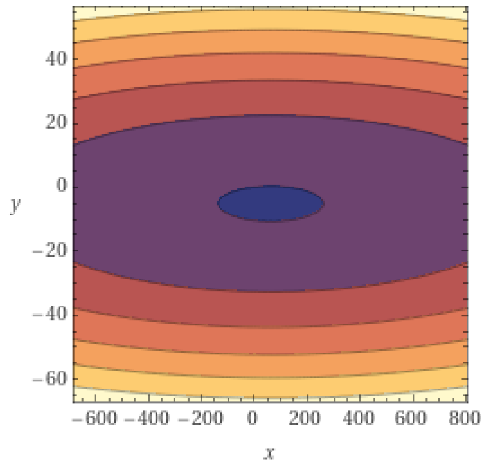

Fig. 8. Model in isoquants format regarding yield (Y) distribution, in relation to the Hh (x-axis), and Bn (y-axis)
Source: Original graph.

The variation of rapeseed yield (Y) was analyzed on each soil work system depending on the applied treatments, as well as between tillage systems.

In the case of the SwsA tillage system (disc tillage), the rapeseed yield had the average value $Y_{(AvgSwsA)}$ = 3,537.50 kg ha^{-1}. The yield increase, generated by the applied treatments (T1 to T4) was positive, close to the average in the case of the T2 and T3 treatments, and above the average value (ΔY = 380.50 kg ha^{-1}) in the case of the T4 treatment. Negative growth was recorded, associated to the T1 treatment (ΔY = -418.50 kg ha^{-1}).

In the case of the SwsB tillage system (direct sowing), the average yield value was $Y_{(AvgSwsB)}$ = 3,795.00 kg ha^{-1}. Compared to the average yield value, treatments T1, T2 and T3 led to negative differences, between ΔY = -603.00 kg ha^{-1} (T1) and ΔY = -80.00 kg ha^{-1} (T3). Only associated to the T4 treatment, the yield of rape registered a positive increase, compared to the average value, ΔY = 1,007.00 kg ha^{-1}.

At the level of the experiment, considering both tillage systems, the average yield value was $Y_{(AvgSwsA\&B)}$ = 3,666.25 kg ha^{-1}. Compared to the average value of the experiment, in the case of SwsA, the T4 treatment generated a positive increase in yield, $\Delta Y_{(SwsA-T4)}$ = 251.75 kg ha^{-1}, and the T1, T2 and T3 treatments generated negative increases.

In the case of the SwsB tillage system, treatments T3 and T4 generated positive yield increases, and treatments T1 and T2 led to negative increases in yield. A significant yield increase was recorded only in the case of the T4 treatment, with $\Delta Y_{(SwsB-T4)}$ = 1,135.75 kg ha-1. The data series resulted by calculation, for the average values, and for the increase in rapeseed yield, according to the tillage systems (SwsA, SwsB) and applied treatments (T1 - T4), are presented in Table 5.

Table 5. Yield increase (ΔY) given by the tillage systems and the treatments applied, the rape culture, the DK Expectation hybrid

	Y (AvgSwsA)	ΔY	Y (AvgSwsB)	ΔY	Y (AvgSwsA&B)	ΔY
SwsA-T1	3,537.50	-418.5	-	-	3,666.25	-547.25
SwsA-T2		22.5	-	-		-106.25
SwsA-T3		15.5	-	-		-113.25
SwsA-T4		380.5	-	-		251.75
SwsB-T1	-	-	3,795.00	-603		-474.25
SwsB-T2	-	-		-324		-195.25
SwsB-T3	-	-		-80		48.75
SwsB-T4	-	-		1,007.00		1,135.75

Source: original data.

From the analysis of equations (1), (2) and (3), and the graphic representations regarding the variation of rapeseed yield in relation to biometric parameters determined in the plants, it was found that the plants stem diameter (Sd), and the number of branches on the plants (Bn), had a significant weight in the definition of rapeseed yield. It can be appreciated, under the conditions of the present study, which the technological elements that positively influenced the diameter of the plants stem, and the number of branches on the plants, contributed positively to the increase in rape yield, the DK Expectation hybrid.

In the conditions of the present study, the T4 treatment ensured high yield in both tillage systems (SwsA, SwsB), with the best yield in the conditions of the SwsB system.

Crop plants were analyzed and studied through different methods and techniques [14, 15], in order to provide data and information for improving management at the crops, land plots and farms level.

In relation to the specifics of crops and the destination of production, different fertilization systems were studied, in order to optimize agricultural technologies [3, 4]. Soil work systems are also in the attention of researchers, for conservation purposes for the soil, as well as for the optimization of costs in the whole of agricultural technologies [2, 3, 16].

Some studies have communicated how aspects of mechanization in agricultural technologies contribute to increasing productivity and agricultural yields. Thus Fu et al. (2016) [6], communicated the variable rate of productivity in rape, in relation to socio-economic and environmental factors, closely dependent on the management of farms and crops and especially in relation to mechanization.

In the context of current concerns, the present study provides information on the yield variation of the rape crop, according to tillage systems, and fertilization treatments, and thus contributes to the series of information and the database, in order to optimize agricultural technologies.

CONCLUSIONS

The study highlighted, through valuable results, how the yield of the rapeseed crop varied according to the tillage systems (SwsA and SwsB), and the applied treatments (T1 to T4).

The direct seeding system (SwsB) ensured better conditions for the growth and development of the rapeseed crop, quantified by better yield (ΔY = 1,135.75 kg ha^{-1} compared to the average production on the two tillage systems, $Y_{(AvgSwsA\&SwsB)}$ = 3,666.25 kg ha^{-1}).

Among the four applied treatments (T1 to T4), treatment 4 (T4) generated greater increases in rapeseed yield, in the case of SwsA tillage system (ΔY = 380.50 kg ha^{-1}), and in the case of SwsB tillage system - direct sowing (SwsB, ΔY = 1,007.00 kg ha^{-1}).

The applied treatments, in the form of fertilizers (the same doses), were better valorised in the case of the SwsB soil work system, as a result of the localized application (starter fertilization, near the seeds and the plants row). It can also be considered the lower cost of establishing the crop associated with the SwsB system, by reducing the number of soil works and associated costs. In addition to these economic benefits, the ecological benefit of conservation works on the soil, can also be considered.

The PCA and CA analysis explained the presence of variance in the set of experimental data, and the classification of variants, in relation to the rape yield, and biometric parameters considered.

Mathematical models resulted by analysis, and graphical models (3D, isoquants), described in statistical safety conditions, and represented suggestively, the variation of rape yield in relation to the considered biometric parameters.

Based on the recorded results, the study recommends the direct seeding system to the rape crop (SwsB) for agricultural practice, with economic and ecological benefits.

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GREEN DEAL AND SOLAR ENERGY- PROSPECTS FOR BULGARIAN RURAL AREAS

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Abstract

Renewable energy is essential for the European Union. The targets presented by the Green Pact are closely related to the development of renewable energy, and it has a vital role in achieving climate neutrality in the EU. Solar energy's importance has increased in the past years. It can help achieve the goals presented in the EU and contribute to the sustainable development of rural areas with unrealized potential. The aim of the study is to outline the dynamics and tendencies in solar energy development in the EU and Bulgarian energy mix and highlight perspectives in the context of rural areas. The results show challenges related to green transition in Bulgaria. Renewable energy, especially solar and wind, has increased in its role in the last few years. However, it should be noted that the country's development began from a lower starting point. Bulgaria is dependent on fossil fuels, and more than 80% of electricity is produced from coal, which is one of the substantial sources of pollution. However, some positive tendencies and possibilities exist for boosting rural economies and employment creation.

Key words**:** *regional sustainable development, energy mix, renewables*

INTRODUCTION

The United Nations' 2030 Agenda and Sustainable Development Goals [37] outlined the path towards sustainability and circularity. In addition, the Intergovernmental Panel on Climate Change (IPCC) publication on the impacts of global warming highlights the climate change challenges. It reports the need for well-targeted actions to overcome these emerging issues [27]. As a leader in this field, in 2019 the EU presented the European Green Deal. The framework focuses on achieving "climate neutrality by 2050 and a 55% reduction in greenhouse gas (GHG) emissions by 2030 compared to 1990 levels" [9]. In addition, The Fit for 55 package [10, 11], which involves different cross-sectorial actions and encourages the EU Member-states to meet the ambitious targets.

Solar energy is one of the fastest-developing renewable energy sources in recent years. It is considered an opportunity to achieve clean production and sustainable development [22]. According to the International Energy Agency, solar power could provide about 11% of the world's electricity production by 2050. [16]. Solar energy can help achieve the goals presented in the EU Green Pact and contribute to the sustainable development of rural areas with unrealized potential.

The aim of the study is to outline the dynamics and tendencies in solar energy development in the EU and Bulgarian energy mix and highlight perspectives in the context of rural areas.

The survey has the following structure: The first part introduces the methodology. The second part outlines a literature review on the linkages between renewable energy and rural areas. Third, the trend in renewable energy development focusing on solar energy is discussed. Based on the analysis, conclusions and recommendations are highlighted.

MATERIALS AND METHODS

The survey is based on EUROSTAT data [13] for energy statistics covered by Regulation (EC) No 1099/2008. In addition, reports and data from EMBER are used in the survey [4, 5, and 6]. The systematic literature review includes study of legislation, reports and publications based on the framework proposed by Romero-Castro [38].

RESULTS AND DISCUSSIONS

Literature review

As a key goal of EU climate ambitions, energy transition is considered an opportunity for rural communities. On the other hand, the availability of land and natural resources make rural areas important for renewable energy prospects [26, 48]. Some authors [24] consider rural areas essential for new local development models based on renewable energy. Rudolph and Kirkegaard, 2019 explain the relationship between rural development and renewable energy [39]. On a political level, several documents highlight the role of renewable energy in supporting rural economies and achieving sustainable development. [3, 19, 32]. The EU legal framework outlines the opportunities, “especially in rural and isolated areas” [3].

The UN Environment Program (UNEP) outlines actions and competencies among stakeholders from various sectors [47]. In addition, in the scientific literature, different studies present factors for developing renewable energy in rural areas. Garrod et al. [14] consider the rural capital for essential. The authors pointed out that using rural areas environment can bring economic and social benefits. Surveys analyze the influence of economic and human capital and cultural, psychological and social factors on rural development [1]. In addition, [28] outlines the local context in renewable energy development and includes physical, community and financial capital as leading drivers. The success of the implementation of renewable energy projects in rural areas is related to trust and relationships between the members of the local communities [15].

On the other hand, there are a number of drivers, challenges and barriers for adopting renewable energy and, particularly, solar energy technologies [33]. The latter is an object of serious debate among scholars due to the growing importance of the topic. Clausen and Streimikiene et al. [2] observe drivers and barriers to adopting renewable energy technologies in rural areas. The transition from fossil energy to renewable is difficult due to new infrastructure construction and operational and start-up expenses [21, 23]. [17] was focused on energy-storage technologies and electricity generation. Financial factors and the higher risk of the investments are critical for developing these projects [29]. In addition, Wall et al. [49] conclude that the cost of renewable energy affects the acceptance of these sources.

Furthermore, networks can stimulate contact and cross-sectorial collaboration [31]. Ryghaug et al. [40] highlight the importance of public acceptance of these technologies. In addition, some authors identify the lack of public knowledge as a barrier [8]. The social disagreement with the renewables in rural communities can be a challenge. According to Irfan et.al. [20], there is a gap between public acceptance and the goals for increasing the share of renewable energy. Simpson et al. [42] points out that incentives and a realistic plan are vital to adopting renewable energy in rural areas. However, the discussions and misconception can encourage the transformation of these issues into practices and rules [43].

While there is a regulatory framework with legislation for renewable energy promotion, often barriers related to planning and implementation occur [7]. Streimikiene et al. [46] consider the underdeveloped business models and a lack of transparency a challenge. Consumers have to play a more significant role in the new energy models [30]. In agriculture, the transition can be encouraged by farmers who can be energy producers rather than just consumers [36]. However, these opportunities are related to the need for capacity building and new business models.

Another important aspect is the new type of land rivalry that occurs with renewable energy development. It can impact forests, environmental assets, and agricultural land [35]. Agriculture, fishery, and tourism can be influenced negatively [25]. Solar photovoltaic power development has changed and can

further influence land use [30]. Institutional factors also are important.
According to some authors, national strategies are lacking behind the ambitious goals. The most severe barrier is the inconsistency of policy and the lack of trust alongside with the difficulties related to the administrative capacity [27, 34, 45].

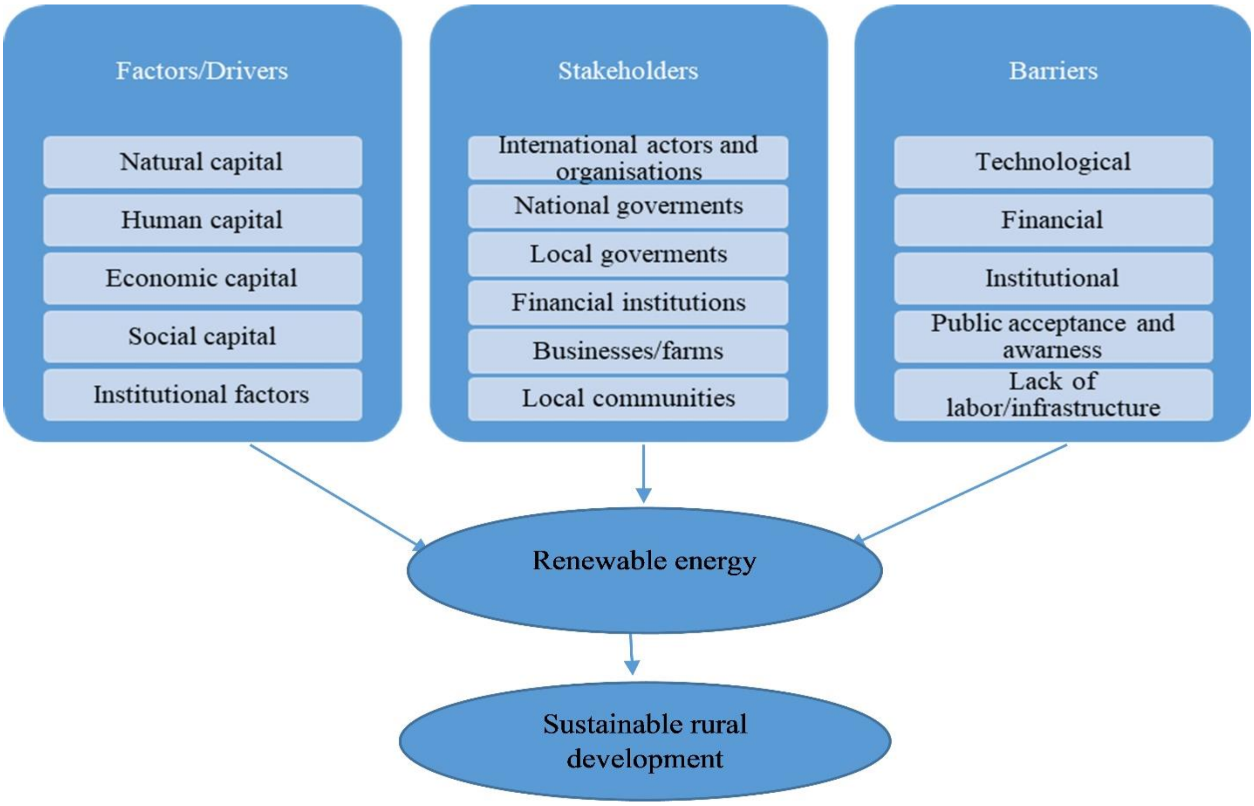

Fig. 1. Conceptual framework for links between renewable energy implementation and rural development
Source: Own survey based on [38, 41, and 47].

Based on the literature review, a conceptual framework that presents the linkages between different actors, barriers and drivers is developed.
The framework explains the role of rural areas and renewable energy in achieving sustainable development, especially in meeting the targets related to the EU climate ambitions.
The innovations and new renewable energy technologies, along with the increased role of renewables in the energy mix, are vital parts of the sustainable development of rural areas. However, some challenges have to be overcome, and opportunities to be taken advantage of in order to achieve the Agenda 2030 targets.

Trends in renewable energy development in the EU and Bulgaria

Renewable energy is seen as a main factor in achieving global climate goals and reducing greenhouse gas emissions.
In 2022, in the EU, the share of consumption from renewable sources was more than 22%, which is slightly higher than in 2021. (Figure 2) The indicator increased significantly for the period 2004-2022.
In addition, EU Directive 2023/2413 has revised the 2030 target from 32% to 42.5%. In this regard, the member states need a more significant growth of around 20 percentage points. That requires well-target initiatives and actions.
According to Eurostat data [13], the highest share of the indicator is recorded in Sweden (66%), the leading country in the EU and far ahead of the other Member states. It is followed by Finland (47%) and Latvia (43%). By contrast, the lowest share is registered in Ireland (13%), Malta (13.4%) and Belgium (14%).
Bulgaria is below the EU average with a share of 19%. However, there is an increase of ten percentage points compared to 2004. The

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results indicate rising tendencies in the EU and some dynamics in Bulgaria. The share of renewable energy was above 20% for the 2018-2020. However, it reduced in the following years.

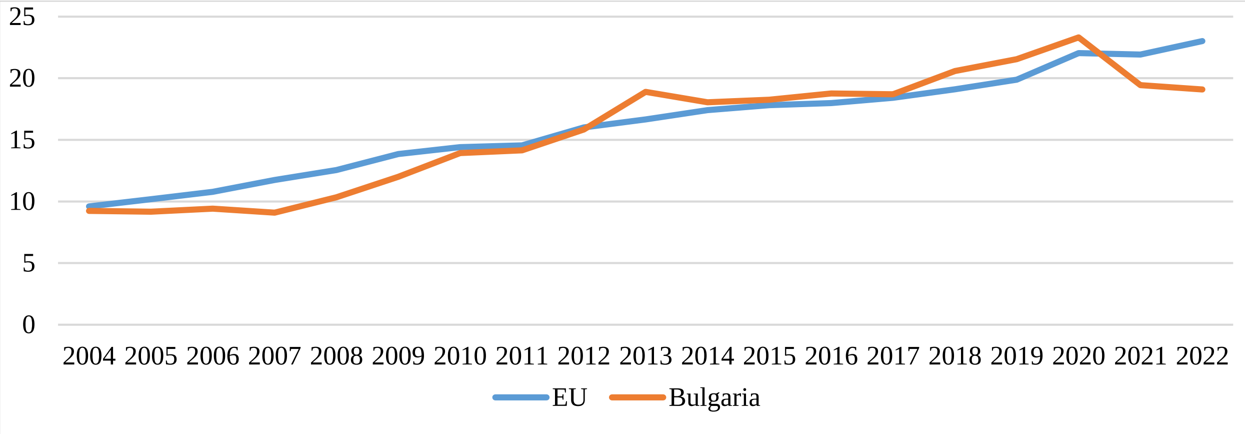

Fig 2. Share of energy from renewable sources, 2004-2021 (% of total energy consumption).
Source: [13].

Based on Eurostat data [13], it should be noted that the highest increase in the indicator for 2004-2022 is registered in Sweden (28 pp), followed by Denmark (27 pp) and Finland (19 pp). The lowest increase is recorded in Slovenia (5pp) and Croatia (6pp).
According to the Eurostat data [13], the highest share of electricity consumption from renewables is registered in Sweden (83%), followed by Denmark (77%) and Austria (75 %). By contrast, the lowest value of the indicator is in Malta (10%), Hungary (15. %), and Czechia (16%). Norway is the leading country in Europe in 2022, with a share higher than 100 %. This means that it produces more than its consumption. In Bulgaria, the share is 29%, more than 12 pp lower than the EU average (40%).
In 2022, the share of renewable energy in transport is almost 10%. This means that the target set by the EU is unlikely to be achieved with the reported growth rates. The share of renewable energy in transport is the highest in Sweden and Finland. On the other hand, it is the lowest 2.4 % in Croatia and 3% in Latvia. In Bulgaria, the share is close to the EU average- 7.8%.
Becoming a world leader in addressing climate change issues and reaching the Green Deal targets requires ambitious actions. In 2022, the EU developed the REPowerEU plan to encourage the transition to clean energy [12].

Based on Ember data [4], it can be concluded that in the last few years, Europe has seen uneven progress in decarbonization. Fossil-generated electricity has declined by 25% since 2015, primarily replaced by wind and solar power. However, this transition is driven mainly by Western Europe, with much more limited progress in Eastern and Southeastern Europe. Overall, fossil fuels still account for nearly half of electricity generation in these parts of Europe.
The results show challenges related to green transition in Bulgaria. Renewable energy, especially solar and wind, has increased in its role in the last few years. However, it should be noted that the country's development began from a lower starting point.
The data show a change in the energy mix in Bulgaria. For the last ten years, non-renewable sources have started to be displaced by renewable ones.
The country expanded renewable energy in 2007, most of which was hydroelectric. Solar installation started in 2009 and reached 100 (MW) in 2011. [4] However, due to changes in the institutional environment and government price policy, only around 12 MW were installed between 2013 and 2014, and capacity has not increased substantially until 2020 [4, 50]. However, the country's dependence on fossil fuels is exceptionally high [50]. It is impressive that more than 80% of electricity is formed from nonrenewables, which are pointed out as one of the biggest

polluters and generators of greenhouse emissions. Regarding the energy mix, a comparison between Bulgaria and the EU shows significant differences in several directions. First, the share of nuclear power is higher than the EU average. Second, coal has a two times bigger share.

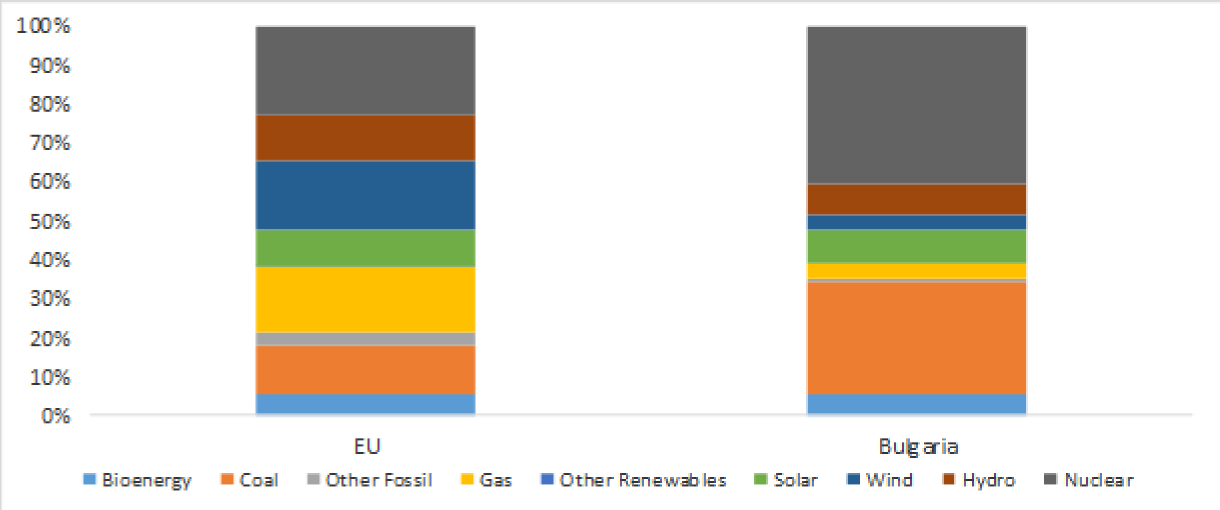

Fig 3. Electricity generation by source (%), 2023
Source: [4].

Third, the share of solar energy in Bulgaria is close to EU-27, while the role of wind energy is insignificant. It can be summarized that Bulgaria is lagging behind despite the EU's set goals and the path towards decarbonization.

Prospects for renewable energy development

The UN climate conference [44] sets a global goal of tripling renewables and doubling energy efficiency. The Net Zero report [18] shows renewable capacity targets as part of policies and strategies worldwide.

According to EMBER data [5], China is developing its green energy sector and aims to double its renewable capacity to 2,461 GW, by 2030.

In the United States, the goals are to reach 938 GW of renewable capacity by 2030 or 59% share of renewable electricity. However, there is a need for more consistent actions.

As a part of the REPowerEU plan, the EU developed a solar energy strategy with the ambition of "over 320 GW of solar photovoltaic capacity by 2025 and almost 600GW by 2030" [12]. However, the REPowerEU renewables target of 69% of energy generation by renewables can only be achieved based on well-directed measures. All Member States must contribute in order to reach the goals.

Bulgaria will receive 480 million euros under the RePowerEU plan, expanding the opportunities for solar energy development. According to Regulation (EU) 2018/1999 requirements, the Member-states had to develop an Integrated Energy plan.

The analysis of the 2030 targets shows the diverse ambitions among member states (Figure 4). Estonia, Denmark, Austria, Portugal and Lithuania have the higher ambitions, with a share above 90% of the energy generated by renewables. By contrast, eight countries (including Bulgaria) set their targets below the EU goals [8].

EMBER report [5] divides a confidence level in achieving the targets. Based on publication analysis, Germany and Sweden are considered countries with high confidence in meeting their goals. On the other hand, Poland, Greece, Romania, and Belgium are classified as countries with low confidence.

The results show different starting points, ambitions and contributions to the EU. Therefore, the 2030 targets raise a number of questions related to the member states' institutional environment, policy, and required actions.

The main target in the Bulgarian energy plan is for 27% of the total energy consumption to be generated from renewables. The main strategic directions are: (1) Decarbonization, (2) Energy efficiency, (3) Energy security, (4) Internal energy market, (5) Research, innovation and competitiveness [5]. Bulgaria's target for solar energy capacity remains low, as solar energy will only account for 2.6% of electricity in 2040 [6]. However, Bulgaria benefits from high solar irradiation, especially in the southern part of the country, and has a solar potential, which is not reflected in the Bulgarian plan objectives.

There are challenges related to the administrative environment and financing difficulties, with insufficient ambition for a green transition.

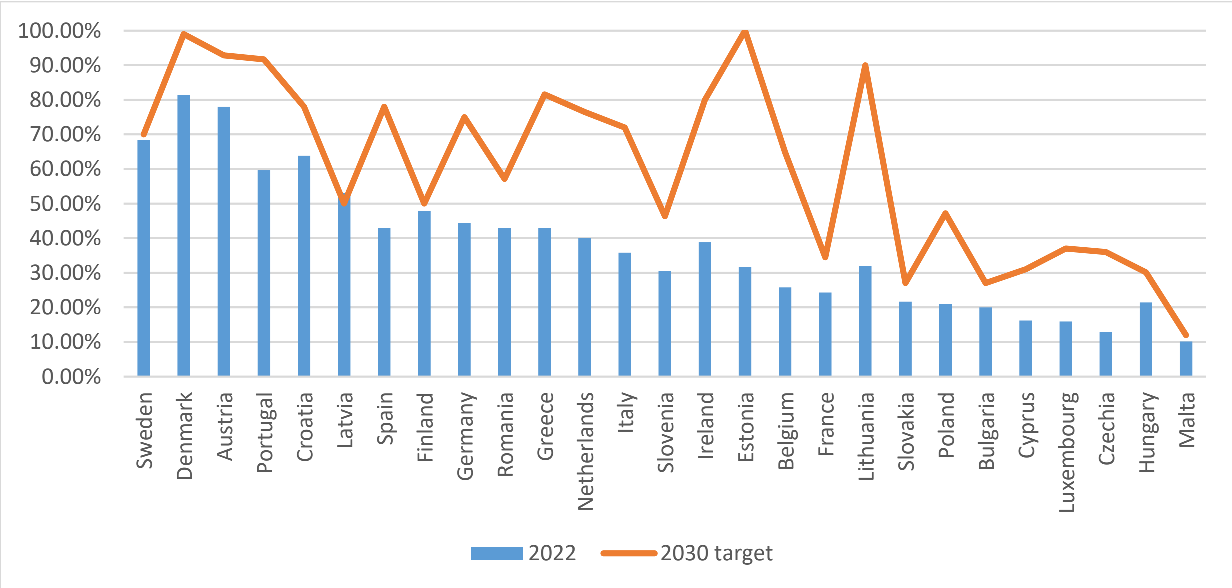

Fig. 4: Share of total electricity generated by renewables: current (2022) and target (2030)
Source: [8].

CONCLUSIONS

Based on the analysis, the following conclusions could be drawn:

(1) Solar energy is one of the fastest-developing renewable energy sources in recent years and an opportunity to achieve Green Deal targets.

(2) Renewable energy development can boost rural economies and provide opportunities for new business models and job creation. However, depopulation and infrastructure are still challenging, along with the question related to the land use dynamics.

(3) The share of renewable energy has increased in recent years in all Member-states. The 2020 target is achieved, and new ambitious goals are developed.

(4) Bulgaria has a share close to the EU average. However, there are dynamics and some variations in the indicator.

(5) In the last few years, Europe has seen uneven progress in decarbonization.

(6) There is a significant difference in the EU and Bulgarian energy mix. The country is still too dependent on fossil fuels as an energy source.

(7) The new Energy plan does not provide an ambitious framework for renewable energy development.

(8) Although Bulgaria has potential for solar energy development, there are unrealized opportunities and inconsistent policy ambitions.

(9) The RePowerEU plan will encourage member states to develop renewable energy capacity. Bulgaria can stimulate PV installation by benefiting from financial support.

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VALUE CHAINS IN RAW MATERIALS, HIGH-TECH AND AGRICULTURAL PRODUCTS. INTERNATIONAL, EUROPEAN AND ROMANIAN PERSPECTIVES

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Abstract

This article explores the complexities and opportunities of agricultural value chains from international, European, and Romanian perspectives. Highlighting the importance of efficient value chain management, the exploration examines first the situation at the global level in the countries with a high economic development: USA, China, Germany, Japan and India, as a reflection on how global and regional policies impact agricultural production and distribution. Market dynamics of raw materials and high tech products and services in terms of export, import and trade balance was analyzed in the EU in the interval 2012-2022, based on Eurostat data, emphasizing its role in shaping value chains. The European lens focuses on the Common Agricultural Policy (CAP) and its implications for member states. The Romanian context highlights local challenges and strategies for integrating into broader value chains. From a methodological point of view, there were used various methods and procedures among which the main ones have been: descriptive context of the literature, trend dynamics in raw materials and high tech-products and services in terms of regression equation and R square, fixed basis index for showing the growth rate on the studied period, comparison method, illustrations in tabulated results and suggestive graphics. By analyzing case studies and current trends, the current research provide insights for enhancing economic efficiency, sustainability, and competitiveness in the agricultural sectors.

Key words: *agriculture, value chains, global markets, European Union, Romania, agribusiness, supply chain management, sustainability, digitalization*

INTRODUCTION

Value chain is a common term in business management, and was first defined by Porter in 1985 "as a multitude of activities that a company caries out in order to deliver products and services to the final consumer" [17, 22].
The concept of value chain is widely recognized as a strategic development framework at global level. Various definitions of the network of relationships within a value chain are found in the literature, allowing for discussions on sectoral or technological value chains [14]. Other authors considered that: "Value chain is an operational model for the sustainable development through economic advantages. It is a way in producing, marketing, buying and selling different products by providing integrated capital, access to various networks,

markets, innovations, knowledge and technologies".

It shows the long way of a product from its conception till its delivery to final consumer and then its recycling after use. In agriculture, it shows how from a natural resource a product arrives from "farm to fork" [3, 4, 5].

Theoretical sources distinguish between different levels of value chains.

These include an industry value-added chain at the micro-level [17], an industry value chain at the meso-level [10], a global value chain at the macro-level and a technological value chain that integrates the micro and medium levels. Unique insights into value creation processes are offered by each of these perspectives.

Both the micro and medium levels are items combined in the technological value chain framework, which suppose the involvement of the value chain of specific technologies and their interactions with other sectors.

This type of value chain has been explored in various studies along the years.

Strategic initiatives are useful for the companies' value chains, which have to redesign production involving logistics capabilities, marketing, sales, and service.

The role of value chains has to be better understood and new business models have to be created for assuring a more sustainable development [1].

The huge volume of information transmitted to consumers have contributed to the change of their purchasing habits and to a higher flexibility in manufacturing systems so that the producing industry is able to achieve a large variety of products to better satisfy consumer needs [20, 21].

The era of the digital economy involves the appearance of new technologies such as Big Data, Internet of Things, Cloud Computing, and Artificial Intelligence which offer support for global economic development [15].

This results in the creation of the concept of the "Big Data Value Chain," which is composed of a series of steps to generate value and meaningful insights from data.

The Big Data Value Chain encompasses the end-to-end process of data management, from data acquisition and storage to data processing, analysis, and the generation of actionable intelligence.

This holistic approach enables organizations to derive maximum value from the vast amounts of data being generated in the digital economy, allowing them to make more informed decisions, optimize operations, and drive innovation across various sectors. "The advances in Big Data and Big Data Value Chain, using clear processes for aggregation and exploitation of data, have given rise to what is called data monetization. Data monetization concept consists of using data from an organization to generate profit. It may be selling the data directly for cash, or relying on that data to create value indirectly." [9].

In agriculture, among the top high-tech innovations, wireless irrigation tools as well as the drones designing the crop mapping are not novelties any more [16].

In the developing countries, the strategy to develop an efficient value chain have to start with the identification of the major constraints such as: restrains to market access, weak infrastructures, lack of resources and institutional gaps. Then, it is need "to find solutions to add value, to create horizontal and vertical chain-network and value chain governance mechanisms" [18].

According to FAO, agricultural value chains have not only an economic impact, but also social and environmental effects which have to be known regarding their trends and challenges in order to find out policy options [7, 8].

In this context, this article investigates and presents the possibilities within agricultural value chains, taking a comprehensive view from international, European, and Romanian standpoints. Emphasizing the significance of effective value chain management, the exploration reveals how global and regional policies influence agricultural production and distribution. The international segment presented regards countries as China, USA, Japan, India, the EU segment regards all 27 countries taking as driven force Germany and Romania as emerging country that adapts at global conditions regarding the agriculture sustainability, value chain management,

adopting circular economy and digitalization in all the processes.
The article also presents the trade for raw materials contributing at high-tech goods and services production.

MATERIALS AND METHODS

For setting up this study the literature in the field was approached in order to create the scientific information background.
The ideas coming from other authors have been evaluated in a critical logical manner and also the authors own opinions have been sustained.
In the study structure the main ideas are presented in a logical manner emphasizing the core of the problems.
In order to analyse the significance of the value chain as a strategic initiative for companies, we conducted a study using the Scopus and Google Scholar data base where the term 'value chain' appeared in article titles, abstracts, or keywords a total of 29,042 times (as of September 29, 2023).
The focus on sustainability policies within value chains underscores the drive for efficiency across economic, social, and environmental dimensions.
Achieving a balance among these aspects and their interdependencies necessitates the adoption of suitable business models that facilitate the seamless integration of functions, technologies, companies, or industries to support sustainable operations.
In the paper structure there were presented the following aspects:
-Value chain of raw materials;
-Production and trade of high-tech goods and services at international level.
The data were collected from Eurostat data base and graphical and tabled representation have been done for a better understanding.
The data series reflected the dynamics of the main indicators in the period 2013-2022.
The analysis emphasizes the trends in the production and commerce with high-tech goods for main sectors and for agriculture field.

RESULTS AND DISCUSSIONS

Value Chain of Raw Materials

Raw materials have historically served as the backbone of economies and the catalyst for their advancement over centuries. Countries endowed with abundant natural resources have often influenced development trajectories and wielded significant influence in the realm of international relations.
In the contemporary world, it is a challenge to effectively manage available resources by considering the entire lifecycle encompassing their extraction, processing, utilization, and disposal. In the age of the green economy and conscientious business practices, environmental and social considerations are inherently intertwined. Within such a comprehensive framework, the creation of value, its origins, and its beneficiaries all play critical roles.
The mix of economic, environmental, and social interests significantly shapes activities related to exploration, mining, processing, and distribution. This interconnectedness within the value chain, embracing the principles of a circular economy.
The utilization of raw materials across various technologies underpins their development and underscores the significance of raw materials amidst the challenges posed by innovative corporate and field strategies. The diverse array of industries reliant on raw materials are in danger because of low supply of these materials.
The primary sectors - Renewable Energy, Electric Mobility, Defence and Space - that rely on cutting-edge technologies, which are in turn enabled by the utilization of raw materials. Critical raw materials, in particular, hold substantial importance as their procurement becomes a pressing concern, particularly given the increasing demand driven by energy transition initiatives, autonomous vehicles, electric mobility, space exploration, and global militarization trends, with recent events such as those in Ukraine underscoring their significance.
The value chain of raw materials starts with the identification of primary resources, by exploring the environment, extracting the

resources from the Earth surface or from the depths, processing the materials by various industries using high technologies in accordance with the progress in science and techniques.

The raw materials are destined to be transformed into high value products which impose the design and then the implementation in the series production.

The obtained products must be used according to the preference of consumers and reused to continue their life cycle.

Across this long way, there are also obtained wastes which have to be collected and recycled according to the principles of the circular economy. A suggestive representation has been done by [12] as shown below in Table 1.

Table 1. The value chain of the raw materials according to the principles of the circular economy

1	**Exploitation of natural resources**
2	Extraction of natural material resources from mines and Earth surface
3	Processing of raw materials using various technologies
4	Raw materials ready to be transformed into products
6	Designing the products
7	Carrying out the production of the designed goods
8	Use and reuse of the products
9	Collection of used products and wastes
10	Recycling

Source: Adapted based on [12].

International trade and production of high-tech goods and services in the EU

The EU is among the major economic player in the international market, besides USA and China.

Its policies are focused on a continuous sustainable development for keeping its high position in the market.

At the EU level, the marketed production of high-tech products increased from €275 billion in 2012 to €355 billion in 2022 (Table 2).

In 2022, high-tech products accounted for 16% of the total imports into the European Union from countries outside the EU.

These imports encompassed a wide range of advanced technological goods such as electronics, machinery, pharmaceuticals, aerospace technology, and software.

Similarly, high-tech products comprised 17% of the total exports from the European Union to countries outside the EU during the same year.

This indicates that the EU is a significant exporter of high-tech products, showcasing its strength in innovation and technological capabilities in various industries.

Regarding these sectors the evolution is positive for all of them, the increase in production of high-tech at global level, as well as at the EU level for this type of the goods and services.

The highest growth rate in the analyzed period was registered by pharmacy products (+54.9%), scientific instruments (+52%) and armament (+150%).

Important increases were also noticed in case of electric machinery (+37.5%), aerospace (+24.2%), electronics communications (+24%).

However, two economic sectors registered a diminished production, like in case of computers and office machines (-12.8%) and non-electrical machinery (-4.4%).

The balance of trade in high-tech products reflects the EU's participation in the global marketplace for advanced technologies and highlights the importance of these products in driving both imports and exports for the region (Table 3).

The data show that in the studied interval the imports value increased by 90.6%, the value of exports by +71.7%, and the trade balance passed from a positive value to a negative one in the last three years, 2020-2022, registering Euro Billion - 36.1.

In 2022, the export value accounted for Euro Billion 445.3 compared to Euro Billion 259.1 in 2012.

In the same year, the import value accounted for Euro Billion 481.3 compared to Euro Billion 252.4 in the year 2012.

The total trade value, increased from Euro Billion 511.7 in 2012 to Euro Billion 926.6, meaning a surplus by +81%.

The EU trade in high-tech products in the period 2012-2022 is shown in Fig. 1.

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Table 2. EU total sold production of high-tech products by sector, 2012-2022

Econ sector	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022/ 2012 %
Electronics communications	75	63	61	65	65	72	75	77	69	79	93	124.0
Scientific instruments	48	49	50	54	55	57	60	63	58	66	73	152.0
Pharmacy	51	52	51	58	59	62	79	85	97	76	79	154.9
Aerospace	33	42	45	43	50	54	45	51	36	40	41	124.2
Non electrical machinery	23	22	22	24	22	23	23	21	16	19	22	95.6
Computers and office machines	19	15	15	15	20	16	22	19	16	14	16	84.2
Chemistry	16	15	16	16	16	15	15	13	14	15	16	100.0
Electrical machinery	8	8	7	8	8	9	10	9	9	10	11	137.5
Armament	2	3	2	2	3	3	3	4	4	4	5	250.0
Total	275	270	271	286	301	311	332	342	320	322	355	129.0

Source: Eurostat, 2024, Sold production, exports and imports, https://ec.europa.eu/eurostat/databrowser/view/DS-056120/legacyMultiFreq/table?lang=en, Accessed on May 10, 2024 [5].

Table 3. The export, import, trade balance value and total trade value in the EU, in the interval 2012-2022 (Euro Billion)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022/ 2012 %
Imports	252.4	243.2	249.1	294.1	301.1	331.7	347.7	364.4	346.5	393.5	481.3	190.6
Exports	259.2	260.4	266.5	301.0	307.7	332.2	348.0	381.6	341.9	384.8	445.3	171.7
Balance	+6.8	+17.2	+17.4	+6.9	+6.7	+0.5	+0.3	+17.2	-4.6	-8.7	-36.1	-530
Total Trade	511.7	503.5	515.6	595.1	608.8	663.9	695.7	746.0	688.5	778.3	926.6	181.0

Source: Eurostat, Comext data base [6].

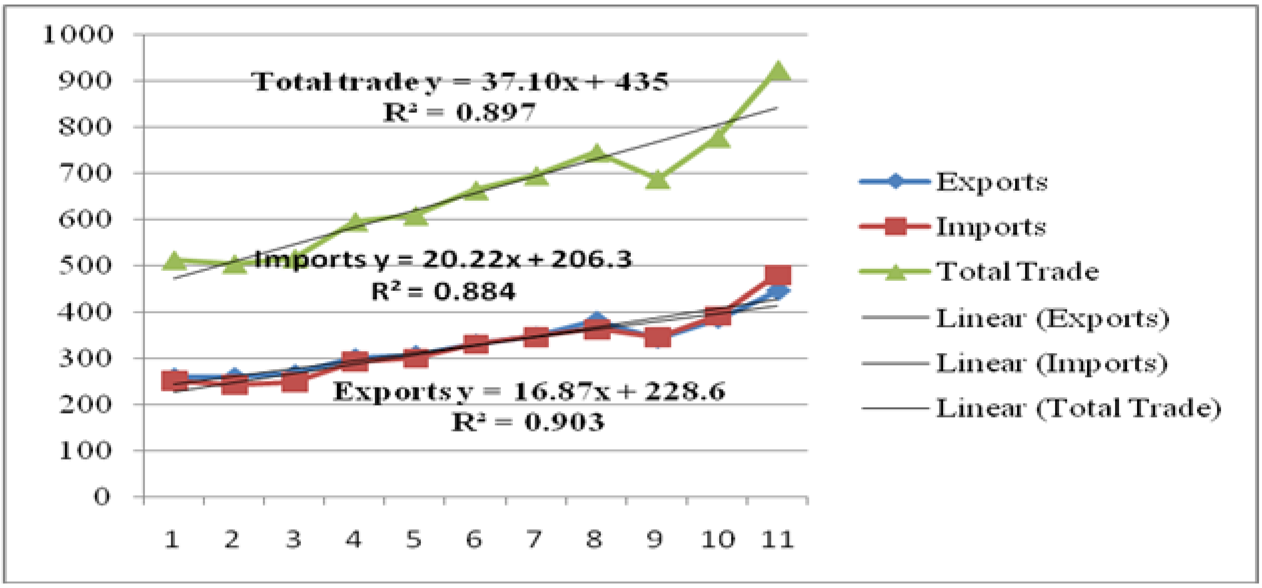

Fig. 1. The EU trade: Exports, Imports, Total trade in high-tech products in the period 2012-2022 (Euro Billion)
Source: Own design and calculation based on Eurostat, Comext data base [6].

Raw materials and high-level goods and services in non-EU countries

The situation is shown in Table 4.

We may easily notice that the both raw materials and high-tech products and services increased in the interval 2013-2022 both in the USA and in Germany.

Moreover, the high-tech products and services have a triple value compared to raw materials highlighting the value added created in the production process.

Table 4. Exports of raw materials and high-level goods and services in USA, CHINA and GERMANY (in trillions of USD)

	usa export of raw materials	usa export of high-level goods and services	china export of raw materials	china export of of high-level goods and services	germany export of raw materials	germany export of high-level goods and services	japan export of raw materials	japan export of high-level goods and services	india export of raw materials	india export of of high-level goods and services
2012	0.54	1.48	0.72	1.50	0.58	1.18	0.11	0.65	0.23	0.28
2013	0.56	1.41	0.75	1.46	0.61	1.16	0.12	0.62	0.25	0.29
2014	0.56	1.46	0.79	1.58	0.62	1.24	0.13	0.64	0.27	0.3
2015	0.45	1.34	0.71	1.56	0.53	1.31	0.11	0.61	0.24	0.29
2016	0.41	1.30	0.63	1.47	0.49	1.30	0.1	0.6	0.23	0.28
2017	0.46	1.39	0.66	1.60	0.51	1.46	0.11	0.63	0.25	0.3
2018	0.52	1.57	0.75	1.75	0.53	1.52	0.12	0.67	0.28	0.32
2019	0.46	1.53	0.71	1.79	0.47	1.53	0.11	0.68	0.26	0.33
2020	0.37	1.32	0.66	1.93	0.39	1.42	0.09	0.65	0.22	0.31
2021	0.52	1.68	0.80	2.56	0.47	1.50	0.1	0.68	0.25	0.34
2022	0.63	1.88	0.87	2.72	0.50	1.61	0.11	0.7	0.28	0.37

Source: Authors' own concept based on the data from World Bank's WDI database [23] and UN Comtrade database [19].

The dynamics in raw materials trade (export) in the non-EU countries for USA, China, Japan, Germany and India, are shown in Fig. 2.

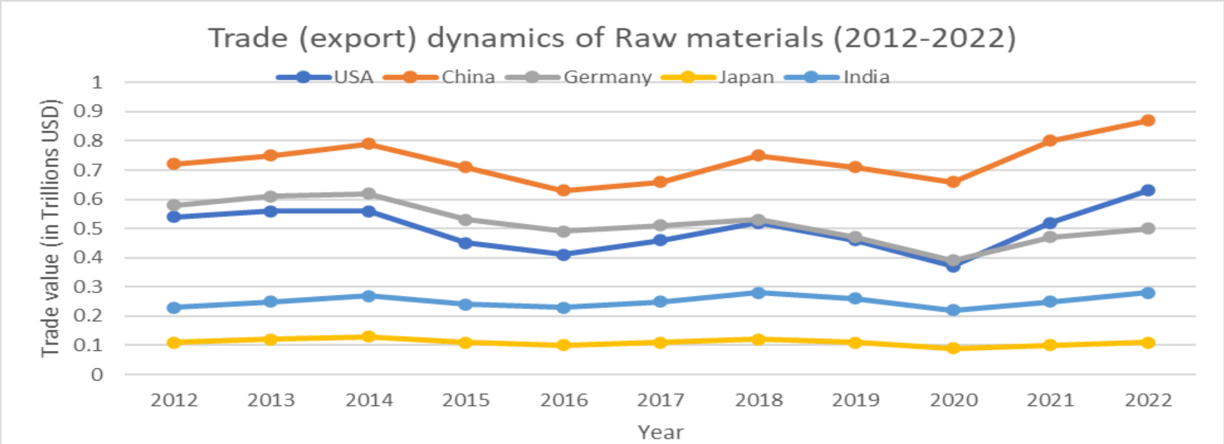

Fig. 2. Trade (export) dynamics of Raw materials in non-EU countries, 2012-2022 (USD Trillion)
Source: Authors' own concept based on the data from World Bank's WDI database [23] and UN Comtrade database [19].

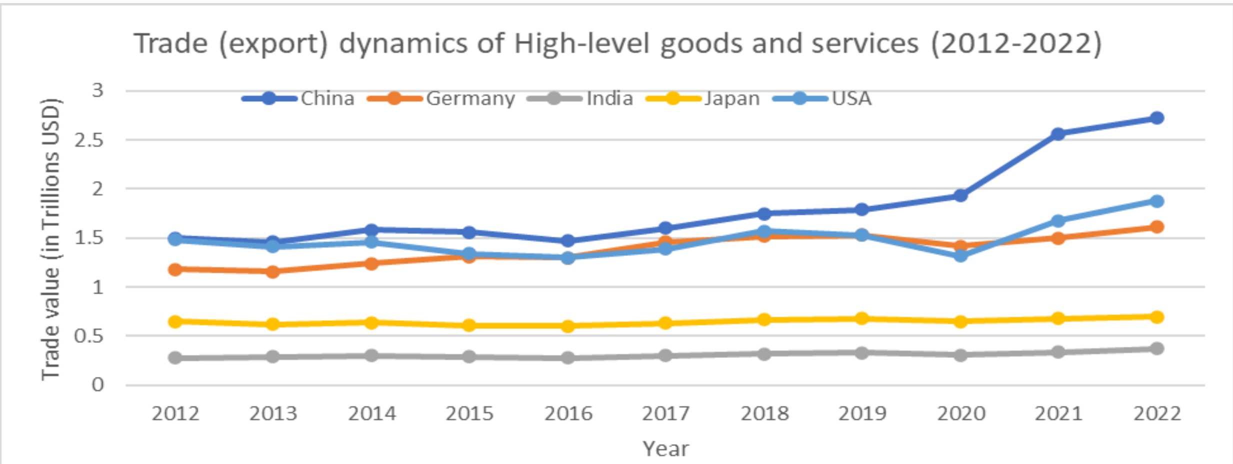

Fig. 3. Trade dynamics of High-level goods and services in non-EU countries, 2012-2022 (USD trillion)
Source: Authors' own concept based on the data from World Bank's WDI database [23] and UN Comtrade database [19]

In Fig. 3 it is presented the dynamics in high-tech goods and services trade (export) for the same countries included in the category in the non-EU countries.

The data from Table 4 and Fig. 2 and 3 show us the situation of each non-EU country in the trade with raw materials and high-level products and services.

United States: while the US maintains a significant volume of raw material exports, its export growth in high-level goods and services has been more pronounced, showcasing a shift towards a more knowledge-based economy and technologically advanced sectors.

China: has experienced the most substantial growth in both raw material and high-level goods and services exports, demonstrating its increasing dominance in global trade and its growing capacity for manufacturing and innovation.

Germany: trade patterns show a balanced approach, with a relatively stable volume of raw material exports and a steady growth in high-level goods and services. This underscores the country's established strength in manufacturing and engineering, while also highlighting its increasing focus on higher-value exports.

Japan: export profile is similar to Germany's, with a consistent level of raw material exports and a gradual increase in high-level goods and services. This suggests a focus on technological innovation and advanced manufacturing, mirroring Germany's strategy.

India: India's export trends indicate a developing economy with growing capabilities. While both raw material and high-level goods and services exports have increased, the growth in high-level goods and services has been more notable in recent years. This suggests a shift towards more value-added sectors as India's economy matures.

The analysis of these trends indicates that China has seen the most remarkable growth in exports, particularly in high-level goods and services, solidifying its position as a global trade powerhouse.

Romania’s value chains

In Romania, the economy has traditionally been oriented towards sectors that involve processing raw materials, such as the agricultural sector, the mining sector, the metallurgical industry, or the textile industry. These sectors have been important for the economy, but in recent years, the country has started to diversify its economy and shift towards high-tech products and services.

Raw materials have played and continue to play a significant role in the Romanian economy, as the country has various natural resources, such as fertile land for agriculture, mineral resources (such as natural gas, coal, oil, metals), rich forests, etc. The traditional sectors based on these raw materials have contributed to Romania's economic history and have been important for exports.

On the other hand, the high-tech sector has experienced significant growth in recent years in Romania. This sector includes products and services based on advanced technologies, such as IT, software, electronics, telecommunications, research and development, artificial intelligence, technology consulting services, etc. Companies in this sector bring innovation, added value, and economic growth opportunities.

Romania has started to become a leading name in the IT industry and technology services in Eastern Europe, with an increasing number of high-tech companies and startups making their presence felt in the global market. Investments in education, research, and innovation have contributed to the development of this sector and to transforming Romania into a technological hub in the region.

Therefore, Romania is in a transition process from an economy based on raw materials to one focused on high-tech products and services, also circular economy, seeking to leverage its potential in the technology field and to adapt to the requirements of a digital and globalized economy.

Value chains in agriculture

The agriculture sector and all the structural changes in the latest period, that involves the introduction of the digitalization and technology in this field.

The 3 directions to study the value chains in

agriculture identified in the latest period are:
(1) The trend of the global trade and value chains –this has an important role in shaping the value chains in agriculture, impacting production, distribution, and market access worldwide.
(2) Technology and innovation - have revolutionized agricultural value chains, improving efficiency, sustainability, and product quality.
(3) Market dynamics and consumer demand - Understanding consumer demand and market dynamics is essential for developing robust agricultural value chains that meet global market needs.

In agriculture, value chain is a sum of activities along the stages in which a raw material is transformed in its final form ready to be consumed and then to be disposed after use, reflecting the value added at each stage.

Agricultural production requires a long range of stages depending on crop type and animal species, genetic material and its productive potential, farms inputs (seeds, fertilizers, pesticides, fuels etc), farmer's knowledge, training level and experience, production technologies, post-harvest activities (collection, transportation, storage, grading, cooling, packing), industrial processing, storage, transport, finance, and feedback from beneficiaries [2].

Therefore, in agriculture, value chain consists of the following parts: input supply, production, primary processing, secondary processing, distribution and retailing.

The detailed activities suitable for each part or phase are shown in Table 5.

Table 5. The main parts of the value chain in agriculture

No.	Part	Details
1	Input supply	Seeds, fertilizers, pesticides, machinery, fuel etc
2	Production	Crops growing and raising animals
3	First processing	Cleaning, sorting, grading, and packaging agricultural products
4	Second processing	Transforming raw materials into products suitable for consumption
5	Distribution	Transportation of the products to wholesalers, retailers or consumers
6	Retailing	Selling products to consumers

Source: Own conception.

The sector of agriculture has its specificity and the value chain has to be approached in a different way than in other economic fields.

First, the farmers need to assure the farm inputs, which means: seeds of high quality, preferable certified seeds with a high genetic potential, fertilizers for strengthening soil productivity, pesticides for plant protection against various pests and diseases, machinery for making the agricultural works etc.

Secondly, the farmers apply the specific technologies in crop production and in animal production, adapted to the soil and climate conditions, varieties and hybrids, animal species, categories, breeds and cross-breds etc

Thirdly, the agricultural products are supposed to various processing technologies depending on the purpose to attain the final product. For instance, in the field of vegetable growing, the products must be cleaned, sorted, graded and packaged. In the field of dairy farms, milk is milked by milking machines in the parlours, transported in the milk tanks where it is stored at a low temperature (4^0 C), and then collected by the dairies, after testing milk quality according to the standards.

Then, the raw materials have to be transformed into consumable products. In general, at the farm level, this is not possible in the most of farms. But in the integrated farms it is possible to process the raw materials. For instance, in a vinery, it is possible to transform grapes in must and wine, in a dairy farm it is possible to process milk in cheese, butter and ice-cream.

After these steps, the marketing and distribution of the products means to apply the shortest ways as the product to reach the consumers. Taking into account that the majority of the agricultural products are perishable, they have to arrive at the consumer in the shortest period of time. Direct deliveries are preferred, except some cases when the products are delivered to wholesalers and retailers. During the Covid-19 pandemic, direct deliveries of agricultural products to consumers have started to be successfully extended. In this way, the farmers could create a panel of consumers who prefer their products. Taking into account the climate change effects, the practice of monoculture and the intensive use of fertilizers and pesticides in agriculture is not suitable anymore because this affect biodiversity, soil health, intensify pollution and increase the risk in food systems. To develop a sustainable agriculture, it is needed to pass to crop diversification and to assure an efficient crop rotation [18]. In food industry, things look to be more complicated in accordance with HCCP and many processing standards.

For in dairy industry, the value chain involves: milk production in dairy farms, milk collection, reception of raw milk, analysis of milk quality, pasteurization process, regulation of fat content, processing in various dairy products (butter, sour cream, cheese, yoghourt, ice-cream etc), storage, distribution, retailing (supermarkets, restaurants, hotels and export) [11].

[13] developed a study case which showed how could be created value added in peas chain for sustaining production destined for export.

Leaving from these steps in value chain the main influence factors are policies, sustainability and standardization.

A comparison of the three levels of our analysis International, European and national (Romania) is presented in Table 6.

Table 6. Comparative analysis regarding value chain

Level	**Policy**	**Sustainability and environmental impact**	**Standards and certifications**
International	Efficient international trade, agriculture and innovation policies	Transportation of the goods	Adhering to international standards and certifications for agriculture
European	Alignment of all the members	Sustainable farming, Biodiversity protection	Adhering to European standards and certifications for agriculture
National (Romania)	Investment Policy, Export policy – both for agriculture	Sustainable practices	Adhering to European standards and certifications for agriculture

Source: Authors' own concept.

Challenges and opportunities in agricultural value chains

I. Economic challenges – are related to market fluctuations and price volatility, present significant economic challenges in agricultural value chains, impacting profitability and financial stability; Access to finance and credit that is the key to invest in agriculture; Trade barriers and tariffs that create increased transaction costs within agricultural value chains; Economic opportunities thorough diversification of products and markets.

II. Technological advancements

Adoption of precision agriculture - The adoption of precision agriculture technologies presents opportunities for increased efficiency and productivity in agricultural value chains, contributing to sustainable practices.

Innovations in agri-tech - Continuous innovations in agri-tech offer opportunities to enhance production, processing, and distribution capabilities within agricultural value chains, fostering competitiveness.

Challenges in technology adoption - Challenges in technology adoption, such as high initial costs and limited digital infrastructure, hinder the realization of technological opportunities within agricultural value chains.

Potential of blockchain and IoT -The potential of blockchain and IoT presents opportunities for improved traceability and transparency in agricultural value chains, addressing consumer demand for quality and sustainability.

III. Sustainability and Resilience – refers to environmental sustainability, resilience to climate change, social sustainability and circular economy.

IV. Policy and Regulatory Frameworks - Government support and subsidies; Compliance with food safety standards; Policy coherence and alignment; Trade agreements and geopolitical influences.

V. Supply chain management.

Figure 4 highlights the phases of the supply chain management.

Fig. 4. Supply chain management
Source: Authors' own concept.

Future trends in agricultural value chains

Integration of IoT and AI in agricultural processes

-*IoT and AI technologies* are being integrated into various agricultural processes to enable data-driven decision-making, optimizing resource utilization and increasing yields.

-*Utilizing big data for predictive analytics* - The use of big data allows for predictive analytics, helping farmers and agribusinesses to anticipate market trends, manage risks, and optimize supply chain logistics.

-*Blockchain for transparency and traceability* - Blockchain technology is increasingly used to create transparent and traceable supply chains, enhancing consumer trust and ensuring the authenticity of agricultural products.

-*Precision agriculture for enhanced efficiency* - Precision agriculture techniques, such as GPS-guided machinery and drone technology, are revolutionizing farming practices, leading to more efficient use of resources and reduced environmental impact.

-*Robotics and automation in farming* - The adoption of robotics and automation in farming operations is increasing, leading to improved efficiency, reduced labor costs, and enhanced productivity in agricultural value chains.

-*Biotechnology and genetic engineering* - Biotechnological advancements and genetic engineering are reshaping agricultural production, offering solutions for pest resistance, improved crop quality, and higher yields.

-*Vertical farming and urban agriculture* - Vertical farming and urban agriculture initiatives are gaining momentum, leveraging advanced technologies to produce food in urban environments, reducing transportation costs and environmental impact.

-*Remote sensing and satellite imagery* -The use of remote sensing and satellite imagery provides valuable insights for monitoring crop health, detecting pests, and optimizing resource allocation in agricultural value chains.

Blockchain Applications in Agricultural Value Chains

Traceability platforms: consumers can scan a QR code and see the journey of their food product. This increased transparency can build trust with consumers and potentially lead to higher demand for Romanian agricultural products.

-*Smart contracts*: automate payments and other processes based on predetermined conditions. This can eliminate unnecessary paperwork and administrative burdens for Romanian farmers, allowing them to focus on core agricultural activities.

-*Microfinance:* facilitate access to financing for smallholder farmers in Romania.

This can help them overcome the challenge of limited access to traditional financial institutions and empower them to invest in improvements for their farms

CONCLUSIONS

The aspects discussed in the scientific paper are the result of many studies from technical and economic point of view and reveals the problems and the advances in trade with raw materials and high- tech products.

Collaborations between different sectors, such as agriculture, technology, and finance, are driving innovation for sustainable solutions, addressing challenges related to food security and environmental sustainability.

Public-private partnerships are playing a key role in driving agricultural development, facilitating investments in infrastructure, research, and capacity building to enhance the efficiency of value chains.

Knowledge exchange and capacity building initiatives are fostering innovation and skill development within agricultural value chains, empowering stakeholders to adapt to evolving market trends and technological advancements.

Initiatives aimed at supporting smallholder farmers and rural communities are essential for fostering inclusive growth within agricultural value chains, promoting economic development and social well-being.

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FARM DEBT AND INVESTMENT. EMPIRICAL EVIDENCE FROM BULGARIAN AGRICULTURE

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Abstract

This article explores the relationship between farmers' investment activity and debt structure in order to bring out the factors mediating the outcome. Overleveraging is one of the most serious problems faced by the Bulgarian farmers due to the high levels of competition in the EU. This research is based on a stratified random sample of 5% (2,985 observations) on farms in the agricultural sector encompassing the sub-sectors crop production, livestock production and auxiliary activities, with a research horizon of five years. A fixed-effect panel threshold regression analysis is used. The obtained results show that where the debt level is high, this has a negative impact on the investment activity of the farms in the agriculture sector.

Key words: *investment, debt, panel threshold regression*

INTRODUCTION

One of the predominant theories regarding the choice of capital structure in terms of investment, was elaborated by [15]. It is called "The Pecking Order Theory". According to its authors, there is no optimal capital structure, but rather a hierarchical approach when considering different sources of financing. They support the thesis that, when financing an investment opportunity, firmsuse their internal sources of finance (e.g. free cash flow) in the first place, as they arecheaper in comparison with the external sources of finance. This is followed by debt and then equity financing.

The second commonly applied theory with regards to choosing a capital structure when it comes to investment decisions, is called the "Trade of Theory". In the trade-off capital structure theory, the firm owners and managers aim at an optimal debt ratio. This maximization is obtained by estimating and comparing the costs and benefits of debt [16]. The thesis here is that time-tested firms often get a loan on more favourable terms in comparison with the newer ones. On the one hand, the longer a firm has been operating on the market, the lower the cost of its debt would be. On the other hand, firms which entering a given market, are seen as riskier and are treated more unfavorably when trying to access financing.

Both theories have undergone a number of empirical tests, mainly in the industry, and less often in the agricultural sector.

For instance, [17] analyzed the determinants of capital structure in the agriculture, forestry, and fishing industry in Central and Eastern Europe. The authors explore these three sectors based on data referring to the period from 2009 to 2016. Their research sample encompasses agricultural enterprises which have been continuously operating for at least two years and covering the period from 1997 to 2006.

In their regression analysis, the dependent variables cash flow, investment, short-term and long-term debt, are simultaneously and endogenously determined by each other for each particular time period. As it might be expected, delayed cash receipts *from receivables and the lower profitability,* are important signals for the creditors when evaluating the credit worthiness of farms. Their research confirms the pecking order theory mentioned above [17].

In a very recent study conducted in 2021, a group of authors use a research sample from agrarian farms in Poland referring to the period from 2009 to 2018. Their main objective is to test the two theories mentioned above. Their results show that the farms with a higher profit rate are also less indebted. Therefore, their profitability reduces the need of external financing in accordance with "The Pecking Order Theory". Also, the increase in investment sends a positive signal to the creditors, which is an indication for a future cash flow [4].

Each farm faces a large number of risks during its existence. As early as in the 80s of the last century, [7] introduced two types of risks associated with the agrarian farm. They called the first type business risk and related it to the risk inherent to the farm, notwithstanding its means of financing. They called the second type financial risk, which they define as the constant variability in the net cash flows, resulting from the financial obligations in connection with the long-term debt financing. To the financial risk, they also add the probability of the farm's bankruptcy.

In 2020, [13] summarized the risk types in the agrarian enterprises analyzed over the years by their predecessors. They systematized them in 5 groups in total: production risks associated with the unpredictable natural processes, i.e. animal husbandry but also those related to weather and climate. Market risks to a large extent focus on uncertainty and price fluctuation in terms of the enterprise's own production but also in terms of the needed raw materials, cost dynamics and market access. Institutional risks are associated with changes in thenational policy and the agricultural legislation. Personal risks are associated with problems with human health or personal relationships. The financial risks which are also the subject of our researchstudy refer to the means of financing, the uncertainty faced by the farm with regards to the cash flows and its financial obligations related to the loans it might be using.

[2] used balanced panel data from a sample of 3,650 French farms referring to the period from 1989 to 1993. The variables for each farm are investments, capital and the new (long-term) loans. Their results show that the investment

behavior of the farms with high levels of indebtedness differs significantly from the bahaviour of the farmswhich are financially independent [2].

A group of authors, based on a survey on the agricultural enterprises in Poland and Slovakia referring to the period from 2017 to 2020, with the purpose of conducting a comparative analysis of the determinants impacting the financial results, obtain the following results: the return on assets in the agricultural sector is a statistically dependent variable, however in the different countries it is affected by different factors. There were a little different results in different countries: in Poland, return on assets and equity, and leverage have the strongest impact on the financial performance of agricultural enterprises. In Slovakia, return on assets and return on equity, debt-to-equity ratio and return on sales have the strongest effect. In Ukraine, return on assets and leverage, as well as the debt-to-equity ratio, have the greatest effect [14].

Other authors support the statement that the farm's capital investment is seen in a particular period of time in the farm's profit variation. Further, they use lagged variables of profitability in order to determine the impact of the capital cost on it [11].

According to a recent research study financed by the European Commission, the objectives of the investment loans vary significantly from country to country. On average for the EU, 63% of the loans provided to enterprises in the agricultural sector are for investment in new plant, machinery and equipment. This is followed by investment in working capital (41%) and land (15%). For Bulgaria, but also for Estonia, the Czech Republic, the Netherlands and Slovakia, investment in land is the main focus for more than 25% of the farms (European Investment Bank, 2019) [6].

In one particular research study on Bulgaria and the agricultural enterprises referring to the period from 2007 to 2020, Kirechev (2021) draws the following conclusions: Observed in an increase in the long-term loans as a result of the increase in investment. They remain a main factor in financing investment, including investment in the purchase of land [12].

On the basis of a survey on 1546 Hungarian farms referring to the period from 2001 to

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2005 and related to investment decision-making, [1] concluded that cash flows are statistically significant and positively correlated with the investment which farms make. They also find out that farms with small loans and which use mostly leased land, have limited liquidity.

MATERIALS AND METHODS

Data and Variables Measurements

The data referring to this survey are based on a stratified random sample of 5% of the farms in the agriculturalsector encompassing the subsectors crop production, livestock production and auxiliary activities (code 01 according to classification of economic activities 2008) for the period from 2017 to 2021. The choice of this sample type is determined by the possibility for increasing the statistical efficiency and the need for adequacy in analyzing the sub-setsindividually. In the survey, the original data set encompasses 2985 observations, which after a procedure of refining and creation of a balanced panel dataset, the observations arefinally reduced to 2,540, or 635 groups of farms for the 5-year survey period. Among the farms surveyed, 78.74% are focused on crop production, 15.35% on livestock production and 5.91% are mixed farms. From all the observations made, the representatives of the micro and small business are predominant, which might suggest a small economic size of the surveyed group. Sharp changes in the relative shares of the farms operating in the sector for the different time periods are not observed, which to a certain extent indicates preservation of the structure in terms of the sectoral performance at national level.

Variables

Our research interest is focused on the variables – net investment and leverage so that as to bring out the relationship between investment activity and farm indebtedness. The dependent variable is defined as annual growth in total fixed assets.

The economic profitability indicator is used to bring out the farm's ability effectively to transform its assets into profit. The net sales growth is a factor, which we assume is positively correlated with the investment activity in the model and outlining the possibilities for growth. For the liquidity indicator, we use the current one. Lenders tend to rely in a higher degree on debt repayment capacity and solvency than on the borrower's profitability and financial efficiency [6]. In order to analyze the effect of indebtedness on the farmers' investment activity, three different estimates of the threshold regressor are included in the sample data (Table 1). This necessity is suggestedby the agricultural farms debt structure and in order to highlight the business risk but also the financial risk. The key to the long-term financial viability of the agricultural farm is investing wisely in production assets.

As main tools for financial risk management are included: financial reserves, savings, credit lines and the financial structure of the agricultural enterprise.

Our hypothesis is that per one unit of decreased debt level, the farms with long-term loans will increase their net investment more than the farms without a bank loan.

Table 1. Description of the study variables

Variables	Formula
Dependent variable	
NI	$(NTGA_t - NTGA_{t-1})/NTGA_{t-1}$
Thresholds	
TDA	Total debt/Total assets
LTDTA	Long term debt/Total assets
STDTA	Short term debt/Total assets
Explanatory variables	
ROA	Net profit/Total assets
SG	$(Sales_t - Sales_{t-1}/Sales_{t-1})$
CL	Current assets/Current liabilities
T	Fixed assets/Total assets
Firm size	LN(TA)
Age	LN(Age)

Source: Author`s calculations.

We should not miss the fact that a large part of the farms in the study are micro and small farms, where access to credit, its security and the lack of qualified staff for elaboration of the business plan constitute high barriers to the implementation of long-term financing. The above-listed factors however are not the subject of this study.

To identify non-linearities in the relationship between debt and investment in real assets, the panel threshold regression model Hansen [9], [10] is used.

This model allows the endogenous identification of threshold levels which divide the study sample into twosampling types for which the linear ratio between the dependent variable and one or more variables of interest are expected to differ. Further, the procedure tests for significance the identified thresholds, relying on confidence intervals obtained by appropriately designed likelihood ratio tests [10].

The model shows that the dependence of the β value on the threshold value is not of primary asymptotic significance, so that the interpretation of β can proceed since γ is a set value. In particular, we are estimating the following threshold model for different subsets of data, referring to the Hansen's model [9], [11] and following the methodology suggested by [8].

Threshold model for different subsets of data:

$$\boldsymbol{I_{it}} = \boldsymbol{\beta_1 D_{it-1} I(D_{it-1} \leq \gamma)} + \boldsymbol{\beta_2 D_{it-1} I(D_{it-1}} > \gamma) + \phi \boldsymbol{Z_{it-1}} + \boldsymbol{\delta_1 I(D_{it-1} \leq \gamma) + \varepsilon_{it}} \quad (1)$$

where:

$\boldsymbol{I_{it}}$ – annual change in the net investment in tangible fixed assets;

$\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ - regression coefficients representing the effect of the leverage on the investment in tangible fixed assets;

$\boldsymbol{Z_{it}}$ –vector-predictor, including the lagged values of the studied variables;

$\boldsymbol{\delta_1}$ – specific intercept mode;

$\boldsymbol{\varepsilon_{it}}$ – statistical error.

It is assumed that the errors $\boldsymbol{\varepsilon_{it}}$ are independent and identically distributed in order to avoid problems with endogeneity.

The leverage measure used is:

$\mathbf{D_{it}}$ it denotes the indicator variable for which the sampling type separation threshold γ is calculated;

$\boldsymbol{I}$ **(●)** Included binary indicator function for whether a particular observation has a debt-to-asset ratio above or below the forecast threshold for a particular year.

Lagged values are used for all indicator variables except for the threshold parameter.

The objective here is to reflect and evaluate the current state but also the impact of the given factors from previous periods onto the resulting value. Hence, the explanatory variables in the model are lagged, and the lag length is 1 year.

After the threshold estimation, determined are the confidence intervals in order to measure thestatistical significance of the obtained value and to test the null hypothesis [18]. It should be considered that the likelihood ratio (LR) tests the null hypothesis where the threshold values are the same ($\gamma = \gamma_0$), while the F statistics also tests the null hypothesis,however with equal values of the regression coefficients (*β1 = β2*).

RESULTS AND DISCUSSIONS

The descriptive statistics of the variables in the present study (Table 2) shows a high volatility of the return on assets, net investment and current liquidity, due to the estimated high levels of the standard deviation.

The average farm in our sample has a debt-to-total assets ratio of 44%, which is an indication that less than half of the total assets are financed by debt. The economic profitability is 9.7% with a significant dispersion of the values.

The average net investment is negative with a high degree of the standard deviation and a high degree of dispersion. The independent variables for size, age and tangibility show a stable result, due to the lower levels of the standard deviation from mean.

It should be taken in consideration that in the asset structure there is almost a parity between the tangible fixed assets (T) and the inventories, receivables, cash and other liquid assets. The observed companies had a liquid business or 18.96 higher current assets to finance obligations in comparison with the value of their current liabilities during the period studied.

The average age of the farms in the sector is 19 years, the youngest being at the age of 11 years, and those with the longest existence -

32 years. In general, observed is heterogeneity in the variables of interest.

Table 2. Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Median	Max.
NI	13.20	108.35	-100	-0.95	2,700
ROA	.097	.15	-.57	0.05	3.24
TDA	.444	.58	.00	0.31	7
T	.48	.24	0	0.506	1
SG	.10	1.12	-1	0	37
CL	18.96	97.11	0	3.24	4,282
AGE	20.51	5.58	11	19	32
TA(log)	7.07	1.51	.69	7.13	12.16

Source: Author`s calculations.

Table 3. Matrix of Correlations

Var.	NI	ROA	T	SG	CL	AGE	TA
NI	1.00						
ROA	0.05	1.00					
T	0.04	-0.16	1.00				
SG	0.06	0.09	-0.00	1.00			
CL	-0.02	0.01	-0.07	-0.01	1.00		
AGE	-0.03	0.06	-0.01	-0.01	0.04	1.00	
TA	-0.03	-0.07	0.25	-0.01	0.05	0.09	1.00

Source: Author`s calculations.

The correlation matrix (Table 3) proves that there is no significant correlation between the studied variables.

Evaluation of the model is contained in Stata 15.1. The parameters, estimates, and statistics are presented in Table 4 and Table 5. The F statistics referring to the overall significance of the parameters is high enough as to reject the hypothesis that the parameters do not explain the changes in the dependent variable NI. The empirical results from the baseline regression presented in Table 4 are proven to be stable.

The estimated debt threshold is 42% at a confidence interval of 95% [0.387, 0.427]. The leverage variable coefficient is significant and negative which suggests the negative impact of the debt level onto the farm investment above the threshold value ($\beta 2$). It should be considered that 40% (1,016 farms) of the observations have debt levels which exceed the threshold value.

The results from the baseline regression confirm previous empirical studies where firm's size and return on assets are positively correlated with investment activity.

Table 4. Baseline Results – Panel Threshold Regression

γ		***Threshold estimate 0.423***
95% confidence interval *p* *R²* *Corr. (u_i, xb)*		*[0.387, 0.427]* *0.2600* *0.0010* *-0.8393*
Threshold		
β1 (low debt)	*9.463****	*(0.003)*
β2 (hight debt)	*-25.602***	*(0.050)*
Estimated coefficients		p-value
ROA	*30.650 **	*(0.050)*
T	*-379.41 ****	*(0.000)*
SG	*-2.343*	*(0.256)*
CL	*-0.005*	*(0.850)*
AGE	*-2.367*	*(0.206)*
TA(log)	*55.800 ****	*(0.000)*
Rho *Sector FE* *Year FE*	*0.548*	
Observations	*2,540*	
No. of firms (group)	*635*	

Source: Author`s calculations.

Note: All independent variables are lagged by one period;***Significant at the 0.01 level, respectively; **Significant at the 0.05 level, respectively; *Significant at the 0.10 level, respectively.

In contrast, the leverage ratio is never positive for the unprofitable farms.

Therefore, even if debt is below the leverage threshold, the investment activity decreases whenever the farm becomes unprofitable.

These results suggest that high profitability in combination with a low debt most probably is an incentive for investment in the sector. This is also confirmed by a study authored by [3].

Another significant statistical result is the fixed tangible assets use intensity, which is negatively correlated to investment. In order to bring out the short-term but also the long-term indebtedness in the sector, we use the STDTA and LTDTA indicators as threshold values. The results from the threshold regression with STDTA, are presented in Table 5, and the results obtained from the threshold regression with LTDTA, are statistically insignificant.

Table 5. Results – Panel Threshold Regression with STDTA

γ		***Threshold estimate 0.621***
95% confidence interval *p* *R²* *Corr. (u_i, xb)*		*[0.504, 0.631]* *0.2500* *0.0020* *-0.8969*
Threshold		
β1 (low debt)	*45.06**	*(0.100)*
β2 (hight debt)	*-59.615***	*(0.022)*
Estimated coefficients		p-value
ROA	*45.391 **	*(0.088)*
T	*-417.95 ****	*(0.000)*
SG	*-3.600*	*(0.279)*
CL	*-0.007*	*(0.714)*
AGE	*-4.052*	*(0.059)*
TA(log)	*71.751 ****	*(0.000)*
Rho *Sector FE* *Year FE*	*0.689*	
Observations	*1,156*	
No of firms (group)	*289*	

Source: Author`s calculations

Note: All independent variables are lagged by one period;***Significant at the 0.01 level, respectively; **Significant at the 0.05 level, respectively; *Significant at the 0.10 level, respectively.

The results from the sample show that the short-term debt is about twice as big as the long-term one, meaning that either the short-term debt was more accessible and/or firms had an increased need to finance large deficits in their working capital and therefore resorted to borrowing a short-term debt. It is encouraging that only 6% (53 farms) of our observations maintain levels above the short-term indebtedness threshold.

CONCLUSIONS

This article applies one of the methods for estimation of the investment activity in relation to farms' indebtedness threshold levels. Using a fixed effect panel threshold regression, the study finds out that the correlation between investment and debt is non-linear.

The estimates made suggest that when the debt is exceeding the determined threshold, this decreases the investment activity. We identify a debt-to-asset ratio threshold of 42 percent. For the farms with debt levels below the threshold, the relationship between debt and investment is strong and depends on a number of in-house characteristics.

These results suggest that the high profitability in combination with a low debt, is most probably an incentive for investment in the sector. A weaker relationship is observed when the debt/investment ratio exceeds the threshold, and hence, categorical statements or assumptions are avoided in the present study.

The findings from this study show that the indicators return on assets and farm size are positively correlated with investment, while the fixed tangible assets use intensity is negatively correlated with them. The short-term debt is approximately twice as high as thelong-term one, meaning that either the short-term debt was more accessible and/or firms had an increased need to finance large deficits of their working capital and hence resorted to borrowing a short-term debt.

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PRODUCTION AND PRODUCTIVITY ELEMENTS IN FIELD PEAS IN RELATION TO MINERAL FERTILIZATION

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Abstract

Legumes represent crops with multiple values at the farm level, from an economic and ecological point of view. The study evaluated the variation of biological yield, grain production and some productivity elements in field peas. The research took place in ARDS Lovrin, Romania. The experiment was organized under the conditions of a cambic chernoziom type soil, in a non-irrigated system. The 'Boxer' pea cultivar was cultivated. Fertilization was done with phosphorus, applied in autumn, in five concentrations (0, 40, 80, 120 and 160 kg ha^{-1} a.s.; a.s. – active substance). On each phosphorus level, nitrogen was applied in spring in five doses (0, 25, 50, 75 and 100 kg ha^{-1} a.s.). The combination of the two fertilizers resulted in 25 experimental variants, in four repetitions. Biological yield recorded values BY=0.800 – 1.640±0.046 kg m^{-2}. Pea grains production recorded values PgP=0.091 – 0.604±0.031 kg m^{-2}. Pea stalks varied between PS=0.584 – 1.026±0.026 kg m^{-2}. Secondary pea production varied between PsP=0.659 – 1.127±0.027 kg m^{-2}. Correlation of variable intensity was recorded between determined parameters. Based on PCA, PC1 explained 72.664% of variance, and PC2 explained 27.217% of variance.

Key words: *biological production, field peas, grain production, mineral fertilizers, multivalent crop*

INTRODUCTION

Leguminous crops are highly important for the production of vegetable proteins, intended for human consumption, fodder and industrialization [21, 28, 29, 35].
Along with the protein production they provide, legumes are also very important from an ecological perspective for agricultural ecosystems, in accordance with the concept of sustainability [7, 9, 30].
Some studies have associated leguminous crops with sustainable development, with sustainability, with the principles of the circular economy, respectively with circular agriculture [18, 24, 25].
The authors of this study, communicated in a previous study, the concept of "ESE triangle", (Economy - Society - Environment), as a pillar of the circular economy [15], and within this concept, legumes occupy important role in the agricultural ecosystems.
Legumes have an important role in the structure of crops and in crop rotation, with ecosystem benefits for the soil, but also economic benefits through nitrogen fixation, the positive influence on the regime of some nutrients and the reduction of doses of nitrogen fertilizers for successive crops [4, 10, 37].
Legumes are very good precursor plants for cereal crops, especially for wheat [5, 20, 36].
The complex approach to leguminous crops, including field peas, highlights the potential of these crops, in terms of grain production, nitrogen fixation in the soil, beneficial ecosystem influence over time [3, 26, 30].
The one-sided approach, only through the lens of grain production, makes the profitability to be only partially surprised, and some studies communicated that the efficiency of leguminous crops was much increased with a complex, economic and ecological approach [2].
The presence of legumes in mid- and long-term crop rotation is important, to ensure the sustainable use of agricultural land, with the support of soil fertility [1, 16].
Although they fix nitrogen during the vegetation period, leguminous crops respond

to fertilization and technological practices, depending on soil conditions and vegetation factors [6, 8, 12, 13, 17]. Within leguminous crops, peas have high importance [22, 34].

The present study evaluated the influence of mineral fertilization with nitrogen and phosphorus on some elements of productivity, biological yield in the field pea crop, and to formulate crop response models in relation to the doses of fertilizers.

MATERIALS AND METHODS

The study took place in the specific conditions of the Western Plain of Romania, within the ARDS Lovrin. The pea crop, the 'Boxer' cultivar, was placed under the conditions of a chernozem type soil. The crop was established in the spring of 2023, in a non-irrigated system.

Adequate vegetation conditions were ensured through the crop technology. In relation to the objectives of the study, fertilization was the factor that generated the response variation of the pea crop to the experimental variants.

In the autumn of 2022, phosphorus fertilizers were applied, in five doses: 0, 40, 80, 120 and 160 kg ha^{-1} active substance (a.s.). On each level of phosphorus fertilization, nitrogen fertilizers were applied in the spring of 2023, in doses: 0, 25, 50, 75 and 100 kg ha^{-1} a.s. From the combination of the two fertilizers, 25 experimental variants resulted, placed in four repetitions.

In relation to the specifics of the pea crop, and the purpose of the study, a series of parameters were analyzed to quantify the way in which the field pea crop capitalized on the applied fertilization.

At the stage of physiological maturity (BBCH 99) [19] the pea crop was harvested and plant samples were taken from the experimental variants. The following were determined: Biological yield (BY, kg m^{-2}); Peas pod number (PpN); Pea pod weight (PpW); Pea pod shells (PpS); Pea stalks (PS); Pea grains production (PgP); Peas secondary production (PsP).

The experimental data were analyzed under the aspect of statistical certainty, the level of correlations between determined parameters. Multivariate analysis (PCA, CA) was used to evaluate the distribution of variants and their association mode, in relation to determined parameters.

The regression analysis was used to evaluate the variation of the main productivity parameters (BY, PgP, PsP) in relation to the applied fertilizers. Appropriate statistical parameters were used to confirm the reliability of the statistical analyzes and the results obtained (e.g. p, R^2, RMSE). Dedicated applications were used for the analysis of the experimental data and the generation of graphic representations [11, 14, 33].

RESULTS AND DISCUSSIONS

At the moment of physiological maturity (BBCH 99), samples were taken from the pea crop, on the experimental variants (25 variants in four repetitions).

Biological production (BY) varied between BY = 0.800 – 1.640±0.046 kg m^{-2}. Peas pod number (PpN) varied between PpN = 316.00 – 860.00±25.550 m^{-2}. Peas pod weight (PpW) varied between 0.130 – 0.778±0.036 kg m^{-2}. Pea pod shells (PpS) varied between 0.052 – 0.174±0.005 kg m^{-2}. Peas stalks (PS) varied between PS = 0.584 – 1.026±0.026 kg m^{-2}. Pea grains production (PgP) varied between 0.091 – 0.604±0.031 kg m^{-2}. Peas secondary production (PsP) varied between PsP = 0.659 – 1.127±0.027 kg m^{-2}. The resulting values based on the descriptive statistical analysis are presented in Table 1.

The correlation analysis led to the values presented in Table 2. Correlations were recorded in conditions of statistical certainty, but also correlations without statistical assurance.

Pea grain production (PgP) showed a very strong correlation with PpW (r=0.997***) and a strong correlation with the other analyzed parameters (BY, PpN, PpS), in conditions of statistical safety at the p<0.001 level. This shows the very high importance in the formation and normal development of pods.

Table 1. Descriptive statistics in the description of field pea parameters, the 'Boxer' cultivar

Statistical Parameters	BY	PpN	PpW	PpS	PS	PgP	PsP
Valid	25	25	25	25	25	25	25
Missing	0	0	0	0	0	0	0
Median	1.200	480.000	0.393	0.090	0.838	0.286	0.909
Mean	1.208	494.360	0.386	0.091	0.827	0.296	0.916
Std. Error of Mean	0.046	25.550	0.036	0.005	0.026	0.031	0.027
Std. Deviation	0.228	127.751	0.178	0.026	0.129	0.154	0.136
Minimum	0.800	316.000	0.130	0.052	0.584	0.091	0.659
Maximum	1.640	860.000	0.778	0.174	1.026	0.604	1.127
25th percentile	1.080	420.000	0.227	0.070	0.758	0.157	0.837
50th percentile	1.200	480.000	0.393	0.090	0.838	0.286	0.909
75th percentile	1.320	556.000	0.476	0.105	0.927	0.371	1.018

Source: Original data.

Table 2. Pearson’s Correlation

Variable		BY	PpN	PpW	PpS	PS	PgP	PsP
BY	Pearson's r	—						
	p-value	—						
PpN	Pearson's r	0.852***	—					
	p-value	< .001	—					
PpW	Pearson's r	0.821***	0.900***	—				
	p-value	< .001	< .001	—				
PpS	Pearson's r	0.818***	0.930***	0.910***	—			
	p-value	< .001	< .001	< .001	—			
PS	Pearson's r	0.577**	0.217	0.021	0.133	—		
	p-value	0.003	0.297	0.920	0.526	—		
PgP	Pearson's r	0.805***	0.878***	0.997***	0.878***	-0.002	—	
	p-value	< .001	< .001	< .001	< .001	0.991	—	
PsP	Pearson's r	0.726***	0.403*	0.214	0.339	0.976***	0.184	—
	p-value	< .001	0.046	0.305	0.097	< .001	0.377	—
* p < .05, ** p < .01, *** p < .001								

Source: Original data.

The multiparameter analysis (PCA) evaluated the way in which the experimental variants are associated with the main productivity elements, respectively with biological production (BY), pea production (PgP) and respectively secondary production (PsP). The result was the PCA diagram, represented in Figure 1. PC1 explained 72.664% of variance, and PC2 explained 27.217% of variance. The experimental variants were distributed within the diagram associated with the component for which they presented high values.

Cluster analysis, based on PgP data (the important parameter of crop productivity analysis) facilitated the grouping of variants, according to the dendrogram in Figure 2 (Coph. corr. = 0.769). Two distinct clusters resulted, with several sub-clusters.

The V18 variant had the highest level of the PgP parameter, and the V10, V11 and V25 variants were also associated in the respective sub-cluster based on similarity (marked in red).

The other variants in cluster 1 (left side of the dendrogram) generated values of the PgP parameter in the same major framing group. On the right side of the dendrogram, the variants with values of the PgP parameter below the average were grouped, also based on similarity.

The regression analysis was used to evaluate the variation of some parameters in relation to the doses of fertilizers (N, P) applied.

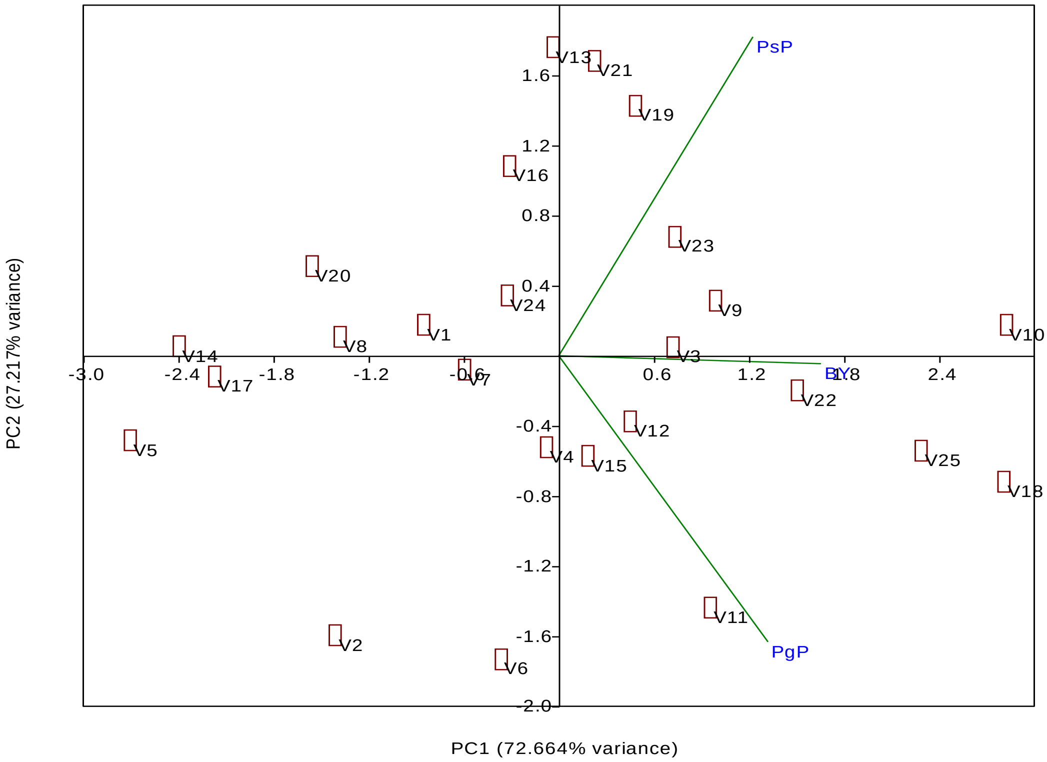

Fig. 1. PCA diagram, with the variants distribution in relation to parameters BY, Pg Psi PsP, 'Boxer' cultivar
Source: Original figure.

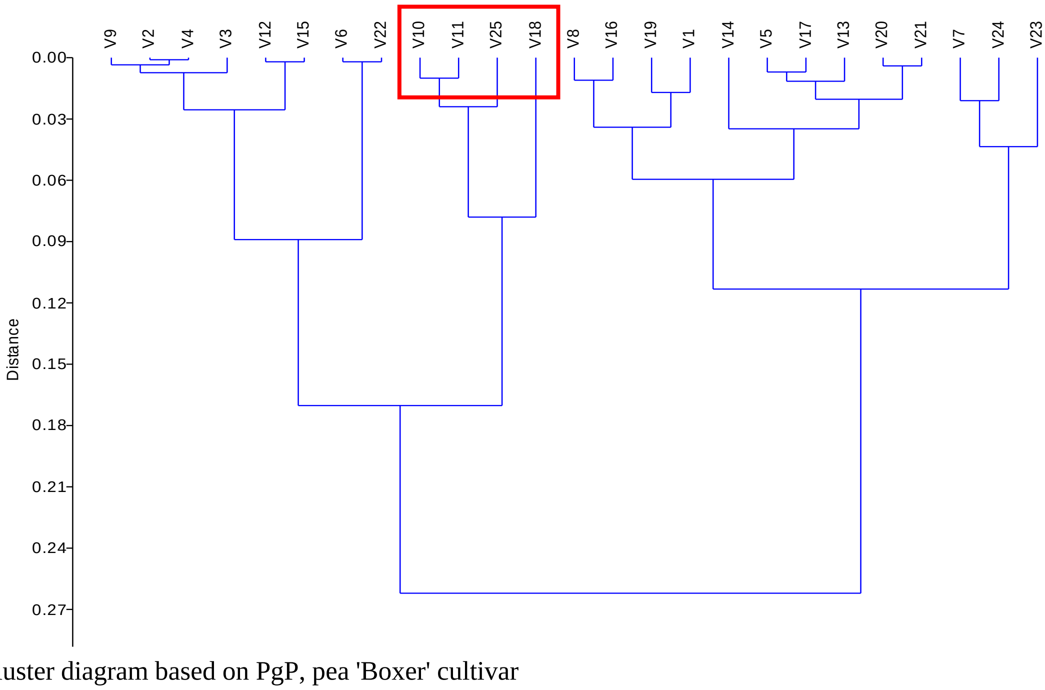

Fig. 2. Cluster diagram based on PgP, pea 'Boxer' cultivar
Source: Original figure.

Biological production (BY, t ha^{-1}) varied in relation to nitrogen and phosphorus doses, according to equation (1), under conditions of R^2 = 0.901, F = 36.4683, p<0.001. The graphic representation of the BY variation in relation to N and P is presented in Figures 3 and 4.

$$BY = ax^2 + by^2 + cx + dy + exy + f \quad (1)$$

where: BY – biological yield (t ha^{-1}); x – nitrogen doses (kg ha^{-1}); y – phosphorus doses (kg ha^{-1});
a, b, c, d, e, f – coefficients of the equation (1); a= -0.00111399; b= -0.00039586; c= 0.22580929; d= 0.14384509; e= -0.00091874; f= 0.

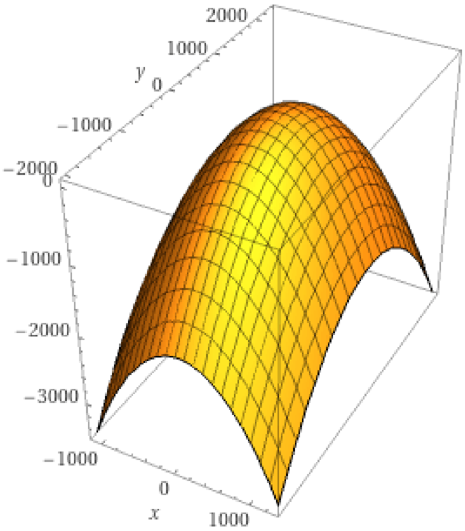

Fig. 3. 3D representation regarding the BY variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

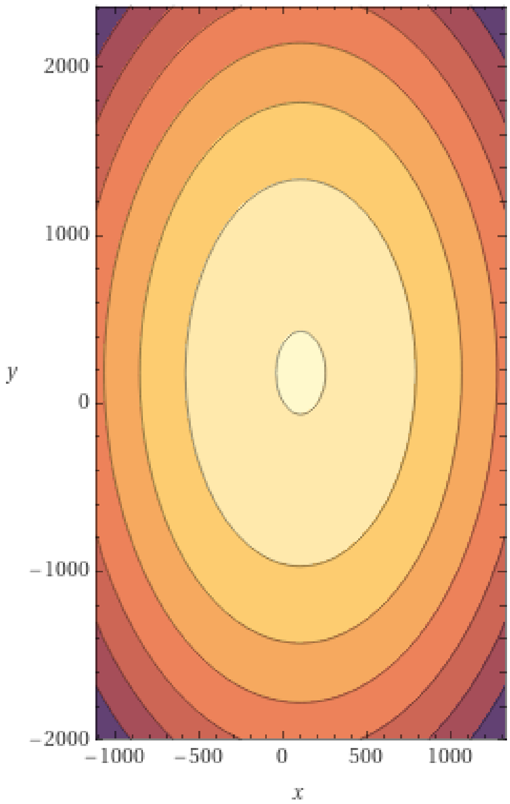

Fig. 4. Representation in isoquant format regarding the BY variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

The variation of peas grain production (PgP) in relation to N and P was described by equation (2) under conditions of $R^2 = 0.702$, $F = 9.4231$, $p = 0.00012$. The graphic distribution of PgP in relation to N and P is presented in Figure 5 and Figure 6.

$$PgP = ax^2 + by^2 + cx + dy + exy + f \qquad (2)$$

where: PgP – Peas grains production (t ha^{-1}); x – nitrogen doses (kg ha^{-1}); y – phosphorus doses (kg ha^{-1}); a, b, c, d, e, f – coefficients of the equation (2);
a= -0.00022827; b= -0.00012425; c= 0.04953960; d= 0.03643154; e= -0.00017263; f= 0.

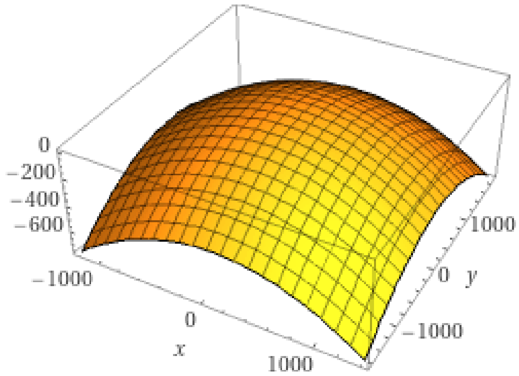

Fig. 5. 3D representation regarding the PgP variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

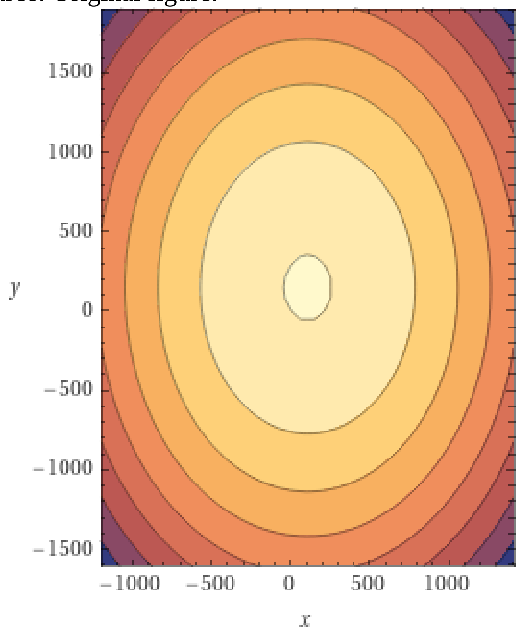

Fig. 6. Representation in isoquant format regarding the PgP variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

The variation of peas secondary production (PsP) in relation to N and P was described by equation (3) under conditions of $R^2 = 0.930$, $F = 53.2414$, $p<0.001$. The graphic distribution of the PsP distribution in relation to N and P is presented in Figure 7 and Figure 8.

$$PsP = ax^2 + by^2 + cx + dy + exy + f \qquad (3)$$

where: PsP – peas secondary production (t ha^{-1}); x – nitrogen doses (kg ha^{-1}); y – phosphorus doses (kg ha^{-1}); a, b, c, d, e, f – coefficients of the equation (3);
a= -0.00084637; b= -0.00028257; c= 0.17260235; d= 0.10881075; e= -0.00072867; f= 0.

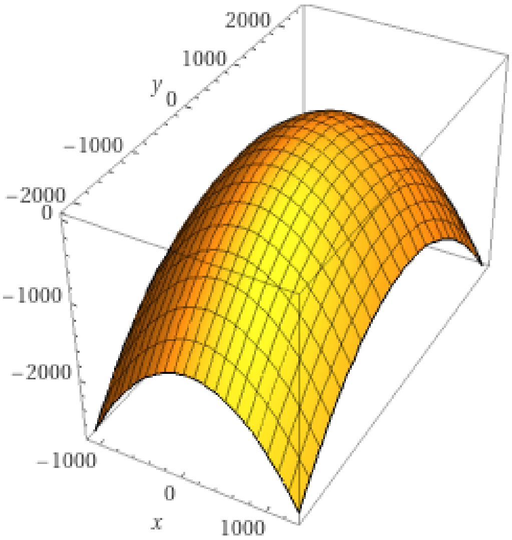

Fig. 7. 3D representation regarding the PsP variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

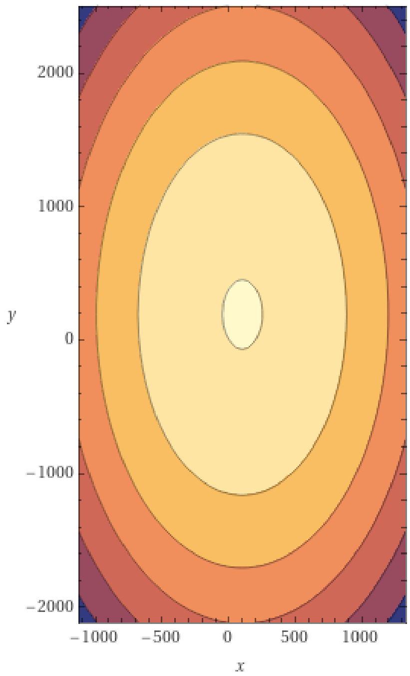

Fig. 8. Representation in isoquant format regarding the PsP variation in relation to N (x-axis) and P (y-axis)
Source: Original figure.

Within leguminous plants, field pea is a crop with multiple values. In addition to grain production, secondary production is of interest as organic matter that decomposes in the soil and contributes to balancing the balance of nutrients in the soil for the crop that follows in the agricultural rotation. Also, the nitrogen fixed during the vegetation makes the field pea crop of high interest in the total nitrogen balance.

The estimation of the production is of interest for organizing the harvesting process, for transport and storage, and of course for the capitalization of grain production on the market. In the conditions of the present study, the regression analysis facilitated the estimation of the parameters considered representative for the rape crop.

The biological yield (BY) was estimated by regression analysis, in relation to the applied fertilization, under conditions of R^2=0.901, p<0.001, and the calculated RMSE parameter presented the RMSE value = 3.8621. In the case of pea grain production (PgP), the regression analysis led to an estimate in relation to the N and P fertilizers applied, under conditions of R^2 = 0.702, p = 0.00012. The value of the RMSE parameter was RMSE = 1.8113. Grain production represents the marketable product, and respectively the element with the most important economic aspect [6, 23, 31].

In the case of the secondary production of peas (PsP), the regression analysis led to an estimate based on the doses of N and P applied, under conditions of R^2 = 0.930, p<0.001. The statistical parameter RMSE showed the value RMSE = 2.4479. The secondary production, represented by the vegetable remains left after harvesting, has medium and long-term interest in restoring soil fertility. By incorporating it into the soil, plant residues are decomposed by microorganisms and contribute to the restoration of soil fertility [27, 32].

Leguminous crops have always shown interest both for the main production (grain production - protein production), but also for the ecological benefits they bring to agricultural ecosystems [3, 30]. All the more now, leguminous crops are appreciated for their positive contribution to the sustainability of ecosystems and agricultural technologies. Associated with the costs of agricultural inputs, leguminous crops can contribute in a considerable proportion to balancing the nitrogen balance in the soil [10, 37].

The field pea crop also presents interest and advantages, associated with the climatic conditions and the threat of aridization by the fact that it is established in early spring, utilizes the soil moisture accumulated during autumn and winter, and reaches physiological maturity, and harvest, before by the dry periods from July to August.

According to the results of this study, the fertilization variants that ensured high productivity levels were differentiated based on the PgP values, and the regression analysis facilitated the estimation of the three important parameters in terms of statistical safety. The communicated results are important for agricultural practice, as well as for research, in order to optimize culture technologies for field peas.

CONCLUSIONS

The field pea crop, the 'Boxer' cultivar, responded differently to the mineral fertilization with nitrogen and phosphorus applied, in relation to the doses, the combinations of fertilizing elements, and the analyzed productivity parameters. The V18 variant generated the highest level of grain production (PgP) under studio conditions, and in the same sub-cluster, on the basis of similarity, the V10, V11 and V25 variants were associated, which have close production values of grains. The cluster analysis facilitated this classification, useful for choosing variants, depending on the results.

According to PCA, the distribution diagram of the variants also makes a selection of them, by associating them with the three important parameters considered, respectively BY, PgP and PsP.

The correlation analysis highlighted different levels of correlation, and of statistical certainty, in the set of parameters analyzed for the field pea crop. Information can be extracted regarding the parameters with which grain production (PgP) is correlated as the main element in crop profitability. There is also information regarding the correlation of secondary production with the pea crop (PsP), which will contribute to the restoration of soil fertility. Biological production (BY) is at levels of strong correlation with PgP ($r = 0.805^{***}$), and moderate correlation with secondary production ($r = 0.726^{***}$). These data confirm the importance of a successful culture, with a high biological production, and the elements of agricultural technology require adequate management, in order to ensure these objectives.

Last but not least, the regression analysis described the variation of the main productivity parameters (BY, PgP, PsP) in relation to the applied fertilization, under statistical safety conditions.

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ANALYSIS AND ASSESSMENT OF THE USE OF PESTICIDES AND FERTILIZERS IN THE RURAL TERRITORIES OF REPUBLIC OF BULGARIA

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Abstract

Modern agriculture poses new challenges related to the increase of the need of sustainable development of the agrarian sector, and rural territories, respectively. The use of large amounts of chemical preparations in agriculture inevitably hides a number of possibilities for dangers, both for all mankind and for the natural environment. The main goal of this article is to analyze and evaluate the current state of use of pesticides and fertilizers in Bulgaria, as part of the agro-ecological indicators affecting the climate and natural ecosystems.Asa result from the research carried out we found that the levels of pesticide use in Bulgaria are below the average, but the last years are marked by a tendency for gradual increase of the areas of the used quantities of nitrogen fertilizers, manure and organic fertilizer, and a deficit in the Phosphorous balance in soil was noted. We need lowering of the degree of ecological risks related to use of pesticides and fertilizers in Bulgaria. This way the results will be multiplied for achieving higher level of economic, social and ecological sustainability in the development of individual rural territories.

Key words: *pesticides, fertilizers, sustainable agricultural practices, indicators, rural regions*

INTRODUCTION

The modern agriculture poses new challenges related to increasing the need of sustainable development of the agrarian sector. The objective of the Farm to Fork Strategy is to change the present food supply system of the European Union, and turn it into a sustainable model of agriculture. Farmers look for and implement innovative agricultural practices, which will contribute not only for protection and preservation of the environment, but to render positive effect upon the climate and biological diversity, as well. Nevertheless, the improper use of excessive quantities pesticides and fertilizers in agriculture can lead to numerous dangers and a series of risks for human health, the environment and losses in preservation of the soil biodiversity. Reducing pesticide use by 50% and fertilizer use by at least 20% are the specific goals outlined in the Farm to Fork Strategy [13].

The priority of the Green Deal is the Farm to Fork Strategy, and its main goal is to introduce and move to a new model for improving environmentally friendly practices related to climate change, preserving the environment and restoring biological diversity [14].

One of the most important resources of Bulgaria are the soil ecosystems, which contribute to providing a large amount of the food products consumed by all of humanity. Regardless of the rich specific characteristics that soils possess, their quality characteristics are increasingly deteriorating due to a number of ecological processes. This damage is the result of unsustainable agricultural practices, applying unreasonable rates of pesticides and fertilizers, as well as a number of processes, such as erosion, compaction and sealing of soils, reduction of minerals and biodiversity. ***The main goal of the development*** is to analyze the level and assess the current situation in the use of pesticides and fertilizers in Bulgaria, as part of the agro-ecological indicators that are relevant in the field of climate and environment. The following **research tasks** stem from the goal set above:

-theoretical review of scientific literary sources related to the sustainable development of the rural territories of Bulgaria;

-analysis of the state with the use of pesticides in the modern agriculture and the rural regions of Bulgaria for the period 2011-2021;

-analysis of the state and tracing of the tendencies with the use of fertilizers in the modern agriculture and the rural regions of Bulgaria for the period 2011-2021;

-deriving guidelines for the development of agriculture and rural territories.

According to FAO (Food and Agriculture Organisation) and WHO (World Health organisation), the term **„pesticide“** denotes a substance, which is applied for treatment of different enemies of the plants – diseases, weeds and pests, including protection, elimination, attraction, repellence and control [16]. The application of pesticides in agriculture by farmers is done in order to limit the impact of pests and diseases on agricultural plants. Use of pesticides plays an important role in the agricultural production, and they may render negative effect on the environment, affect the quality of waters, soils, biological diversity and ecosystems or accumulate in the form of residual substances in foods. Plant protection products come in a variety of forms and include herbicides, fungicides and insecticides (Sustainable use of plant protection products – there is a limited progress in measurement and reduction of risks. Special report, 2020).

The current Pesticides Directive 2009 (Directive 2009/128/EC) [3] outlines a framework for achieving sustainable use of pesticides by limiting the impact of permissible hazards and their impact on public health and the natural environment. In Bulgaria, in 2012, a National Action Plan (NAP) was developed for the sustainable use of pesticides, which considers effective actions on the application of alternative methods and means to achieve a reduced risk impact of the use of pesticides on people and nature. Therefore, it is necessary to encourage farmers to use environmentally friendly agricultural practices and to apply chemical preparations within reasonable limits, thereby preserving and protecting soil ecosystems [9].

Organic farming is a nature-saving model of agriculture that contributes to the promotion and development of the local economy on a local, regional and national scale [10].

Opportunities for sustainable management of soil resources in the rural regions of Bulgaria contribute to provision of the population with healthy and quality food products, striving to alleviate the consequences of the climate change and restricting the loss of biological diversity. Transition to sustainable systems of production outlined new challenges in front of the agricultural holdings with an opportunity to achieve sustainability in the rural territories.

The contemporary agricultural techniques usually require using great quantities of fertilizers. Nutrients, such as Nitrogen (N) and Phosphorous (P), are absorbed in the soil by the plants themselves. These are offered mainly in the form of mineral – inorganic – fertilizers, which are widely used in the agriculture to optimize the production, and organic fertilizers such as manure. Nitrogen is the most frequently used nutrient – by volume. As the main nutrient, nitrogen is used most often in practice, while phosphorus and potassium are used in more limited quantities [4].

Many farmers apply large quantities of mineral fertilizers, and the young plants cannot absorb even part of the Nitrogen. This way the Nitrogen is released in the environment. Accordingly, increase of usage of Phosphorous fertilizers results in accumulation of Phosphorous in the soil. This will inevitable create ecological risk of high concentrations of Phosphorous and pollution of the environment [6].

The effect of the use of chemical fertilizers and pesticides can be sought in two directions, for example, the lack of balance in the natural environment and human health, and on the other hand, it contributes to increasing the costs of farmers. Nitrates and nitrites are considered a risk factor for people's health, if they are consumed in quantities that exceed the limits highlighted by specialists. Their presence has been proven to be due to uncontrolled application, especially in the case of fertilizers or organic nitrogen [2].

In time, it was found that the practice of a conventional agriculture, which implies that sometimes the excessive use of pesticides, contributes directly to the degradation of the environment, to the depletion of resources and the loss of biodiversity [15].

As a whole the attention must be drawn to the implementation of sustainable agricultural models, which will suggest focusing on agricultural practices based on knowledge, in order to provide opportunities for dealing with ecological, economic and social challenges of the conventional agriculture [7].

Nature-friendly agricultural practices and ecologically-oriented technologies for growing agricultural crops lead to stabilization of the agro-ecosystems and increasing their sustainability. The vision of the updated agricultural policy sets the foundations of a fairer and sustainable future for farmers and rural territories. An important accent are the sustainable models for production with a view to the ecological agricultural practices, the eco-sustainability and efficient organisation and management of biological holdings [11].

Balanced territorial development is an important aspect of the sustainable development of rural regions. It is well-known fact that the sustainable development looks for an answer to the needs of the today's generation, without questioning the opportunities of the future generations to meet and realize their needs. This does not only mean reasonable use of natural resources and restoration of the ecological balance. Application of innovative model of biological production is beyond doubt one of the opportunities with significant effect for achieving greater sustainability in the development of the rural economy on a territorial scale [12].

The studied literary sources and authors' opinions on the problems considered show that despite the unsustainable agricultural practices and over-exploitation of natural resources attention must be drawn to the encouragement of sustainable models and technologies for stimulation the development of rural territories on a national scale. It is crucially important for our national economy to find the sustainable solutions for prevention of reduction of chemical fertilizers and pesticides in agriculture with a contribution to restoration of the ecosystems and an opportunity to provide a new and better balance between sustainable food supply system, health status of the population and preservation of the environment on a territorial scale.

MATERIALS AND METHODS

Analysis is implemented on the basis of publicly accessible information on strategic, regulatory, European and national documents, data from the agro-statistics kept by the Ministry of agriculture and food, Annual reports of the Ministry of the environment and waters (MEW), Executive Environment Agency (ExEA) and Eurostat. The methods of study used include comparison, analysis, synthesis, induction, tabular and graphic representation of the tendencies.

The study is based on data of FAOSTAT by basic indicators, and namely: use of pesticides, insecticides, herbicides, fungicides and bactericides in Bulgaria and EU for the period 2011-2021; sales of pesticides in Bulgaria and EU for the period 2011-2021; used quantities mineral fertilizers in Bulgaria and against the used farm area for the period 2011-2021,areas fertilized with Nitrogen and Phosphorous fertilizers in Bulgaria and as a percentage of the used farm area for the period 2011-2021; used quantities and treated areas with manure in Bulgaria for the period 2011-2021, consumption of Nitrogen, Phosphorous and Potassium fertilizers in Bulgaria and EU for the period 2011-2021; sales of mineral fertilizers in Bulgaria and EU for the period 2011-2021.

In order to trace the present state and the place of Bulgaria on a country level we made comparison with the statistical data and on EU level.

The statistics presented herein refers to the used and sold quantities of different categories pesticides and mineral fertilizers, expressed as active ingredients, kg and absolute volumes (tons) of Nitrogen, Phosphorous and Potassium, as well as used and treated areas with manure, expressed per hectare.

RESULTS AND DISCUSSIONS

For many years, enormous amounts of pesticides and fertilizers have been used quite in the agriculture. In the so-called conventional agricultural practice, due to the high level of various chemical preparations imported into agriculture, large quantities of the produced food products can be obtained, but at the same time there are also a number of risks, such as environmental pollution and deterioration of the biological balance in nature. On the basis of the published statistical data for Bulgaria regarding the applied quantities of pesticides and fertilizers in the past years, for the period after 1990, we can state that higher quantities have been used more intensively. In relation to the development of rural regions of Bulgaria particular attention is paid to the rural territories, where agriculture is predominantly being developed. Therefore, in the present period the most up-to-date regulatory strategic documents emphasize on the reduction by 50 % of the use of chemical pesticides and losses of nutrients, as well as reduction of use of fertilizers by at least 20 %, and at the same time 25 % of the total agricultural land in the EU should be occupied with biological agriculture. A need of reduction of the dependence on pesticides and antimicrobial products and reduction of the excessive mineral fertilization is outlined, by expanding the methods of the sustainable biological agriculture for improvement of the environment and preservation of the soil resource. In order to achieve a high degree of sustainability in the development of rural areas in Bulgaria, we will conduct a longer and more in-depth analysis of the use of pesticides and mineral fertilizers for the period 2011-2021 (a ten-year period).

Analysis of the present condition with the use of pesticides in the modern agriculture and rural regions of Bulgaria

To achieve the set goal, we will examine the general state of pesticides and some of their types, and the information about the data on their current state in Bulgaria is based on FAOSTAT data (Figure 1).

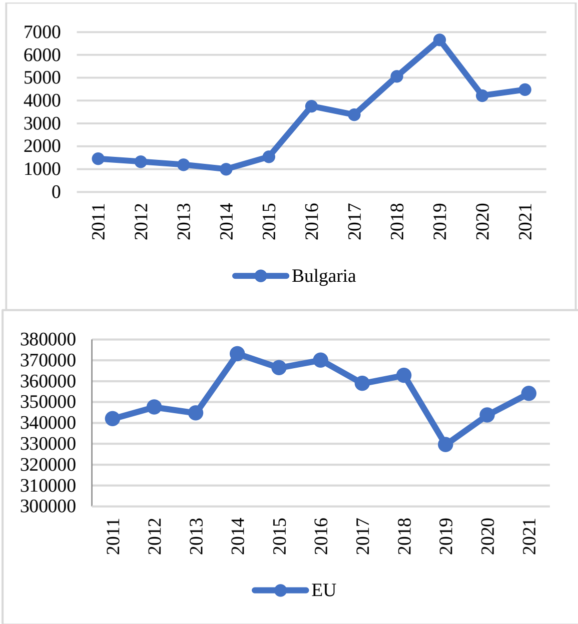

Fig. 1. Use of pesticides in Bulgaria and EU for the period 2011-2021 (tons of active ingredient)
Source: authors' figure based on data from Eurostat [5].

Pesticides are measured in tons of active ingredient. For the period 2011-2021, it became clear that the highest use of pesticides was registered in 2019 – 6,663 tons of active ingredients, and the lowest usage was 1,001 tons of active ingredients in 2014. For comparison, data in the EU show just the opposite, that the highest use of pesticides was in 2014 – 373,107 tons of active ingredients, and in 2019 was the lowest consumption - 329,560 tons of active ingredients. Tracing down the statistical data from the preceding reference period 2014-2020 against the present 2021, we can summarize that the tendency of the pesticide use in Bulgaria results in their increase.

From the data presented in Figure 2 about the total use of insecticides in Bulgaria we can say that the most significant quantity of insecticides used in the agriculture was in 2019 – 730 tons of active ingredients, and the least quantity used was 103.15 tons of active ingredients in 2011.

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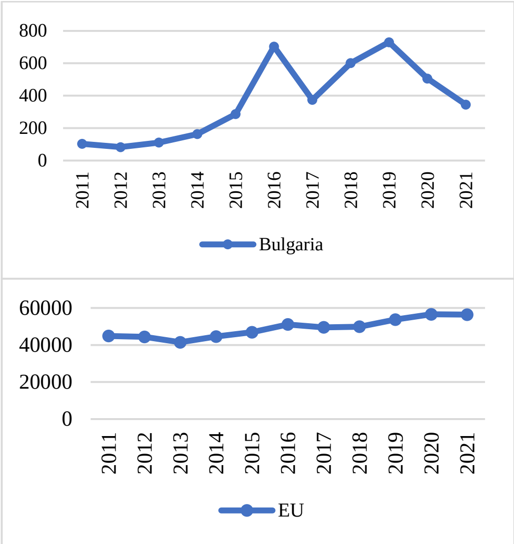

Fig. 2. Use of insecticides in Bulgaria and EU for the period 2011-2021 (tons of active ingredient)
Source**:** authors' figure based on data from Eurostat [5].

The consumption of insecticides in the EU marks comparatively sustainable tendency of increase for the period 2011-2021. The highest use rate was noted in 2020 – 56,544 tons of active ingredients, and the lowest one in 2013 – 41,444 tons of active ingredients.

From the data analysed on the use of herbicides in Bulgaria for the period 2011-2021 it can be seen that the maximum used quantity was registered in 2019 – 4,340 tons of active ingredients, and the minimum quantity is 636.2 tons of active ingredients in 2015 (Figure 3).

For comparison in the EU the highest use was seen in 2020 – 119,602 tons of active ingredients, and the lowest use - in 2019 – 107,933 tons of active ingredients.

According to published statistics, in 2018, the highest use of fungicides and bactericides was registered in Bulgaria - 1,817 tons, and in 2014, the lowest consumption was observed - 186 tons (Figure 4).

For comparison in the EU during the analyzed period, the data show that the maximum amount used was registered in 2018 – 160,438 tons of active ingredients, and the minimum amount used was observed in 2019 – 131,295.

The analysed statistical data for the use of pesticides in Bulgaria for the period 2011-2021 show that the levels are below the average in comparison with EU, but in the latest several years of the analysed 10-year period a tendency of increase was seen, and this increase can continue in the future, due to the unusual changes in the climate and the increase of the average annual temperatures in the atmosphere.

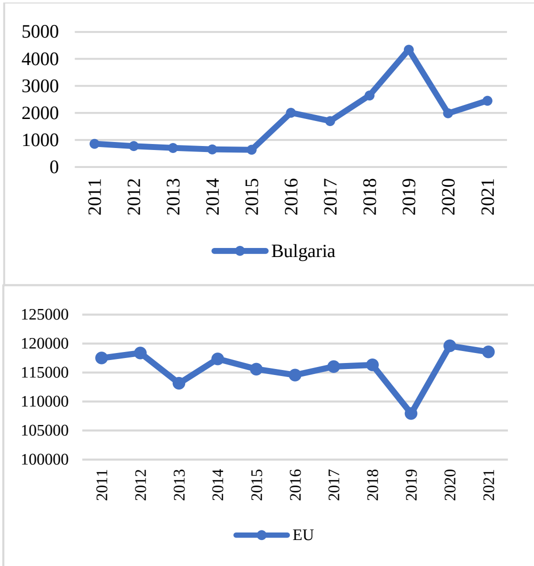

Fig. 3. Use of herbicides in Bulgaria and EU for the period 2011-2021 (tons of active ingredient)
Source: authors' figure based on data from Eurostat [5].

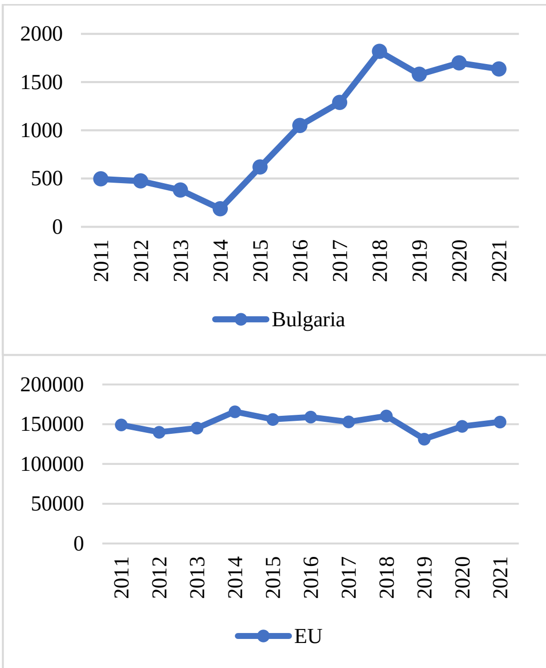

Fig. 4. Use of fungicides and bactericides in Bulgaria and EU for the period 2011-2021 (tons of active ingredient)
Source: authors' figure based on data from Eurostat [5].

Every year, Eurostat publishes up-to-date statistical information on the relevant quantities of plant protection products in rural areas to track trends in the development of pesticides in a territorial scope.

For the analysed 10-year period we can consider the sales of pesticides in Bulgaria, and for the period 2012-2014 they are decreased, but from 2015 to 2021 they mark a tendency of increasing (Table 1).

The lowest value was registered in 2014 – 1,002 tons, and the highest in 2018 – 5,000 tons. Tracing the last reference period 2014-2020 for development of the rural regions we assume 2014 as the baseline value or the so-called „standard", with which we will compare the respective years.

The change in the increase of the total amount of sales of pesticides in Bulgaria in 2021 against 2014 is +3,425.

Table 1. Total amount of sales of pesticides in Bulgaria and EU for the period 2011-2021 (tons)

Years	Country		Country	
	Bulgaria	Change against 2014	EU-27	Change Against 2014
2011	No data	-	359,468	-9,634
2012	1,331	+329	347,915	-21,187
2013	1,196	+194	349,591	-16,511
2014	**1,002**	**St**	**369,102**	**St**
2015	1,542	+540	203,530	-165,572
2016	3,759	+2,757	371,523	+2,421
2017	3,359	+2,357	359,878	-9,224
2018	5,000	+3,998	354,583	-14,519
2019	4,632	+3,630	333,356	-35,746
2020	4,186	+3,184	345,999	-23,103
2021	4,427	+3,425	355,175	-1,392

Source: authors' table based on data from Eurostat [5].

From the data presented in table 1 for the period 2011 - 2021, sales of pesticides in the EU maintain their levels. 350,000 tons is the registered total volume sold per year and is estimated to be around 355,000 tons in 2021. In the last analyzed year, compared to 2014, the change in the reduction of the total volume in sales of pesticides in the EU was -1,392.

Analysis of the present condition with the use of fertilizers in the modern agriculture and the rural regions of Bulgaria

Pesticides and fertilizers are immutable part of the modern agriculture, used for pest control and improvement of agricultural yields. Pesticide resistance in soil is usually changed by the fertilizers used. Fertilizers are widely used in agriculture in the form of mineral and inorganic fertilizers, as well as in the form of manure to provide nutrients important to agricultural crops. Nitrogen and Phosphorous fertilizers would significantly improve production of agricultural crops, but their excessive use can lead to losses of nutrients in the environment, which contributes to its pollution and destruction.

On the basis on data of Eurostat there is an updated statistical information published for Bulgaria on the quantities of mineral fertilizers used, and as kg/ha against the utilised farm area (UFA) for the period 2011-2021.Thus for example, in 2021 Nitrogen fertilizers (N) – 342,890 tons, Phosphorous fertilizers (P_2O_5) – 72,964 tons and Potassium fertilizers (K_2O) – 42,917 tons (Table 2) were used. The highest use of Nitrogen fertilizers was registered in 2011 – 371,015 tons, and the lowest was seen in 2012 – 245,000 tons. The maximum quantity of Phosphorous fertilizers used was registered in 2016 – 82,623 tons, and the minimum quantity used was registered in 2013 – 52,123 tons. Regarding the Potassium fertilizers - four successive years are outlined with the highest usage rate, and namely, 2018-2021 – 42,917 tons, and the lowest rate was registered to 12,723 tons in 2011.On this basis we can calculate the relative share in % computed against the utilised farm area (kg/ha) of the total used fertilizers for each calendar year. For example, if we trace the last reference period 2014-2020 for development of rural regions we assume 2014 as the baseline value or the so-called „standard", in 2015 the relative share was 11.96% against the preceding (baseline) year. The relative share in the next 2016 against the preceding 2015 marks a drastic increase by 26.38%. It must be noted that in the next 4 years (2017, 2018, 2019, 2020) a gradual increase of the total mineral fertilizers used was seen in the rural territories of Bulgaria – by 19.37 %, 20.28 %, 23.94 %, 27.09 %, respectively. This increase can be explained by the increase in the area of cultivated land after the accession of our country to the EU, due to the abandoned lands and the increased areas sown with technical crops, requiring additional application of large amounts of mineral fertilizers [8]. In 2021 a drop of 19.73 % was reported. As a whole, we can summarize that various quantities of mineral fertilizers have been used in our country, but there was a desire for them to be consumed within the certain norms, in order to limit the negative effect upon the environment and natural resources.

Table 2. Used quantities of mineral fertilizers in Bulgaria, in tons and as kg/ha against the utilised farm area (UFA) for the period 2011-2021

Years	Nitrogen (N)		Phosphorous (P_20_5)		Potassium (K_20)		Total fertilizers		Relative share %
	t	kg/ha	t	kg/ha	t	kg/ha	t	kg/ha	
2011	371,015	108.8	48,780	14.3	12,723	3.73	432,518	126.83	20.81
2012	245,000	70.48	49,000	14.1	24,000	6.9	318,000	91.48	12.85
2013	292,381	80.9	52,123	14.42	35,188	9.74	379,692	105.06	-0.07
2014	296,591	82.09	54,268	15.02	28,429	7.87	379,288	104.98	**St**
2015	329,546	90.46	65,931	18.1	32,714	8.98	428,191	117.54	11.96
2016	365,913	100.61	82,623	22.72	34,012	9.35	482,548	132.68	26.38
2017	351,120	96.54	67,753	18.63	36,909	10.15	455,782	125.32	19.37
2018	339,329	93.45	76,274	21.01	42,917	11.82	458,520	126.28	20.28
2019	352,486	97.13	76,780	21.16	42,917	11.83	472,183	130.12	23.94
2020	364,335	99.98	78,935	21.66	42,917	11.78	486,187	133.42	27.09
2021	342,890	93.95	72,964	19.99	42,917	11.76	458,771	125.7	19.73

Source: Eurostat [5].

The fertilized areas with Nitrogen and Phosphorous fertilizers in Bulgaria (thousand ha) and as a percentage of the utilised farm area for the period 2011-2021 are presented in the next Figure 5.

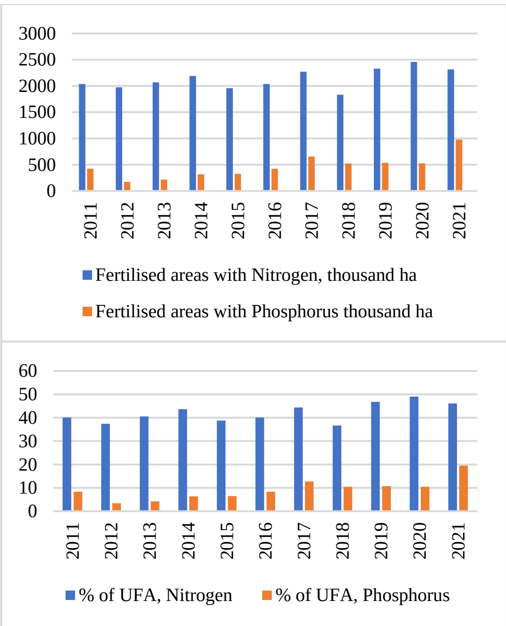

Fig. 5. Fertilized areas with Nitrogen and Phosphorous fertilizers in Bulgaria (thousand ha) and as a percentage of the utilised farm area (UFA) for the period 2011-2021

Source: authors' figure based on data from BABH (Bulgarian Food Safety Agency) [1].

On the basis of the above-specified data regarding the fertilized areas with Nitrogen it is evident that in 2018 minimum quantity of used Nitrogen fertilizers – 1,831.9 thousand hectares was seen, and the maximum quantity used was in 2020 – 2,457.6 thousand hectares. Regarding the areas treated with Phosphorous, data shows that the lowest use was registered in 2012 - 174,5 thousand hectares, and the highest use was reported in 2021 – 979 thousand hectares. If we take into account again 2014 from the last reference period (2014-2020), as a baseline value and compare it with 2021, we will note a slight increase by 5.3 % - from 2,190.5 thousand hectares for 2014 to 2,314 thousand hectares for 2021.

The tendency in the fertilized areas with Phosphorous is similar to the fertilized areas with Nitrogen. In 2021 an increase was seen against 2014 by 67 % - from 318,4 thousand hectares for 2014 to 979 thousand hectares for 2021.

The manure used in agriculture improves on the one hand, the soil fertility, and on the other hand, contributes to the development and feeding of plants. It contains all basic for the plants micro- and macro-nutrients, stimulants and carbohydrates. Organic fertilizers are main element for maintaining the balance of humus in soil and play an important role for the sustainable management of the soil fertility. The quantities of manure used and the areas treated with manure in Bulgaria for the latest 3 years (2019, 2020, 2021) are presented in the next figure (Figure 6). The data presented show that the tendency with the used quantities of input manure in Bulgaria marks a sustainable increase. In 2019, 451,654 tons of manure were used on an area of 30,758 ha.

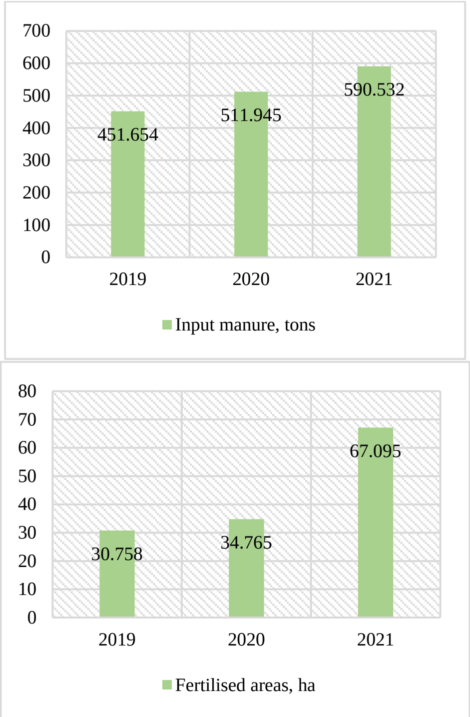

Fig. 6. Used quantities and treated areas with manure in Bulgaria for the period 2019-2021
Source: authors' figure based on data from BABH (Bulgarian Food Safety Agency) [1].

In 2020 there is a positive tendency of increasing, both, of the input manure, and of the fertilized areas – 511,945 tons of manure and 34,765 ha of fertilized areas.

In 2021, the total quantity of the input manure amounted to BGN 590,532 tons, which is an increase of 13.3 % against the preceding year from the studied period.

In 2021, there were almost double as much treated areas in comparison with the preceding 2020 – from 34,765 ha they are increased to 67,095 ha or an increase of 48.18 %. Analysis of data for the last 3 years in Bulgaria prove the established tendency for gradual increase of the areas, fertilized with manure, as well as an increase in the quantity of organic fertilizer used.

On the basis of the statistical data reviewed for the *use of mineral fertilizers in Bulgaria, we can summarize that* the tendency of increasing of the used quantities of Nitrogen fertilizers per unit of area, upon failure to comply with the legally set requirements for management and of the Good agricultural and ecological conditions, creates a risk of pollution of waters with Nitrates. The application rate of Nitrogen fertilizers is not exceeded, but nevertheless, the data about the Nitrogen balance show that there is an ecological risk of pollution of waters with Nitrates. Regarding the use of Phosphorous, we found a deficit in the Phosphorous balance in the soil. The unbalanced ratio of fertilization and the intensive increase of the used mineral fertilizers render negative effects upon the quality of soils, the agricultural produce and the environment.

Next, we will review the total consumption of mineral fertilizers in Bulgaria, the consumption of Nitrogen fertilizers, Phosphorous fertilizers and Potassium fertilizers, individually for the analysed 10-year period (2011-2021), and we will make comparison with the data about the EU, in order to trace the present condition and the place of Bulgaria on a country level and on EU level.

Figure 7 shows data about the consumption of mineral fertilizers for the period 2011-2021.

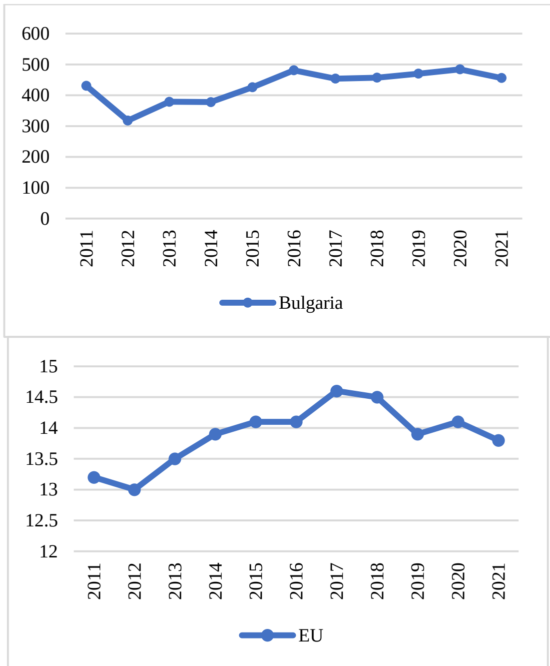

Fig. 7. Consumption of mineral fertilizers in Bulgaria (tons) and EU (million tons) for 2011-2021
Source: Eurostat [5].

Reviewing the data, we can say that the tendency for the used mineral fertilizers in Bulgaria leads to comparatively stable increase (Figure 7). An increase against the basic 2014 by 17.32 % was seen - from 379,288 tons to 458,771 tons in 2021.

According to the published data on European Union level the consumption of mineral fertilizers in 2021 decreased against 2020. The total quantity of **mineral fertilizers** – Nitrogen, Phosphorous and Potassium used in the agricultural production in the EU amounted to 13.8 million tons in 2021. This represents a drop of 2.17 % in comparison with 2020. In 2017 was registered the highest consumption of 14.6 million tons. For comparison, in 2012 was seen the lowest consumption of 13 million tons.

The data presented in the next figure about the consumption of Nitrogen fertilizers in Bulgaria for the period 2011-2021 shows a tendency of gradual increase and decrease (Figure 8).

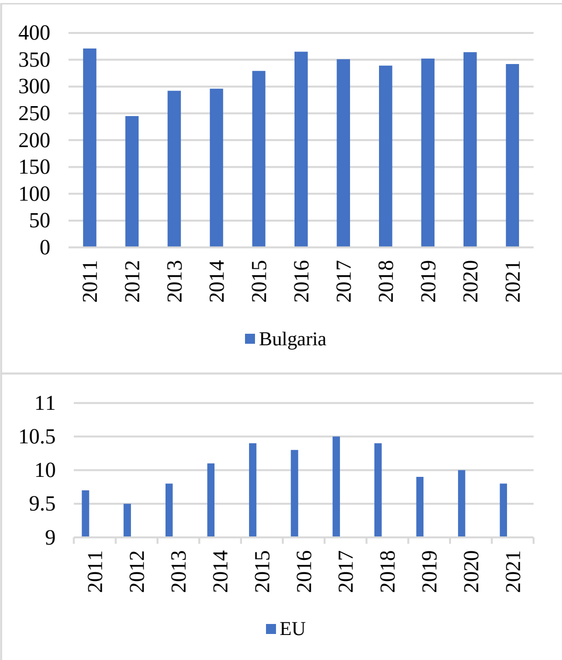

Fig. 8. Consumption of Nitrogen fertilizers in Bulgaria (tons) and EU (million tons) for the period 2011-2021
Source: Eurostat [5].

The highest values were registered in the first analysed year – 2011, and namely 371,015 tons, and the lowest ones were reported in 2012 – 245,000 tons. 2021 saw a tendency of decrease by 6.25 % against 2020. The consumption of **Nitrogen fertilizers** in the agriculture in the EU in 2021 was estimated to amount to 9.8 million tons, a decrease against 2020 by 2 %, which is in conformity with the noted short-term tendency after 2017 onwards. Nevertheless, the lowest value remains in 2012 – 9.5 million tons.

Reviewing the data analysed on the consumption of *Phosphorous fertilizers* in Bulgaria for the period 2011-2021 it can be seen that the maximum quantity used was registered in 2016 – 82,623 tons, and the minimum quantity was reported in 2011 – 48,780 tons. In 2021 a decrease of 8.18 % was seen against the preceding 2020.In 2021 the consumption of **Phosphorous fertilizers** in the agriculture in the EU was 1.1 million tons, i.e. a drop of 9 % was registered against the level in 2020 (Figure 9).

The highest use was found to be in 2019 and 2020 – 1.2 million tons, and in 2011 and 2012 the lowest consumption was registered - 1 million tons.

According to the published data during the four consecutive years (2018-2021) the highest consumption of Potassium fertilizers in Bulgaria – 42,917 tons was registered, a the lowest consumption is 12,723 tons in 2011 (Figure 10). In 2021, an increase against the basic 2014 by 33.75 % was seen - from 28,429 tons to 42,917 tons.

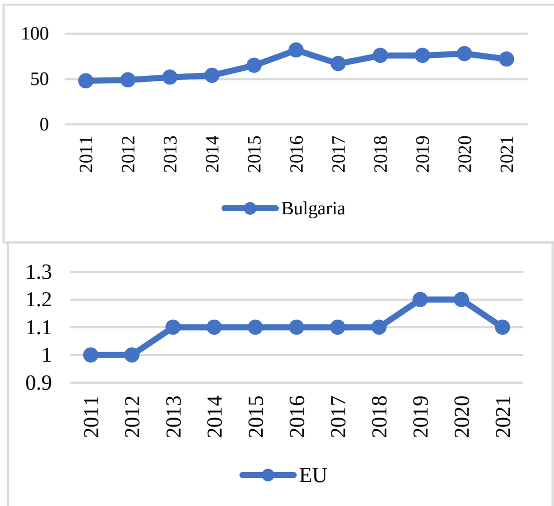

Fig. 9. Consumption of Phosphorous fertilizers in Bulgaria (tons) and EU (million tons) for the period 2011-2021
Source: Eurostat [5].

Data for the consumption of Potassium fertilizers on EU level during the analysed period shows that the maximum quantity used was registered in 2018 and 2019 – 3 million tons, and the minimum quantity used was seen in 2011 and 2012 – 2.4 million tons.

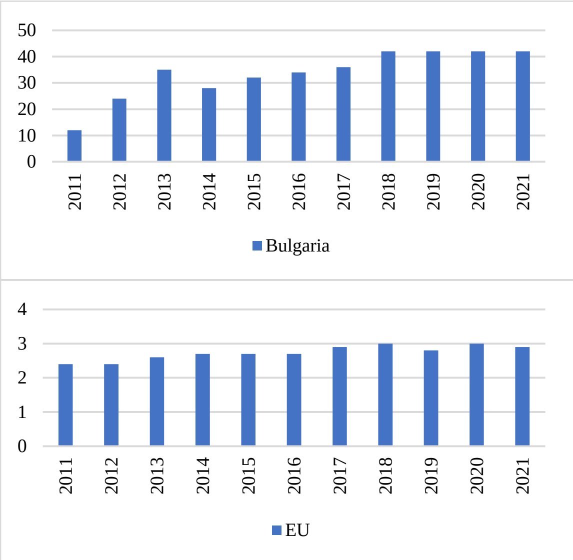

Fig. 10. Consumption of Potassium fertilizers in Bulgaria (tons) and EU (million tons) for the period 2011-2021
Source: Eurostat [5].

Eurostat publishes up-to-date data on the quantities of mineral fertilizers consumed in Bulgaria, on an annual basis. Using its data, we can trace the dynamics of sales of mineral fertilizers on the level of Bulgaria and the EU for the analysed 10-year period. For the period 2011-2014 sales of mineral fertilizers decreased, but from 2015 to 2020 they mark a tendency of increasing (Table 3).

Table 3. Total amount of sales of mineral fertilizers in Bulgaria and EU for the period 2011-2021 (tons)

Years	Country		Country	
	Bulgaria	Change Against 2014	EU-27	Change Against 2014
2011	305 848	+33 748	14 318 890	-951 552
2012	265 421	-6 679	15 161 003	-109 439
2013	237 853	-34 247	14 857 124	-413 318
2014	**272 100**	**St**	**15 270 442**	**St**
2015	338 127	+66 027	15 024 143	-246 299
2016	375 642	+103 542	13 488 226	-1 782 216
2017	377 418	+105 318	15 647 730	+377 288
2018	316 133	+44 033	15 096 746	-173 696
2019	371 226	+99 126	15 157 954	-112 488
2020	295 112	+23 012	15 359 774	+89 332
2021	259 287	-12 813	15 483 882	+213 440

Source: Eurostat [5].

The lowest value was registered in 2013 – 237,853 tons, and the highest was established in 2011 – 305,848 tons. Tracing the last reference period 2014-2020 for development of the rural regions we again assume 2014 as the baseline value or the so-called „standard“, with which we will compare the respective years. The change in reduction of the total amount of sales of mineral fertilizers in Bulgaria in 2021 against 2014 was -12,813. The largest amounts of mineral fertilizers sold at the EU level were registered in 2017 – 15.6 million tons, and the smallest amounts of sales were observed in 2016 – 13.4 million tons. The change in reduction of the total amount of sales of mineral fertilizers in Bulgaria in 2021 against 2014 was -173,696.

CONCLUSIONS

As a result from the analysis done and the assessment of the present state of use of pesticides and fertilizers in agriculture and rural regions of Bulgaria for the period 2011-2021 we can draw some particular summarizations and conclusions:

-Literary analysis of authors’ opinions and the results of our study for the last years draws still more the attention towards encouragement of sustainable models and technologies for stimulation of the development of rural territories on a national scale. Sustainable solutions for reduction of chemical fertilizers and pesticides in agriculture, contributing to the recovery of the ecosystems and preservation of the environment on a territorial scale are of crucial importance.

-Bulgaria, being EU Member State, continues the policy for efficient application of the sustainable use of pesticides in the direction of gradual and permanent reduction of the utilised chemical methods and treatment products and their replacement with alternative ones, nature-friendly sustainable agricultural practices for preservation of the population’s health and preservation of natural resources. Application of such environment-friendly approaches contribute to the reduction of the risk from the use of chemical pesticides and mineral fertilizers in soil, to ensure stability of the agro-ecosystems and protection of the environment in the long-term aspect. This way will be guaranteed the sustainability of individual rural territories.

-In Bulgaria the highest consumption of pesticides was registered in 2019 – 6,663 tons of active ingredients, and the lowest use was 1,001 tons of active ingredients in 2014. The most significant quantity of insecticides used in the agriculture in Bulgaria was in 2019 – 730 tons of active ingredients, and the least used quantity was 103.15 tons of active ingredients in 2011. In Bulgaria the maximum quantity of herbicides used was registered in 2019 – 4,340 tons of active ingredients, and the minimum quantity was 636.2 tons of active ingredients in 2015. The levels of pesticide use in our country are below the average, but in the last several years from the analysed 10-year period a tendency of increase was seen.

-In 2021, Nitrogen fertilizers used were 342,890tons, Phosphorous fertilizers – 72,964 tons and Potassium fertilizers – 42,917 tons. The Nitrogen fertilizers used in Bulgaria in 2021 showed a tendency of decrease by 6.25 % against 2020. For the Phosphorous fertilizers, a decrease of 8.18 % was reported against the preceding 2020, and Potassium fertilizers registered the highest consumption in Bulgaria over the four consecutive years (2018-2021) – 42,917 tons, and the lowest consumption was 12,723 tons in 2011. Concerning the use of Phosphorous we found a deficit in the Phosphorous balance in the soil. Data shows an established tendency of gradual and stable increase of the areas, fertilised with manure, as well as an increase of the quantity of organic fertilizers used for the last 3 years in Bulgaria (2019, 2020, 2021).

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FARM SIZE AND TECHNICAL EFFICIENCY OF THE AGRICULTURAL SECTOR IN THE EUROPEAN UNION (EU-27)

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Abstract

The majority of studies of agricultural productivity support the view that there is a relationship between productivity and farm size. How the size of a farm is related to its efficiency is a constant problem in agricultural economics research. It also has important implications for agricultural development policy. For developed countries, including the countries of the European Union, numerous studies show that, with the increase in the size of farms, their efficiency usually increases. Moreover, there is a constant decrease in the number of farms and the concentration of land and labor. For this reason, the problem of the influence of the economic size of a farm is included in the scope of the research related to the analysis of the relationship between the farm size and its efficiency. The purpose of the paper was to investigate the relative technical efficiency of the agricultural sector in the European Union (EU-27) using the Data Envelopment Analysis (DEA).It was found that with the increase in economic size, the technical efficiency of the researched farms improved.Attention was paid to the possibility of reducing labor inputs, mainly in farms of economic size classes ES1-ES4. No need to reduce the level of capital expenditure has been demonstrated. This emphasizes the growing importance of the substitution of labor with capital.

Keywords: *farm size, technical efficiency, Data Envelopment Analysis (DEA), Malmquist Index, EU Member States*

INTRODUCTION

The efficiency of management in agriculture and in other sectors of the economy is of fundamental importance. Despite the fact that in the recent years the importance of the efficiency paradigm has undergone transformation from a typically practical approach related to production efficiency, through a financial approach focusing on ratio analysis towards a multidimensionalassessment considering financial, economic, social and environmental aspects. However, among economist there is an agreement regarding the fact that the economic development requires refinement of efficiency of business entities, and ensuring efficiency in a multidimensional approach cannot be achieved without improving efficiency in technical, economic, and financial terms. The efficiency of management in agriculture is one of the main factors explaining the differences in the development of farms and their competitiveness [3, 31, 33]. For this reason, the analysis of the factors determining the efficiency of farming in the agriculture is in the focus of attention of farmers as well as other stakeholders striving to develop and modernize the agricultural sector. Due to the importance and role of agriculture in maintaining food security, the issue of agricultural farms efficiency is of particular interest to politicians and citizens of every country. Research on agricultural efficiency acknowledges the relationship between farming efficiency and the size of the farm [1, 2, 5, 18, 19, 22, 23, 26, 27, 55, 58].The impact of farm size on its efficiency is a constantly discussed issue in agricultural economics research. This is important from the point of view of creating agricultural development policy mechanisms.In the case of low-income countries or developing countries, where most agricultural farms are small, not exceeding 5 ha of agricultural land, it is pointed out that smaller agricultural farms are more effective than larger ones [4, 14, 46]. In contrast, in the case of developed countries where the level of technological advancement is higher, research shows that as the scale of production increases, the efficiency of farming improves

[6, 7, 12, 17, 37, 41, 46,57], and even growing disproportions are observed [32]. However, it should be borne in mind that striving for an unlimited increase in the size of the farm may result in negative external effects [28, 38]. The relationship between farm size and efficiency was explained by the presence of economies of scale and transaction costs [11, 17, 21, 58, 59].

Due to the constant high importance of management efficiency in agriculture and the need to constantly analyze the factors determining the economic efficiency of farms, the article deals with the issue of assessing management efficiency on farms of various economic size classes.

MATERIALS AND METHODS

In the assessment of the efficiency of the researched agricultural farms the Data Envelopment Analysis (DEA) method was used. The DEA is based on mathematical programming method that determines the effectiveness of objects described by vectors of inputs and outputs. It is possible within the scope of the DEA method to determine among objects the ones that are effective, but also for the ineffective ones obtaining information on necessary changes in the technology that will lead to the improvement of efficiency. This method is commonly used to assess theproductivity of enterprises in many areas of the economy, including agriculture[9, 10, 25, 40, 45, 49, 51, 54]. It is particularly useful when considering a production technology that produces more than one product from more than one input. Therefore, the challenge in measuring productivity is the appropriate aggregation of inputs and outputs of the production process. The result obtained in this way is called the Total Factor Productivity (TFP). The analysis of the efficiency of agricultural farms using the DEA method was carried out using the following set of inputs and outputs:

- inputs

x1 – total assets(SE436) [EURO],
x2 – total labor input (SE010) [AWU],
x3 –total utilized agricultural area (SE025) [ha],

- outputs

y1 – total output (SE131) [EURO].

The analysis used economic data for European Union (EU27) agricultural farms for the years 2013-2022 obtained from the FADN Public Database (Farm Accountancy Data Network) [20]. All result categories are given in accordance with the FADN methodology (symbols of result categories in accordance with the FADN methodology are given in brackets). The inputs and outputs determined in this way were subjected to the productivity analysis. An output-oriented model with constant returns to scale was used to analyze efficiency [16]. Considering n objects that use k inputs and obtain l outputsfrom their use, data on inputs and outputscan be presented in the form of the following matrix of dimension $n\times(k+l)$:

$$\underbrace{\begin{matrix} x_{11} & \cdots & x_{1k} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ x_{n1} & \cdots & x_{nk} \end{matrix}}_{\text{input}} \;\; \underbrace{\begin{matrix} y_{11} & \cdots & y_{1l} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ y_{n1} & \cdots & y_{nl} \end{matrix}}_{\text{output}} \qquad (1)$$

To assess the technical efficiency of a certain established facility N ($1 \le N \le n$) the following conditions will be formulated regarding the outputs and then the inputs obtained by object N in relation to other decision-making units. The aim of the model is to proportionally reduce expenditures without reducing the outputs. Mathematically, it comes down to the following notation:

$$\min_{\lambda_1,\dots,\lambda_n} \theta$$

$$\lambda_1,\dots,\lambda_n \ge 0$$

$$\left.\begin{matrix} \lambda_1 y_{11} + \cdots + \lambda_n y_{n1} \ge y_{N1} \\ \vdots \\ \lambda_1 y_{1l} + \cdots + \lambda_n y_{nl} \ge y_{Nl} \end{matrix}\right\} \text{the outputs do not decrease (2)}$$

$$\left.\begin{matrix} \lambda_1 x_{11} + \cdots + \lambda_n x_{n1} \le \theta \cdot x_{N1} \\ \vdots \\ \lambda_1 x_{1k} + \cdots + \lambda_n x_{nk} \le \theta \cdot x_{Nk} \end{matrix}\right\} \text{inputs are reduced } \theta \text{ times (3)}$$

The model given above has the following solution:

$$\lambda_i = 0 i \neq N$$
$$\lambda_N = 1$$
$$\theta = 1 \quad (4)$$

If there is no solution such that $\theta \neq 1$, the decision object is considered to be effective. Otherwise, the value 1–θ shows how much the inputs can be reduced without reducing the outputs. To introduce returns to scale variable into the model, an additional condition is assumed:

$$\lambda_1 + \cdots + \lambda_n = 1 \qquad (5).$$

The distinctive feature of the DEA method is the estimation of the relative efficiency of the enterprise without assuming in advance some form of function linking inputs with the achieved outputs.

As a result of using the DEA method, information is obtained on:

-the level of productivity of each researched unit,

-achievable level of production (reduction of inputs) assuming optimal production possibilities,

-model units that are characterized by the best use of inputs.

Subsequently, an analysis of changes in the efficiency of farms was carried out in individual economic size classes. A non-parametric method was used, based on the Malmquist productivity index. The Malmquist index is a measure of the dynamics of efficiency in two time periods (*tit+1*). It involves a certain synthesis of assessments of the productivity of a given facility in both periods in relation to other units from the periods *tit+1*. The Malmquist index allows the change in total productivity to be broken down into a change in technical efficiency and a change in the frontier of technological possibilities. Färe et al. [16] define the change in the output-based Malmquist productivity index as:

$$m_o(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} x \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right]^{1/2}$$

where: $d_o^t(x_t, y_t)$ - technical efficiency of the entity over the period *t;*

$d_o^t(x_{t+1}, y_{t+1})$ - technical efficiency of the entity for data for the *t + 1* period and technology in period *t*;

$d_o^{t+1}(x_t, y_t)$ - technical efficiency of the entity for data from period *t* and technology in the period *t + 1*;

$d_o^{t+1}(x_{t+1}, y_{t+1})$ - technical efficiency of the entity in the *t + 1* period.

A Malmquist index value greater than 1 will indicate an increase in total factor productivity (TFP), less than 1 will indicate a decrease in total productivity, and equal to 1 means no change in productivity.

In the analysis of the efficiency of the researched farms, the two-factor distribution of the Malmquist index proposed by Färe et al. [16] was used, which has the following form:

$$M_O = TE_O x TP_O$$

where: TE_O measures the change in technical efficiency change of an entity between periods *tit+1*, and TP_O determines technological change. To calculate the Malmquist productivity indices, the same set of variables was adopted as in the case of analyzing the efficiency of agricultural farms using the DEA method.

RESULTS AND DISCUSSIONS

By assessing the efficiency of the researched farms diversified in terms of economic size using the DEA method, technical efficiency indicators were obtained (Table 1).If the value is 1, the conclusion can be drawn that there has been no more efficient use of resources in the set of objects examined.On the other hand, if the technical efficiency index is below 1, it means that with a given level of resources, the level of effects can be increased.Our own research shows that technical efficiency improves as economic size increases.With the technical efficiency of farms in economic size classes ES1-ES3 being at a similar level.The technical efficiency index for the largest farms - ES6 - was 1 in all years analyzed.Farms in economic size class ES5 also had significantly higher technical efficiency than other farms in smaller economic size classes.With that said, the efficiency gap between ES5 and ES6 farms was not as large as for farms in the lower economic size classes.It is clear that the smallest farms ES1-ES3 are characterized by similar levels of technical efficiency. The remaining farm classes ES4, ES5 and ES6 form separate farm groups.This indicates a significant disparity between farms in economic size classes ES1-ES3 and the rest.Only economic size ES4 farms achieve higher technical efficiency. The increase in economic size from the ES1 and ES2 classes to the ES3 level did not produce any clear positive effects during the period under review.It is only from the economic size of ES4 that positive effects can be seen.This indicates that a small increase in farm size from a low level does not have a positive effect.It is only when the appropriate scale of production is exceeded that the farmer benefits.Small farms are not in a position to achieve the same level of efficiency as large farms.In the long term, farming with low efficiency will not allow this type of farm to function and grow.Small farms will be 'out of business' and their resources can be absorbed by larger farms, helping to improve efficiency and provide a sustainable basis for agricultural development.The problem for such an agricultural development strategy is the limited allocation of agricultural production factors, especially land [43, 44, 52] , and the environmental and social functions of farms [28]. An important aspect of agricultural policy should be to support the development of small farms through easier access to land (purchase or lease) [8, 39, 47, 50, 53], helping farmers to access credit, marketing, technology [13, 24, 35, 42].

Table 1. Technical efficiency indicators of the surveyed farms for the period 2013-2022

Year	**DMU***					
	ES1	**ES2**	**ES3**	**ES4**	**ES5**	**ES6**
2013	0.353	0.320	0.383	0.472	0.736	1.000
2014	0.387	0,344	0,385	0,468	0,735	1,000
2015	0,376	0,353	0,380	0,476	0,731	1,000
2016	0,358	0,326	0,365	0,455	0,687	1,000
2017	0,386	0,327	0,367	0,461	0,688	1,000
2018	0,289	0,313	0,379	0,485	0,703	1,000
2019	0,284	0,299	0,345	0,442	0,657	1,000
2020	0,283	0,306	0,351	0,449	0,662	1,000
2021	0,315	0,327	0,370	0,475	0,683	1,000
2022	0,325	0,316	0,370	0,480	0,703	1,000
2013-2022	0,353	0,320	0,383	0,472	0,736	1,000

* DMU – Decision Making Unit
Source: Own calculation on the basis of data from FADN.

Promoting diversification in the production of high-value commodities can play an important role in raising the small-holders' income and he development of the rural nonfarm sector [15].

Table 2 shows the relationship of the estimated output targets to those actually achieved with the given inputs.For decision-making units in which the optimal production sizes (outputs) were equal to the actual output sizes, the ratios of reference to actual sizes were equal to 1.A distinctive feature of the approach presented is the use of (estimated) output targets set by decision-making units (DMUs) as benchmarks for performance comparisons.This leads to a comparison of the performance of the optimum target with the actual performance achieved.The actual realized outputs in the decision-making units analyzed do not achieve the target results due to inefficiencies.The research shows that the obtainable production based on given inputs on farms of economic classes ES1 - ES5 in all the years analyzed was higher than the actual production obtained.As economic size increased, these differences decreased.

Table 2. Comparison of reference quantities with actual output quantities - effects: y1 - total output (SE131) for the decision-making units in the surveyed farms for the period 2004-2020 (actual volumes=1)

Year	DMU					
	ES1	ES2	ES3	ES4	ES5	ES6
2013	2.84	3.13	2.61	2.12	1.36	1.00
2014	2.59	2.90	2.60	2.14	1.36	1.00
2015	2.66	2.83	2.63	2.10	1.37	1.00
2016	2.80	3.06	2.74	2.20	1.46	1.00
2017	2.59	3.06	2.73	2.17	1.45	1.00
2018	3.46	3.19	2.64	2.06	1.42	1.00
2019	3.53	3.34	2.90	2.26	1.52	1.00
2020	3.53	3.27	2.85	2.23	1.51	1.00
2021	3.18	3.06	2.70	2.11	1.46	1.00
2022	3.08	3.16	2.70	2.08	1.42	1.00

Source: Own calculation on the basis of data from FADN.

Table 3 presents an analysis of the relationship between estimated input values and actual input values.For decision-making units in which the optimum input sizes (inputs) were equal to the actual input sizes, the ratios of reference to actual were equal to 1.All values below 1 indicated a possible level of input reduction with given effects.The data indicate a possible level of reduction mainly in labor inputs (x2), but primaryin the smallest farms ES1-ES4.The analysis carried out does not indicate a need to reduce capital (x1) and land resources (especially on ES1-ES3 farms).The findings highlight the importance of the relations between production factors.

Table 3. Comparison of reference quantities with actual input quantities - inputs: x1 - total assets (SE436), x2 - total labor input (SE010), x3 - total utilized agricultural area (SE025) for the decision-making units in the surveyed farms for the years 2004-2020 (actual quantities=1)

Year	Inputs	DMU					
		ES1	ES2	ES3	ES4	ES5	ES6
2013	x1	1.00	0.96	1.00	1.00	0.93	1.00
	x2	0.15	0.38	0.60	0.79	1.00	1.00
	x3	0.97	1.00	1.00	0.90	0.85	1.00
2014	x1	1.00	0.92	0.96	1.00	0.94	1.00
	x2	0.13	0.37	0.59	0.80	1.00	1.00
	x3	0.91	1.00	1.00	0.92	0.87	1.00
2015	x1	1.00	0.94	1.00	1.00	0.97	1.00
	x2	0.12	0.36	0.59	0.77	1.00	1.00
	x3	0.87	1.00	0.97	0.88	0.81	1.00
2016	x1	1.00	0.96	1.00	1.00	0.99	1.00
	x2	0.13	0.37	0.59	0.77	1.00	1.00
	x3	0.87	1.00	0.99	0.86	0.81	1.00
2017	x1	1.00	1.00	0.97	1.00	1.00	1.00
	x2	0.13	0.37	0.59	0.74	1.00	1.00
	x3	0.85	0.99	1.00	0.84	0.82	1.00
2018	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.38	0.57	0.69	0.96	1.00
	x3	0.88	0.93	0.90	0.76	0.75	1.00
2019	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.39	0.59	0.71	0.96	1.00
	x3	0.88	0.98	0.91	0.76	0.77	1.00
2020	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.38	0.60	0.73	0.99	1.00
	x3	0.88	0.93	0.89	0.75	0.75	1.00
2021	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.37	0.58	0.72	0.99	1.00
	x3	0.90	0.91	0.89	0.75	0.75	1.00
2022	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.14	0.31	0.52	0.67	0.92	1.00
	x3	0.70	0.81	0.81	0.70	0.69	1.00

Source: Own calculation on the basis of data from FADN

Under conditions of dynamically changing prices of production factors and especially the increasing cost of labor compared to other factors of production, it is becoming necessary to substitute labor with capital[29, 30, 34, 36, 48, 56].

This was followed by an assessment of changes in farming efficiency using the Malmquist Index.The results are presented in Tables 4-12 for the individual years of the analysis period and in Table 13 for the averages for the period 2013-2022.In 2014, average farm productivity increased by 3.3% compared to 2013 (Table 4).With the exception of class ES3, all the farm classes surveyed recorded an increase in the Malmquist index in 2014.A decomposition of the Malmquist index into two components shows that economic size classes ES2 and ES3 experienced a decrease in technological progress, while the others experienced an increase.In contrast, the technical efficiency of farms in the economic size classes ES1 - ES3 has increased, while it has decreased in ES4 and ES5 and remained unchanged in ES6 farms.

Table 4. Change in Malmquist index in 2014/2013

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.096	1.019	1.117
ES2	1.078	0.972	1.047
ES3	1.006	0.983	0.988
ES4	0.992	1.040	1.031
ES5	0.999	1.013	1.012
ES6	1.000	1.005	1.005
Average	1.028	1.005	1.033

Source: Own calculation on the basis of data from FADN.

In the year 2015, average farm productivity decreased by 2.9% compared to 2014 (Table 5), with both technical efficiency and technical capacity decreasing.

Table 5. Change in the Malmquist index in 2015/2014

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.972	0.931	0.905
ES2	1.025	1.011	1.036
ES3	0.986	0.977	0.964
ES4	1.018	0.931	0.948
ES5	0.994	0.945	0.939
ES6	1.000	0.971	0.971
Average	0.999	0.961	0.971

Source: Own calculation on the basis of data from FADN.

Only ES2 farms showed an increase in the Malmquist index.Similarly, a decrease in the Malmquist index of 1.8% was also recorded in 2016 (Table 6).The exception was the ES6 farms.The decline in productivity was due to a decline in technical efficiency.

In 2017, the situation of agricultural farms was more favorable. An increase in the Malmquist index was recorded in all economic size classes (Table 7).This increase has been achieved both through improvements in technical efficiency (the exception being ES6 farms, where no change has been recorded) and through technological progress.

Table 6. Change in the Malmquist index in 2016/2015

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.952	1.016	0.967
ES2	0.925	1.030	0.953
ES3	0.962	1.020	0.982
ES4	0.955	1.016	0.970
ES5	0.939	1.051	0.987
ES6	1.000	1.036	1.036
Average	0.955	1.028	0.982

Source: Own calculation on the basis of data from FADN

Table 7. Change in Malmquist index in 2017/2016

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.078	1.024	1.104
ES2	1.001	1.036	1.037
ES3	1.003	1.032	1.035
ES4	1.013	1.024	1.037
ES5	1.002	1.042	1.045
ES6	1.000	1.039	1.039
Average	1.016	1.033	1.049

Source: Own calculation on the basis of data from FADN.

In 2018, there was a 6% decline in the Malmquist index. While this varied between farm groups (Table 8), the largest decrease was recorded in ES1 farms.

Table 8. Change in Malmquist index in 2018/2017

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.750	0.966	0.724
ES2	0.959	0.969	0.929
ES3	1.033	0.982	1.014
ES4	1.053	0.966	1.018
ES5	1.021	0.966	0.987
ES6	1.000	1.004	1.004
Average	0.963	0.975	0.940

Source: Own calculation on the basis of data from FADN.

A 1.8% increase in the Malmquist index was recorded in 2019 (Table 9), this was due to an increase in the level of technological progress, while technical efficiency decreased. All classes of economic size of farms were characterized by an increase in technological progress and a decrease in technical efficiency (except for ES6 farms, where this indicator did not change).

Table 9. Change in Malmquist index in 2019/2018

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.981	1.073	1.053
ES2	0.954	1.073	1.024
ES3	0.911	1.073	0.978
ES4	0.910	1.073	0.977
ES5	0.935	1.073	1.004
ES6	1.000	1.079	1.079
Year	0.948	1.074	1.018

Source: Own calculation on the basis of data from FADN.

The opposite situation occurred in 2020. All farm groups experienced a decline in productivity, but mainly due to a decrease in the level of technological progress (Table 10).

Table 10. Change in Malmquist index in 2020/2019

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.998	0.970	0.968
ES2	1.023	0.970	0.993
ES3	1.018	0.970	0.987
ES4	1.016	0.970	0.985
ES5	1.007	0.971	0.978
ES6	1.000	0.990	0.990
Average	1.010	0.973	0.983

Source: Own calculation on the basis of data from FADN.

In contrast, in 2021 (Table 11) and 2022 (Table 12) the situation has improved significantly and an increase in the Malmquist index has been recorded.

Table 11. Change in Malmquist index in 2021/2020

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.112	1.040	1.157
ES2	1.069	1.040	1.111
ES3	1.054	1.040	1.096
ES4	1.058	1.040	1.100
ES5	1.033	1.057	1.092
ES6	1.000	1.064	1.064
Average	1.054	1.047	1.103

Source: Own calculation on the basis of data from FADN.

Table 12. Change in Malmquist index in 2022/2021

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.032	1.098	1.133
ES2	0.967	1.098	1.062
ES3	1.000	1.098	1.098
ES4	1.012	1.098	1.111
ES5	1.029	1.146	1.180
ES6	1.000	1.198	1.198
Average	1.006	1.122	1.129

Source: Own calculation on the basis of data from FADN.

This is due to both technological progress and changes in technical efficiency (except for ES2 in 2022).

Table 13. Change in Malmquist index from 2013 to 2022

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.991	1.014	1.005
ES2	0.999	1.021	1.020
ES3	0.996	1.019	1.015
ES4	1.002	1.016	1.018
ES5	0.995	1.028	1.023
ES6	1.000	1.041	1.041
Average	0.997	1.023	1.020

Source: Own calculation on the basis of data from FADN.

In addition to the analysis for individual years, an analysis of the Malmquist index for the whole period is also presented, where the average values for 2013-2022 are used (Table 13).In all farm groups the Malmquist index was above one. It was also found that the largest ES5 and ES6 farms had the largest increase in the Malmquist index, while ES1 farms had only a 0.5% increase in the Malmquist index.This indicates a growing disparity between the smallest farms (ES1) and the rest of the farm group, especially ES6 farms. The decomposition of the Malmquist index into two components shows that, in all farms economic size classes, technological progress increased, while technical efficiency decreased (except for ES6 farms, where no change was recorded, and ES4 where a minimal increase of 0.2% was recorded).These data make it possible to analyze the impact of technical efficiency changes and technological change on the change in productivity of individual facilities.The reason for the changes in the total productivity index was a change in the production (technological) capacity rather than a change in the way the farms used their assets within the available technology.The efficiency gap lies in the mix of available factors of production.

CONCLUSIONS

Improving the efficiency of farms is one of the essential conditions for strengthening their competitive position and economic strength.The paper assesses the economic efficiency at the microeconomic level on agricultural farms of different economic sizes.The study used the non-parametric DEA method to estimate changes in farm efficiency over time and to assess the relative efficiency of farms in each economic size class.

As a result of the research work, the following statements can be made:

(1)As the economic size increased, the technical efficiency of the surveyed farms improved. A clear efficiency gap was observed between farms in economic size classes ES5 and ES6, and ES4 as well as another group of farms in economic size classes ES1-ES2. This is an indication that a significant increase in production scale is necessary for a significant improvement in farm efficiency. A minor increase does not lead to a clear improvement in management efficiency. The benefits in terms of greater efficiency are only realized when the appropriate production scale is exceeded.

(2)For a given level of production, the analysis also indicated a possible reduction in inputs.Attention was drawn to the potential for labor input reduction, mainly on farms in economic size classes ES1-ES4.There has been no evidence that a reduction in the level of capital expenditure is necessary.This indicates the growing importance of capital substitution for labor.These trends are indicative of a process of "pushing" labor out of agriculture and allows labor costs to be reduced. Furthermore, assuming that the 'freed' labor resources from the farm can be used in non-agricultural activities, this should have a positive impact on the disposable income of the farmer's family.Therefore, agricultural, and rural development policies should implement instruments to activate farmers to seek non-agricultural sources of income.The economic development of the country is also important for this process of substitution of labor with capital.In particular, the low level of unemployment allows labor to be 'pulled out' of agriculture.

(3)All economic size classes recorded an increase in technical efficiency (Malmquist index) during the period under review.The smallest improvements in efficiency were recorded in the ES1 farms, and the largest in the ES6 farms.This indicates a growing disparity between farms of different economic sizes.

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WASTE MANAGEMENT IN BROILER INDUSTRY, BULGARIA

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Abstract

Under the current global policies for sustainable development, agriculture and animal husbandry are among the sectors which need to shift their production concepts towards more efficient, eco-friendly and smart technologies. Poultry farming is currently the most rapidly growing agricultural industry. This sector aims at stable economic growth combined with environmental safety which is an opportunity to introduce a transition of the business from the traditional linear model to circular economy. The present study focuses on the aspects of poultry waste management which sees waste as a resource for utilization. We discuss the main principles of circular economy in the view of a real-life example from one of the intensive poultry-breeding industries in Bulgaria which had implemented practices for waste-to-energy solutions.

Key words: *poultry, waste, circular economy*

INTRODUCTION

The current development of global economy encourages processes related to adding value to waste, by-products and resource flows. The recycling of materials is strongly integrated in the initiatives along the entire life cycle of products and promoted by the European Green Deal and the Circular Economy Action Plan [29] with the aim to offer innovative solutions to an improved resource management. As one of the primary goals of EU is to be a climate-neutral and resource-efficient economy by 2050, member states are expected to develop more sustainable practices using the raw materials and energy potential of waste in ways that are economical and environmentally acceptable [2].

Local societies are encouraged to introduce systems where "the value of products, materials and resources is retained in the economy for as long as possible and the generation of waste is minimized" [6]. In order to implement the circular economy principles into practice, the waste management should change the understanding of wastes and see them as resources utilized through innovative recycling and treatment techniques [10].

The perceived benefits from such development could result in cost savings, resource conservation, brand reputation of the operators, business sustainability [30]. Agriculture and animal husbandry are among the sectors that generate waste at a large scale, thus these sectors are in urgent need to form strategies and implement circular economy in order to solve the environmental, social and economic concerns of unsustainable waste management. As [14] proposed agricultural waste could be used as a source of fertilizers for crop production and biogas production as renewable energy. Biogas installations offer the farmers a viable waste treatment solution for conversion of organic waste into energy [6], beneficial not only for the rural communities but for the industrial enterprises as well. Although the current legislation promotes implementation of such methods in the agricultural business that generates most of the livestock waste like poultry industry, some operators continue to work in linear economy mode [16]. However, some prospective poultry enterprises had partially turned to circular practices [24] and joint biofuel projects with other stakeholders [2, 28]. Better understanding and exploration of the model offered by circular economy for the purpose of waste pollution management from livestock and poultry could be enhanced further through digitalization and simulation among the stakeholders [32].

In this context, the study aimed to analyze the aspects of poultry waste management so that waste to be reutilized as a resource for producing renewable energy.

MATERIALS AND METHODS

The study focused on the operation and performance of one of the large-scale industrial poultry enterprises established in Bulgaria. After collection of raw data on the outputs from the production chain in 2023, we processed the data and analysed them with regard to the current development of poultry production in the country and abroad, in particular poultry waste management. Several main categories of waste were defined and their rates for 2023 were presented in one table and two diagrams. The techniques introduced by the enterprise for recycling or re-use of some of the poultry waste were discussed in the light of the principles of circular economy. In order to gain insights into the main directions of the circular economy we studied the relevant legislative framework and official reports from the European Commission.

RESULTS AND DISCUSSIONS

According to the data available there is an increase in the poultry meat production in the EU estimated to 15.2 million tons in total in 2018 which is approximately a quarter higher than the production in 2010 [8]. The increasing demand and level of production in the rapidly developing poultry sector [3] at global level is fully reflected in the poultry production in Bulgaria as well, evident from the data reported by the Ministry of Agriculture – from 71,138 tons meat in 2015 to 113,094.2 tons in 2020 and 120,000 tons in 2022 [17, 18]. This increase in the poultry meat production in the country accounted for about 59% rise for the period 2015-2022 and respectively led to increase of the waste that is a big share in the intensive poultry breeding. In the poultry enterprise that appeared as an object of our study in 2023, the broiler production accounted for 9,631,087.704 kg (carcass weight) from which 6,934,383.147 kg were poultry meat and 2,696,704.557 kg were slaughterhouse waste or 28% of the production (Table 1).

There was another category of waste produced related to broilers that died during transportation to the slaughterhouse – 2,450.296 kg or 0.025% if compared to the carcass weight.

Table 1. Poultry production in the studied intensive breeding industrial enterprise in Bulgaria, 2023

Premises	Broilers unfit or died during transportation		Broiler production (carcass weight)		Slaughterhouse waste, kg	Poultry meat, kg
	kg	Number	kg	Number		
1	375.454	171	1,495,390.546	708,396	418,709.3529	1,076,681.193
2	376.653	176	1,502,107.347	720,912	420,590.0572	1,081,517.29
3	405.803	197	1,464,299.197	717,917	410,003.7752	1,054,295.422
4	392.727	185	1,743,280.273	847,803	488,118.4764	1,255,161.797
5	486.689	223	2,066,096.311	997,573	578,506.9671	1,487,589.344
6	412.97	191	1,359,914.03	645,588	380,775.9284	979,138.1016
Total	**2,450.296**	**967**	**9,631,087.704**	**3,920,272**	**2,696,704.557**	**6,934,383.147**

Source: Authors` data from the survey.

The intensive production provided poultry meat on the market which compared to the all other meat (carcass weight) was over 50% in Bulgaria and at the same time chicken accounted for the highest share of poultry meat [9]. There were deviations in the poultry production in the last years, mostly due to the constant outbreaks of Highly Pathogenic Avian Influenza (HPAI) leading to killing and destroying the birds for disease control purposes, but in 2023 the EU poultry production quickly recovered [7].

In the common linear economy, the take-make-dispose approach [23] maintained a constant outflow of output at the end of the production chain, thus materials seen as waste were usually disposed. Currently, a new legal framework is in place within the European

Union that regulates waste management and encourages transition to circular economy with using the waste as secondary raw materials for recycling [31]. In agriculture, “livestock waste” as defined includes animal excrement, bedding, water, soil, hair, feathers or other waste resulting from the processing of animal products [22]. In our study, the abattoir waste together with the broilers died during transportation (mortality waste) fall into this category and were subjected to further inclusion in activities that lead to partial transition to circular practices. The mentioned waste after slaughtering was collected and delivered to another facility for processing as raw materials and food for other animal species. This practice appeared in line with the parts of the 6R concept of reducing, reusing, recycling, repurposing, remanufacturing and rethinking [23] which for the studied poultry enterprise led to sustainable performance, lessening the negative effect on the environment and economic profits. Abattoir waste was studied profoundly for the risk it posed to the public and animal health being a hub of pathogens and the solid waste exposure in terms of air, water, and soil pollution and the associated health challenges that could arise due to improper solid waste management practices [20].

Poultry waste appeared to be a major problem to the poultry industry due to its large-scale accumulation [3]. In fact, poultry waste could be divided into several categories in order to find more efficient and sustainable ways of its management - litter and manure waste, feather waste, mortality waste, abattoir waste, and hatchery waste [33]. In our study, the amount of litter and manure waste for 2023 was 3,975,660 kg in total and the amount varied through the months and seasons (Fig. 1). The reasons for the variations were predominantly related to the production process planning as a whole and issues like density of bird population (capacity, disease control measures and depopulation, biosecurity, etc.).

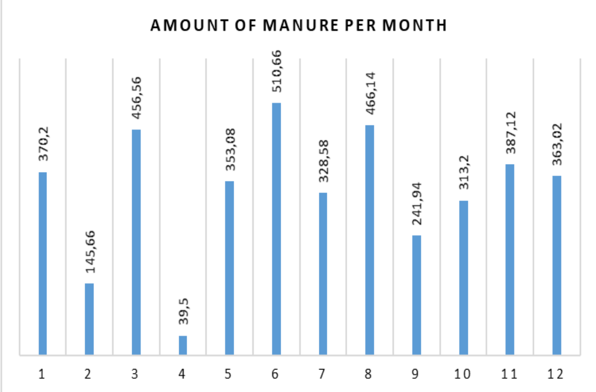

Fig. 1. Monthly produced litter and manure waste in kg from the studied industrial poultry enterprise, 2023
Source: Authors` data from the survey

Techniques for waste management were found to be dependent on many factors and as [15] stated the specialization in one or few industries of an administrative region in the country usually defined the type of waste there – industrial, municipal, agricultural and the common waste management issues like accumulation of large quantities of waste. Poultry industry, generating “livestock waste” in great amounts, usually implements several techniques for its disposal - composting of poultry manure to obtain fertilizers and soil improvers, anaerobic digestion of poultry manure for energy recovery [12], and also pyrolysis of poultry manure into different types of biochar that can be applied in agriculture, horticulture and industry [5]. Some of the mentioned common techniques were proven to be useful for sustainable poultry waste management with focus on the carbon, nitrogen and phosphorus cycles and subsequent “matter recovery” [11]. The poultry enterprise in our study had previously fully operated into linear economy model and used to subject the manure to composting. With its partial transition to circular economy practices, the enterprise currently included the manure into a production line for biofuel, thus contributing to energy recovery. Such practices, according to [33] should be further encouraged among the stakeholders with the support of the policymakers through waste-to-wealth projects in the regions. Biofuel production appeared as one of the highly environmental and economic sustainable projects with this regard [2] to produce value-added products from agricultural residues and food processing side streams through integrated approach [11].

Another category of poultry waste that should be strictly regulated is the share of birds that died during the process of their growing on the farm (Fig. 2). The mortality waste generated in the poultry enterprise in the study accounted to 159,030.7 kg for 2023. As the enterprise had not fully made its transition to circular economy, the approach to dispose the mortality waste was through incineration. It was considered a valid approach as this method was also used to prevent environmental contamination and public and animal health threats due to bacteria and viruses [1].

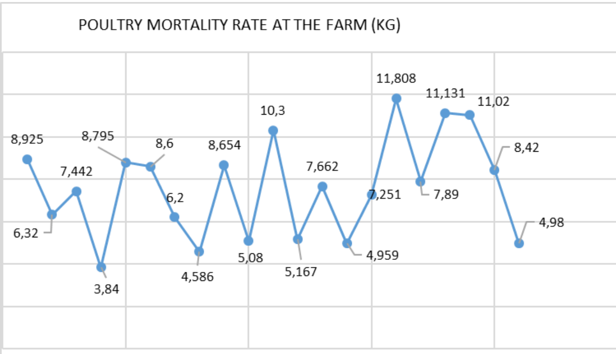

Fig. 2. Mortality waste in kg produced at the studied industrial poultry enterprise, 2023 (carcasses were collected more than once a month)
Source: Authors` data from the survey.

However, carcass incineration in animal husbandry was considered potentially harmful as many pollutants from poultry incineration caused environmental issues [19] contamination of air, soil and water; social concerns related to odor; economic constraints related to the alarming increase in the costs of raw materials like: kerosene, diesel and wood for burning and the labor cost [1]. Moreover, a lot of research had documented detrimental effects of incinerators on the public health resulting in cancer, cardio-cerebrovascular diseases and respiratory diseases, pregnancy outcomes and congenital anomalies [25, 21]. While [26] argued that newer incinerator technologies might reduce exposure of pollutants to public health, there were other traditional techniques of carcass disposal like composting that could overcome some of the concerns [4], especially the infectious threats and environmental contamination. The poultry enterprise in the study had previously applied the composting method regarding waste management but temporarily, only in cases of HPAI outbreaks. A way to turn towards more sustainable practices was offered by [13] through hydrothermal treatment of carcasses and processing of chicken bones into valuable by-products rich in calcium and phosphorus and later re-used.

CONCLUSIONS

The production of poultry meat worldwide had increased in the last decade and with this the amount of waste from the poultry industry had multiplied. The traditional techniques for waste management in linear economy include composting of poultry manure to obtain fertilizers and soil improvers, anaerobic digestion and also pyrolysis. In these models the waste is usually disposed and a lot of environmental, health and economic issues arise.

In order to improve and maintain sustainability, one of the industrial poultry enterprises in Bulgaria had adopted some practices that view waste as a resource for reusing, recycling, repurposing and rethinking in the production cycle. The studied enterprise had partially introduced circular economy techniques with regard to the manure waste management and abattoir waste management that showed good results across economic, social and ecological dimensions. Further transition to circular economy is needed with the support of policymakers, governmental bodies and other stakeholders in order to create incentives to operators who produce value-added products from agricultural waste.

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THE CONTRIBUTION OF AGRICULTURE COMPARED WITH OTHER ECONOMIC SECTORS TO THE FORMATION OF ROMANIA'S GROSS DOMESTIC PRODUCT

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Abstract

Agriculture was and remains the support of human existence, representing the backbone of the Romanian rural economy. The gross domestic product represents a macroeconomic indicator of results, being the consequence of the efficient use of resources. In this context, the authors analyze the place that agriculture holds in achieving the gross domestic product in Romania compared to the European Union, as well as its dynamics. In this sense, the share of resources in the formation of the gross domestic product in the period 2000-2022 is presented. The main research methods used for this work are: analysis, synthesis, comparison and mathematical analysis. From the analysis carried out, conclusive ideas emerge, and the article becomes even more suggestive, in that it is accompanied by tables synthesized by the authors and relevant graphics that highlight and support the assessments that the authors make in the content of this article. At the end of the paper, the authors emphasize the fact that the GDP is the most complex indicator that reflects the transformations that the Romanian economy has gone through in recent years. From the point of view of the use of resources, it can be seen that the share of the agricultural sector has registered a downward evolution, which can be largely explained by the increase in the importance of industry and the service sector in the overall national economy.

Key words**:** *agriculture, GDP, Romania, evolution, economic sectors, EU*

INTRODUCTION

The history of world economic development demonstrates that, at all times, the well-being of a people was given by the level of the Gross Domestic Product (GDP), which represents "the gross value of the final production of goods and services produced during a period of time by the economic agents that carry out their activity within the national borders"[17].

The Gross Domestic Product is the main indicator of economic development and growth, representing the added value created in a calendar year to which taxes and customs duties are added. At the level of an economy, each economic branch contributes a certain weight to the formation of GDP [6].

The economic growth of a country is measured by the result indicator Gross Domestic Product [3, 4].

Developed countries are generally characterized by more advanced post-industrialised economies, meaning that the service (tertiary) sector has a higher share than the industrial (secondary) sector, in contrast to developing countries that are in the process of industrialisation or are pre-industrial and almost entirely agrarian, some of which may fall into the category of least developed country [18].

There are thus three situations:

• when the share with which the agricultural sector (PA) participates in GDP formation is less than 3-4% (PA ≤3-4%) - the country is developed

• when the share with which the agricultural sector (PA) participates in GDP formation is between 5-15% (5≤PA ≤15%) - the country is medium developed

• when the share with which the agricultural sector (PA) participates in GDP formation is greater than 3-4% (PA≥3-4%) - the country is developing [9].

Gross domestic product (GDP) per capita is another macroeconomic indicator that measures the value of all final goods and services produced in the national economy during a year and is divided by the population of that country [10].

An important element in the economic development of a country is the successful use and exploitation of the advantage that economic resources represent.

From this point of view we find that on resources, in the branches of the national economy, the results are among the most contradictory [1,7, 8].

The issue of the place and role of agriculture in economic development is addressed in numerous economics articles, emphasizing the importance of agriculture in this regard. Therefore, the question of economic development cannot be raised without taking into account the effects of the development of the agricultural sector, which is closely related to other economic branches, especially industry.

In this context, the purpose of this paper is to highlight the importance and the need to know one of the most relevant problems of the structure and dynamics of Romania's economic evolution, through the prism of the main synthetic indicator - the GDP, and to emphasize the important role that agriculture plays in its formation.

MATERIALS AND METHODS

The main research techniques applied in the preparation of this paper include analysis (especially structural analysis of GDP by resources), synthesis, comparison, mathematical analysis, graphical representation and interpretation.

The research starts with the bibliographic study using the specialized literature in the field both from the country and from abroad. Then follows the stage of statistical data collection, processing, graphical representation and interpretation. To determine the dynamics of the GDP in Romania, the authors use the dynamic/chronological time series that highlight the temporal characteristic of the phenomena, being an important tool in the context of macroeconomic analyses.

Specific to dynamic series is the fact that they are defined for complex entities, characterized by a high level of variation in indicator data, including temporal structural variations.

The statistical analysis of time series should be based on a system of indicators that characterize the multiple quantitative relationships within the series and over the period to which the data refer (2000-2022).

For dynamic/time series indicators, the statistical data obtained from processing can be absolute, relative and average data which, together, make it possible to statistically characterize the development of the phenomena studied by interpreting the objective trend in their development at each given stage. In this paper relative indicators are determined.

Relative indicators have a very important place in the concrete analysis of the dynamics of socio-economic phenomena. Indicators are widely used in macroeconomic analyses in connection with establishing proportions and correlations between different activities and sectors of the national economy.

The relative measure, which shows how many times a phenomenon has changed over time, is called the dynamics index and can be calculated on a fixed and chain basis.

- **The dynamic index with a fixed base** is denoted by $I_{i/0}$ and is calculated as the ratio between the level of each year (Y_i) and the level of the year chosen as the base (y_0); it is usually expressed as a percentage, according to the formula:

$$I_{i/0} = \frac{y_i}{y_0} \cdot 100, \quad ....(1)$$

- The chain-based dynamics index is noted with $I_{i/i-1}$:

$$I_{i/i} = \frac{y_i}{y_{i-1}} \cdot 100, \quad ....(2)$$

In order to determine how the main resources of the national economy are used to produce gross domestic product, the authors use the indicator GDP structure by main branches of the national economy - P GDPr (agriculture, industry, services, other branches) which is calculated as the percentage ratio of gross domestic product (GDP) of the respective branch (GDPr) to total GDP (GDPT), based on the following mathematical formula:

$$P\ PIB_r = (PIB_r/PIB_T) \text{ x } 100.......................(3)$$

RESULTS AND DISCUSSIONS

Romania's place in the EU by GDP

Romania's economy in 2022 was 286 billion euros in current prices, ranking 12th in the European Union, out of the 27 member states. The share of the Romanian economy in the European GDP was 1.81% of the aggregate GDP of the EU (15,797 billion euros).

Table1.Gross Domestic Product by EU member countries, 2022

No.	Specification	Total GDP (billion euros)	% of EU GDP
1	Germany	3,867	24.46
2	France	2,642	16.72
3	Italy	1,909	12.08
4	Spain	1,328	8.41
5	Netherlands	942	5.96
6	Poland	654	4.14
7	Sweden	557	3.53
8	Belgium	552	3.49
9	Ireland	502	3.18
10	Austria	447	2.83
11	Denmark	375	2.37
12	**Romania**	**286**	**1.81**
13	Czech Republic	276	1.75
14	Finland	266	1.69
15	Portugal	239	1.51
16	Greece	208	1.32
17	Hungary	169	1.07
18	Slovakia	107	0.68
19	Bulgaria	84	0.53
20	Luxembourg	78	0.49
21	Croatia	67	0.43
22	Lithuania	66	0.42
23	Slovenia	58	0.37
24	Latvia	39	0.25
25	Estonia	36	0.23
26	Cyprus	27	0.17
27	Malta	16	0.11
28	**UE-27**	15,797	100

Source: Own processing after [15].

The European economy continues to be dominated by Germany – which holds a quarter of the EU economy (€3,867 billion), France (€2,642 billion), Italy (€1,909 billion), Spain (€1,328 billion) and the Netherlands (€942 billion). Cumulatively, the first five European economies have a share of approximately 65% of the aggregate GDP of the European Union (Table 1) [19].

Figures 1 and 2 presents the hierachy of the EU member states based on the GDP level in teh year 2022.

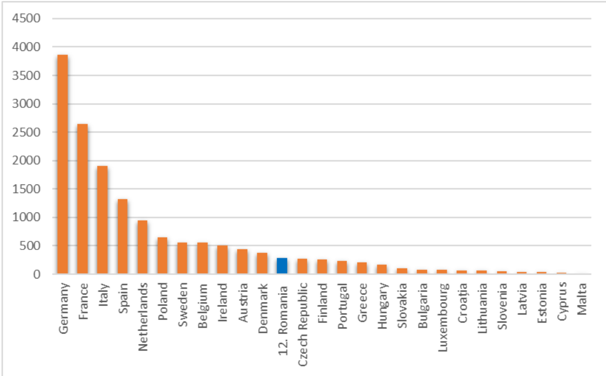

Fig. 1. Gross Domestic Product by EU countries, 2022 (billion euro)
Source: Own design based on the data from [15].

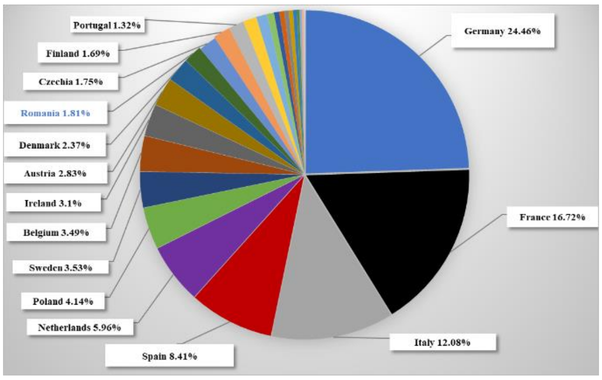

Fig. 2. Percentage share of European Union Gross Domestic Product (GDP) in 2022 by Member State
Source: Own design based on the data from [15].

On the other hand, although the national economy places Romania in the first part of the EU ranking, the low value of the GDP per capita indicator, of 15,040 euros/inhabitant, compared to the European average (37,257 euros/inhabitant), keeps Romania in the 26th position among the 27 EU member states, the only country with a lower performance being Bulgaria (Table 2) [5].

Luxembourg, Ireland, Denmark, the Netherlands and Sweden continue to hold the top spots as the richest countries in the European Union per capita.

At the same time, Bulgaria and Romania constinue to remain on the last position with the lowest GDP per inhabitant (Table 2).

Table 2. Gross Domestic Product per capita by EU member countries, 2022

No.	Specification	GDP/capita Euro/capita
1	Luxembourg	119,230
2	Ireland	98,260
3	Denmark	63,540
4	Netherlands	53,260
5	Sweden	53,160
6	Austria	49,440
7	Finland	47,990
8	Belgium	47,250
9	Germany	46,150
10	France	38,590
11	Italy	32,390
12	Italy	31,790
13	Cyprus	29,600
14	Slovenia	27,980
15	Spain	27,910
16	Estonia	27,170
17	Czech Republic	25,830
18	Lithuania	23,620
19	Portugalia	23,310
20	Latvia	20,720
21	Greece	19,670
22	Slovakia	19,590
23	Hungary	17,520
24	Poland	17,310
25	Croatia	17,240
26	**Romania**	**15,040**
27	Bulgaria	12,400
28	EU-27 average	37,257

Source: Own processing based on the data from [15].

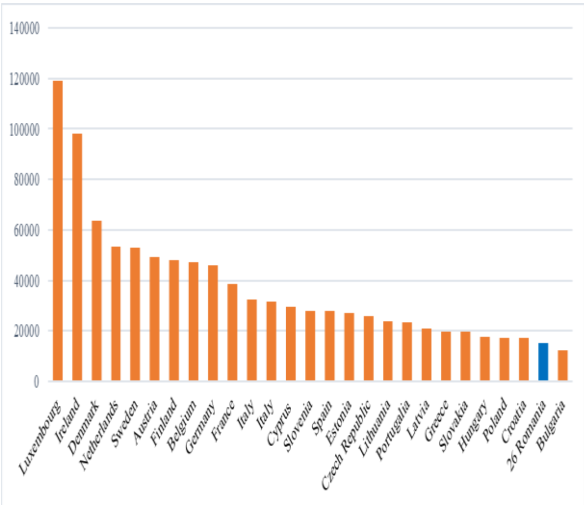

Fig. 3 Gross Domestic Product per capita by EU member countries, 2022
Source: Own processing based on the data from [15].

Also, Figure 3 reflects the the descending order of the EU member states for this important indicator of the living standard which is GDP per inhabitant.

GDP dynamics in Romania

If we analyze the evolution of Romania's GDP from 1990 to the level of 2022, we observe an important increase in both total GDP and GDP per capita.

Tabel 3. GDP evolution in Romania in the interval 1990-2022

Year	Total GDP Million lei	Fixed base dynamics index (%)	Chain dynamics index (%)	GDP/capita (lei)
2000	80,873.1	100	100	3,604.7
2001	117,391.4	145	145	5,238.7
2002	152,271.5	188	129	7,025.0
2003	191,917.6	237	126	8,895.6
2004	244,688.3	302	127	11,406.4
2005	286,861.9	354	117	13,455.3
2006	342,762.6	423	119	16,172.8
2007	425,691.1	526	124	20,384.6
2008	539,834.6	667	126	26,284.9
2009	530,894.4	656	98	26,065.8
2010	528,514.5	653	99	26,103.6
2011	558,889.9	691	105	27,739.7
2012	591,799.1	731	105	29,501.2
2013	634,967.8	785	107	31,766.3
2014	669,703.9	828	105	33,625.7
2015	711,929.9	880	106	35,915.7
2016	763,652.5	944	107	38,751.4
2017	857,895.7	1,060	112	43,786.0
2018	951,728.5	1,176	110	48,864.9
2019	1,058,190.3	1,308	111	54,613.9
2020*	1,066,780,5	1,319	100	55,361,2
2021*	1,187,402,4	1,468	111	62,089,4
2022**	1,409,783,9	1,743	118	74,000,0

Source: [13] *[14]** [11].

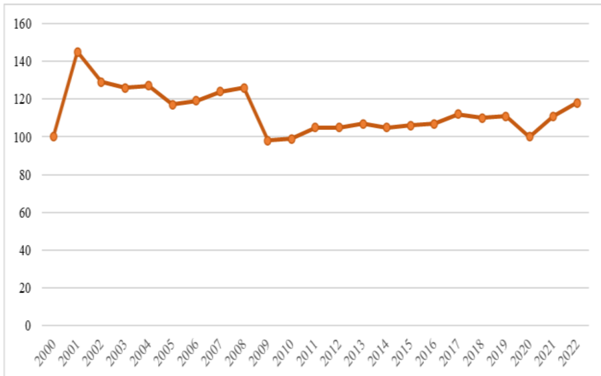

Fig. 4. GDP dynamics in Romania, according to the Chain Dynamics Index, in the period 2000-2022, %
Source: [13] *[14]** [11].

Regarding the dynamics of GDP, considering the crisis from 2007 which lasted until 2010-2012, as well as the subsequent evolution after 2012, with more pronounced increases starting from 2015, 2016, 2017, we can appreciate that Romania's economy is on a positive trend (Figure 4).

As can be seeb from this figure, the dynamic index of the gross domestic product and the gross domestic product/inhabitant had an ascending evolution.

GDP structure by economic branches

Agriculture currently holds and will continue to hold a dominant position in the national economy through the natural resources at its disposal and through the contribution it has to the formation of the Gross Domestic Product.

The evolution of the weight with which agriculture participates in the formation of the GDP is a relevant indicator regarding the evolution of the Romanian economy.

Tabel 4. The evolution of the share of the main economic sectors in the formation of GDP in Romania, (%)

Year	Agriculture	Industry	Construction	Services	Net of taxes
2000	10.8	25.1	5.2	49.2	9.7
2001	13.2	26.6	5.7	45.2	9.3
2002	11.4	27.1	6.2	45.6	9.7
2003	11.9	25.7	6.3	45.3	10.8
2004	12.7	25.5	6.4	45.1	10.3
2005	8.6	25.2	7.0	47.9	11.3
2006	7.8	25.0	8.0	48.3	10.9
2007	5.5	24.7	9.6	49.3	10.9
2008	6.3	25.4	11.4	46.6	10.3
2009	6.1	25.7	10.7	48.4	9.1
2010	5.0	30.0	8.0	46.2	10.8
2011	6.2	32.4	6.3	43.0	12.1
2012	4.7	25.3	7.5	50.3	12.2
2013	5.4	25.4	7.0	50.4	11.8
2014	4.7	25.6	6.4	51.7	11.6
2015	4.2	24.2	5.9	53.5	12.2
2016	4.1	24.0	6.1	55.5	10.3
2017	4.3	23.7	5.2	57.3	9.5
2018	4.3	22.7	5.5	57.9	9.6
2019	4.1	21.2	6.1	59.0	9.6
2020*	3.8	19.6	6.6	60.3	8.8
2021*	4.5	20.6	6.2	59.1	9.6
2022**	4.5	22.5	6.3	57.7	9.0

Source: [13] *[14]** [11].

The decrease in the contribution of agriculture to the formation of total GDP is based on the structural transformation of the Romanian economy and the transition from an economy based mainly on agriculture and industry to one dominated by services (Table 4).

Regarding the contribution of each economic sector to the formation of GDP, we can see that the share of agriculture in Romania's GDP gradually decreased, being below 10% after 2005, a fact due to the accelerated economic growth that Romania had before 2007. The decreasing trend is maintained in, after 2012, the contribution of agriculture being below 5% (Table 4, Figure 5).

The tendency to reduce this share is an important result from the perspective of diminishing the contribution of agricultural supply to GDP fluctuations, against the background of increasingly unstable climatic conditions and the reduced capitalization of farms [16].

Fig. 5. Evolution of the share of agriculture in Total GDP, in Romania, (%)
Source: [13] *[14]** [11].

Tabel 5. Share of agriculture in Total GDP, at EU level, 2022

No.	Country	% of agriculture in Total GDP
1	Austria	1.4
2	Belgium	0.6
3	Bulgaria	3.9
4	Croatia	3.1
5	Cyprus	1.6
6	Czechia	1.9
7	Denmark	1.2
8	Estonia	2.5
9	Finland	2.3
10	France	1.9
11	Germany	0.9
12	Greece	3.8
13	Hungary	3.2
14	Ireland	1.1
15	Italy	1.8
16	Latvia	5.0
17	Lithuania	4.0
18	Luxembourg	0.2
19	Malta	0.9
20	Netherlands	1.5
21	Poland	2.8
22	Portugal	1.9
23	Romania	4.5
24	Slovak Republic	2.2
25	Slovenia	1.8
26	Spain	2.3
27	Sweden	1.5
28	EU	1.7

Source: Own processing based on teh data from [20].

Even if the share with which agriculture participates in the formation of GDP registers a downward trend, the value of the indicator remains relatively high, compared to the EU average, being a source of instability of GDP values, considering the influence of changes in climatic factors, the low level of endowment technical-material and under the conditions of an insufficiently developed and diversified economy (Table 5, Figure 6).

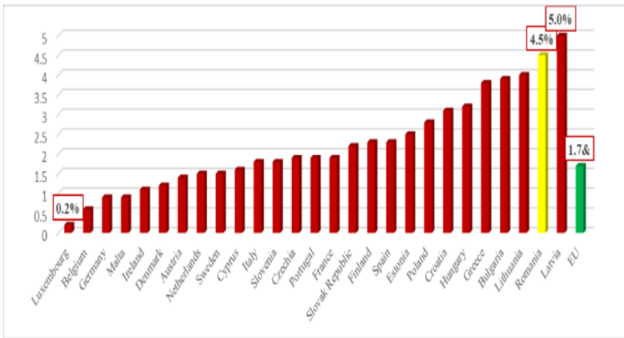

Fig. 6. Share of agriculture in Total GDP, at EU level, 2022
Source: [20].

Table 6. GDP structure by activity subsectors year 2000 compared to year 2021

Specification	2000		2021	
	Mil. lei	%	Mil. lei	%
Agriculture	8,777.9	10.8	53,619.0	4.5
Industry	20,253.5	25.0	243,830.7	20.6
Construction	4,221.5	5.2	73,538.2	6.2
Trade, transport, HoReCa	14,816.8	18.3	221,599.1	18.6
Information and communications	3,961.3	4.9	74,496.3	6.3
Financial intermediation and insurance	3,278.5	4.0	32,765.7	2,7
Real estate transactions	5,926.0	7.3	92,271.8	7.8
Professional, scientific and technical activities	1,973.7	2.4	82,272.4	6.9
Public administration and defense; social security from the public system, education, health and social assistance	7,600.7	9.4	167,064.8	14.0
Performing, cultural and recreational activities	2,217.1	2.7	31,602.8	2.7
Net taxes on the product	8,329.6	10.0	115,095.1	9.7
Total GDP	80,873.1	100.0	1,1874,02.4	100.0

Source: Own processing according to [13, 14].
*We analyzed the year 2021, because neither the Statistical Yearbook 2022 nor Romania in figures 2023, Statistical Brief contain the GDP structure by economic subsectors, but only by main sectors.

The large share of agriculture in the formation of the GDP of 4.5% in 2022 compared to 1.7%, which is the average of the EU and other member states, ranks Romania in 2nd place after Latvia, which has a share of 5.0% (Table 6).

Going in more detail in the analysis, i.e. following the structure of the GDP by activity subsectors, by comparing the year 2000 with the year 2021, (Table 6) it stands out the way in which the structure of the Romanian economy has transformed - in the last period of time.

this reflects the reversal of some trends who decided to change the development model: from one based on agriculture and industry, to one based on consumption and the presence of the state, currently.

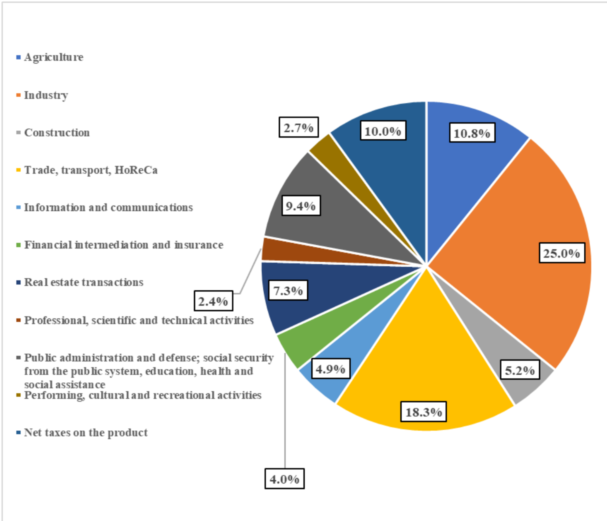

Fig. 7. GDP structure by branch in 2000, %
Source: Own design based on the data from [12].

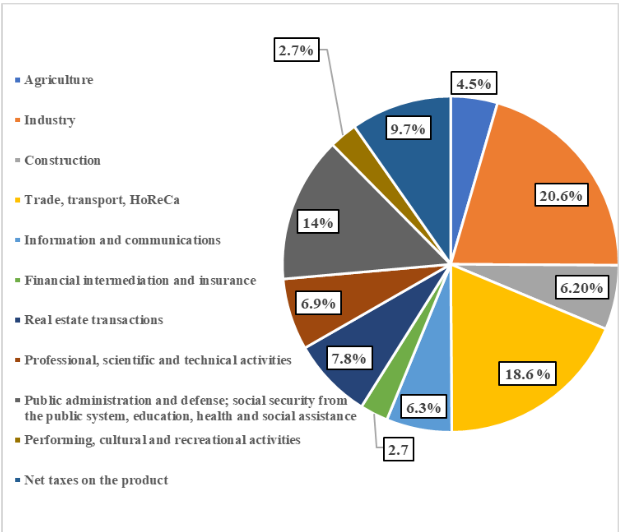

Fig. 8. GDP structure by branch in 2021, %
Source: Own design based on the data from [11].

Although the year 2021 brought a slight increase in the share of industry in the

Romanian economy, from 19.6% in 2020 to 20.6%, the share of industry in GDP recorded a sharp decline (after agriculture) in the economic branches, of about 4.4 percentage points in GDP.

The construction sector also lost ground, its weight decreasing by almost two percentage points.

CONCLUSIONS

Following the analysis, the authors drew a series of conclusions. Thus, although over time, it has undergone some conceptual methodological changes, taking into account the economic system Romania has gone through, the Gross Domestic Product has always been a complex indicator of the results of the Romanian economy.

Regarding the GDP structure by economic branches, there is a decrease in the weight with which agriculture participates in the formation of total GDP, followed by industry and the growth of the service sector.

However, the share with which agriculture participates in the formation of the Total GDP is still high compared to the EU average, indicating the poor performance of the other two sectors, especially industry.

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COMPARATIVE ANALYSIS OF INCOME AND EXPENDITURE TRENDS IN AGRICULTURAL HOUSEHOLDS IN ROMANIA

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Abstract

The study focused on the comparative analysis of income and expenditure trends in agricultural households in Romania. By using a comparative analytical framework, an investigation was conducted into how the evolution of income and expenses influences the economic condition of agricultural households. The primary aim of this research was to recognize fluctuations and patterns in the incomes of agricultural households, while examining how these factors influence farmers' purchasing choices. Through comparative analysis, we gained deeper insights into the expenditure structure in agricultural households across the development regions in Romania. Specialized articles from the main scientific databases were used for documentation. The research was conducted using official statistical data provided by the National Institute of Statistics for the period 2018-2022. The study's results highlighted that understanding the evolution of incomes and expenses in households, with a focus on the agricultural category, can enable the development of appropriate economic and social policies to support the overall well-being and economic development of Romania. Thus, it can be appreciated that the conducted research can provide valuable information in the analysis of sustainable development in the agricultural sector, for the improvement of farmers' quality of life and rural communities.

Key words: *agricultural households, income, expenditure, Romania*

INTRODUCTION

The national economy has undergone numerous transformations in recent years, and the well-being of households, especially farmers, has been a constant concern for specialized research. Romania's progress in achieving sustainable development goals is modest compared to the European average [3].

The purpose of this study was to provide a comprehensive perspective on the economic evolution of households and farmers, highlighting regional variations and significant changes in recent years.

The analysis of incomes, expenses, and their structure can have significant importance for various fields and can be used by multiple stakeholders, such as economists and researchers, the government and other public authorities, businesspeople, or the general population.

The research aimed to analyze the average incomes of households at the national and regional development level during the period 2018-2022. National income and expenditure were taken into consideration, with a focus on the social category of farmers. In recent times, researchers have shown increasing concerns regarding the analysis of territorial inequalities concerning household incomes. Therefore, Zaman, Goschin, and Vasile (2013) noted that this aspect should be examined from a multidimensional perspective, transcending traditional regional analyses of economic disparities, with an enhanced focus on elements of social inclusion and exclusion [15].

In the research conducted by Lupu (2018), significant inequalities were observed in terms of access and utilization of resources, with various discrepancies existing between regions in Romania. Low-income households face challenges in adapting to social, political, and economic changes [4].

Household incomes are influenced by the evolution of international agri-food markets. Significant differences between the incomes of Romanian farmers and those of other countries may be attributed to disparities in adopted wage policies, as well as factors related to the level and composition of the labor force [7].

Therefore, the research can provide a detailed perspective on regional inequalities and how they affect various social categories, especially farmers. Due to the limited job opportunities and relatively low incomes, a significant portion of rural residents are engaged in agricultural activities, primarily aimed at meeting the needs of their own households. This peculiarity of Romanian agriculture is not easily rectified, given that many farmers are elderly, and changing their field of activity is difficult and not necessarily desirable [1].

The differences between the average incomes and expenditures of agricultural households and those at the national level can be explained by the imbalance between the demand and supply of labor in agriculture, which can affect both the population and the financial performance of businesses in the sector, with implications for the national economy [5].

In an analysis conducted by Stanciu (2020) [14], it was found that there is a correlation between understanding the direction of buying habits and managing numerous economic challenges [5].

In the process of devising rural development strategies, it is essential to pay increased attention to human factors from various perspectives and in all their manifestations [2].

Among the numerous human factor analysis indicators are indicators related to average incomes, average expenditures, and the structure and proportion of household expenses.

In Romania, the operation of territorial administrative structures still does not entirely rely on the financial approach of the European Union (EU), which is a significant factor contributing to the dysfunction of regionalism at the national level [6].

In the process of formulating rural development strategies, it is essential to pay attention to human factors from as many perspectives as possible and in all their manifestations.

MATERIALS AND METHODS

Information regarding the income and expenditures of the population was obtained by accessing official data provided by the National Institute of Statistics (NIS) in Romania for the period 2018-2022. Scientific open access articles from ResearchGate, Clarivate, SCOPUS, and Google Scholar databases were used for documentation. Legislative aspects were selected from information provided by national and European public institutions. The collected data was statistically processed and graphically represented. The obtained results were compared with information from specialized literature for validation.

RESULTS AND DISCUSSIONS

The total average monthly household incomes are an essential component in assessing the economic health of the country and the well-being of its citizens (NIS, 2023a) These incomes represent the total amount of money entering a household on a monthly basis and serve as a crucial tool for quantifying the population's standard of living. Analyzing this financial information at the regional level can provide a detailed picture of economic inequalities in Romania. Significant differences exist in the incomes recorded among the development regions at the national level.

Table 1 presents information regarding the total average monthly household incomes for the development regions in Romania during the period 2018-2022.

Table 1. Monthly Average Incomes by Regions (RON)

	Region	2018	2019	2020	2021	2022
1	North-West	4,516	5,192	5,598	6,242	6,992
2	Central	4,426	5,041	5,705	5,944	6,766
3	West	4,172	4,840	4,986	5,434	6,430
4	South Muntenia	4,021	4,306	4,908	5,214	5,969
5	South-West Oltenia	3,638	4,210	4,563	5,041	5,754
6	South-East	3,706	4,257	4,506	4,775	5,440
7	North-East	3,414	3,860	3,971	4,553	5,145
National average		**4,251**	**4,790**	**5,216**	**5,683**	**6,464**

Source: Authors' by using [8] (2023).

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According to the presented data, a general trend of increasing average monthly household incomes can be observed in all regions and at the national level during the analyzed period, correlating with the national economic development.

At the national scale, average incomes saw a significant increase of 52% in 2022 compared to 2018. Notably, there's a notable variance in regional growth trends, with the highest observed in the Northwest Region (2,476 RON), and the lowest in the Northeast Region (1,367 RON). In concrete terms, the contrast between the highest and lowest-ranked regions in 2022 amounted to 1,847 RON, a figure higher than the monthly net minimum wage level recorded in 2022 (1,594 RON).

The Bucharest-Ilfov sector has the highest level of average monthly household incomes, while households in the Southeast and Northeast Regions have lower average incomes compared to other regions.

Table 2 showcases the average monthly household incomes across development regions. Throughout the analyzed period, a consistent upward trend akin to the national level is evident. Notably, the Northwest Region emerges with the highest average monthly incomes per household for farmers, while the Southwest Oltenia and Northeast Regions report the lowest average values. Of particular significance is the Northwest Region's outstanding performance, exhibiting a remarkable 90% growth, which stands as the highest at the national level.

Table 2. Average Monthly Incomes of Agricultural Households (RON)

	Region	2018	2019	2020	2021	2022
National average		2,770	2,937	3,151	3,505	4,352
1	North-West	3,407	3,508	4,171	4,109	6,506
2	Central	2,374	3,310	3,970	4,132	6,065
3	West	4,732	3,423	4,255	4,719	5,655
4	South Muntenia	2,849	3,669	3,156	2,696	5,274
5	South-West Oltenia	3,335	2,961	3,271	3,847	4,744
6	South-East	2,395	2,876	2,907	3,149	3,480
7	North-East	2,151	2,182	2,304	2,872	2,621

Source: Authors, by using [8] (2023).

The Central and South-Muntenia regions have recorded significant increases in farmers' incomes, displaying positive economic dynamics. There are significant differences in farmers' incomes across various regions. The North-West Region surpasses the national average. In terms of overall income, the South-West Oltenia Region ranks fourth nationally, but in terms of agricultural household incomes, it is at the bottom of the ranking. Although, overall, during the analyzed period, average incomes in the social category of farmers are lower than the national household incomes, their growth is more accelerated. Consequently, the increase in average household incomes at the national level from 2018 to 2022 is 52.06%, which is 5.19% less than the growth observed in rural areas.

This trend may indicate a positive dynamic in farmers' incomes but also a continuance of inequalities in income between social categories and regions. By comparing the growth in farmers' incomes with the national income growth, the effectiveness of existing agricultural policies can be evaluated. If farmers' incomes are increasing more rapidly than those at the national level, it could be an indicator of the success of agricultural sector support policies. Significant differences in household income growth may suggest the need for special strategies to be applied in regions with slower growth to reduce regional disparities. Economic development in the agricultural sector can influence the well-being and quality of life in rural areas.

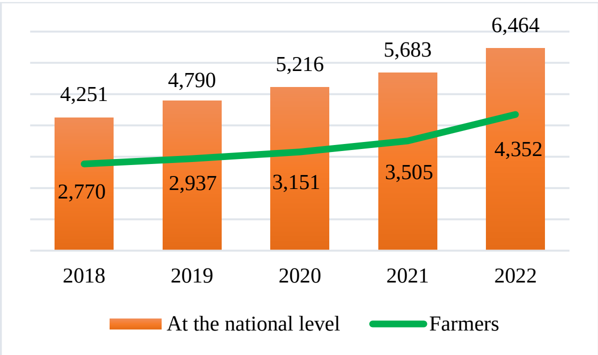

Fig. 1. Evolution of Average Total Incomes
Source: Authors, by using [8] (2023).

In Figure 1, a comparison between the evolution of average total incomes of farmers and those at the national level during the period 2018-2022 can be observed. In the year 2018, at the national level, average total incomes were significantly higher than those for farmers, with figures standing at 4,251 RON compared to 2,770 RON, respectively. Overall income averages across the nation, also saw a significant increase during the analyzed period (52.06%), reaching a value of 6,464 RON in 2022. The faster increase in incomes for farmers has led to a reduction in the difference compared to the national average, reflecting an overall improvement in the economic level.

Table 2 presents a comparison between household expenditures at the national level and those in the agricultural sector. Household expenditures can have a significant impact on the standard of living and savings. To assess the well-being and financial sustainability of a household, both incomes and expenditures must be quantified. By comparing income levels with expenditures, it can be determined whether households are able to cover their basic expenses and meet their long-term financial goals.

Table 3. Monthly Average Expenditures: National vs. Farmers

Region		2018	2019	2020	2021	2022
National average	All categories	3,667	4,092	4,372	4,876	5,611
	Farmers	2,532	2,752	2,822	3,190	4,025
North-West Central	All categories	4,048	4,542	4,725	5,371	6,157
	Farmers	3,199	3,349	3,494	3,868	5,929
West South Muntenia	All categories	3,758	4,245	4,704	4,925	5,765
	Farmers	3,262	2,974	3,265	3,112	5,135
South-West Oltenia South-East	All categories	3,090	3,508	3,526	4,083	4,588
	Farmers	2,255	2,768	2,666	2,922	3,199
North-East North-West	All categories	3,248	3,799	4,026	4,343	4,919
	Farmers	3,098	2,924	3,042	3,540	4,593
Central West	All categories	3,370	3,627	4,069	4,338	5,208
	Farmers	2,076	2,904	3,410	3,741	5,367
South Muntenia South-West Oltenia	All categories	3,173	3,616	3,847	4,295	4,993
	Farmers	2,110	2,068	2,122	2,758	2,553
South-East	All categories	3,643	4,128	4,214	4,573	5,254
	Farmers	2,640	2,379	2,832	2,375	4,514

Source: Authors' by using [9] (2023).

At the national level, during the analyzed period, the total average monthly household expenditures increased significantly, from 3,667 RON in 2018 to 5,611 RON in 2022. Agricultural households also experienced an expenditure growth from 2,532 RON (2018) to 4,025 RON (2022). The increase in expenditures is noticeable both at the national level and particularly for agricultural households. There are significant differences in total average monthly expenditures among various development regions.

The Northwest Region records higher expenditures compared to other regions, while the Southwest Oltenia Region reports lower expenditures, especially for farmers. The Northwest Region registered the highest increase in expenditures for farmers during the analyzed period. Farmers, in general, have lower expenses than the national average, indicating a relatively lower standard of living or a prevalence of the subsistence system. However, there is a significant increase in the expenditures recorded by agricultural households during this period, indicating an improved financial situation or a reduction in production for own consumption. The increase in farmers' expenditures can be influenced by agricultural policies and government support.

Supplementing the analysis with data on expenditures for purchasing food products by main social categories, monthly averages per person, can provide a more detailed perspective on the economic situation and how households manage food expenses.

Figure 2 displays the evolution of expenditures for agri-food products by major social categories (RON), highlighting the average monthly amounts per person, throughout the period 2020-2022.

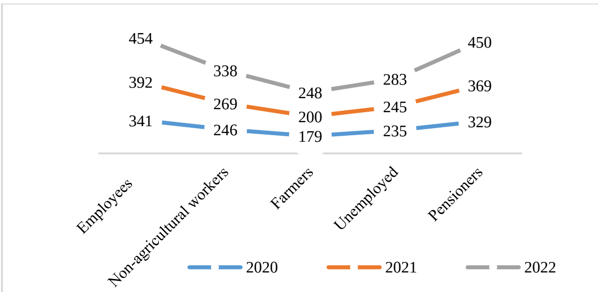

Fig. 2. Agri-Food Expenditures by Social Categories
Source: Authors', by using [10] (2023).

Expenditures on agri-food products per person have increased for all social categories, which can be linked to rising incomes and a higher standard of living for Romanians during the analyzed period. This increase may indicate that the population has additional financial means, allowing them to purchase a wider

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range of higher-quality food products and, practically, to increase the amounts allocated, given the rising prices of agri-food products.

According to the data presented in Figure 2, it is observed that farmers allocate a smaller sum of money for the purchase of agri-food products compared to other categories.

This observation can be approached from various perspectives. Economically, farmers may face financial constraints, experience income fluctuations depending on the season, and largely depend on crop performance. Socially, farmers may have dietary habits or preferences that result in lower expenses for agri-food products. Many agricultural households in Romania practice subsistence farming, benefit from food resources from their own production, and have a smaller budget for expenses in this category. The allocation of small amounts of money by farmers for agri-food products can also indicate that they prioritize financial resources differently than other categories.

The structure of agri-food expenditures by social categories correlates with the proportion of expenditures on product and service categories.

In Figure 3, the proportion of total expenditures allocated at the national perspective is illustrated, and Figure 4 displays the distribution of these expenditures among farmers, specifically for the acquisition of agricultural-food products and non-alcoholic drinks, for which farmers allocate approximately 44%. The percentage allocated among farmers is higher than the national average (34%), but nevertheless, the actual amounts allocated, calculated based on these percentages, are lower.

Additional data analysis and comparisons between the percentages of product and service categories provide insights into how the Romanian population manages expenditures and how they fit into a broader context of life and business.

The configuration of overall household spending across the country for the year 2022 is depicted. This information at the countrywide scale offer an insight into the priorities and preferences of Romanian households' expenditures in the last year of the analyzed period. Most of the expenditure is directed towards basic needs, such as food and housing, which may indicate that a significant portion of the population is facing economic difficulties.

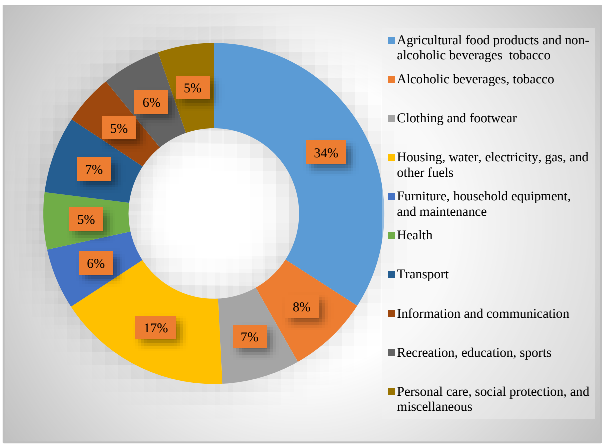

Fig. 3. Expenditure Distribution at the National Level
Source: Authors' by using [11] (2023).

Agri-food items and non-alcoholic drinks account for a substantial segment (34.1%) of household spending across the nation, underscoring the pivotal role that food plays within their financial planning.

Spending on living quarters: electricity, gas, water services, and additional fuels represents 16.6%. Nationwide, the sum of these primary categories surpasses 50% of the total outlays, command a substantial share of the budget, leaving a smaller proportion for other needs. Expenditures on the purchase of alcoholic beverages and tobacco account for 7.7%, reflecting a higher inclination of households towards these products compared to even the amounts allocated for health, which represent a smaller share, at only 5.4%.

Another interesting aspect is that only 4.8% of the household expenditure budget is allocated to resources for technology, information, and communication. This may indicate an increased need for education and awareness of the benefits of these products and services. In the lower part of the ranking are expenses related to recreation, education, sports, personal care, social protection, and various other services.

The structure of total expenditures, at the national level, is influenced by several factors such as income levels, cost of living, cultural habits, and individual preferences.

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Government policies, including subsidies for certain categories or taxes, can influence how households allocate their budgets. These policies can encourage or discourage certain types of expenditures.

By comparing the expenditure structure in agricultural households with that at the national level, differences in how farmers allocate their financial resources can be observed (Figure 4).

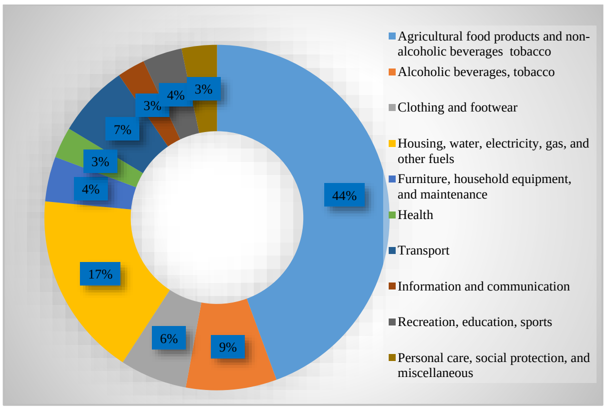

Fig. 4. Distribution of Expenditures in Agricultural Households
Source: Authors' by using [11] (2023).

According to the data, it can be observed that the needs of farmers can be influenced by the specific requirements of agricultural activities. These include the purchase of products for personal consumption, along with the requirement for investments in farming machinery and technological advancements.

In relation to costs for housing and services, this specific sector of farmers sets aside 17.3% of their overall budget. The variation compared to the national benchmark could be associated with the specific housing needs in rural areas. Higher costs may be due to factors such as limited access to services and infrastructure.

Farmers spend 8.5% of their budget on alcoholic beverages and tobacco. Regarding health, they allocate a smaller percentage of 2.9% of their budget, compared to the national average of 5.4%. This situation may be determined by limited access to medical services in rural areas and may indicate a need to increase investments in this sector. Other expenditure categories have relatively similar proportions, with small differences between farmers' households and the national average.

The activities of farmers encourage consumer behavior directed towards domestic consumer goods and influence the distribution of total income. This aspect has also been analyzed by Silvius S., who has concluded that the development of the segment of domestically marketed products represents one of the most evident changes in consumer behavior and acquisitions at both the European and national levels [13].

It is useful to analyze and promote education and training programs for farmers to help them make more informed financial decisions and improve their agricultural practices to enhance the sustainability of these activities.

CONCLUSIONS

During the period 2018-2022, a significant increase in average monthly household incomes was recorded both nationally and among farmers. The increase in national incomes was approximately 52%, while that of farmers was even higher at 57.25%, indicating an overall improvement in the financial situation. The analysis revealed significant differences among the development regions of Romania. The Northwest development region recorded the highest average monthly incomes, while the Southwest Oltenia had the lowest values. These differences reflect regional economic inequalities. The disparities between regions indicate the need for the development of equitable regional development tools to reduce economic inequalities and ensure balanced economic growth across the country. The Central and South-Muntenia regions experienced significant increases in incomes for agricultural households, signaling positive economic developments. Despite agricultural households earning below the national mean, their income growth rate exceeded that of the national standard average. An accelerated increase in household expenditures relative to income levels can suggest a convergence trend between available income and expenditure levels.

The high percentage of agri-food product expenditures out of total household income highlights the global issue of food waste and loss. Increased consumption and higher food demand, coupled with inadequate consumer education and lack of information, result in one-third of global food production being wasted, while people worldwide face hunger and malnutrition [12].

Farmers play a significant role in the national economy, and the increase in their expenses can support rural development and the local economy. Economic and social policies must consider the needs of different social groups and regions to ensure economic development.

Research results can serve as a basis for developing impact strategies to enhance economic growth and raise living standards. Additionally, they can contribute to reducing inequalities and ensuring balanced economic growth throughout the country.

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EXTERNAL AND INTERNAL THREATS TO FOOD SECURITY

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Abstract

Food security is a paramount global concern, where the delicate balance of availability, affordability, and stability of food resources faces continuous threats from external and internal factors. The present paper provides an in-depth research work of these threats, examining their multifaceted impacts on agricultural systems and the global food supply. Through an extensive analysis of contemporary literature and empirical evidence, the present study navigates the complex web of challenges that threatens food security. Insights gathered from this research pave the way for potential strategies to mitigate the threats, promoting a more sustainable global food landscape. It emphasizes the urgency of a collective and interdisciplinary approach to preserve the future of food security in an evolving and challenging global environment.

Key words: *food security, external threats, internal threats, agriculture, political instability*

INTRODUCTION

The foundational pillar of human well-being is inextricably intertwined with the concept of food security, a condition that ensures that people have continuous access to sufficient, safe, and nutritious food for a healthy and prosperous existence [30]. However, achieving this critical balance is constantly challenged by a complex interaction of external and internal factors, which necessitates careful research work on the multilateral challenges that impedes global food security.

External threats, emblematic of the complex environmental changes caused by climate change, have emerged as major determinants that affect the stability and availability of food resources globally [22]. The increase in extreme weather events, changes in rainfall patterns, and changes in temperature regimes are contributing to the vulnerability of agricultural systems, impacting crop yields and compromising the overall sustainability of food production [10]. At the same time, geopolitical conflicts and their side effects are becoming increasingly powerful disruptors of the global food supply chain, manifesting in trade disruptions, food embargoes, and local hunger. These external dynamics therefore necessitate nuanced and adaptive strategies to strengthen food security in an ever-changing global landscape.

Along with external threats, internal challenges rooted in the structure of agricultural practices and distribution systems further complicate the quest for food security. Unsustainable agricultural practices, driven by a combination of resource mismanagement and economic constraints, contribute to soil erosion, reduce agricultural productivity and compromise the long-term viability of food systems [20]. Furthermore, inefficiencies in distribution systems perpetuate inequitable access to food resources and intensify issues of food affordability and equity [11].

This complex interplay of external and internal factors forms a complex web of challenges that defy simple solutions, requiring an interdisciplinary lens to understand the complex dynamics that threatens global food security. Therefore, in-depth research work on both external and internal threats becomes imperative to lay the foundations for evidence-based, sustainable, and resilient strategies to strengthen global food systems.

MATERIALS AND METHODS

A comprehensive review of existing literature was conducted to identify and analyze external and internal threats to food security. Peer-reviewed scientific journals, reports from international organizations, and data from agricultural databases were systematically surveyed to gather information on the impact of climate change, geopolitical conflicts, agricultural practices, and other important factors on food security. The analysis aimed to provide a comprehensive understanding of the interconnected character of these threats and their implications for global food systems. The present paper quotes pieces from works of Bulgarian and foreign authors. Summaries and conclusions are made. Some of the results are presented by figures.

RESULTS AND DISCUSSIONS

External Threats to Global Food Security

Food security, a cornerstone of human well-being, faces an increasingly complex set of external threats that challenge the delicate balance of availability, affordability, and stability of food resources on a global scale. The aim is to provide a comprehensive overview of external threats to global food security, highlighting their diverse character and emphasizing the urgent need for interdisciplinary solutions. External threats to food security include: *climate change, natural disasters, pest and disease outbreaks, global trade disruptions, global economic turmoil, political instability and conflict, health crises, and land erosion* (Figure 1).

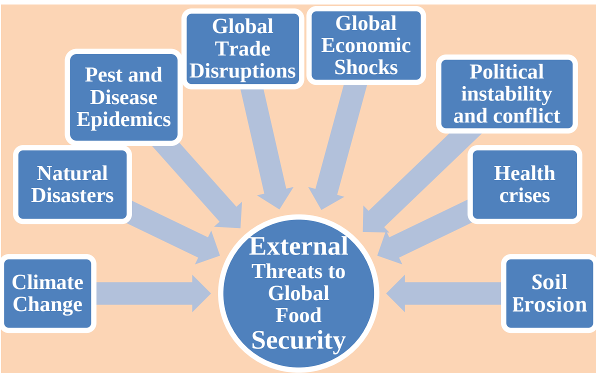

Fig. 1. External Threats to Global Food Security
Source: Information summarized by author.

Climate Change

Climate change, characterized by changes in long-term weather patterns, is emerging as a complex and pervasive threat to global food security.The diverse effects of climate change, including severe weather occurrences, alterations in rainfall patterns, increasing temperatures, and shifts in the frequency and severity of climate-related disasters, present considerable obstacles to global agricultural practices and food production. [21].

A significant sign of climate change is the growing frequency and intensity of extreme weather phenomena. Floods, droughts, hurricanes, and heat waves are becoming more common, disrupting agricultural operations and causing significant losses in crop yields [21]. These events not only directly damage crops but also cause soil erosion and nutrient depletion, further compromising the long-term productivity of agricultural lands.

Changes in precipitation patterns, including variations in the intensity and distribution of precipitation, have profound implications for agriculture [21]. Excessive rainfall can lead to waterlogging and leaching of nutrients, which harms crop growth, while prolonged droughts lead to water scarcity and reduce irrigation capacity and agricultural production.

Rising global temperatures are contributing to changes in vegetation and altering the suitability of regions for certain crops [21]. Thermal stress on crops affects their development, ripening, and overall productivity, which leads to changes in the geographical distribution of suitable areas for growing different crops.

Disasters linked to climate, like wildfires and storms, are occurring more often and with greater severity, leading to immediate harm to crops, livestock, and farming infrastructure. These events often result in soil degradation, reduction of cultivable land, and interruptions in distribution networks, exacerbating issues related to food security. Additionally, the effects of climate change are not limited to land-based ecosystems, as rising sea levels also impact coastal regions and agricultural zones at lower elevations [21]. The encroachment of saltwater into freshwater supplies undermines the viability of land for farming, particularly in areas reliant on rice cultivation. Addressing the effects of climate change on worldwide food security necessitates a comprehensive strategy that includes adaptive measures, sustainable farming techniques, and global collaboration [8]. Enhanced efforts in scientific research, investment in climate-resilient crop varieties, and the promotion of climate-friendly agricultural techniques are integral components of a comprehensive strategy to strengthen global food security in the face of ongoing climate change challenges.

Natural Disasters

Natural disasters, characterized by sudden and intense geological, meteorological, or hydrological events, pose a significant threat to global food security. These events, ranging from earthquakes and hurricanes to tsunamis and wildfires, can cause widespread and profound impacts on agricultural systems, disrupting food production, distribution networks, and overall food availability [4]. Earthquakes resulting from tectonic plate movements have the potential to cause severe damage to agricultural infrastructure, including irrigation systems, storage facilities, and transportation networks [4]. Soil displacement, soil shaking, and changes in topography can compromise cropland productivity, leading to both short- and long-term disruptions to food production.

Tropical storms such as hurricanes and typhoons, characterized by strong winds and heavy rainfall, can cause significant damage to crops and livestock [4]. Accompanying floods and storm surges can lead to soil erosion, salinization, and loss of arable land, which further impacts the agricultural sector and compromises food security.

Tsunamis triggered by underwater seismic activity can flood coastal areas and lead to saltwater intrusion into fertile lands [4]. This infiltration negatively affects soil quality and renders agricultural land unsuitable for cultivation, posing a long-term threat to food production in the affected regions.

Wildfires, often aggravated by prolonged periods of drought and high temperatures, can devastate agricultural landscapes, destroying crops, orchards, and rangelands [4]. Consequences of wildfires include soil degradation and nutrient loss, affecting the resilience of ecosystems that support food production.

Cyclones, characterized by strong winds and heavy rainfall, can cause extensive crop damage and disrupt agricultural operations, especially in coastal areas [4]. Subsequent floods can lead to waterlogging and nutrient leaching, which harms soil health and agricultural productivity.

Volcanic eruptions, although less frequent, can have a profound impact on agriculture through the deposition of ash and volcanic materials [4]. This ash fall can disrupt sunlight penetration, alter soil pH, and introduce toxic elements, adversely affecting yields and food production.

Mitigating the impact of natural disasters on global food security requires a multi-pronged approach, including pre-disaster preparedness, sustainable agricultural practices, and effective post-disaster response mechanisms [7]. Strengthening early warning systems, implementing sustainable land use practices, and improving adaptive capacity within vulnerable communities are key components of a comprehensive strategy to address the complex challenges posed by natural disasters to food security.

Pest and Disease Epidemics

Pest and disease outbreaks affecting crops, livestock, and fisheries are persistent and multifaceted threats to global food security. These biological challenges, often intensified by environmental change and globalization, can significantly reduce agricultural productivity, threatening the availability of food for populations worldwide [11].

In agriculture, pests such as insects, fungi, and nematodes pose constant challenges to crop production. Invasive species driven by globalization and climate change can spread rapidly and destroy crops, resulting in significant yield losses [11]. Examples include the fall armyworm, which has demonstrated its ability to devastate maize crops on continents [9].

Livestock diseases, ranging from viral and bacterial infections to parasitic infestations, have profound implications for food security due to their impact on animal health and productivity. Foot-and-mouth disease, for example, can cause significant economic losses and disrupt livestock livelihoods [11].

Diseases affecting aquatic species in the fishery can lead to mass mortality and reduced fishing catches. The emergence of new pathogens in aquatic environments, often associated with environmental changes and aquaculture practices, poses challenges to the maintenance of fish resources [13].

The emergence of new and more dangerous plant diseases, such as those caused by fungi and bacteria, introduces uncertainty into agricultural ecosystems. Pathogens such as bacterial wilt affecting bananas and tomatoes emphasize the dynamic character of plant diseases and their potential to cause widespread crop failure [13].

Globalization plays a major role in the spread of pests and diseases, facilitated by increased international trade and travel. Invasive species unintentionally transported across borders can establish in new regions and pose a threat to local agriculture [2]. This enhanced the interconnected nature of global food systems and the need for international cooperation in pest and disease management.

Mitigating the impact of pest and disease outbreaks on global food security requires a holistic and integrated approach. This includes the development and implementation of sustainable agricultural practices, the promotion of resilient crop varieties, and the improvement of early detection and rapid response mechanisms [13]. Furthermore, international cooperation is crucial to address the transboundary nature of these challenges and prevent the spread of pests and diseases across borders.

Global Trade Disruptions

Global trade disruptions resulting from trade conflicts, protectionist measures, or geopolitical tensions pose complex challenges to global food security. While the interlinkage of global markets fosters economic expansion, it also introduces weaknesses in the food supply chain that can have worldwide repercussions, impacting the availability and cost of food [32]. International trade disputes, frequently manifested in the form of tariffs and trade obstacles, can hinder the cross-border movement of agricultural commodities. Such tariffs may result in higher prices for imported food items, impacting the affordability of food in countries that rely on imports [32]. Ongoing trade tensions between major economies highlight potential risks to global food security.

During periods of crisis or geopolitical tension, countries may implement food export restrictions to ensure domestic supplies. Although a protective measure for the exporting nation, these restrictions can escalate food shortages in importing countries, especially those that are highly dependent on staple food imports [32].

Global food supply chains, intricately linked through complex networks of producers, distributors, and retailers, are vulnerable to disruptions caused by trade tensions. Any supply chain disruptions, whether due to logistical challenges or geopolitical events, can lead to delays, shortages, and increased food prices [32].

Countries highly dependent on global markets for their food supply face increased risks during trade disruptions. Reliance on imports of essential commodities exposes these countries to the uncertainty of international trade relations, potentially compromising their ability to secure stable and affordable food supplies [32]:

Trade disruptions can disproportionately affect small-sized farmers in developing countries who rely on international markets for income. Reduced access to global markets due to trade tensions can hamper their economic prospects and sustainability, further perpetuating poverty and food insecurity [15].

Global trade disruptions contribute to increased volatility in food prices and affect both importing and exporting countries. Sudden changes in trade dynamics can lead to price spikes, which makes food less affordable for vulnerable populations and escalate food insecurity [32].

Mitigating the impact of global trade disruptions on food security requires a coordinated and multifaceted approach. This includes promoting transparent and predictable trade policies, increasing the resilience of local food systems, and promoting international cooperation to address the root causes of trade tensions [15].

Global Economic Shocks

Global economic shocks, characterized by widespread economic downturns, financial crises and disruptions in international trade, have profound implications for agricultural systems and global food security. These shocks, often triggered by factors as diverse as recessions, currency fluctuations and commodity price volatility, can lead to complex challenges that reverberate throughout the food supply chain [31].

Economic shocks contribute to increased volatility in commodity prices, which affect key agricultural inputs such as fertilizers, fuels and machinery. Fluctuations in these prices can affect production costs, affect farmers' decision-making processes, and potentially lead to changes in crop choices and land-use practices [31].

Economic downturns can disrupt international trade flows, affecting exports and imports of agricultural goods. Reduced demand for exports can affect the incomes of exporting nations, while disruptions in imports can lead to shortages and higher prices in importing countries, especially those that are highly dependent on global food markets [31]. Economic crises often limit access to financial resources for agricultural production. Reduced credit availability and increased interest rates can limit farmers' ability to invest in inputs, technology and infrastructure, potentially leading to reduced productivity and agricultural output [31].

Rural communities, heavily dependent on agriculture for their living, are particularly vulnerable to economic shocks. Income losses, reduced employment opportunities and increased poverty levels can compromise the stability of these communities, contributing to increased food insecurity [31].

Economic shocks can affect consumers' purchasing power by affecting their ability to afford food. Sudden economic downturns or financial crises can lead to income loss and food price increase, limiting access to nutritious food for vulnerable populations [31].

Governments facing economic challenges may experience budget constraints, affecting their ability to implement effective agricultural policies and provide support to farmers. Reduced public investment in agriculture can hinder efforts to increase productivity and sustainability in the sector [31].

Mitigating the impact of global economic shocks on agricultural systems and food security requires a comprehensive and adaptive approach. This includes measures such as social safety nets to protect vulnerable populations, policies to stabilize commodity prices, and international cooperation to address systemic problems contributing to economic shocks [31].

Political Instability and Conflicts

Political instability and armed conflict, widespread challenges in different regions, have profound and far-reaching impacts on agricultural systems, food production and global food security. The complex interconnections between political dynamics and food security necessitate an in-depth study of the multifaceted consequences of such disruptions [7, 17].

Political instability and conflicts often lead to population displacement and disruption of agricultural activities. Forced migration, whether within borders or between nations, uproots communities and disrupts traditional agricultural practices, leading to immediate and long-term consequences for food production [7].

Conflict zones often experience acute food shortages due to disruptions in production, distribution and access. The destruction of infrastructure, including transport networks and markets, impedes the movement of food, contributing to localized and sometimes widespread food insecurity [7].

Ongoing conflicts often impede humanitarian access to affected populations, making it challenging to deliver basic food aid and support. Access constraints, security risks and logistical challenges impede timely and sufficient delivery of food aid to those in need [17].

Political instability and conflicts lead to the destruction of livelihoods, especially in rural areas that are heavily dependent on agriculture. Farmers may lose their land, livestock and equipment, escalating poverty levels and hindering the recovery of affected communities [7].

Conflict zones have witnessed the destruction of vital agricultural infrastructure, including irrigation systems, storage facilities and processing plants. The purposeful destruction of such infrastructure disturbs the entire agricultural value chain and breaks the sustainability of food systems [17].

Long-term conflicts contribute to a decline in agricultural productivity as a result of reduced investment, lack of technology transfer and abandonment of sustainable agricultural practices. This, in turn, has long-term implications for the recovery and reconstruction of post-conflict food systems [7].

Conflict intensifies social and economic disparities, as disproportionately affects vulnerable groups. Women, children and marginalized communities often bear the burden of the consequences, facing increased risks of malnutrition, displacement and limited access to resources [17].

Managing the complex interaction between political instability, conflict and food security requires concerted efforts on multiple fronts. Strategies include conflict resolution and prevention, post-conflict recovery, investment in sustainable agricultural systems, and the promotion of inclusive policies that prioritize the needs of vulnerable populations [17].

Global Health Crises

Global health crises, typical for pandemics such as the COVID-19 pandemic, present multifaceted challenges that extend beyond public health to affect food supply chains and global food security [14, 23].

Health crises disrupt various elements of food supply chains, including production, processing, transport and distribution. Movement restrictions, lockdowns and health protocols contribute to labor shortages, logistical challenges and disruptions in the flow of goods, which affect food availability in local and international markets [14].

Health crises often result in labor shortages in the agricultural sector because of illness, quarantine measures or worker migration. Reduced labor availability impedes agricultural activities such as planting, harvesting and processing, thereby affecting overall productivity and causes disruptions in the food supply chain [23].

The financial fallout from health emergencies, such as unemployment and diminished earnings, impacts individuals' buying power and their capacity to obtain food. This challenge in affording food is increasingly becoming a significant issue, particularly for at-risk groups, contributing to a rise in food insecurity [23].

The globalized nature of food supply chains increases their vulnerability to disruption during health crises. Interconnectedness and cross-border dependencies make it difficult to limit impacts to specific regions, as seen during the ripple effects of the COVID-19 pandemic on international trade and food distribution [14].

Health concerns have an impact on consumer behavior leading to changes in food preferences, purchasing patterns and demand for specific products. These changes can create challenges for manufacturers and suppliers, requiring adaptability to evolving market dynamics [23].

Transport restrictions, that is a key component of food supply chains, can lead to delays in the supply of agricultural raw materials and finished products. Perishable goods may spoil, contributing to food waste, while non-perishable goods may experience long transport times, affecting overall food availability [15].

Health crises require adaptation and innovation in food supply chains. Technologies such as online agricultural trading platforms, contactless delivery systems and digital supply chain management solutions are emerging as strategies to address disruptions and ensure a continuous flow of food products [23].

Navigating the complex interplay between health crises and food security requires a comprehensive approach. Strategies include strengthening local food systems, increasing the resilience of supply chains, implementing crisis response policies and promoting international cooperation to address systemic vulnerabilities [15].

Soil Erosion

Soil erosion, a complex and multifaceted environmental challenge, poses a significant threat to agricultural systems and the overall global food security landscape. This phenomenon, driven by unsustainable land use practices, deforestation and soil degradation, has far-reaching consequences for the capacity of land to support food production [26, 11].

Unsustainable agricultural practices, such as excessive chemical use, monoculture farming and poor land management, contribute to the degradation of cultivated land. Soil erosion, loss of soil fertility and reduced water holding capacity are among the results of these practices, reducing the ability of the land to support productive agriculture [26].

Deforestation caused by agricultural expansion and other changes in land use leads to the loss of critical ecosystems. Forests, which have a crucial role in soil conservation and maintaining biodiversity, are essential for sustainable land management. Their destruction contributes to soil erosion, reduced water quality and disruption of the ecological balance, all of which affect agricultural productivity [26].

Soil degradation encompasses processes such as nutrient depletion, salinization and acidification. Prolonged cultivation without adequate nutrient replenishment and sustainable practices leads to poor soil health. Depletion of essential nutrients, such as nitrogen and phosphorus, compromises soil fertility and reduces its capacity to support diverse and productive crops [11].

Land degradation leads to the loss of arable land, which reduce the total land available for cultivation. This, combined with reduced soil fertility, results in reduced yields. Main food crops are particularly vulnerable, which leads to challenges in meeting the growing global food demand [26].

Land degradation contributes to water scarcity because degraded soils have a lower capacity to retain water. In arid and semi-arid regions, the desertification process is intensifying, turning fertile land into unproductive desert landscapes [18]. This further escalates the challenges to sustaining agriculture in the affected areas [26].

Land degradation contributes to climate change through feedback mechanisms. Deforested areas, for example, reduce the capacity to capture carbon dioxide, worsening greenhouse gas emissions. Climate change, in turn, can intensify land degradation processes, which create a feedback loop that further compromises the agriculture sustainability [26].

Land degradation management and its implications for global food security requires comprehensive strategies. Sustainable land management practices, afforestation efforts and the promotion of agro-ecological approaches are integral components of a sustainable and productive agricultural system [11, 26].

Each of these factors poses unique challenges that disrupt the delicate balance of food production, distribution, and availability worldwide. The multifaceted nature of these threats underscores the urgent need for interdisciplinary and international cooperation to devise and implement effective strategies for mitigation and adaptation.

Key to addressing these challenges is the adoption of sustainable agricultural practices, enhancement of global and local food systems' resilience, and commitment to continuous scientific research and innovation. Equally important is the role of policy-making that supports transparent trade practices, stabilizes economies, and prioritizes the needs of the most vulnerable populations.

The interconnectedness of these threats also highlights the importance of a proactive approach in anticipating and preparing for future challenges. This involves strengthening early warning systems, investing in climate-resilient agriculture, promoting sustainable land use, and fostering global cooperation to manage and mitigate the impacts of these threats on food security.

In essence, ensuring global food security in the face of these external threats requires a concerted effort from governments, international organizations, the private sector, and communities. By working collaboratively and strategically, it is possible to build a more robust, equitable, and sustainable global food system capable of withstanding the challenges of today and tomorrow.

Internal Threats to Food Security

Global food security faces internal challenges primarily stemming from agricultural systems, especially due to unsustainable methods and the intensification of agriculture. This section offers an in-depth examination of these challenges, emphasizing their impact on food production, biodiversity, and enduring sustainability.

A schema on internal threats is shown in Fig. 2.

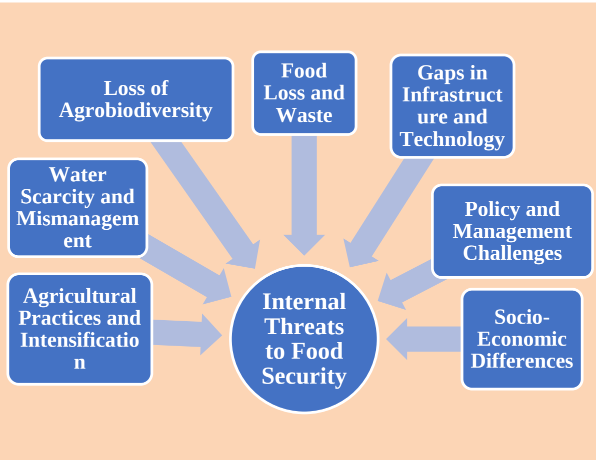

Fig. 2. Internal Threats to Food Security
Source: Information summarized by author.

Agricultural Practices and Intensification

One internal threat results from the excessive use of agrochemicals in modern agriculture. The application of fertilizers and pesticides contributes to soil degradation, which have a negative impact on soil structure, fertility and overall health [19]. This method jeopardizes the enduring viability of agricultural systems.

Monoculture, or cultivating a single type of crop across large expanses, poses another internal risk. This approach diminishes biodiversity and increases the vulnerability of crops to pests and diseases [25]. Lack of crop diversity undermines the resilience of agricultural ecosystems.

Poor land management practices, such as improper irrigation and erosion control, contribute to soil degradation. This internal threat reduces the capacity of the land to sustain agricultural productivity in the long term [19].

The intensification of agriculture often leads to a soil fertility decrease. Continuous cultivation without proper soil management depletes essential nutrients, affecting crop quality and posing a lasting domestic challenge to food security [25].

Excessive use of agrochemicals, monoculture practices, poor land management and impacts on soil fertility collectively compromise the sustainability and resilience of agricultural systems. Addressing these domestic challenges is essential to fostering a more sustainable and secure global food landscape.

Water Scarcity and Mismanagement

Water scarcity and mismanagement pose enormous domestic threats to global food security, affecting the availability and efficiency of water resources crucial to agricultural production. This section provides a detailed analysis of the domestic challenges posed by water scarcity and mismanagement, exploring their implications for food systems.

One of the internal threats arises from inefficient irrigation practices in agriculture. In many regions, conventional irrigation methods lead to significant water loss due to over-irrigation or inefficient distribution systems [16]. This intensifies water scarcity concerns and compromises the sustainability of food production.

Over-abstraction of groundwater for agricultural purposes contributes to domestic water scarcity. In regions highly dependent on groundwater, excessive pumping can lead to depletion of aquifers, affecting both current and future water availability [24].

Internal threats also arise from the pollution of water sources used in agriculture. Pollution from agricultural runoff, agrochemicals and industrial discharges poses risks to water quality, affecting both the environment and the suitability of water for irrigation [16].

Water scarcity directly affects crop yields and food production. In regions where water is a limiting factor, reduced irrigation can lead to reduced agricultural productivity, affecting the overall availability of food resources [24].

Water scarcity directly affects crop yields and food production. Inefficient irrigation practices, over-extraction of groundwater, pollution of water sources and the consequent impact on yields collectively contribute to the vulnerability of food systems. Addressing these domestic challenges is imperative to ensure sustainable water use and increase the sustainability of global food production.

Loss of Agrobiodiversity

Global food security is also threatened internally by the diminishing agrobiodiversity in farming systems. This section thoroughly examines the issues arising from reduced crop diversity, discussing how it affects resilience, adaptability, and sustainability in the long run. Furthermore, the use of high-yielding varieties (HYVs) has played a significant role in the decrease of agrobiodiversity in modern agriculture. The widespread cultivation of a limited number of genetically uniform crops optimized for high productivity reduces the overall diversity of cultivated plants [3].

A decrease in crop diversity increases the vulnerability of agricultural systems to pests, diseases and environmental stress. Monocultures resulting from HYV adoption lack the genetic variability necessary for natural resistance, making crops more susceptible to internal threats [29].

Loss of agrobiodiversity reduces the resilience of food systems. Diverse crop varieties provide a natural buffer against environmental fluctuations and uncertainties, increasing the adaptability and resilience of agriculture [3]. Agricultural systems with reduced agrobiodiversity face constraints in adapting to changing climate conditions. Lack of genetic diversity limits the crop ability to develop and thrive under new climate scenarios, which poses intrinsic challenges to long-term food security [29].

The adoption of high-yielding varieties, increased vulnerability to pests and diseases, reduced resilience of food systems, and constraints on climate adaptation collectively call into question the sustainability and adaptability of agriculture. Managing these domestic challenges is crucial to fostering a diverse and sustainable global food landscape.

Food Loss and Waste

Global food security faces internal threats due to the substantial issue of food loss and waste along the food supply chain. This section delivers a detailed exploration of the internal aspects of food loss and waste, elucidating their complex consequences for resource utilization, sustainability, and food security.

The inefficiency of post-harvest practices is such a internal threat, where inadequate handling, storage and transportation contribute to significant food loss. Post-harvest losses occur at various stages of the supply chain, from farm to market, undermining efforts to optimize resource use [12].

Lack of proper storage facilities is a key domestic challenge that leads to food wastage. Insufficient storage infrastructure for perishable goods leads to spoilage, reducing the total quantity and quality of food available for consumption [13].

Internal factors also include consumer behavior that contributes to food waste. Practices such as over-purchasing, improper storage at home and discarding edible food products escalate the overall impact of food waste in communities [12].

The difficulty in reallocating excess food to those who need it is a key internal factor contributing to food loss and waste. Challenges in logistics, regulatory barriers, and insufficient collaboration among involved parties obstruct attempts to divert surplus food to regions struggling with food insecurity [12]. Apart from the direct effects on food accessibility, internal elements associated with food loss and waste also have environmental consequences. The breakdown of thrown away food leads to the production of greenhouse gases, which adds to climate change and further exacerbates challenges in global sustainability [12].

Inefficient post-harvest practices, inadequate storage, consumer behaviour, redistribution challenges and environmental impacts together highlight the need for comprehensive strategies to address internal inefficiencies in the food supply chain.

Gaps in Infrastructure and Technology

Internal risks to worldwide food security are closely tied to the lack of infrastructure and technological advancements in agricultural systems. This comprehensive analysis delves into the intricacies of these domestic issues, examining how shortcomings in infrastructure and technology hinder the effectiveness of food production and distribution globally. Inadequate road infrastructure significantly undermines the effectiveness of food distribution systems. In regions with inadequate or substandard roads, transit times increase, resulting in delays in the transport of agricultural production and an increased risk of post-harvest losses [1].

Internal threats are amplified when there is limited access to modern agricultural technology. The lack of advanced tools and machinery hinders the adoption of efficient farming practices, which affect the productivity and overall sustainability of agricultural systems [27].

The lack of adequate storage facilities represents a significant domestic challenge to global food security. Inefficient post-harvest storage leads to increased food losses, especially in regions where perishable crops prevail, affecting the availability of food for consumption [12].

Infrastructure and technology gaps disproportionately affect smallholder farmers, which may lack the resources to overcome these challenges. The limitations in access to markets and productivity contribute to internal threats, as they cause poverty and impede sustainable agricultural practices [27].

Managing infrastructure and technology gaps is crucial to improving global food security. Investments in transport, the promotion of modern agricultural technologies, improved storage facilities and targeted support for smallholder farmers collectively form the basis for building sustainable and efficient food systems.

Policy and Management Challenges

Internal threats to global food security are closely related to policy and governance challenges governing agricultural systems. This comprehensive analysis delves into the nuanced nature of these internal threats, exploring their multifaceted impacts on the development of sustainable and resilient food systems.

A critical domestic challenge lies in the formulation and implementation of agricultural policies. When policies lack coherence, they fail to adapt to the dynamic nature of agriculture, or prioritize short-term gains over long-term sustainability, they contribute significantly to internal threats to food production and distribution [5]. Inadequate investment in rural development is a significant domestic challenge. Insufficient financial allocation for rural areas affects critical aspects such as infrastructure, education and health, which keep the differences and hinder the creation of resilient and sustainable food systems [28].

The effectiveness of internal governance structures is fundamental to the integrity of food systems. Faults in governance, such as corruption, lack of transparency and ineffectiveness of regulatory bodies, reduce the capacity to implement and enforce policies effectively, intensifying domestic threats to food production and distribution [5]. Policy and governance challenges have a direct impact on the promotion and adoption of sustainable agricultural practices. In the absence of clear policies that support environmentally sound and socially responsible farming methods, domestic threats to soil health, biodiversity and ecosystem resilience persist [5].

Coherence and adaptability of agricultural policies, increased investment in rural development, strengthening of governance structures and promotion of sustainable practices collectively form the basis for building sustainable and equitable food systems.

Socio-Economic Differences

Socio-economic disparities pose a significant internal threat to global food security, intertwining economic inequalities with access to and availability of basic food resources. This in-depth analysis delves into the multifaceted nature of socioeconomic disparities and their profound implications for fair food distribution on a global scale.

A significant domestic challenge arises from discrepancy in wealth distribution, where certain segments of the population possess significantly more economic resources than others. This wealth gap directly affects people's purchasing capacity, as it affects their ability to access a varied and nutritious diet [6].

The absence or inadequacy of social safety nets exacerbates internal threats to food security. Vulnerable populations, deprived of sufficient economic support during times of crisis or hardship, face increased challenges in securing reliable and nutritious food supplies [13].

Socio-economic disparities are perpetuated by unequal access to education and employment opportunities. Limited access to quality education and well-paid jobs limits people's ability to escape poverty and secure sufficient food resources for themselves and their families [13].

Initiatives aimed at redistributing wealth, strengthening social safety nets, and promoting equitable access to education and employment opportunities collectively contribute to mitigating domestic threats and promoting a more inclusive and sustainable global food system.

CONCLUSIONS

Global food security is under constant threat from both external and internal factors. External threats such as climate change, natural disasters, global trade disruptions, conflicts and pandemics can quickly disrupt food supply chains and availability. Internal challenges such as unsustainable agricultural practices, water scarcity, biodiversity loss, food loss and waste, inadequate infrastructure, governance issues and socio-economic disparities further exacerbate risks to food security.

A comprehensive and collaborative approach is essential to address these complex challenges. Internationally, countries must cooperate on climate-resilient agriculture, disaster preparedness and trade policies to mitigate external threats. Domestically, sustainable agricultural practices, improved water management, conservation of agrobiodiversity, reduced food waste, improved infrastructure and fair governance are crucial for building sustainable food systems.

In conclusion, achieving global food security requires concerted efforts at local, national and international levels. Although the challenges are significant, proactive measures, innovative solutions and global cooperation can pave the way to a more secure and sustainable food future for all.

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STUDY REGARDING THE INTEREST OF ROMANIAN CONSUMERS FOR ORGANIC AGRICULTURE

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Abstract

Organic farming is developing as a sustainable alternative to intensive, conventional farming practice based on increasing yields, by maximizing the use of production factors to continuously increase agricultural production. Organic farming is, now, appreciated because it eliminates chemicals and produces health food with a positive impact on the environment. Sustainable development requires a healthy life due to responsible food production and consumption. These goals can be achieved in a food system where producers contribute through moral behaviours and where consumers are informed. All these aspects are gaining increasing importance at European and global level in the context of sustainable development. Considering these aspects, we carried out this research with reference to the interest of the inhabitants of the Western Romania for ecological products. The analysis of the data, obtained from the field application of a questionnaire and their interpretation, shows that, in Romania, although the area cultivated in the organic system is still small, there is an increased interest in the organic farming system both on the part of farmers and on the part of consumers.

Key words: *consumers, interest, organic agriculture, questionnaire*

INTRODUCTION

The practice of this type of agriculture has become a viable alternative to conventional agriculture because it allows the optimal correlation between the quantity and quality of the food and the health of people [1, 2, 6, 10]. The products made in the organic farming system, in addition to being healthy products for food, are in correlation with the environment and contribute to the process of sustainable development [5, 7, 8, 9, 13, 14].

In this context, the role of ecological agriculture in ensuring the food security of the population becomes obvious.

Currently, food security, the population's access to basic agri-food products and appropriate quality are major problems and concerns of the states of the world, but mainly of developing or underdeveloped countries.

In recent years, the COVID-19 pandemic has had a significant impact on people around the world. It was noticed that buying and consumption habits have changed substantially [12]. We can affirm the fact that, in response to environmental changes, people are able to change their consumption behavior, take more care of their own health and move towards the consumption of ecological products. This new consumer attitude is beneficial for the market of these products and this opportunity must be exploited.

Also, various international bodies are concerned about organic agriculture and its effects on the environment and health of individuals [4, 3, 11].

Through reports and positioning on the production – trade chain, these bodies obtain the guarantee that, every time organic products are bought, there is a certainty that they are healthy for the people, and that the agricultural practices do not harm the environment.

In this context, the purpose of the paper was to analyze the interest of the inhabitants of the Western Romania for ecological products using a field survey based on a structured questionnaire.

MATERIALS AND METHODS

In order to find out about the interest of the Romanian consumers for the organic products, the measure in which the population in Romania prefers and consumes organic products, a field survey was initiated, directed to the western part of the country (the counties of Arad and Timiș).

The sample was established by applying the questionnaire to a heterogeneous group of 610 respondents from different age categories, professional training, training level, and social categories.

The data included in the questionnaires were processed with the help of the SPSS program. Based on the processing of primary information, we obtained a database that was analysed and interpreted.

The questionnaire was filled in only once by each person and contained 20 questions, of which five were demographics. The research had a level of probability of 95% and an error of ±5% and was carried out between March 1 and June 1, 2022.

The questions referred to:

Q1.Gender of the respondent;
Q2. Age of the respondent;
Q3.Social status of the respondent;
Q4.Education of the respondent;
Q5.Profession of the respondent;
Q6.Level of knowledge about organic products;
Q7.Way of obtaining information about organic products;
Q8. Other names the respondent associated to organic products.
Q9.Characterisation of organic products;
Q10. Advantages of organic product;
Q11. Disadvantages of organic products;
Q12. Consumption of ecological products;
Q13.Consumer concern for ecological products;
Q14.The kind of ecological products that consumers would prefer;
Q15.The habit of buying ecological products.
Q16.Knowing the price of organic products;
Q17.Price affordability for ecological buyers;
Q18.Possibilities of consuming ecological products in the area of the people surveyed;
Q19.The possibilities of expanding the consumption of ecological products;
Q20.The importance of the export of ecological products for the growth of the farmers' economy.

RESULTS AND DISCUSSIONS

When we started the construction and application of the questionnaires, we took into account the figures that indicate the import/export value of organic products as well as the volume of sales and consumption of organic products in Romania. According to [4, 3, 11], the volume of organic retail sales increased in the period 2015-2021 from 24.84 million euros to 40.65 million euros. The import of organic products amounts to 35 million euros for each of the years included in the period 2015-2021 and the export to 200 million euros. The consumption of organic products per capita increased from 1.25 euros/person in 2015 to 2.06 euros/person in 2021 [4, 3, 11]. These digits, let us to consider that the organic products market is on an upward trend.

The responses the questionnaire were as follows:

Q1. The first question referred to the gender of the respondents. Among the people questioned, 61.96% were women and 38.04% were men. We noticed the greater concern of women for shopping (62%).

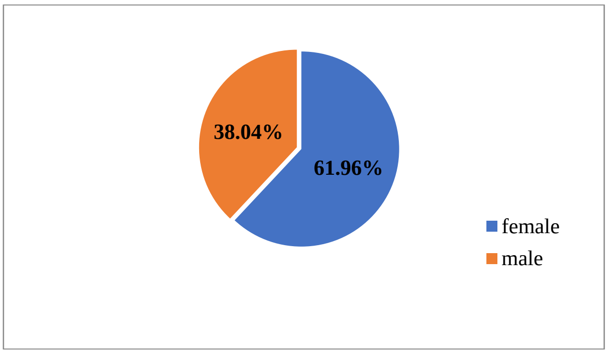

Fig.1. Gender of the respondents
Source: own calculations based on the information from the questionnaire.

Women are also the ones that decide, to the greatest extent, on the structure and size of the products purchased (Fig.1).

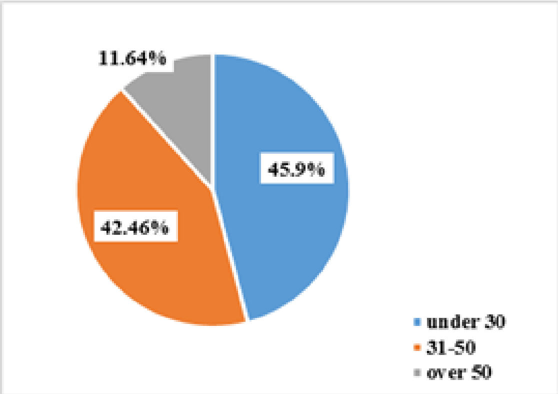

Fig. 2. Framing by age groups of respondents
Source: own calculations based on the information from the questionnaire.

Q3. Regarding the social status of the respondents (according to their own assessments), 11.80% considered that they have a good social status (294 people), 48.20% an average social status, and 244 people (40.00%) a modest social status (Fig.3).

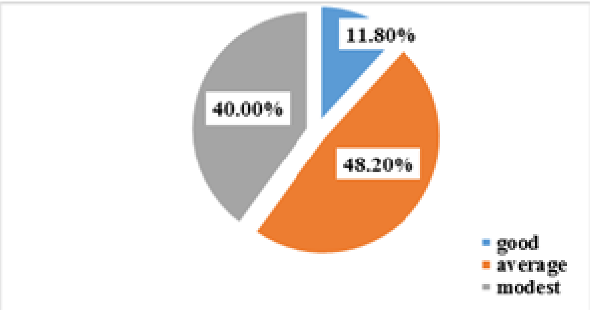

Fig. 3. The social status of the persons questioned.
Sourc: results based on questionnaires.

Q4. Regarding the education of the 610 respondents, most of them, 484 people, were university graduates or undergraduates (79.34%), high school graduates (11.96%) and post-secondary school graduates (2.90%). Only 2.45% were secondary-school graduates, 1.96% primary-school graduates and 1.39% professional school graduates, Fig.4.

Q5. As for the profession of the respondents, we found that 228 people (37.37%) were teachers, doctors and engineers, 167 people (27.37%) were students, 3.93% were pensioners and the difference of 31.33% had other occupations (Fig. 5).

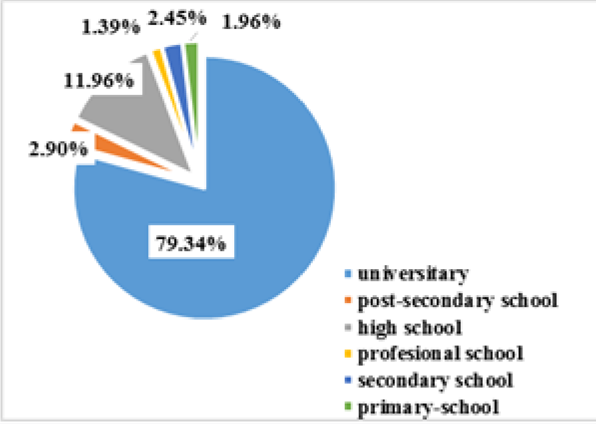

Fig. 4. The level of education of the people questioned.
Source: results based on questionnaires.

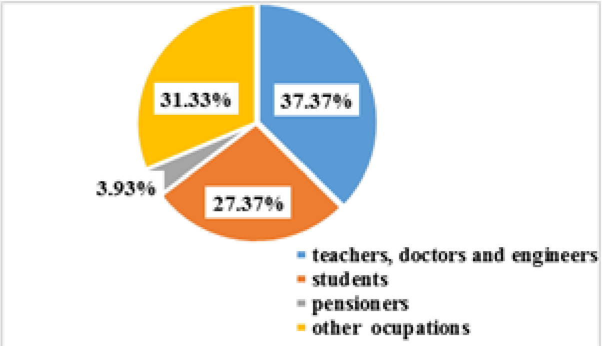

Fig. 5. Respondents' occupation
Source: results based on questionnaires.

Q6. To the question, what do I know about organic products? 567 people respectively 92.95%, answered "yes" and 7.05% (43 people) answered "no" (Fig. 6).

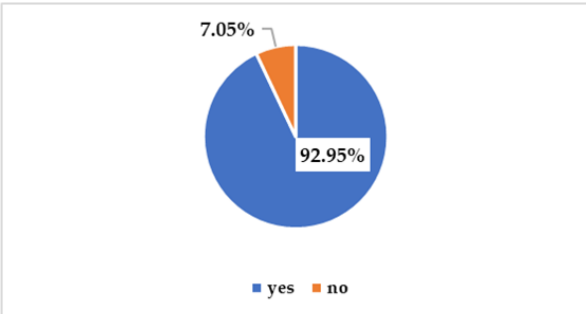

Fig. 6. Knowledge about organic products.
Source: own calculations based on the information from the questionnaire.

Q7. As for the source of information about organic products, the responses were 4.91% from the press, 049% from the radio, 25.40% from TV, 29.50% from word of mouth and 39.70% from other sources (Fig. 7).

Q8. As to other names associated with organic products, the highest share of respondents, 39.01% (238 persons), said they associate it with natural products, 30.98% (189 persons) with products obtained without chemicals, 21.96% (134 persons) with organic products, 6.05% (140 persons) with unpolluted products and 2% gave other answers (Fig. 8).

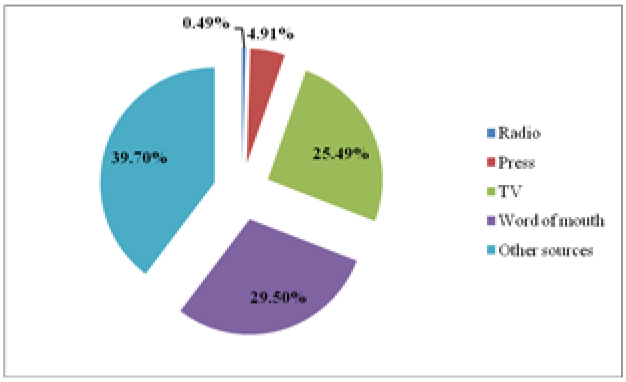

Fig. 7. Sources of information about organic products.
Source: own calculations based on the information from the questionnaire.

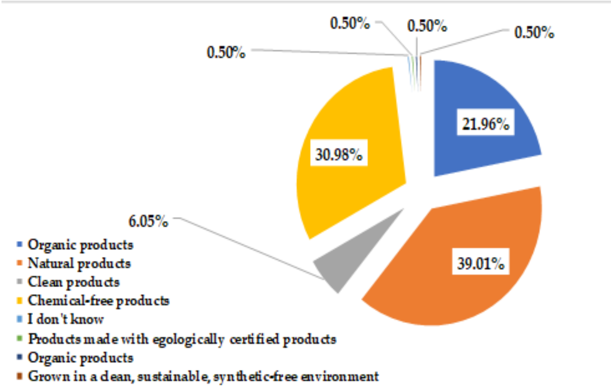

Fig. 8. Names associated with organic prodcts.
Source: own calculations based on the information from the questionnaire.

Q9. As far as the characterization of organic products was concerned, the respondents characterized them in positive terms, only a small part had negative comments on organic products (Table 1).

Table 1. Characterization of organic products (selection)

Healthy	**Beneficial High-quality**	**Naturally obtained products**	**Natural, unchanged products**
Natural Controlled, healthier. Safe products	Products that do not endanger human health. High-quality products, good for health	Products that are less processed	High-quality products, good for health
An utopia! A useless trend, I would prefer higher standards for the rest of foods	Expensive and rare Organic products are recommended to be consumed, but what is happening today is not exactly a loyal practice from traders	Very high price, quite doubtful as source, few laboratories for certification	Products obtained from crops where no fertilizers, pesticides, chemically treated seeds are used
Tasty, good for Health Healthy products	Products respondent to a control, obtained in a certified-quality system	Products complying with specific technology and protected area	Reducing the risk of various diseases with the taste of old
Products that give you mental comfort because you can consume them without worrying that there are traces of pesticides	Products in whose technology no synthetic chemicals are used.	Better than non-ecological but also more expensive	Products obtained by the normal culture cycle without using synthesis (chemical) products
Healthy and tasty	Products with a low content of pesticide residues	Better life quality	Healthy, non-cancerous
Healthy life Traceability from seed to plate Beneficial for the body	Healthier products obtained in more environmental-friendly conditions. Absolutely necessary for daily consumption	Products with no GMOs, synthetic chemicals, fertilizers, or pesticides; limited amounts of additives	Natural products without added substances. Good but expensive
A healthier alternative to classic products	Healthier products than ordinary ones	Products that will grow more and more in the future	Products as natural as possible, within the limits of possibilities
Products obtained in accordance with the legislation in force on organic farming	Theoretically healthier, without a way of accelerated development or additives	Closer to the nature	Long-term beneficial effects Fitting a healthy diet

Source: Own results.

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Q10. Regarding the advantages of organic products, it was a nice surprise to see that 73.20% of the respondents (446 people) knew the benefits of these organic products, while the remaining 26.80% did not (Fig. 9).

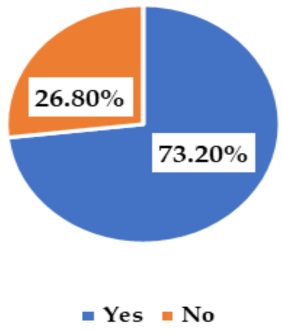

Fig. 9. Knowing the advantages of ecological products.
Source: results based on questionnaires.

Q11. Regarding the information about the disadvantages of ecological products, 79.20% of the people questioned "no" (because they did not know these products have disadvantages) and 20.80% said "yes" (Fig. 10).

Q12. Regarding the consumption of ecological products, 87.70% (535 persons) of the respondents said "yes", at least occasionally, and 12.30% (75 persons) said "no" (Fig. 11).

Q13. As for the interest in consuming environmentally - friendly products, 83.60% of respondents were interested (510 persons), almost 11.40% were undecided (70 people), and the difference of 5% (30 persons) were not interested in such products (Fig. 12).

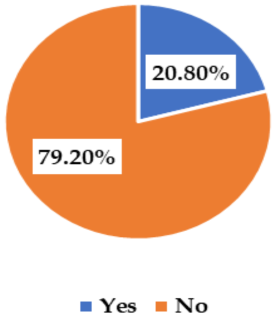

Fig.10. Knowing the disadvantages of ecological products.
Source: results based on questionnaires.

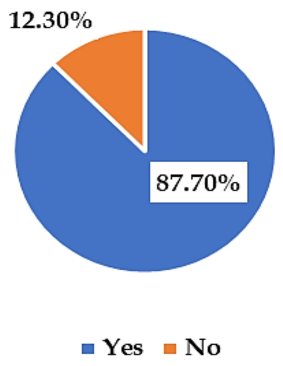

Fig.11. Ecological products consumed.
Source: results based on questionnaires.

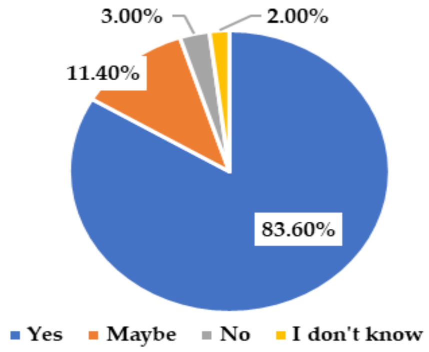

Fig.12. Consumption of ecological products.
Source: results based on questionnaires.

Q14. Regarding the type of organic-certified products preferred, most respondents said they preferred fruits, vegetables, meat, and milk. The conclusion is that the farmers in the organic farming system should go to the production of this type of ecological agri-food products (Table 2).

Table 2. Top organic products preferred by respondents.

Vegetables and fruit	Dairy products	Meat and cold cuts
Olive oil	All categories	Eggs
Cosmetics	Honey	Jam

Source: Own results.

Q15. As far as the frequency of buying organic products is concerned, 45.20% of the respondents (276 persons) consume them weekly, 23.60% (144 persons) consume them occasionally, 13.44% (82 persons) consume them several times per week, 6.72% consume them daily (41 persons) and 2.62% (16 persons) consume them on a monthly basis (Fig. 13).

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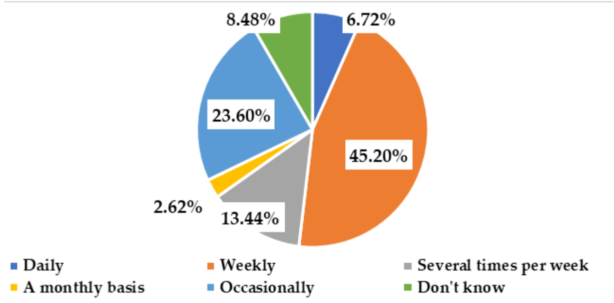

Fig. 13. Frequency of buying organic products
Source: results based on questionnaires.

Q16. Regarding knowing the price of ecological products, 185 persons (30.33%) replied „yes", 50.33% responded "somehow", and 19.34% said "no".

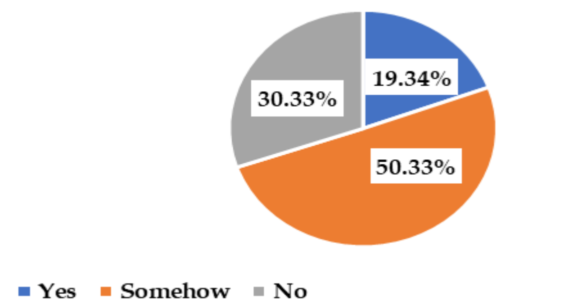

Fig. 14. Information on the price of organic products
Source : results based on questionnaires.

Q17. To the question about an acceptable price level for organic products, 56.00% (342 persons) answered "25% more expensive", and 29.50% (180 people) said "the same as the other products" (Fig. 15).

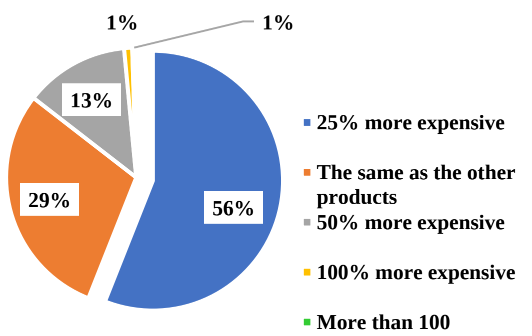

Fig. 15. Price level accepted for organic products.
Source: own calculations based on the information from the questionnaire.

Q18. Regarding the prospects about the consumption of organic products in the area where the questionnaire was applied, 11.40% (70 persons) replied that such products have an immediate perspective, 21.96% (134 persons) replied that such products will have perspectives in the next 2-3 years, 18.36% (112 people) said they will have a perspective over five years, and 39.84% have not expressed any opinion ("I do not know"), and 8.44% (51 people) replied that organic products have no perspective (Fig.16).

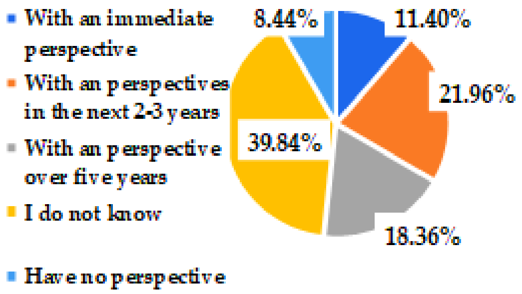

Fig.16. Perspectives of organic products consumption in Timiș County.
Source: own calculations based on the information from the questionnaire

Q19. Regarding expanding the possibilities of expanding the consumption of organic products, the people surveyed proposed detailed solutions shown in Table 3.
Q20. Referring to the importance of the export of ecological products for the growth of the farmers' economy
, 53.77% (328 persons) replied "yes", 12.95% (79 people) said "to a large extent", 12.45% (76 persons) "to a small extent", and the rest of respondents replied "no" (9.01%) and „I do not know" (11.82%) (Fig. 17).

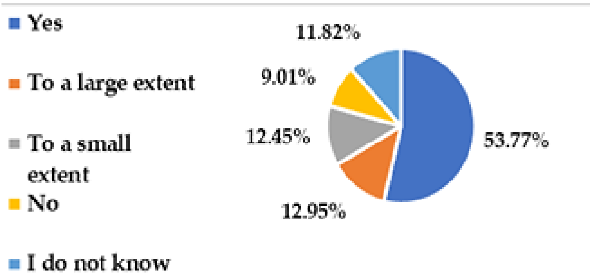

Fig. 17. Chance of the export of organic products for the Romanian economy.
Source: own calculations based on the information from the questionnaire.

Table 3. Selection of answers regarding the extension of the consumption of organic products

More promotion	Promoting them on the market, in the online environment	Promotion of local producers Elimination of intermediaries
Development of Ecological Agricultural Products Processing Companies	Subsidizing and educating, increasing awareness of the population on its benefits	Government facilities Help for the farmers
Cultivation on as higher areas as possible	Enforcing appropriate cultivation technologies	Public purchases of local bio products
Tax, VAT, and charge reduction to favor a more affordable price for buyers	There should be no fake "ecological" products. Thus, consumers would trust to consume more of this product category	Reinforcing the connection between producers and buyers, by advertising and facilitating the sale of products directly by the producers (possibly through associations)!

Source: Own results.

CONCLUSIONS

Following the analysis of the data obtained with the help of the questionnaire, we obtained interesting information that could be considered by the decision-makers of agricultural policies in Romania.

The field investigation carried out based on a questionnaire applied to the 610 respondents allowed us to know how the inhabitants of western Romania prefer and consume organic products and, at the same time, helps farmers who practice organic farming to understand all the economic advantages of this farming system.

Of the total of the people questioned, 83.60% said they were interested in the consumption of organic products and only 5% stated that they were not interested in such products. Consumers believe that by consuming these products they protect their health, a statement that is confirmed by the answer to question Q9 (Table 1) where respondents characterized them in positive terms, only a small part had negative comments on organic products. Re-related to the quality/price ratio in terms of ecological products we found that 30.33% of the respondents believed that they had sufficient information about the price of organic products, while 50.33% had partial information. Regarding the level of the price accepted by the respondents, we found that 56.00% were willing to offer a 25% higher price for organic products compared to conventional ones, a situation that leads us to the conclusion that such products will be successful on the market.

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ANALYSIS OF THE DYNAMICS OF ORGANIC AGRICULTURE IN THE EUROPEAN UNION WITH AN EMPHASIS ON ROMANIA

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Abstract

The organic farming system emerged in the context of sustainable agricultural development, contributing to the promotion of an agricultural system that protects the environment. The specific practices of ecological agriculture contribute to the protection of biodiversity, to the maintenance of soil fertility, to the reduction of soil erosion, to the reduction of pollution of water resources, and to the reduction of greenhouse gas emissions. Also, in organic farming, energy consumption is reduced because this farming system is based on practices that require a lot of manual labour compared to conventional agriculture that consumes more energy. The European Commission demands, through the European Green Pact – Farm to Fork, that, by 2030, 25% of European agriculture should be organic. Based on these considerations, the authors of this paper carried out a study on the evolution of organic agriculture in Europe with an emphasis on Romania to analyse whether this objective proposed by the EU is achievable or not. The result of the analysis highlights that it is unlikely that this particularly ambitious goal will be achieved by 2030, noting that, in 2021, only 4.3% of the agricultural area cultivated in the ecological system.

Key words: *organic agriculture, farms, România, evolution*

INTRODUCTION

The development of human society, population growth, culture progress, and particularly modern sciences and technologies progress have led to the improvement and diversification of technical activities and of the production of material goods. In this context, society determines the appearance and growth, at an alarming rate, of numerous harmful substances with negative effects on the living, on the natural ecological balance, contributing to the pollution and degradation of water, air and soil. We find that, in the last decades, through various activities, man has become an important factor in environmental pollution.

With the important progress registered in the economic and social development of humanity of the last century, agricultural activities have often produced imbalances of natural systems and has created environmental problems. The degradation of water, flora, fauna, and soil have direct effects on living things, with serious and, sometimes, irreversible repercussions on people. Agricultural activities can produce pollution by practicing intensive agriculture systems, using high-energy industrial technologies, using excessively chemical fertilizers, insecticides, fungicides, and herbicides or other chemicals. The economic and social evolution of the current period is in close correlation with the degree of development of agriculture, with its possibility to ensure the availability of food for the growing population, including raw materials for the processing industry [11].

Intensive agriculture will have an increasingly negative impact on the environment. In these conditions, the organic farming system has an important role in the sustainability of food production, having important contributions in reducing the dependence of agricultural production on the high consumption of pesticides, in reducing the negative effects of excess nitrogen and in reducing greenhouse gas emissions. In this context, organic agriculture becomes an agricultural production system with the clear objective of maintaining the long-term sustainability of the entire system [3, 13, 19].

In general, Romania's agricultural lands are considered among the most fertile in Europe, due to all physical and chemical elements in the soil, which determines the growth of plants, and to the texture of the soil, the humus content, the soil reaction, the saturation in bases, salinity, hydro-physical character, etc., which creates favorable premises for organic farming.

Table 1. European Green Pact Objectives

The European Green Pact	**Objectives** Farm to Fork **2030**	European Agriculture – 25% organic	**Effects**	Food loss and waste prevention
		Reducing the use of chemical fertilizers up to 20%		Sustainable food production
		Reducing the use of pesticides up to 50%		Sustainable food processing and distribution
		Reducing the use of antibiotics by 50%		Sustainable food consumption
		Reducing nutrient losses up to 50%		

Source: own construction based on [6, 4, 1].

The organic farming system requires the observance of certain agricultural exploitation rules, which are based on principles that should maintain diversity and ensure environmental protection. In organic farming, they forbid the use of genetically modified organisms, the use of growth hormones, the use of ionizing radiation, while the use of antibiotics and chemical fertilizers, and of insecticides and herbicides is restricted. All substances used in organic farming to control weeds, diseases and pests should be approved by the European Commission in order to be used in organic production [1].

In this regard, the EU regulates organic production at the Union level by the Regulation (EU) 2018/848 of the European Parliament and of the Council on Organic Production and Labelling of Organic Products, a regulation that "should harmonize the norms on organic production for all the products that enter its scope and should provide detailed production rules for different product categories" [15].

The aim pursued in this scientific work is to analyze the evolution of the ecological agriculture system in Romania, the possibilities of expanding and developing agriculture in an ecological system correlated with the European provisions and with the available land resources of Romania.

In order to achieve the goal, we established the following stages of the research:

a) Study on Romania's land resources and the situation of ecological agriculture in Romania.

b) Study on the evolution of organic farming in the context of EU policies.

MATERIALS AND METHODS

The research methodology for achieving the specific objectives included the statistical analysis of the primary data using, as a working tool, the Microsoft Excel analysis program (tables, graphs). For the analysis, statistical methods have been used for comparisons, structures, and dynamics. One of the methods used to prepare the gross analysis material was the documentation of the official databases provided by the National Institute of Statistics (INS – Tempo Online, Statistical Yearbooks, General Agricultural Census 2020) and data, information bulletins, and communiqués published by the Ministry of Agriculture and Rural Development

(MARD), as well as different publications or complementary information taken from the Internet.

RESULTS AND DISCUSSIONS

Study on Romania's land resources and the situation of the ecological agriculture system in Romania

Romania has important agricultural resources among the countries of the European Union.

Regarding the agricultural area used, Romania occupies an important position, the sixth place at the EU level.

The agricultural area of the 28 EU Member States (including the United Kingdom) was almost 175 million ha (2013), which means an average area of 16.1 ha per agricultural holding. Most agricultural farms were registered in Romania (3.6 million), a country that owned one third (33.5 %) of the total EU farms of 10.8 million.The largest farms în EU member countries, with an average size of 133 ha werw registered in the Czech Republic.

Six Member States reported average areas of less than 10 ha, the smallest means being recorded in Romania, Cyprus, and Malta [8, 9].

Through the land resources it has, Romania can develop different agricultural systems, including ecological agriculture, which contribute to the protection of the environment and the production of food with a higher value from the perspective of ensuring the health of consumers, through the use of natural or derived substances natural [2, 7, 14]. According to the last General Agricultural Census 2020, Romania, has an agricultural area of 12,763 million ha, of which arable land represents 8.565 million ha, i.e., 67% of the country's agricultural area. Pastures and meadows cover an area of 3.7 million ha (29.2%), permanent crops cover 344 thousand ha (2.7%), family gardens cover 124 thousand ha (0.97%), and greenhouses and solaria cover 6 thousand ha (0.13%) (Fig. 1).

The analysis of the statistical data in dynamics shows that the agricultural area of Romania of 12.8 million ha is declining compared to 2002 by 1.168 million ha, as a result of removing from the agricultural circuit of important areas of agricultural land.

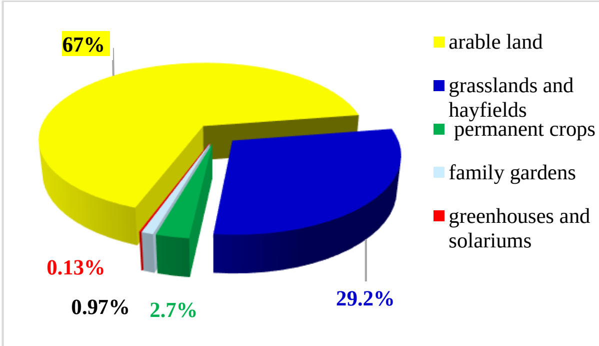

Fig.1. Structure of agricultural land in Romania
Source: own construction based on [20, 16].

The reduction of land areas by including them in the urban area, (especially the metropolitan area of the municipalities and the capital, Bucharest) represents a phenomenon found in areas with higher productivity, while changing the category of use of agricultural land to the forest is common in disadvantaged areas. There is a major difference between rural and urban areas, residents living in rural areas are marked by a significantly higher level of poverty and lower standard compared to inhabitants living in urban areas. In this situation, organic farming would be an activity of diversification and growth of the revenues of the inhabitants from the poorer areas of Romania (Fig. 2). The national land resources are favorable to the development of a competitive and sustainable agriculture, but the laws regarding land property adopted after 1990 caused an excessive fragmentation of the agricultural areas. In the last 10-15 years, we have witnessed a process of grouping the lands and establishing medium and large farms although the small farms remain predominant. Compared to the other Member States of the European Union, Romania has an average size of farms like Malta or Cyprus, island countries with far less agricultural land.

The founders of the EU PAC conceived the rural space, primarily as a living environment, both a social-cultural environment and an economic space, based on the agri-food economy but also on the non-agricultural economy on which they can develop all the permanent, continuity-generating activities

that allow the natural sustainable development of rural communities [12].
In Romania, non-commercial small subsistence and semi-subsistence households predominate and comprise over 95% of the number of holdings and over six million hectares of agricultural land. These constitute, at the same time, agro-food production spaces, family living environments and in many cases rural tourist areas of the best quality, which contribute to maintaining the ecological balance and lend themselves to the development of ecological farming systems, thus maintaining rural communities alive.

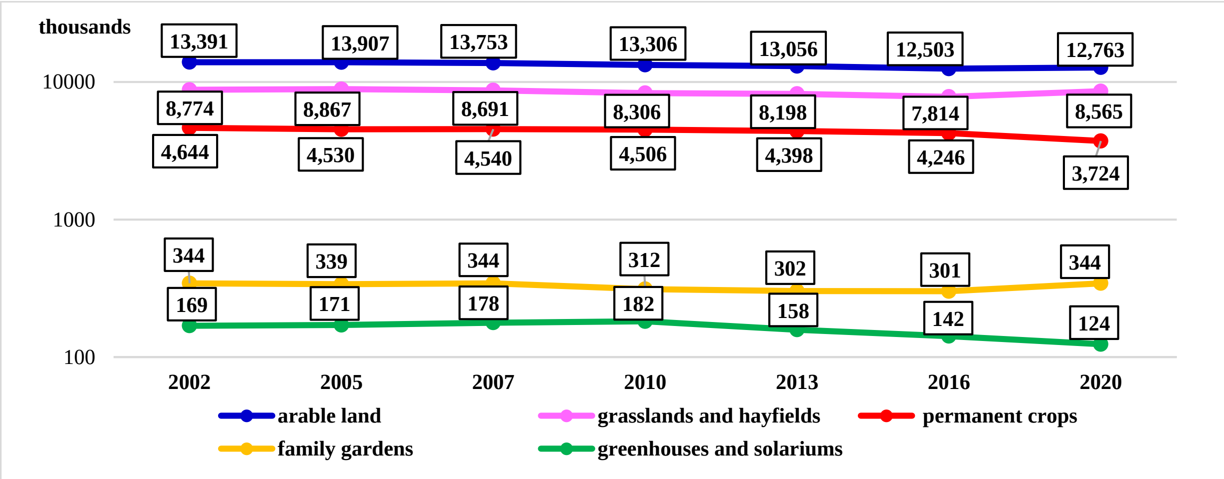

Fig.2. Evolution of agricultural land areas according to use in Romania, 2002-2020.
Source: own construction based on [20, 17].

Regarding the number and area of the agricultural holdings that operate in Romania, statistical data highlights the existence of small farms in a very large number, in parallel with very large, but numerically small farms (in 2020, 0.87% of the Romanian farms had 38.75% from the agricultural area of the country. At the same time, small farms operate in Romania (99.13%), without legal personality but owning 61.25% of the agricultural area and hindering the development of agriculture in Romania. (Table 2).

Table 2. **Dynamics** of the size of agricultural holdings in Romania based on legal status

Nr. Crt.	Indicatori	U.M.	years							
			2002	2005	2007	2010	2013	2016	2020	2020 %
1.	**Total agricultural holdings**	**Thousands**	**4,485**	**4,256**	**3,931**	**3,859**	**3,630**	**3,422**	**2,887**	**100%**
2.	**Utilised agricultural area (UAA)**	**Thousands ha**	**13,931**	**13,907**	**13,753**	**13,306**	**13,056**	**12,503**	**12,763**	**100%**
3.	**Average UAA/ holding**	**Ha**	**3.11**	**3.27**	**3.50**	**3.45**	**3.60**	**3.65**	**4.42**	**-**
4.	Agricultural holdings with legal personality	thousands	23	18	17	31	28	26	25	**0.87**
5.	UAA of holdings with legal personality	Thousands ha	6,222	4,805	4,787	5,856	5,785	5,576	4,946	**38.75**
6.	**Average UAA/ holding** with legal personality	Ha	274.43	263.08	270.45	190.78	207.49	213.64	194.78	-
7.	Agricultural holdings without legal personality	thousands	4,462	4,238	3,914	3,828	3,602	3,396	2,862	**99.13**
8.	UAA of holdings without legal personality	Thousands ha	7,709	9,102	8,966	7,450	7,271	6,927	7,817	**61.25**
9.	**Average UAA/ holding** without legal personality	Ha	1.73	2.15	2.29	1.95	2.02	2.04	2.73	-

Source: own construction based on [20, 17].

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In this situation, there is a need to attract young farmers in the rural area, who will take over and modernize/develop the farms, by applying different technologies, including ecological ones, in order to face the pressures of the agro-food markets.

In addition to the positive aspects related to environmental protection, organic farming has an important role in the social and economic sustainability of rural communities.

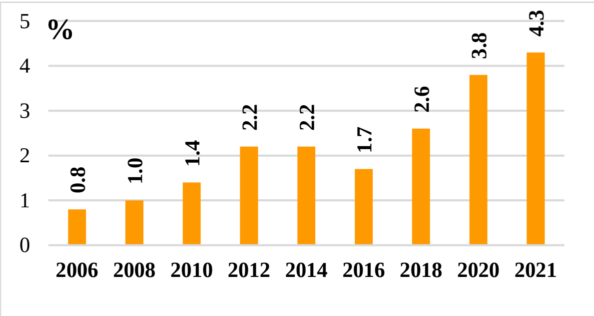

Fig. 3. Evolution of the share of organic farming areas in Romania.
Source: own construction based on [5, 6].

In 2006, the areas cultivated in an ecological system in Romania occupied a share of only 0.8% of the agricultural area of Romania, reaching in 2021 to occupy an area of 4.3% (Fig. 3), with all the financial efforts from the EU through the PAC.

Organic agriculture has registered a constant development in Romania, as a result of the financial support granted through the PAC-Pillar II. During the 2007-2013 programming period, organic agriculture was supported through the support granted under Measure 214 – Agro-environmental payments, package 5 – organic agriculture from PNDR 2007-2013 in order to maintain certified organic production.

The support of organic agriculture continued during the 2014-2020 programming period through the implementation of Measure 11 – organic agriculture from the PNDR, which supports active farmers registered in the organic agriculture system, both for the operations carried out in order to convert to organic agriculture (submeasure 11.1) as well as for maintaining certification in ecological agriculture (sub measure 11.2). This support will also continue through the 2023-2027 National Strategic Plan (PNS) [18].

In Romania, between 2010 and 2021, the areas cultivated organically increased from 182,706 ha to 578,718.45, (Fig. 5).

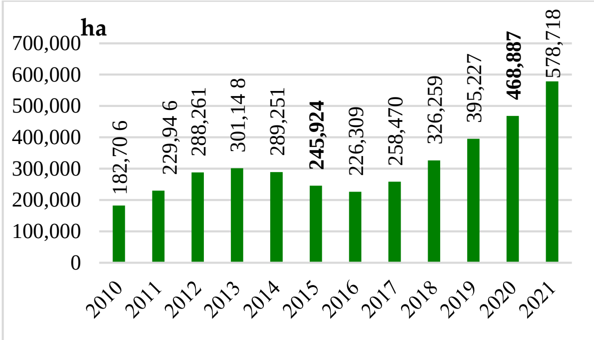

Fig. 4. Dynamics of ecologically cultivated in Romania (ha).
Source: own construction based on [20, 5, 6, 1].

According to the Ministry of Agriculture and Rural Development, the area cultivated in an ecological regime in Romania increased, in 2021, by 109,831 ha compared to year 2020.

Of the 578,718 ha of organically farmed area, 344,541 ha were fully converted and the remaining 234,177 ha were under conversion.

In 2020, in Romania, of the total area cultivated organically, 291,629 ha were arable crops, 155,038 ha were permanent crops and 22,221 ha were permanent meadows.

Related to the operators of organic products in Romania, at the level of the Ministry of Agriculture and Rural Development, various measures (compliant with European standards), have been established, which support these operators.

A code of best practices related to climate change and its effects on agriculture is published on the ministry's website, as well as a series of information related to organic agriculture, which ensures easy access for those interested in information related to the reconversion and certification procedure, issues related to national and community legislation, etc.

The control and certification of organic products is currently ensured by private inspection and certification companies [15]. They are approved by the Ministry of Agriculture and Rural Development, based on the criteria of independence, impartiality and competence established by [10]. Ministry of Agriculture and Rural Development approval of inspection and certification bodies is necessarily preceded by their accreditation by a body qualified for this purpose. Also, every year the list of certified operators in organic agriculture is published [18].

Among them are certified operators who have benefited from expertise and technology from abroad. We want to emphasize the role of FDI in the development of organic agriculture. Current economic research emphasizes the link between foreign direct investment, exports and economic growth. Recent analyzes have highlighted the role of exports and foreign direct investments in stimulating economic expansion, a fact that also manifests itself in the ecological agriculture segment. It is an economic reality that exports of organic products contribute to economic growth.

Figure 5 shows the dynamics of certified operators in Romania, in organic agriculture.

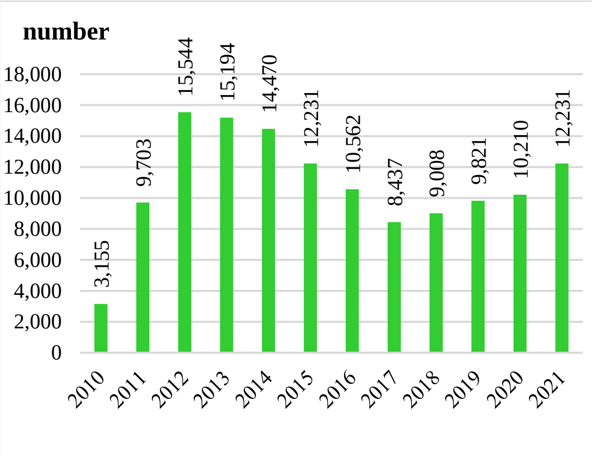

Fig. 5. Dynamics of operators in Romania certified in organic agriculture.
Source: own construction based on [20, 5, 6, 1].

Trends in organic farming in EU countries

According to statistical data, the area cultivated in organic mode has increased considerably.

In the year 2021, at the level of the European Union, 15,639,063 ha were cultivated in organic regime, which represented 9.63% of the cultivated area of the EU. Romania contributed significantly to the increase of the cultivated area in organic regime, a country ranking seventh at the EU level in terms of cultivated area after France, Spain, Italy, Germany, Austria, and Sweden (Fig. 6).

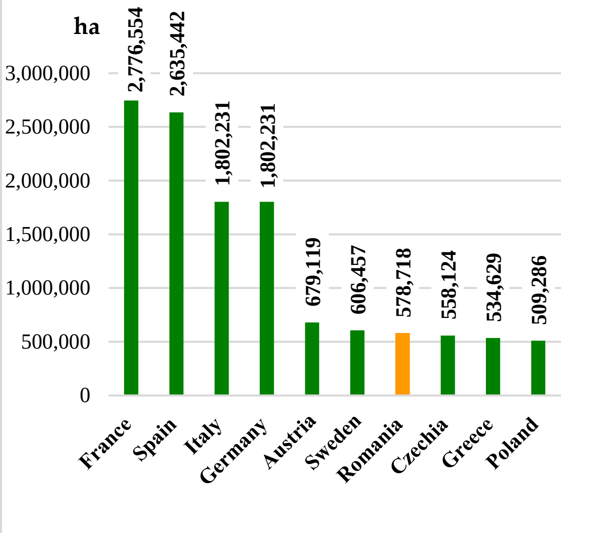

Fig. 6. The first 10 EU countries with organic cultivated areas, 2021.
Source: own construction based on [20, 5, 6, 1]

The share of the areas cultivated organically of the total agricultural land per countries is presented in Figure 7.

Although the European Green Pact *Farm to Fork* requires that, by 2030, European agriculture is 25% organic, the foreseen statistical data shows that most of the countries in the EU will hardly reach this value.

In 2021, there were almost 380,000 organic producers and more than 82,000 processors were operating in the EU (Table 3).

Table 3. Organic operators in EU and in Romania, 2023

Indices	EU States	Romania	
		No.	%
Producers	378,226	11,562	3.00
Processors	82,500	209	0.25
Importers	6,378	34	0.53
Exporters	2,404	25	1.04

Source: [6].

Among EU countries, Austria had, in 2021, a share of 26.5% of agricultural land cultivated organically, all other countries had less than 25% (Fig. 7).

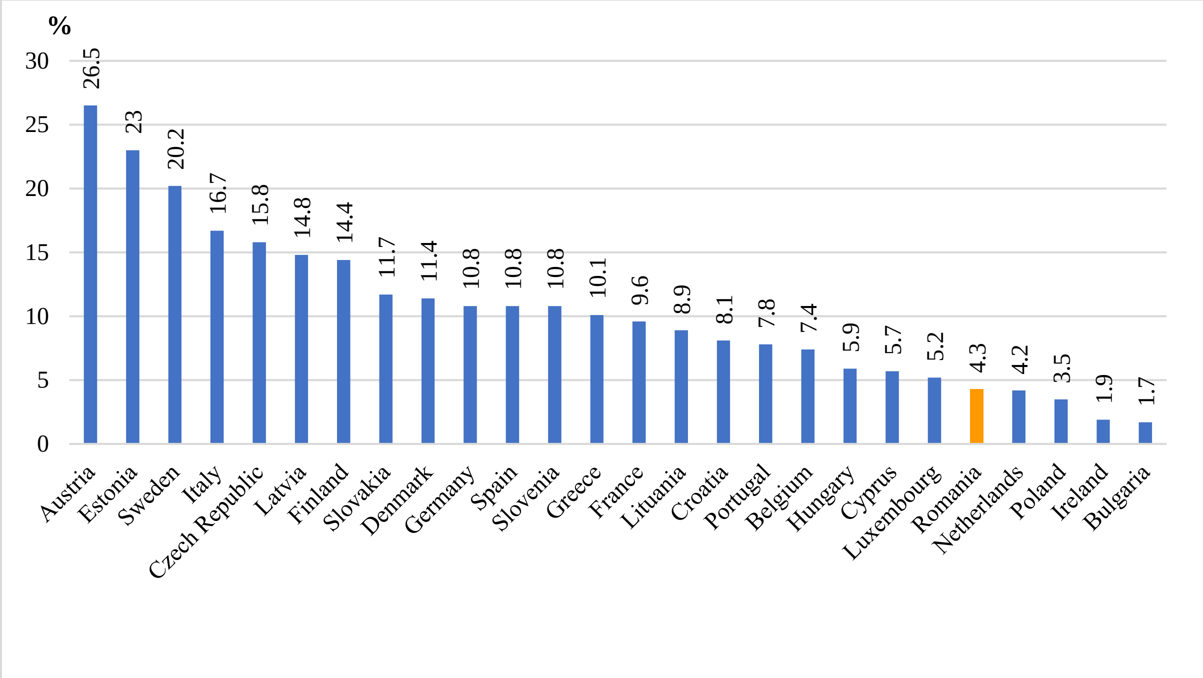

Fig. 7. Share of organically cultivated areas in the EU, 2021.
Source: own construction based on [5, 6].

Italy is the country in the EU that has the most organic producers 75,874 (17%) followed by France 58,413(13%), Spain, 52,861(11%), Germany 36,307(8%), Greece 29,869 (7%), Austria 23,961(6%), Poland 18,598 (4%), and Romania 11,562 (3%) (Fig. 8).

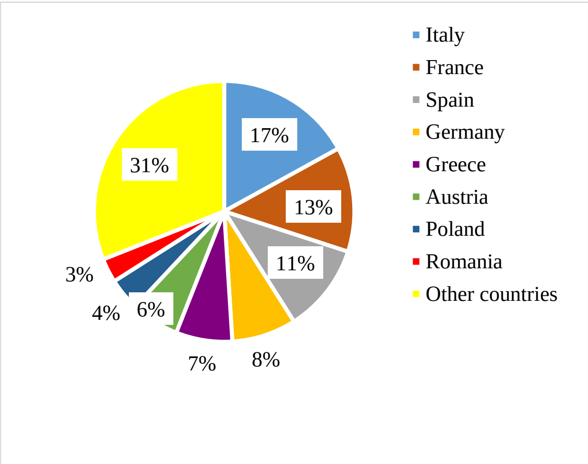

Fig. 8. Share of organic producers per EU countries, 2021.
Source: own construction based on [6].

The data in Figure 9 shows that almost 80% (more precisely 78%) of organic processors are in Italy (27%), Germany (22%), France (22%), Spain (7%) and Romania with a weight of just 0.25%. In Romania because of the lack of processing facilities, in general, but especially in the field of organic production, the raw organic material is exported.

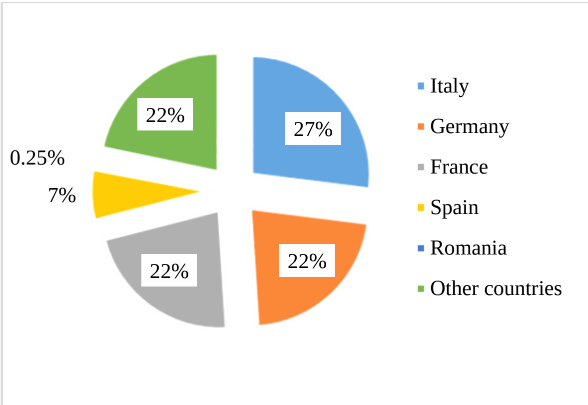

Fig. 9. Share of organic processors per EU countries, 2021.
Source: own construction based on [6].

According to statistical data, the largest number of importers of organic products (2021) at EU level are: Holland, Germany, Belgium, France, Italy, Sweden, Spain, Ireland, Denmark, and Poland. The most important countries in which Romania exports organic-certified products (mostly raw material) are Italy, France, Germany, Austria, USA, and Japan (2023). The market for organic products has increased more slowly than the area cultivated organically. At the level of the EU countries, retail sales of

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organic products reached 46,665 billion euros, Romania ranking before Bulgaria, Hungary, and Portugal with 41 million euros.

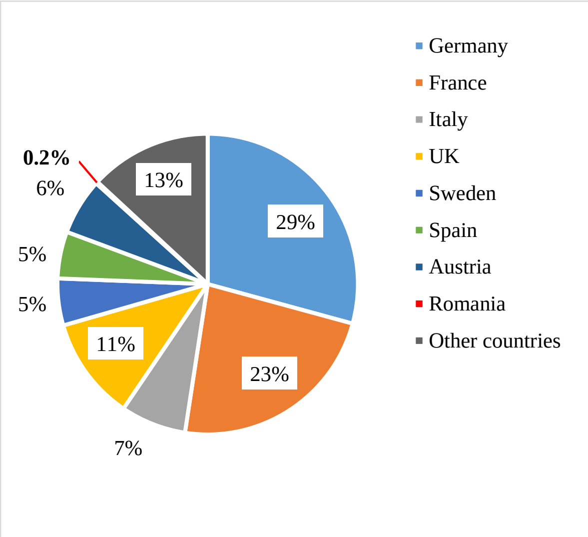

Fig. 10. Top EU countries in organic retail sales.
Source: own construction based on [6].

By far, it is clear that Germany and France record the highest levels of market share at EU level with 29% (Germany)) and 23% (France). Romania had 0.2% of the retail sales of organic products (Fig. 10).

Regarding the consumption of organic products per inhabitant, we note that in the EU there is an average of 104.3 euros/inhabitant. Denmark ranks first in this indicator with 384 euros/inhabitant. Although in Romania there are increases in the consumption of organic products, it currently represents around 2 euros/inhabitant, according to statistical data [15].

The transition period to organic farming is a maximum of two years for annual crops and a maximum of three years for perennial crops.

Support is granted in the form of compensatory payments calculated in the form of standard costs based on the assessment of additional costs and income losses resulting from the application of practices specific to organic farming.

The beneficiaries of this support must meet the following criteria: be a farmer, user of an agricultural area located on the territory of Romania, identifiable in the Integrated Administration and Control System (IACS); the farm must have an area of at least 1 ha, and the plots must not be smaller than 0.3 ha and for vineyards and orchards, fruit bushes, hops, fruit and wine nurseries of 0.1 ha; is registered, every year and requests support, according to the legal provisions, as an operator in organic agriculture; undertakes to keep a record of agricultural activities related to the implementation of commitments.

The compensatory payment granted through the PAC represents 100% non-reimbursable public support. The methodology for calculating compensatory payments was developed in 2022 as part of the Study on the establishment of the technical framework and standard costs that are the subject of interventions regarding organic agriculture from the National Strategic Plan 2023-2027. The compensatory payments granted for the application of ecological agricultural practices during the conversion period are calculated in the form of standard costs for each of the six proposed packages: Package 1 – agricultural crops on arable land (including fodder plants) located in conversion to organic farming – 293 euros/ha/year; Package 2 – vegetables (including potatoes) under conversion to organic farming – 500 euros/ha/year; Package 3 – orchards in conversion to organic farming – 620 euro/ha/year; Package 4 – vineyards in conversion to ecological agriculture – 530 euros/ha/year; Package 5 – medicinal and aromatic plants under conversion to ecological agriculture – 365 euros/ha/year; Package 6 – option 6.1 – permanent meadows under conversion to ecological agriculture – 143 euros/ha/year; Package 6 – option 6.2 – permanent meadows under conversion to ecological agriculture with commitment to agro-environment and climate – 39 euros/ha/year.

CONCLUSIONS

The agricultural resources of Romania represent an important share of national wealth. In Romania, compared to other states of Europe, agriculture is one of the most important branches of the economy, with a priority role in the restructuring and modernizing of the entire economic activity, precisely through the environment and the quality of agricultural land.

Romania records the largest number of EU agricultural farms, of 2,887 million ha, with a very small average size of 4.42 ha. Agricultural farms without legal personality have 2,862 million ha, with an average area of 2.73 ha and with 7.817 million ha of agricultural land. These small farms are suitable for the development of organic farming, thus contributing to the sustainable development of rural communities.

Although in the last years, in Romania the organic farming system had an upward trend, the areas cultivated organically did not exceed, in 2021, 5% of the total agricultural area used. In this situation, of course we ask ourselves the following question: How can Romania will contribute to reaching the indicator imposed by the European Green Pact, Farm to Fork? The achievement of the objective imposed by the EU will be very difficult by Romania by 2030, because from 2006 the share cultivated organically was 0.8% and it reached, in 2021, after 15 years, a share of only 4,3%. In this situation, in order to reach the proposed indicator in Romania, it should record an increase of 2.59% annually to reach the 25% area cultivated organically (imposed by the European Commission's objectives) from the total organically-cultivated area.

More significant growths of the areas cultivated organically in Romania took place after 2016, when the area was practically doubled from 226,309 ha to 578,718 ha in 2021. The acceleration of the growth of organic areas is due to the national program of rural development -The National Rural Development Plan 2014-2020, focused on environmental protection through environmental and climate measures (allocation for environmental and climate measures during the 2014-2020 programming period exceeded 30%, respectively 2,622 million euros from the total allocation of 9,622 million of euros, through the European Fund for Agriculture and Rural Development).

Organic farming received through measure M.11 Organic farming, the amount of 236 million euros, thus aiming to improve the balance between economic development and sustainable use of natural resources, but also to maintain and increase the attractiveness of rural areas, as basic elements in the diversification of economic activities. In 2021, the area cultivated organically increased by 23.40% compared to 2020 (46,827 ha), following the trend of increases in the EU countries that have 15,639 million ha cultivated organically.

Compliance with the rules in the field of organic agriculture determines:

-Increasing the confidence of consumers in the organic products produced at the EU level by strengthening the control system of organic products.

-Encouraging small farmers to practice organic farming through new norms for producers who facilitate the passage of small farmers to this agricultural system.

-Compliance with quality standards by all EU traders by introducing new norms for imported organic products.

-Diversification of commercialized organic products.

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ANALYSIS OF THE CAUSES OF CAMEROON'S PERMANENT DEPENDENCE ON RICE IMPORTS

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Abstract

This study, which aims to analyze the causes of Cameroon's permanent dependence on rice imports, is inspired by the observation that the expense linked to rice imports has a very negative influence on the Cameroonian trade balance; however, the country produces rice which is mainly exported to certain neighboring countries. To carry out this study, the objectives were set to analyze the marketing channels of Cameroonian rice, and to identify the factors that favors rice consumption. The target populations are traders and consumers of rice in Cameroon. The regions covered are those of the Far North, North, and Center, which produce most of the rice in Cameroon. To collect data in the field, questionnaires and interview guides were developed. As for the traders, an interview guide was used to collect information, after carrying out a categorization. For this purpose, local wholesalers of paddy rice, foreign wholesalers of paddy rice, foreign wholesalers of processed rice, retailers of markets close to production areas, local wholesalers of processed rice, wholesale retailers, supermarkets, and shopswere identified. At the consumer level, populations residing in production areas, populations in metropolises close to production areas, and populations in metropolises far from production areas were identified. The data collected was analyzed using software such as SPSS and Excel spreadsheet. The tables and figures made it possible to clearly present the results, and thus facilitate their interpretation. It therefore appears that wholesalers of paddy rice who sell it directly to foreign buyers, making a gross margin for an 80 kg bag which varies between 2,000 and 3,000 FCFA, while those who process before reselling on the local market make barely a margin of 500 FCFA. In addition to this observation, we observe that wholesalers of processed rice who sell their products in metropolises far from the production basins have a gross margin which is completely double that observed in the metropolises close to the production basins; which is justified by the presence of intermediaries, and the transport costs necessary to ensure the transition of rice from production areas to consumption centers. The results show that 43.2% of Cameroonians consume on average 1 kg of rice per day; but unfortunately, most are not aware of the existence of locally produced rice, and even those who are aware of it cannot easily find it on the market. In the metropolises of the southern zone of Cameroon, for example, we have around 50% of the population who are not aware of the fact that there is rice produced in Cameroon, 30% of the population who are informed but never had the opportunity to consume it.In view of all these parameters, Cameroonian rice is oriented primarily towards neighboring countries which are closer to the production basins, while the country continues to import rice from outside to satisfy the needs of its populations.

Key words: *rice, marketing circuit, consumption, import, export, Cameroon*

INTRODUCTION

Food crops is the basis of nutrition and the survival of populations [1]. Among the food crops produced in Cameroon, cereal products occupy a special place. According to [10], cereal products constitute the staple food of a large part of the Cameroonian population, even in regions where these products are traditionally little consumed compared to roots and tubers. Rice therefore represents one of these cereal crops which has become established over time in the eating habits of African populations in general and Cameroonians in particular [10]. According to MINADER (2009) [8], rice is a guarantor of food security, its strategic importance largely explains the large number of interventions by public authorities in this sector, which explains that this agricultural market is characterized by a large number of distortions, aid, barriers and subsidies. We unfortunately see that, to satisfy its rice needs, Cameroon is obliged to import, while most of its production, already very insufficient, is sold abroad. Cameroon, unable to satisfy the rice needs of its population, turns to imports, which contributes to accentuating the imbalance in its trade balance. This situation is all the more serious because it is not a particularity of Cameroon, but of all African countries. Macauley and Tabo (2015) [5] affirm this by clarifying that although local rice production increased rapidly after the 2007-2008 food crisis, a key problem facing the rice sector in Africa in general is that local production has never matched demand. The continent therefore continues to depend on imports to meet the growing demand for rice. According to MINEPAT (2020) [9], the value of rice imports increased from 96.7 billion FCFA in 2010 to 212.5 billion FCFA in 2013 [9]. Over the period 2014-2018, the value of imports however increased serrated around an average of 159 billion FCFA. In 2005, imports amounted to 433,000 tons, or 84% of national demand. In 2013, imports exceeded 600,000 tons [10]. The country has a strong dependence on the outside world for this food; According to the national rice development strategy document in Cameroon, national demand is almost essentially covered by imports [12].

According to MINEPAT (2020) [8], this demand increased from nearly 726,000 tons in 2014 to nearly 783,000 tons in 2018. The average annual growth between these two years was therefore around 2%.The increase in demand for rice is explained by several factors such as population growth and especially galloping urbanization which moves people away from rural areas where food crops are produced, and forces them to look for crops that are easy to maintain, to transport and cook. The rice sector is one for which the country is highly dependent on international markets, while paradoxically the domestic production potential is considerable. According to Achancho (2013) [1], Cameroon displays relative food self-sufficiency but imports more than 75% of the rice consumed, despite significant production potential. In particular, there are favorable natural conditions which are still little exploited. Indeed, rice cultivation can be done in almost all naturals regions of Cameroon (MINADER, 2009) [8]. But this production has so far been concentrated in production basins which are mainly located near border areas, which favors the export of this product, which is already unable to satisfy national needs.

[7] therefore estimates that only 30% of production is consumed in Cameroon, the rest (70%) is sold in neighboring countries, mainly Nigeria. As for Mamadou (2013) [6], rice produced both under rainfed and irrigated conditions is almost 75% exported to Nigeria. The trends in the results of these two authors are approximately the same, although there is a slight gap.

Ultimately, we see that Cameroon depends very heavily on the external market to satisfy its rice needs, yet it is already very insufficient local production is oriented towards export; However, according to Mendez (2011) [7], the rice market is characterized by the residual aspect of the supply. Considering the global statistics produced by the FAO, rice seems to have the primary purpose of contributing to the food security of the populations of countries that cultivate it [9]. This means that countries first produce for their own market before exporting a part of it, which varies depending on the country. Until the 1990s, the share of trade remained below 5%. According to [10], for a global production of white rice of 502.2 million tons, only 46.2 million tons, or 9.2%, were internationally traded, making the global rice market a surplus management.

This article therefore aims to understand why rice produced in Cameroon is exported to neighboring countries, while the country continues to depend on imports to meet its needs; which causes it to lose a lot of foreign currency, and exposes it to risks which may be due to the shortage of rice on the world market? to answer this question, it will be a question of analyzing the marketing circuits of Cameroonian rice, and of identifying the factors which favor the consumption of rice?

MATERIALS AND METHODS

To collect data in the field, questionnaires and interview guides were developed. The administration of these survey tools was direct, that is to say it was a question of going to the field, physically meeting all the actors concerned in the different selected areas. As for the traders, an interview guide was used to collect information, after carrying out a categorization. It was administered to 8 local wholesalers of paddy rice, 15 retailers in markets near production areas, 7 local wholesalers of processed rice, 15 wholesalers-retailers in urban and peri-urban markets, 5 supermarkets, and 10 shops. At the consumer level, populations residing in production basins, populations in metropolises close to production basins, and populations in metropolises far from production basins were identified. For households residing in production areas, 150 households were surveyed in Yaguoa which is the main production area in the country, 50 households in Mora, and 100 in Lagdo. For the populations of metropolises near the large production basins of the north, 100 questionnaires were administered to the populations of the city of Maroua. In the southern part of Cameroon, the city of Yaoundé was chosen to also administer 100 questionnaires, because it is the main drop-off point for cargoes coming from the north. The data collected was analyzed using software such as SPSS and Excel spreadsheet. The tables and figures made it possible to clearly present the results, and thus facilitate their interpretation.

RESULTS AND DISCUSSIONS

The results obtained within the framework of this study were grouped into two main parts, namely the marketing of rice produced in Cameroon, and the factors which promote the consumption of rice.

1.1.Rice marketing

To transit from production areas to various destinations across the national triangle and even outside the country, Cameroonian rice passes through several types of actors. This section is about understanding who they are, how they are organized, what their economic strengths are, and above all why they prefer to sell their products to foreign buyers. To this end, it will be a question of starting with the typology of traders, then the structuring of the rice market, and finally estimating the gross margins.

1.1.1. Typology of traders

Several categories of actors are involved in the rice marketing circuits in Cameroon. Going from upstream to downstream, we record:

-*Producers:* After field production, producers must market their rice to get money. They sell it in the form of paddy, either to wholesalers who will take care of the processing and distribution at the national and international level, or they are responsible for marketing their already husked rice on local markets. They pay an amount to the artisanal hullers, which is determined based on the quantity of rice they have. After shelling, they set up at local markets where they sell their products in detail, directly to consumers.

-*Processors-wholesalers of Paddy rice*: These are natural or legal persons who have a rice processing unit, and who will purchase paddy rice from producers, to transform it before marketing it. They sell their products to wholesalers who will take care of distribution across the country, and even outside the country.

-*Local wholesalers of paddy rice:* These are natural or legal persons who do not have a processing unit, but buy paddy rice from producers, to then resell it to foreign paddy rice wholesalers, or else they will pay the necessary amount to the processing units for shelling before marketing it. They sell the processed product to wholesalers of processed rice, who will take care of distribution across the country and even outside the country, or directly to retailers who operate in markets near the production areas.

-*Foreign wholesalers of paddy rice:* They come from neighboring countries such as Nigeria and Chad. Although the governor of the Far North region signed a note about three years ago prohibiting the export of rice to these neighboring countries, it is clear that the phenomenon persists, although with less intensity. They buy rice directly from producers or from local paddy rice wholesalers.

-*Foreign wholesalers of processed rice:* Just like foreign wholesalers of paddy rice, they come from Nigeria and Chad. They buy the rice already processed and packaged, from local paddy rice wholesalers, or from wholesale paddy rice processors. They cross borders to market it in their respective countries.

-*Local wholesalers of processed rice:* These are natural or legal persons who purchase already processed rice from local paddy rice wholesalers or paddy rice wholesale processors, and are responsible for transporting it to the main metropolises of the country. The rice is stored in large storage warehouses from where distribution will be carried out. They distribute their rice to processed rice wholesalers, Wholesaler-retailers of processed rice, supermarkets, and shops.

-*Wholesaler-retailers of processed rice:* Wholesaler-retailers of processed rice: these are natural persons who have small stores in urban or peri-urban markets, allowing them to store their goods in order to gradually sell them, either wholesale or retail.

-*Retailers of market near production areas:* They buy paddy rice from local paddy rice wholesalers, or directly from producers; They will have it shelled and sell it in detail at the market with boxes and plates.

-*Supermarkets:* They are found in all major cities; they are supplied by local wholesalers of processed rice.

Shops: These are fixed points of sale which are located throughout the territory. But Cameroonian rice is mainly found in shops in big cities. They are supplied by local wholesalers.

1.1.2. Structure of the Cameroonian rice market

The rice market is structured from production to consumption. We begin below by presenting the flow of rice in the different markets of Cameroon, then the method of setting prices, the method of payment, the method of financing, the mode of communication, and finally the marketing circuits.

1.1.2.1.Flow of rice produced in Cameroon

Figure 1 below represents the structure of the markets through which rice produced in Cameroon passes.

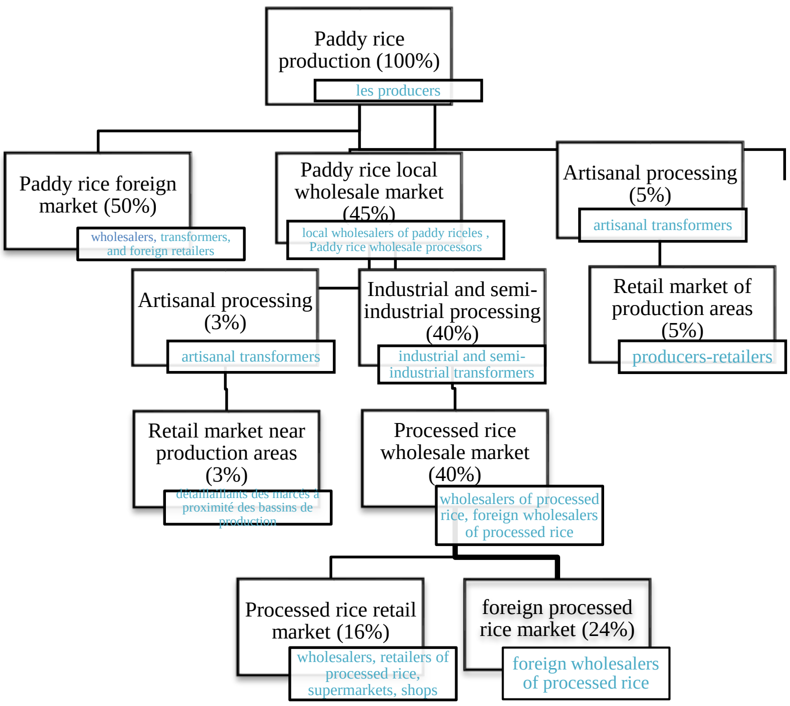

Fig. 2. Market flow of rice produced in Cameroon
Source: Own conception.

The marketing of Cameroonian rice begins at the level of producers who can store it or deliver it directly after harvest. It can be sold to foreign buyers and sent to an external market, or go directly to artisanal processing to end up on the retail market in the production areas. It can also be delivered to the wholesale paddy rice market, to move on to artisanal processing and end up in retail markets near the production areas; or move to industrial or semi-industrial processing and then end up in the wholesale market for processed rice, and drop to the retail market throughout the country and even abroad. 50% of the rice produced in Cameroon is directly delivered by producers to foreign buyers, 45% is delivered to the local wholesale market, which also directs 2% of its rice to foreign buyers, for a total of 52% of paddy rice who goes to foreign countries; Only 5% are oriented towards artisanal processing. After hulling, 24% of the rice that was delivered to the wholesale market is directed towards foreign buyers; which makes a total of 76% of Cameroonian rice which is exported to neighboring countries.

1.1.1.1.Method of setting the price of rice

The price of rice varies depending on the market, it is generally an over-the-counter market. Indeed, depending on the period, the price of paddy rice varies depending on whether we are in a period of abundance or shortage; it is sold a little more expensive when foreign buyers are in the market. As for processed rice, its price is much more influenced by the geographic location of the market and the positioning of the brand on the market. Prices at this level tend to be approved according to range.

1.1.1.2.Payment method

Producers generally require cash payment, which creates a real problem for paddy wholesale processors, who do not have enough resources to purchase in cash the quantities of rice necessary to operate their machines at optimal capacity. In certain localities we find “warrantage”; it is a payment method where buyers pre-finance producers to enable them to respect the requirements of technical itineraries, and achieve their maximum yields. They therefore collect the paddy rice from these producers in the long term, assess what it costs based on the prices on the market, deduct the amount corresponding to the pre-financing, and pay them the rest. For processed rice, the main method of payment is cash, although it sometimes happens that some traders develop a relationship of trust with their customers, which allows them to make the goods available to them on account.

1.1.1.3.Funding method

Essentially, the actors involved in the rice marketing circuit self-finance their activities. At the producer level, those who do not have the financial reserves necessary for direct financing of rice cultivation, sell part of the reserves of other products (beans, sorghum, etc.), to purchase production inputs; others who have the possibility resort to credit, which credit is granted to them by people who trust them enough to be sure that they will be reimbursed.

Some traders benefit from subsidies from the state and its partners; these subsidies are generally made in kind; this can be through the construction of storage stores, or the provision of means of transport.

1.1.1.4.Mode of communication

The increasingly remarkable use of ICTs in rural areas now helps to facilitate communication between the different actors in the rice sector in Cameroon. Indeed, contrary to old practices which would have buyers arrive on the field and deal with the situation encountered, it is possible today to make phone calls, or exchange through social networks and agree on the quantities available and on the price before carrying out on the field with complete peace of mind.

Orders are therefore placed in advance and delivery dates are fixed; the buyer has the opportunity to better organize themselves before traveling. Producers have the opportunity to inform and attract potential buyers by making publications on pages created on social networks for this purpose.

They can be informed of price developments on the national and international market, through the internet which is becoming increasingly available in rural areas.

1.1.1.5.Marketing channels

Rice marketing channels go from producers to final consumers, via various intermediaries. There are very short ones which establish a direct link between the producer and the consumer, and long ones which integrate several intermediaries. Figure 2 below presents the different marketing circuits through which rice produced in Cameroon passes. It shows that there are fourteen (14) circuits through which rice produced in Cameroon can pass. The shortest establishes direct contact between the producer and the consumer, and the longest integrate four (4) intermediaries.

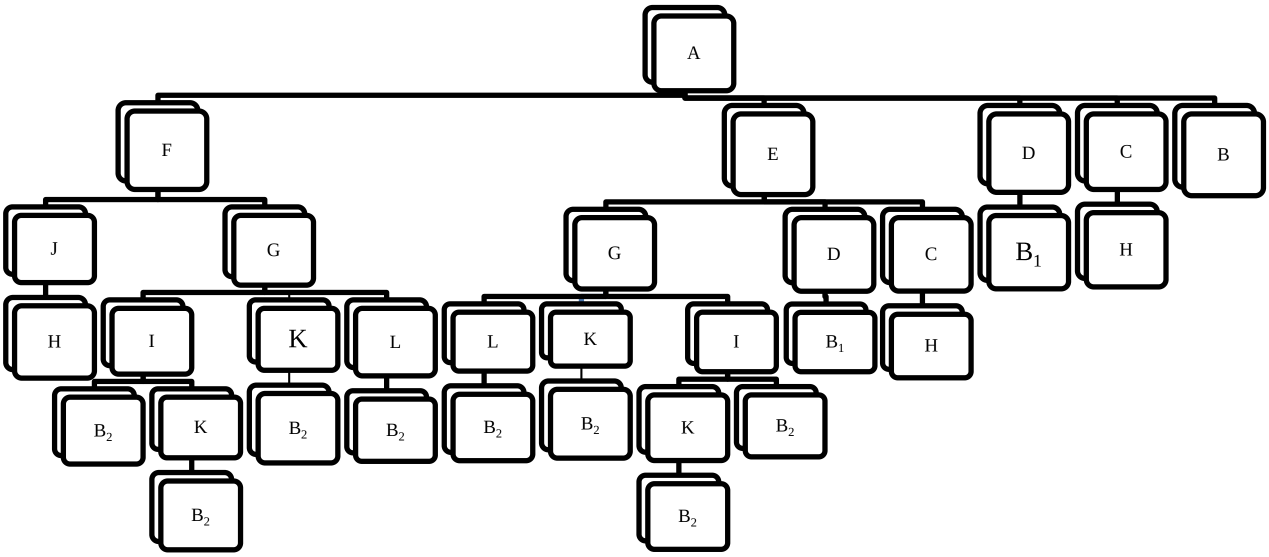

Fig. 3. Marketing circuit for rice produced in Cameroon
Source: Own conception.
Legend: A = Producers; B = Consumers in production areas; C = Foreign paddy rice wholesalers; D = Retailers of market near production areas; E = Local paddy rice wholesalers; F = Paddy rice wholesale processors; G = Local processed rice wholesalers; H = Outdoor circuits; I = Processed rice wholesalers retailers; J = Foreign wholesalers of processed rice; K = Boutiques Shops; L = Supermarkets; B_1 = Consumers near production areas; B_2 = Urban and peri-urban consumers

1.1.2. Gross margins of rice traders

In this section, we are particularly interested in rice produced in the basins of the far north; it was not easy to go to the Ndop area which is the second largest production basin in Cameroon, due to the not very stable security situation. It is a question here of working with traders who ensure the transition of rice from producers to the final consumer. These include: local wholesalers of paddy rice, local wholesalers of processed rice, wholesale retailers of processed rice, retailers of markets near production areas, super markets, and shops.

-*Local paddy rice wholesalers*: They have added value which varies depending on the market. The average purchase price of a bag of paddy rice being estimated at 14,000 FCFA, the same bag is resold to foreign buyers at a price which varies between 17,000 FCFA and 19,000 FCFA. With a transport cost estimated on average at 1,000 FCFA, for the removal of bags from the production basins to the exchange sites, we record an added value which varies between 2,000 and 3,000 FCFA per bag of paddy sold. To have significant monthly income, these traders need to sell large quantities of rice, unfortunately this is a market that is not regular; hence their involvement in various other activities. It should nevertheless be noted that the latter have a very great advantage, because when these foreign buyers arrive on the market, they buy large quantities of rice and at a better price; which allows to make significant profits in a short time, and invest in other activities.

-*Processors-Wholesalers of paddy rice*: Here we find individuals who buy paddy rice from producers, transform it before reselling it. Generally they work with semi-industrial

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processors to whom they pay 1,000 FCFA per 80 kg bag of paddy, which will give a yield of 50%, which makes 40 kg. We thus obtain added value for an 80 kg bag, which looks like this:

Wholesale processors of paddy rice =
=(40 x 400) – 14,000 – 1,000 – 500 =
= 16,000 – 15,500 = 500 FCFA gross margin

-*Local wholesalers of processed rice:* There are two types of actors in this category; those who buy processed rice to resell it in the metropolises of the northern part close to the production basins, and those who buy rice to resell it in the metropolises of the southern part of Cameroon. To carry out the analyses, the city of Maroua which is the main metropolis close to the largest production basins in the northern part was chosen, and Yaoundé which is the main point of origin for rice in the southern part. Table 1 presents in detail the gross margins of local wholesalers of rice processed and marketed in Maroua.

Table 1. Gross margin for the case of the city of Maroua

Grade	Ranges	Purchase price (FCFA)	Selling price (FCFA)	Unit price (FCFA)	Gross margin (FCFA)	Gross margin rate (%)
First grade	25 kg	12,000	13,500	540	1 500	11.11
	5 kg	3,200	3,500	700	300	8.57
	1 kg	700	750	750	50	6.66
Second grade	50 kg	17,500	19,000	380	1,500	7.89
	25 kg	9,500	10,500	420	1,000	9.52
	5 kg	2,500	2,700	540	200	7.4
Superior breaks	25 kg	9,000	9,500	380	500	5.26

Source: Own results.

Overall, we observe that the price of a kg of rice is cheaper when the packaging volume is large. On the other hand, for first grade rice, the gross margin rate is greater when the packaging is large. This observation can be explained by the fact that small containers sell out quickly and traders rely on the quantities sold to maximize their profit. At the level of second grade rice, the highest gross margin rate is observed on the 25 kg ranges which are more in demand by households, traders can afford to sell a little more expensive, already having the guarantee of the existence of the market. As for the consumer, he would benefit from buying the larger ranges, where the price per kg is cheaper. It should be noted that lower breaks are mainly consumed locally in the production areas, which is why they are not found in the marketing channels. As for the upper breaks, we could find them on the market in the northern part, but not in the southern part.

Table 2 presents the gross margins of local wholesalers of processed rice, and marketed in the city of Yaoundé.

Table 2. Gross margin for the case of the city of Yaoundé

Grade	Ranges	Purchase price (FCFA)	Selling price (FCFA)	Unit price (FCFA)	Gross margin (FCFA)	Gross margin rate (%)
First grade	25 kg	12,000	15,000	600	3,000	20
	5 kg	3,200	3,800	700	600	15.78
	1 kg	700	800	800	100	12.5
Second grade	50 kg	17,500	20,000	400	2,500	12.5
	25 kg	9,500	11,500	460	2,000	17.39
	5 kg	2,500	3,200	640	700	21.87

Source: Own results.

We generally observe that the kg of rice produced locally is more expensive in the southern part of Cameroon, compared to the prices applied in the northern part, and also the gross margin rates have increased from simple to double; this difference is mainly due to the fairly high cost of transport and the added value due to the benefit of intermediaries. It nevertheless remains true that the larger the range is, the lower the price per kg is. If at the level of first grade rice we observe that the gross margin rate is more significant when the range is large, at the level of second grade rice we observe the opposite. This is explained by the fact that for first grade rice, the smallest ranges are the most requested by customers, while for second grade rice the largest ranges are the most requested.

-*Wholesaler-retailers of processed rice:* These are individuals who have small stores in urban or peri-urban markets allowing them to store their goods in order to gradually sell them, either wholesale or retail. They operate mainly in the southern part of the country. Most of these traders have abandoned the marketing of locally produced rice, because of its very slow flow. Those who continue this activity exclusively sell wholesale. Some have tried retailing in the past, but these are no longer found these days, they only sell imported rice in this form. In fact, these are traders who open bags of 25 or 50 kg of rice which they display in front of their stores and sell to customers who are served by the kg. Table 3 presents the gross margins of wholesalers for wholesale market.

Table 3. Gross margins of wholesaler-retailers for wholesale market

Grade	**Ranges**	**Purchase price (FCFA)**	**Selling price (FCFA)**	**Unit price (FCFA)**	**Gross margin (FCFA)**	**Gross margin rate (%)**
Second grade	50 kg	20,000	21,000	420	1,000	4.76
	25 kg	11,500	13,000	520	1,500	11.53
	5 kg	3,200	3,800	760	600	15.78

Source: Own results.

Traders in this category are not interested in marketing first grade rice, because while they are already facing the slow flow of locally produced rice overall, the flow of first grade rice is still much slower. This fairly expensive rice is more in demand by Cameroonians with higher incomes. Middle-class Cameroonians with very low incomes primarily buy second-class rice at affordable prices.

Supermarkets: These are the large shopping areas found in our big metropolises, they are frequented by Cameroonians with intermediate incomes, and much more by the more affluent. They are supplied with first grade products, including the 25 kg, 5 kg, and 1 kg ranges.

Table 4. Gross margins of supermarkets

Grade	**Ranges**	**Purchase price (FCFA)**	**Selling price (FCFA)**	**Unit price (FCFA)**	**Gross margin (FCFA)**	**Gross margin rate (%)**
First grade	25 kg	15,000	16,000	640	1,000	6.25
	5 kg	3,800	4,200	840	400	9.52
	1 kg	800	900	900	100	11.11

Source: Own results.

We observe here that the smaller the ranges, the greater the gross margin rate. This is explained by the fact that, on the shelves of our supermarkets, the smallest ranges are the most requested by customers, and traders can afford to maximize profit there.

Shops: In our metropolises, you can find first grade of local rice in certain shops.

The ranges sold are 1kg, and sometimes those of 5 kg.

Table 5. Gross margins of shopkeepers

Grade	Ranges	Purchase price (FCFA)	Selling price (FCFA)	Unit price (FCFA)	Gross margin (FCFA)	Gross margin rate (%)
First grade	5 kg	3,800	4,500	900	700	15.55
	1 kg	800	1,000	1,000	200	20

Source: Own results.

1.2.Factors that favor rice consumption

Rice produced in Cameroon is marketed through various channels. Whatever the circuit through which the rice transits, it ends its journey at the consumer level. These consumers adopt rice in their diet based on various criteria. In this section it is therefore a question of presenting how the consumption of rice takes place in households, the criteria which allow consumers to appreciate the rice they consume, and finally the reasons which push them to choose rice than other species.

1.2.1. Rice consumption in households

The analysis of rice consumption in households was carried out along two very important axes, which are: the frequency of rice consumption in households, and the average ratio consumed per household in one day.

1.2.1.1.Frequencies of rice consumption in households

All the people met as part of this study suggest that rice is consumed in Cameroon by all citizens without distinction of social class. The analysis was done by grouping consumers into three (3) categories which are: consumers in the production areas of the northern zone, consumers in the metropolises close to the production areas, and consumers in the metropolises in the southern zone far from production areas. Table 6 Below shows the distribution of rice consumption frequencies according to the different categories of consumers.

Table 6. Frequencies of rice consumption in households

Area		1/7	2/7	3/7	4/7	5/7	6/7	7/7	Total
Production area	Workforce	0	45	39	39	39	39	99	300
	Rate (%)	0	15	13	13	13	13	33	100
Metropolises near production areas	Workforce	19	21	26	12	4	4	14	100
	Rate (%)	19	21	26	12	4	4	14	100
Metropolises far from production areas	Workforce	20	62	11	7				100
	Rate (%)	20	62	11	7				100

Source: Own results.

Observing the results summarized in the table above, it appears that the frequency of rice consumption is greater for populations residing in production area. We recorded 33% of interviewees who consume rice seven (7) days a week. These are peoples who have a fairly ancient rice culture, which became part of their eating habits a very long time ago. It should be noted that the most reluctant households consume rice for at least two times per week. When we move from production areas to nearby metropolises, we see that the rate of consumers who eat rice every day has fallen considerably; it goes from 33% to 14%. On the other hand, we observe respectively 26%, 21%, and 19% of consumers who eat rice 3 times, 2 times, and 1 time per week. We therefore realize that, by leaving the production areas, consumers have a much more varied diet during the week, which implies the possibility of having a more balanced diet. When we go to the metropolises of the southern part of Cameroon, further away from the production areas, we observe that those who consume rice frequently eat it a maximum of 4 times a week. Most consumers in this category eat rice in their households twice a week; they represent 62% of consumers. We can conclude by stating that, the further away from the production areas, the less frequency of rice consumption, and consequently the diet is more varied.

1.2.1.2.Average ratio of rice consumed per household in a day

At the end of the data collection, it appears that the average quantities of rice consumed per household in Cameroon vary from 0.5 kg to 6 kg per day. Table 7 summarizes the results obtained after data analysis.

Table 7. Variations in quantities of rice consumed on average per household per day

Quantities of rice eaten per day per household (kg)		**0.5**	**1**	**1.5**	**2**	**3**	**4**	**5**	**6**	**Average/ Totals**
Production area	Workforce	7	138	28	106	7	7		7	300
	Rate (%)	2.33	46	9.33	35.33	2.33	2.33		2.33	
	Quantity	3.5	138	42	212	21	28		42	1.62 kg
Metropolises near production areas	Workforce	18	33	15	22	3	2	7		100
	Rate (%)	18	33	15	22	3	2	7		
	Quantity	9	33	22.5	44	9	8			1.25 kg
Metropolises far from production ereas	Workforce	30	45	20	5					100
	Rate (%)	30	45	20	5					
	Quantity	15	45	30	10					1 kg
National level	Workforce	55	216	63	133	10	9	7	7	500
	Rate (%)	11	43.2	12.6	26.6	2	1.8	1.4	1.4	
	Quantity	27.5	216	94.5	266	30	36	35	42	1.49 kg

Source: Own results.

By scrupulously examining our table, we observe that, going from the rice production basins of the northern zone, passing through the metropolises of the said zone, to arrive at the metropolises of the southern zone, the average quantity of rice consumed per household in a day gradually decreases. We leave in the production basins with an average of 1.62 kg of rice consumed in one day per household, at an average of 1.25 kg in the northern metropolises, to drop to an average of 1 kg per day per household. in the metropolises of the southern part of Cameroon. This difference is due to the variation in household size. Thus, from the people interviewed, we record an average size of 9 people per household in our production areas, an average of 6 people per household in the metropolises of the northern zone, and an average of 5 people per household in the metropolises of the southern zone. We can further confirm this opinion by observing that in the metropolises of the southern zone, the largest households consume a maximum of 2 kg of rice in a day, and they only represent 5% of the sample. On the other hand, in the metropolises of the northern zone, we find some who are capable of consuming up to 5 kg of rice in a day, and in the production areas which are rural areas we arrive at 6 kg of rice consumed in a single day, by a single household. Most households have an average consumption capacity of 1 kg of rice in a day, all areas combined; 43.2% of respondents belong to this category.

1.2.2. Rice Appreciation Criteria

Surveys carried out in metropolises near production areas revealed that 28% of these populations prefer to eat local rice, compared to 34% who prefer to eat imported rice; the remaining 38% have no particular preference. In the metropolises of the southern zone on the other hand, around 50% of respondents are not aware of the fact that there is rice produced in Cameroon, 30% are informed but have never had the opportunity to consume it, 12% say they consume it occasionally, and only 8% say they consume it regularly although they find it in certain sections of supermarkets. This situation further favors the sale of this product abroad, because some traders complain that the sale of Cameroonian rice on the local market is too slow, hence their preference for the marketing of imported rice; which is more in demand and sells quickly.

1.2.2.1.Appreciation of rice on the market

Consumers take into account a certain number of criteria to choose rice on the market. These include color, texture, brand, origin, and price.

Color: We find rice with various colors on the Cameroonian market. Depending on the consumers, the assessments are different. Some consumers like yellow-colored parboiled rice because they find it to be more nutrient-rich because during the parboiling process, nutrients on the skin migrate to the seeds, making them richer in addition to giving them a yellowish color. Others like white rice because they find it easy to cook, because they no longer need to wash it and find that it swells a lot.

Texture: Rice is appreciated differently depending on its texture. This is how we have long grain rice which is the top of the range, then follows the 5% broken, 25% broken, upper broken and lower broken, which are chosen by consumers according to their income level. We also record the level of impurity which is a very important criterion for consumers who most often prefer clean rice which makes the cooking task easier.

The brand: Some consumers are more attached to the brand of rice because they were satisfied with it from the first tastings. There are some who say they prefer broli brand, while others prefer “mémécassé”, etc. this without worrying about the packaged variety or any other criterion.

Origin: There are consumers who like the idea of consuming locally, and are not willing to consume rice other than that produced locally. On the other hand, there are some who say they prefer Thai rice, others prefer Vietnamese, Pakistani rice, etc.

Price: Given the current economic situation, most of the people we meet, buy rice at the market no longer taking into account their organoleptic preferences, or any other assessment criteria, but rather according to their level of income. The price has therefore become a very important criterion in the choice of rice at the market.

1.2.2.2.Appreciation of rice after cooking

After making the choice on the market, consumers also have the opportunity to appreciate the quality of their rice after cooking. Those of the consumers met during our surveys listed a certain number of criteria which are: perfume, appearance, color, and taste.

Perfume : During and after the rice cooking process, the smell released can help determine the quality and type of rice. For example, we have so-called fragrant rice, which is a better quality rice. Not only does it give off a smell that is very appreciated by consumers, but it also has a very good flavor.

Appearance: Rice after cooking can have a granulated appearance which is the form most appreciated by consumers, or have a pasty and sticky appearance, which makes it difficult to serve although sometimes the taste can be appreciable.

Color: Just as we can appreciate rice in the market based on its color, we can also do so after cooking, because it does not change color after it is cooked.

Taste : This is the most important criterion in the appreciation of rice. Whatever the selection criteria taken into account when purchasing rice, the final objective is that it can have an appreciable taste.

1.2.3. Reasons for choosing rice

Rice is a food increasingly consumed and appreciated by households in Cameroon. Various reasons were put forward by the respondents to justify this interest in rice: firstly, it is a food very appreciated by children, it is always available on the market, it is cheaper compared to other products, and ultimately very easy to cook. Overall, consumers believe that eating rice regularly causes stomach upset and diarrhea. They also find that rice is digested quickly and you feel hungry again very quickly; it must therefore be alternated with other heavier meals.

Local rice produced in Cameroon is very appreciated by its consumers who find that it has a very good natural aroma and good flavor. Notwithstanding these qualities that Cameroonian rice presents, its consumers note a certain number of problems that they encounter with this rice: they find that Cameroonian rice is not often well cleaned, it is sticky, when it is poorly cooked they become mushy, and it doesn't rise much.

The transition of Cameroonian rice goes through fourteen different circuits to reach the final consumer. The shortest establish direct contact between the producer and the consumer, and the longest integrate four intermediaries. These differences depend on whether it is marketed in production areas, in metropolises close to production areas, in metropolises far from production areas, or abroad. The price per kg is therefore different between traders in the north and those in the south. This difference is accentuated by the fairly high cost of transport to transit from the north to the south. Based on the law of supply and demand, we will therefore understand that the demand for rice can gradually decline, as we move away from the production basins, due to the increase in price due to the cost of transport. Hine and Ellis (2001) [2] also state that, if the margin between the producer (farm) price and the consumer selling price is high, the effective demand transferred to the producer will be reduced. And the direct consequence of this situation is to promote, at the level of production basins, the export of Cameroonian rice to neighboring countries. This is how Mamadou (2013) [6] rightly confirms that rice produced as much under rainfed conditions as under irrigated conditions is nearly 75% exported to Nigeria.

In addition to the cost of transport which favors the increase in the price of local rice, going from the production basins to the metropolises, we also note the fact that Cameroonians prefer imported rice, compared to local rice. This corroborates with the assertions of JICA (2017) [4]. which stipulate that, regarding the quality of local rice, populations living in cities are generally wealthier and prefer imported rice because it is of better quality than local rice which contains many impurities. Field investigations also reveal that, notwithstanding the qualities that Cameroonian rice presents, its consumers note a certain number of problems that they encounter with this rice: they find that Cameroonian rice is not often well cleaned, it is sticky, when it is poorly cooked they become mushy, and it does not rise much. In addition to these shortcomings noted by consumers, Jangolo (2016) [3] believes that, in the face of foreign competition, Cameroonian rice can hardly stand up, this is due to a total refusal to promote and recognize this commodity in the markets and supermarkets. From North to South and from East to West, Cameroonians opt for rice of Western and/or Asian origin. Surveys carried out in metropolises near production areas revealed that 28% of these populations prefer to eat local rice, compared to 34% who prefer to eat imported rice; the remaining 38% have no particular preference.

The program to support the development of agricultural sectors (PADFA) strives to bring all technical and technological innovations to milling, bleaching, parboiling and packaging operations under a label of origin in order to give a new start to the marketing and consumption of local rice. Despite these efforts, the situation remains unchanged, which may mean the existence of other reasons as stated by Ngo (2019) [11] who finds that local brands also suffer from a marketing and distribution deficit in the face of foreign brands, from Asian countries. In the same vein, our results show that most Cameroonians are not aware of the existence of locally produced rice, and even those who are aware of it do not easily find it on the market. In the metropolises of the southern zone of Cameroon, for example, we have around 50% of the population who are not aware of the fact that there is rice produced in Cameroon, 30% of the population who are informed but never had the opportunity to consume it. The study by Um II (2023) [13], carried out in the city of Yaoundé, presents an almost similar situation but even more accentuated, because according to its data, out of 380 people surveyed, 222 people do not know Cameroonian rice, or 58.42%. Which could suggest that there has been a slight advance in the popularization of this product, although very insignificant.

In addition, at the wholesale level of the paddy rice market, we record gross margins that are very favorable to those who direct their goods abroad. While local wholesalers who sell their rice abroad make a gross margin which varies from 2,000 to 3,000 FCFA per bag of paddy, those who process and resell locally in bulk barely make a gross margin of 500 FCFA. Which naturally gives priority to exports, to the detriment of local consumption.

CONCLUSIONS

By way of conclusion, we can say that this study, which aimed to analyze the causes of Cameroon's permanent dependence on rice imports, is inspired by the observation that, despite all efforts made to boost the level of local rice production, more than half of the rice consumed in Cameroon comes from imports. This raises the question of why rice produced in Cameroon is exported to neighboring countries, while the country depends on imports to meet its needs; which causes it to lose a lot of foreign currency? The study therefore set itself the objectives of analyzing the marketing channel of Cameroonian rice, and identifying the factors that favor its consumption. The study took place in Cameroon, targeting rice traders and consumers. The Far North, Northern and Central regions, which produce most of the rice in Cameroon, were covered. To leave the production areas for the final consumer, the rice will pass through traders where several categories are identified which are: paddy rice wholesalers, foreign paddy rice wholesalers, processors-wholesalers of paddy rice, local wholesalers of processed rice, foreign wholesalers of processed rice, wholesalers in markets near production areas, wholesalers-retailers of processed rice, supermarkets, and shops. The results show that 43.2% of Cameroonians consume on average 1 kg of rice per day. But unfortunately, most are not aware of the existence of locally produced rice, and even those who are aware of it cannot easily find it on the market. In the metropolises of the southern zone of Cameroon, for example, we have around 50% of the population who are not aware of the fact that there is rice produced in Cameroon, 30% of the population who are informed about it. never had the opportunity to consume it.

Following the analysis of the results, **we can recommend as perspectives**, to get Cameroonians to consume more local rice, and stop exports, the implementation of the following strategies: Organize campaigns to popularize the local rice, with the aim of making as many Cameroonians as possible aware of the existence of local rice of which they seem to be unaware; encourage the expansion of rice cultivation in all ten regions of the country, in order to reduce transport costs from production areas to consumption areas; facilitate access to financing for actors involved in rice processing, which will make it possible to purchase enough paddy rice to operate their machines at their optimal level; intensify the fight against the porosity of Cameroonian borders, which is the source of illicit exports of Cameroonian rice to foreign countries; and improve the organoleptic qualities of local rice, which will lead consumers to have more interest in this product.

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CHALLENGES OF THE CONSUMPTION BEHAVIOUR TOWARDS THE ECO-FOOD PRODUCTS. A STUDY ON THE SUSTAINABLE HUMAN NEEDS

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Abstract

The human needs and the consumer behaviour are in a permanent transformation and having more sustainable and healthy food becomes a priority. The consumer behaviour follows the trends of the population needs. Eco-food consumption is increasing, as a result of agricultural, nutritional and food production policies. The producers in the eco-food branch should focus on quality that meets the consumers' demands. This study is focused on eco-food products analysis from the new consumption behaviour and sustainability point of view. The main purpose is to analyse the attributes perceived by consumers and their interest related to viability and sustainability of the eco-food, in association with expected benefits. The methods used for research are the market survey and focus group, alongside the incursion in the literature related to eco-food consumption behaviour. The research area is delimited on Iași County population, only for the eco-food products consumers. The results indicate a growing interest for the eco-food consumption, especially among middle-aged people, interested in better quality of life, personal and family health, and a sustainable new lifestyle.

Key words: *behavior, consumption, development, eco-food, needs*

INTRODUCTION

Human consumption is a topic of major interest for the current research and production environment. However, an analysis of it only in the general way is nonsense, given that the categories of consumption vary a lot, according to multiple criteria and with the involvement of numerous influencing factors. Consumption is a determining factor of production and has direct implications on resource management. A simple view of the link between these components indicates the permanent circularity of the resource-production-consumption relationship.

The main subject of paper is food consumption, from the perspective of consumption behavior of ecological food products. From here derive some particularized subthemes, at least by referring to the existing literature. The needs of food consumption are considered as a vector of the change in consumption behavior, the way to adapt organic food producers to these needs, the orientation of European policies regarding the production, marketing and consumption of organic food products.

The analysis of general human consumption is based on Abraham Maslow's Hierarchy of Needs Pyramid, according to which among the basic needs of people are the needs of food consumption [16]. That is why the attention directed to the evolution and particularities of food consumption is fully due, especially in the context of the overlap of the new food consumption models with the major challenges of food and nutrition policies, as well as with the issue of the sustainability of the needs expressed by consumers today.

The present work emphasizes the specifics of food consumption in a modern, evolved society, where consumption needs are considered from different perspectives, by referring to the: time, well-being, quality of life, emancipation, etc.

Throughout the paper, reference will be made to the specific situation in Romania. The connection of the concepts of food consumption behavior and sustainability proves to be justified, given that among the objectives of sustainable development horizon 2030, there is also Objective 12 "Sustainable production and consumption" [19].

The main arguments in favor of approaching this topic are supported by related aspects such as: the alteration of production resources, difficulties in waste management, the health status of the population, the protection of environmental factors, government spending, etc. These global concerns are not very recent, but are now finding their place in organic farming policies. A first consideration of sustainable consumption was in 1994, in Oslo, when The United Nations Environment Program (UNEP) [20] defines sustainable consumption as "the use of products or services to meet the demand of consumers and enhance quality of life while reducing the use of non-renewable resources and waste generated during consumption". [1, citing 8 and 11]. It is an undeniable fact that technology and food production processes have advanced greatly, which has allowed the supply and variety of food products to be constantly increasing in relation to the amount of food consumed. According to National Institute of Statistics [13], in 2022 a Romanian consumed, on average, 2.268 grams of food/day, 2.345 grams/day in 2021 and 2.293 grams/day in 2020. Qualitatively, the average net daily consumption is assessed by the caloric content of food; in Romania, from 3,464 calories/day in 2015 to 3,558 calories/day in 2021. But, the quantitative increase in food consumption does not mean a qualitative one.

Another aspect in the analysis is the major social changes that have taken place in the last 10-15 years in Romania. The increase in the standard of living and access to information have made individuals develop superior capacities for choice and decision, to become emancipated, to consume more variedly. The economic changes that our country has gone through have produced major changes including in food consumption behavior. Economic growth is reflected in GDP 2.5% higher in 2023 compared to 2022, and 4.5% higher in 2022 compared to 2021 [13]. The higher level of human development is indicated by the increase in the HDI (Human Development Index) value from 0.811 in 2015 to 0.821 in 2021 [20]. These changes attracted the orientation towards the consumption of organic food, Romanians becoming more and more interested in these products, for reasons related to well-being, health, a new lifestyle and emancipated behavior, understanding of sustainability, etc. The literature shows the principles of ecological consumption: "Buying organic foods depends on the respect of three essential principles: health consciousness, the equilibrium of the economic situation, and the protection of the environment." [15 citing 9].

The problem of organic food consumption, reflected in the adaptation of consumption behavior, is anchored in European policies that emphasize the quality of food consumption in connection with the quality and depletion of agricultural production resources.

[2] claim that "Food quality is one of the main strategic goals of the reformed CAP, taking into account the impact of agriculture on the climate change", and in this context "the consumers are playing an important role in boosting the food quality all over EU." The increase in sales of organic food products is supported by the production of an increasing number of such products and their assortment variation.

In Romania, the most consumed organic food products are: dairy, soft drinks and basic foods, fruits and vegetables, eggs.

This is the context in which we propose the objectives of the paper:

O1. Analysis of the interest of Romanians in Iași county for the consumption of eco-food products;

O2. Perception analysis of the reasons and benefits resulting from the consumption of eco-food;

O3. Establishing a connection between food consumption behavior, human needs and the challenges of sustainability requirements. Specifically, this study is focused on eco-food products analysis from the sustainability point of view, the market attitude towards its qualities and consumption interest for this category of food. Compared to other approaches in the specialized literature, this paper emphasizes the three-dimensional aspect of the influencing factors of eco-food consumption: the policies for organic agriculture, the change in consumption behavior and the consumption needs given to the sustainability requirements.

MATERIALS AND METHODS

The organization of the paper is based on the analysis of four fundamental notions: consumption behavior, ecological agriculture, ecological food products, sustainable needs. Starting with a foray into specialized literature, we argue the research approach with statistical data and information, with national and international recognition. In this sense, databases such as: Eurostat, INS, UNEP, EC are used [7, 13, 20, 5] Next, we will present the notions that allow the argumentative transition to the main topic of the paper: the reasons and interest of the people of Iași for the consumption of organic food products.

The concept of consumer behavior appears in a vast and diversified profile literature, including an interdisciplinary one, but it is less present in the local literature. The American Marketing Association (2017) [1] defines consumer behavior as "the dynamic interaction of affect and cognition, behavior and environmental events by which human beings conduct the exchange aspects of their lives". In agreement with other definitions, consumer behavior involves a number of processes that characterize the selection, buying, use of products, services, ideas or experiences by individuals or groups to meet their needs and desires [3 citing 18]. The variation of studies on food consumption behavior is not very large, and regarding the analysis of sustainable consumption, the literature is very recent, only in the last 5-10 years gaining a greater scope. Muresan et. all (2021) mentions regarding food consumption behavior that "A substantial number of studies have underlined that consumers have positive attitudes with respect to sustainable food behavior but also that the behavior is influenced by the socio-demographic characteristics of consumers." [12].

To analyze the problem of consumption, it is necessary to consider consumption needs. Maslow's pyramid indicates food consumption at the base of the pyramid, but given socio-economic progress and demographic changes, transformations are also noted in consumption behavior. These two variables, consumption needs and consumption behavior, influence each other. In fact, the consumer behavior follows the trends of the population needs, and the consumption of eco-food shows that it is a component of two categories of needs: basic and those at the top of the pyramid (development, self-improvement, self-actualization).

Eco-food consumption behavior is interdependent with organic agriculture. In fact, the consumption of eco-food is directly associated with the production systems of organic agriculture, which is booming in Romania. The consumer benefits from the results of organic production rules, but knows less about the aspects that guarantee quality through product certification, organic cultivation techniques, EU regulations, etc. Organic production techniques mandated at EU level include: crop rotation, banning the use of chemical pesticides and synthetic fertilisers, limits on the use of antibiotics for animals, banning genetically modified organisms (GMOs), free-range farming and the use of organic feed [6]. The basic rules in organic production are: protecting the environment, maintaining biodiversity, animal welfare, strengthening consumer confidence in organic products [6]. Romanian agriculture generating ecological products is focused on four main branches of production: vegetable products, animal products, processed products, beverages [4].

The consumption of organic products in Romania has increased, but at a slow pace. Representatives of large commercial chains mention that "Although they have had sustained growth in recent years, organic products still remain a niche category. In 2023, the consumer was much more informed and aware, wanting to know what they were buying, where it came from, how it was packaged and transported.” [14].

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Regarding the size of the organic food market, it is determined by food consumption behavior and consumer perception of organic food. An impediment to the detailed analysis of this market is that the reported data is not updated or is very difficult to identify. For this reason, we will refer to the sales of organic food products from 2018. At the EU level, they were 37.4 billion Euros, almost as much as in the USA (40.6 billion). In the top of the countries with the largest volume of sales of organic food products are: France 9.1 billion Euros, Germany 10.9 billion Euros, Italy 3.5 billion Euros. Dynamically, at the European (EU-28) level, the organic food market grew from 20.8 billion Euros in 2012 to 37.4 billion in 2018, and organic agricultural land grew by 33.7%.A general situation regarding the progress of the organic food production base, by processing Eurostat data from 2021, is presented in Table 1. We chose this reference indicator, since organically cultivated land is the basis for obtaining the raw material for food production in the ecological system.

Table 1. Total ecologically cultivated area (ha.), fully converted and under conversion.2012-2021, EU-28.

Country	2012	2021	%
Portugal	200,833	768,800	282.8
Croatia	31,904	121,924	282.2
France	1,030,881	2,775,671	169.3
Hungary	130,607	293,597	124.8
Bulgaria	39,138	86,310	120.5
Romania	288,261	578,718	100.8
EU (1)	9,457,886	15,921,242	68.3

Source: Eurostat, 2023 - Developments in organic farming [7].

Romania ranks very well, in 6th place, compared to the EU average and other countries. In the 9 years of transition to ecological production systems, the agricultural area cultivated ecologically has doubled, and Bulgaria and Hungary surpass Romania's situation by very little (about 20%).

Within ecological production systems there is also the consumer who, through his behavior, strongly influences the consumer market. Motivations, perception, expected benefits, preferences and actual consumption behavior are qualitative factors with a major impact on the evolutionary trend of this market. In addition, it is important to note that eco-food is a practically accepted concept relatively recently in the current language of the population. Regarding the reasons underlying the consumption of eco-food, the most significant are: health, high quality, personal beliefs and values, the desire to support local producers, environmental protection, curiosity, ethical norms, animal protection, positive previous experiences [3].

Muresan et. all (2021) shows that "consumers' attitudes towards sustainable food behavior are mainly influenced by age and education level and the health issues represent an important aspect that defines food consumption behavior" [12], and [15] mentions that "most consumers are convinced that organic products are more nutritious than non-organic products.

However, the most common reason identified was that organic food is considered safer and more nutritious, the second most common reason was protecting the environment, followed by supporting the economy and local communities." [17].

The present paper analyzes the determinants of the consumption behavior of eco-food products, considering the constantly changing human needs and the requirements of a sustainable development. Methodologically, an empirical-descriptive content is developed, based on recent statistical data and specialized literature. The study used as main methods for research the questionnaire, focus group, and, also, the incursion in the reports of eco-food consumption behavior. The variables used for the analysis are: consumption motivation, perceived quality, consumer confidence, price perception, expected benefits.

The research area is delimited on Iași County population, Romania, the main goal being to identify and analyze the parameters with influence on the consumption interest of the eco-food products. The research universe is limited to consumers of organic products from supermarkets in Iasi county (Lidl, Carrefour, Kaufland).

The investigated clusters are made up only of consumers who recognize the ecological label, consume by conscious choice these types of food, habitually. We chose to do the study on

Romania, namely Iași county, because the market for organic food products is growing, consumers have a new consumption model based on supporting local production, and being sustainable and "eco" is a new trend in Romanian food consumption. Other arguments also supported by literature [3]: Romanian market of organic food products is different from the Western European markets in terms of quantity, diversity, accessibility, in terms of culture, level of information and confidence of consumers and producers.

The respondents participating in the establishment of the database, following the application of the questionnaire with 15 questions, were in number 136; the distribution was done in the online environment, but also at the place of purchase (supermarket).

The focus group was organized on a small sample of 9 people, but representative of the study topic. Even if qualitative research can lead to subjectivism or is not widely accepted, it has the quality of providing valuable information about perception, attitude and motivation.

RESULTS AND DISCUSSIONS

Through the quantitative analysis, based on the questionnaire, two directions of analysis were considered: (1) the experience of consuming eco-food products; (2) the interest shown for this type of consumption.

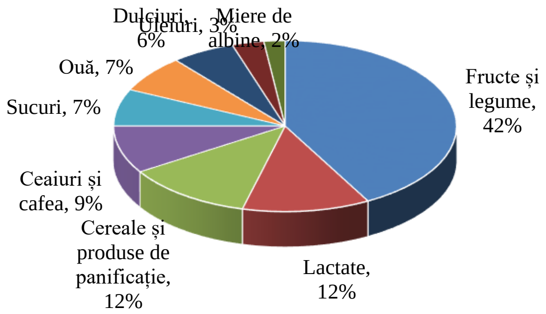

Fig. 1. Reponses to Q1 ”Which organic food product do you prefer to eat on a regular basis?”
Source: Own results based on the respondents' answers.

The general profile of consumers of organic food products in Iași county is: predominantly female, age 35-45 years, urban environment, medium to high income, higher education level, family with children, increased interest in health and a balanced lifestyle.

The results of the market survey are presented next, descriptively and interpretatively (Figures 1 to 5).

We chose these product categories in accordance with the statistics that mention the organic food products with the most frequent consumption, respectively products that we visualized as predominant on the shelf. It is found that the most preferred are organic fruits and vegetables (42%), followed by dairy products (12%), cereals and bakery products (12%). It is observed that staple foods also remain the most preferred. All valid responses were selected according to consumer profile, so the age of all respondents is 35-45 years old.

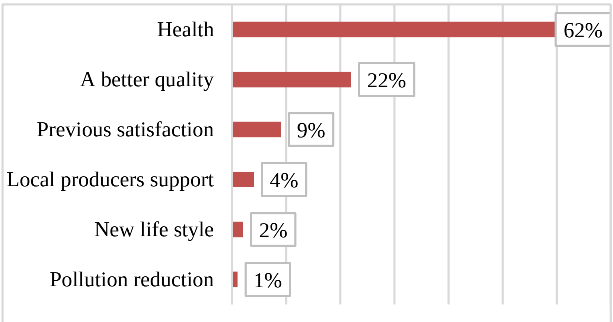

Fig. 2. Reponses to Q2 ”What is the main reason why you decided to eat organic food?”
Source: Own results based on the respondents' answers.

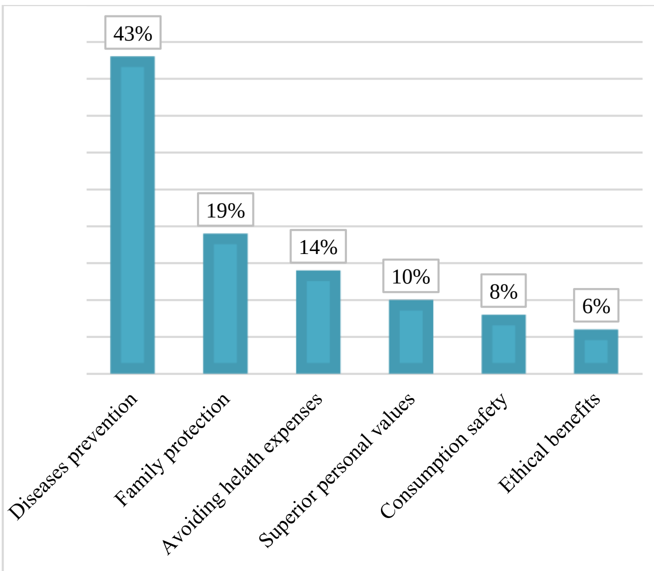

Fig. 3. Reponses to Q3 ”What is the most important benefit you expect to get as a result of eating organic food products?”
Source: Own results based on the respondents' answers.

Consumers of organic products in the chosen research environment, like those in most similar studies, mention health as the main reason for consuming organic food products (62%). At a long distance, but with a significant weight, is also the better quality of these products (22%). In contrast, a new lifestyle or reducing pollution matters too little (2% and 1%, respectively).

The health-related benefit, i.e. prevention of illness, is the most important for 43% of respondents, followed at a considerable distance by family protection (19%) and avoidance of health expenses (14%). Ethical benefits matter very little (6%), meaning the contribution to the protection of the environment and the well-being of animals, compliance with civic norms, altruism, etc.

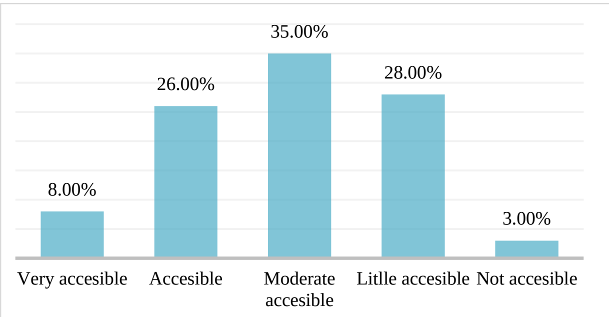

Fig. 4. Reponses to Q4 ”How do you assess the prices of eco-food products compared to the prices of similar products, but which do not come from the organic production system?”
Source: Own results based on the respondents' answers.

As can be seen from the graph above, there are not many consumers who appreciate the prices of organic food products as very affordable (only 8%), and 3% consider them unaffordable. However, most (35%) say that they would have no difficulty in purchasing these products. Accessibility means the availability of payment and fitting into the budget allocated to the food consumption basket.

Consumer trust in eco-food products is predominantly at a higher level (total trust, very high and high, respectively 18%, 24% and 38%), these benchmarks adding up to a trust degree of 80%, which seems natural given that the respondents are consumers of organic food products.

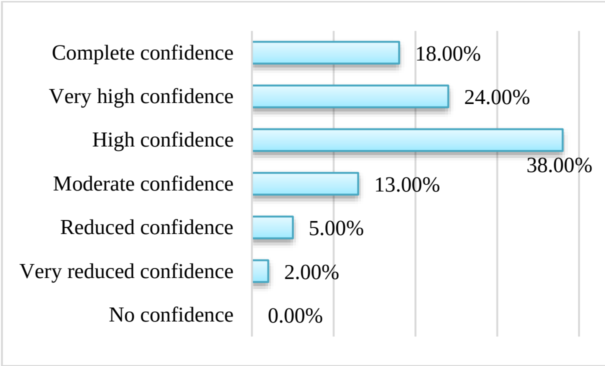

Fig. 5. Reponses to Q5 ”How confident are you about the organic certification of the food products you consume?”
Source: Own results based on the respondents' answers.

Regarding the focus group, its organization was more difficult and the aim was to form a sample as representative as possible.

Table 2. Focus group analysis of perception in eco-food consumption

Attribute	Synthesis results from the processing of the collected information
Appearance	A bit eye-catching but not garish, compatible with the natural look
Attractiveness	High, proper
Expected benefits	Health, healthy lifestyle, satisfying decent needs, balance, quality
Availability	Average, not all necessary products can be found, specialized shelves
Labeling	Easy to recognize, markings, logos, rigorous signage
Purchase intent	More preferred, frequent purchase, only certain product categories
Confidence in certification	No details are known about the certifiers, there are some doubts
Price	Even if it is slightly higher, it is acceptable
Organoleptic properties	Much more pleasant taste, natural flavor, natural color, pleasant smell
Consumption recommendation	A referral network is created, especially through quality and safety

Source: Own results based on the respondents' answers registered and transcribed from the focus-group.

The profile of the focus group consumers is very similar to that of the survey participants. In the course of approximately 90 minutes, a semi-structured interview was conducted, given that we used the same reference parameters as in the survey: reason for consumption, expected benefits, price perception, degree of trust; to these we added other parameters, summarized in Table 2.

From the synthesis of the research in the focus group, the following specific aspects are concluded:

- the predominant keywords are: health, pleasant, natural, protection, guarantee;
- there are some female-male differences: women are more concerned with purchase and consumption, the main reason being care for the whole family;
- the predominantly consumed products are: dairy, bakery, coffee, juices, eggs;
- an adjacent motivation for the consumption of organic food is the ethical sense and responsibility assumed towards future generations, towards the environment and natural resources;
- the notion of sustainable need was less recognized, instead that of sustainability was considered a normality in responsible consumption behavior;
- the participants were very animated by the topic.

The results of the paper indicate a growing interest for the eco-food consumption, especially among the young and middle-aged people, interested by quality pf products connected with personal health and a sustainable new life style.

CONCLUSIONS

Consumers of organic food products in the chosen research environment are informed and become increasingly aware of the specifics of this type of consumption, as well as the benefits obtained. Considering the eco-food consumer's custom behavior and consumption needs, producers and marketers can advertise the product in a formal and informal manner.

From the perspective of European agricultural policies, there is an acceleration of the pace of encouraging organic consumption, starting from strategies for the fastest possible transition to organic production systems. Our conclusion regarding this aspect is that a closer monitoring of industrialized food production, which has reached alarming levels, is sought, or there are major concerns about the way natural resources are managed, ecological production being a sustainable solution.

The results of the study on the consumption behavior of eco-food products, from the considerations of more sustainable needs, show that the population in the reference area of the research, Iași county, has as main reasons for consumption: personal and family health, product quality. The expected benefits are: a new more sustainable lifestyle, the contribution to reducing the pressure on environmental factors. The work, however, also has some limits, primarily by restricting the research area to a single county in Romania. Then, only a descriptive analysis was performed. The work could also have addressed the issue of the vulnerability of eco-food products, respectively of counterfeit products. The usefulness of the content of the paper: it can support the implementation of information campaigns and awareness of the importance of organic food consumption, with an impact on encouraging production at the local community level. It can also be considered a form of practical approach to the notion of sustainability, from the perspective of analyzing the needs for which individuals make consumption commitments.

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FINANCIAL PROFITABILITY OF AGRICULTURE IN BULGARIA

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Abstract

Efficiency in agricultural business activity is directly related to the high financial results. The main approaches to business evaluation are related to the investment in production capital and the return on the investments made. The object of research in this article is the profitability of equity capital in the Agriculture sector in Bulgaria. Known in economic literature as Financial profitability, it is an important indicator for both owners and future investors, as it shows the profitability of capital invested in production. The main goal of this article is to make a comparative analysis and assessment of the direct factors that have an impact on the profitability of equity capital in agriculture. Based on the collected statistical information, the method of the financial profitability calculation was selected, through the influence of changes in the equity load factor and revenue profitability. The conclusion is related to finding a causal relationship between the components of financial profitability, which is the basis for specific recommendations and opportunities to increase its level.

Key words: *profitability, equity capital, factor analysis, Bulgaria*

INTRODUCTION

The industrial sector is of great importance for the development of a country. Countries with stable industries have seen accelerated economic growth, improved national income, and increased living standards of citizens.

Due to its low economic indicators compared to the countries of the European Union, the industry in Bulgaria is a top priority.

The agro-industry is one of the most important branches of the economy, as it includes the cultivation of plants and animals, which are the basis for the production of food products necessary for feeding the population,

The production of biofuels, fibers, medicines and others are necessary for the normal course of human life. This industry also makes it possible to increase the population density in individual areas.

During this century, a huge number of scientists and inventors contributed to the development of human civilization [5][3]. Agriculture is dependent on climatic conditions. With the development of this industry, the use of artificial fertilizers, pesticides, plant selection becomes necessary. The genetic modification of some crops leads both to an increase in the yields of the cultivated plants and to a number of ecological problems related to the health of people and the environment.

Agriculture is a branch of strategic importance, as the production provides food for the population, supports biodiversity, creates raw materials for many other branches and sectors of the national economy. Regional integration applies under certain conditions imposed by the object to the subject [4][10].

The production of agricultural products is used for different purposes. Production of cereals, vegetables, fruits and meat serve as food for the population. Other products like cotton, wool, hemp, silk are used for clothing. A third group of products is related to the cultivation of plant species from which biofuels are produced, such as methane, ethanol, biodiesel. There are also some of the products produced in agriculture that are used for decorative purposes such as flowers, exotic fish and pet birds.

Everything said so far leads to the conclusion that the technical progress of the agro-industry plays a key role and is a decisive factor in the development of humanity and social changes in the world.

According to National Statistical Institute, NSI, data, the gross added value created by the branches of the national economy in 2022 amounts to 76,266 million euro at current prices and marks a real growth of 5.3% compared to the previous year. In the Agricultural sector, it amounts to 4.3% of the total in the country and marks a decrease of 0.7% compared to the previous year [12].

In 2022, the agrarian trade of Bulgaria will show a growth of 42.8% on an annual basis, which in terms of value amounts to 14938.8 million euros. This is largely due to the unusually high inflation on a global scale, which also affected the agricultural sector. The export of agricultural goods during the year amounted to 8,269.9 million euro, which is 36.9% above the level of 2021. Even more serious is the increase in imports by 50.9% compared to the previous year. The traditionally positive balance in Bulgaria's agricultural trade shrank by 1.3% on an annual basis, to 1,601 million euro [7].

The aim of the Agricultural Policy introduced by the European Union is to help farmers cope with new challenges and to respond to the changing attitudes and expectations of people, this way they will increase food quality and biodiversity and rural development. In the end, the main goal is to have high-quality products delivered to the market and also profit for the producers in rural areas [8].

According to the "Classification of economic activities" in the branch Agriculture with its two main directions "Crop growing" and "Livestock breeding" is located in sector A "Agriculture, forestry and fisheries and economy" [11].

Capital is most often associated with the monetary expression of the value of invested assets. It is a set of resources owned by the entrepreneur, through which the relevant products or services will be produced.

At the start of the activity of any production, initial capital is needed, through which assets necessary for the normal functioning of the respective company are purchased. A large part of this capital is occupied by equity capital. This is money that can grow or have so-called added value. Equity is one of the most important economic indicators, as it helps investors assess the financial stability of a company.

The equity capital is that invested by the founders and partners in the creation of the business organization. It can be increased later. Equity represents the value of a company's assets after all debts and liabilities have been paid. However, high equity may indicate that the company is not using debt effectively to maximize its profit [2].

The accounting reporting of equity capital is organized through the system of accounting accounts, which are provided for in the Model National Chart of Accounts, which each enterprise individualizes for its accounting needs. The purpose of their use is to provide the most accurate and reliable accounting reporting of the economic operations of the equity capital as a whole [6].

In relation to the National Accounting Standard, equity capital together with (provisions), long-term, short-term liabilities and financing are the main items in the accounting balance sheet and are found in the Liabilities section of the balance sheet. In turn, the company's own capital is formed by three elements: fixed capital, reserves and financial result [9].

The goal of every single entrepreneur is to produce goods and services that, through their realization on the market, satisfy the needs of consumers and thereby make a profit.

The profitability of the business must first of all be profitable, i.e. shows the rate of return on capital invested in the enterprise. It is determined by indicators characterizing the company's ability to generate profit. Profitability indicators are the relationship between the achieved financial result and the working capital [1]. The human capital is very important as a resource for agriculture especially in the rural areas.

For the purposes of this paper, we will use return on equity, also known as Financial profitability. The indicator calculated on the basis of the equity capital shows how many BGN revenues were obtained from one or one hundred BGN equity capital. It characterizes the effectiveness of the management from the point of view of the shareholders of the enterprise and expresses in a pure form the interests of the owners. Therefore, it is often seen as a key investment indicator. It characterizes the profitability of the enterprise from all types of activities in the enterprise.

MATERIALS AND METHODS

The calculation of the return on equity is based on aggregated statistical information from the financial and accounting reports of agricultural companies. This sample represents 7% stratified information of the companies employed in the agricultural sector in Bulgaria. For greater detail, an individual comparative analysis of the two main directions in the agrarian sector, namely "Crop breeding" and "Livestock breeding", was made. The data used are for a period of 5 years from 2017 to 2021 respectively.

When calculating Return on equity or Financial profitability, we could use the ratio of net profit (after tax due) over the value of equity.

Return on equity is calculated using the formula [14]:

$$\mathrm{Roe} = \frac{\mathrm{NP}}{\mathrm{E}} \,.\, 100\,, \quad \text{..............................}(1)$$

where:
Roe – Return On Equity;
NP – Net Profit;
E – Equity.

For a greater depth of analysis, it is necessary to calculate the Equity Load Coefficient, the profitability of the income as well as its change [13]. The equity load factor C_{EL} is calculated according to the formula:

$$C_{EL} = \frac{\mathrm{TR}}{\mathrm{E}} \,.\, 100\,, \quad \text{........................}(2)$$

where:
C_{EL} – Coefficient of equity load;
TR - Total Revenue;
E – Equity.

Return on a revenue basis (Ror) is calculated according to the formula:

$$\mathrm{Ror} = \frac{\mathrm{NP}}{\mathrm{TR}} \,.\, 100\,, \quad \text{..............................}(3)$$

where:
Ror - Return on Revenue;
NP – Net Profit;
TR - Total Revenue.

Return on Equity is influenced by 2 factors:

(a)The influence of changes in the Equity Load Coefficient

I_{CEL} is calculated by the formula:

$$I_{CEL} = \Delta C_{EL} \,.\, \mathrm{Ror}_{(0)} \quad \text{............................}(4)$$

where:
ΔC_{EL} – The change in the Equity Load Coefficient;
$\mathrm{Ror}_{(0)}$ – Return of previous year's revenue

(b)The influence on the changes in Return based on revenue (Ror) is calculated according to the formula:

$$I_{ROR} = \Delta \mathrm{Ror} \,.\, C_{EL(1)} \quad \text{............................}(5)$$

where:
ΔRor– changes in Return based on revenue;
$C_{EL(1)}$ – Coefficient of equity load for current year.

In the analysis of the financial profitability of the enterprises in the agricultural industry, it is necessary to make a structural (vertical) analysis of the liabilities of the balance sheet. The ratios between the main elements of the capital will make it possible to reveal what share each indicator occupies in the total liability, which is a prerequisite for a full assessment and analysis of the financial condition of the industry.

RESULTS AND DISCUSSIONS

We can see from the data in Table 1, that there are values of a wide range for the Return on Equity in the Plant Breeding sector. They are in the range of 10.13% to 22.83% for the period 2017 – 2021. Also, it could be mentioned that in the first two periods we can see negative values in the Return on Equity, which is totally different if we compare the results with the end of the analysed period, where the values are positive and reach their highest levels of 11.54 percentage points, which means that for every BGN 100 of equity, the balance sheet profit increased by BGN 11.54.

This increase is due to the influence of two factors:

- as a result of the increase in the Equity Load Coefficient, the Return on Equity increased by 0.66 points.
- as a result of the increase in the Return of revenues, the Return of Equity increased by 10.88 points. The change in the Return on equity in the Plant production industry at the end of the examined period (2021) compared to the beginning (2017) marked an increase of 9.24%. This increase was driven by both a decrease in influence to the Equity Load by 0.76 points and an increase in influence of the Return on Revenues by 10.00%.

Table 1. Return on equity in the Plant production sector for the period 2017 – 2021

Plant production	**Value (thousands BGN)**					
	2017	2018	2019	2020	2021	2021/ 2017
Net (Balance) Profit	124,176	118,331	104,209	122,766	295,415	
Equity	913,985	973,461	1,028,474	1,087,079	1,293,951	
Return on Equity	13.59	12.16	10.13	11.29	22.83	
Absolute change compared to previous year		-1.43	-2.02	1.16	11.54	9.24
Total Revenue	895,666	901,036	919,771	949,983	1,196,802	
Return of revenues	13.86	13.13	11.33	12.92	24.68	
Absolute change compared to previous year		-0.73	-1.80	1.59	11.76	10.82
Equity Load Coefficient	0.98	0.93	0.89	0.87	0.92	
Absolute change compared to previous year		-0.05	-0.03	-0.02	0.05	-0.06
Influence of Equity Load Coefficient		-0.75	-0.41	-0.23	0.66	-0.76
Influence of Return based on revenue		-0.68	-1.61	1.39	10.88	10.00

Source: [12].

Regarding the Return on equity in the Livestock sector, we can see according to Table 2 that there are higher values at the beginning of the period. In the year 2021, there is a decrease of 7% compared to the start of the period.

Table 2. Return on equity in the Livestock sector for the period 2017-2021

Animal production	**Value (thousands BGN)**					
	2017	2018	2019	2020	2021	2021/ 2017
Net (Balance) Profit	40,629	29,558	34,399	31,156	29,230	
Equity	232,241	247,052	250,221	271,368	275,002	
Return on Equity	17.49	11.96	13.75	11.48	10.63	
Absolute change compared to previous year		-5.53	1.78	-2.27	-0.85	-6.87
Total Revenue	349,395	361,018	365,255	363,456	391,201	
Return of revenues	11.63	8.19	9.42	8.57	7.47	
Absolute change compared to previous year		-3.44	1.23	-0.85	-1.10	-4.16
Equity Load Coefficient	1.50	1.46	1.46	1.34	1.42	
Absolute change compared to previous year		-0.04	0.00	-0.12	0.08	-0.08
Influence of Equity Load Coefficient		-0.50	-0.02	-1.14	0.71	-0.95
Influence of Return based on revenue		-5.03	1.80	-1.13	-1.56	-5.92

Source: [12].

The change in Return on equity only in 2019 has a positive value and is 1.78%. In the remaining years, it is a negative value and decreases at the end of the period, reaching its lowest value -0.85% in 2021, which means that for every BGN 100 of equity, the balance sheet profit has decreased by BGN 0.85.

This increase is due to the influence of 2 factors,
- as a result of the increase in the Equity Load Coefficient, the Return on Equity increased by 0.71%.
- as a result of the decrease in the Return of revenues, the Return of Equity decreased by 1.56%.

The change in the Return on equity in the

Livestock sector at the end of the research period (2021) compared to the beginning (2017) marked a decrease of 6.87%. This decrease was due to both a decrease in changes in the load factor of 0.95% and a decrease in changes in Return of Revenues of 5.92%.

Vertical analysis occupies an important place in the financial strategy of enterprises engaged in the agro-industry. It is used in determining the state, structure and capital changes in enterprises. The structural analysis is carried out on the basis of the main elements included in the liabilities of the balance sheet and allows to reveal the share of each indicator in the total result for a certain period.

Due to the fact that the results obtained from the analysis of the Capital structure in the crop and livestock sectors showed similar values, it was necessary to generalize them for the agriculture sector.

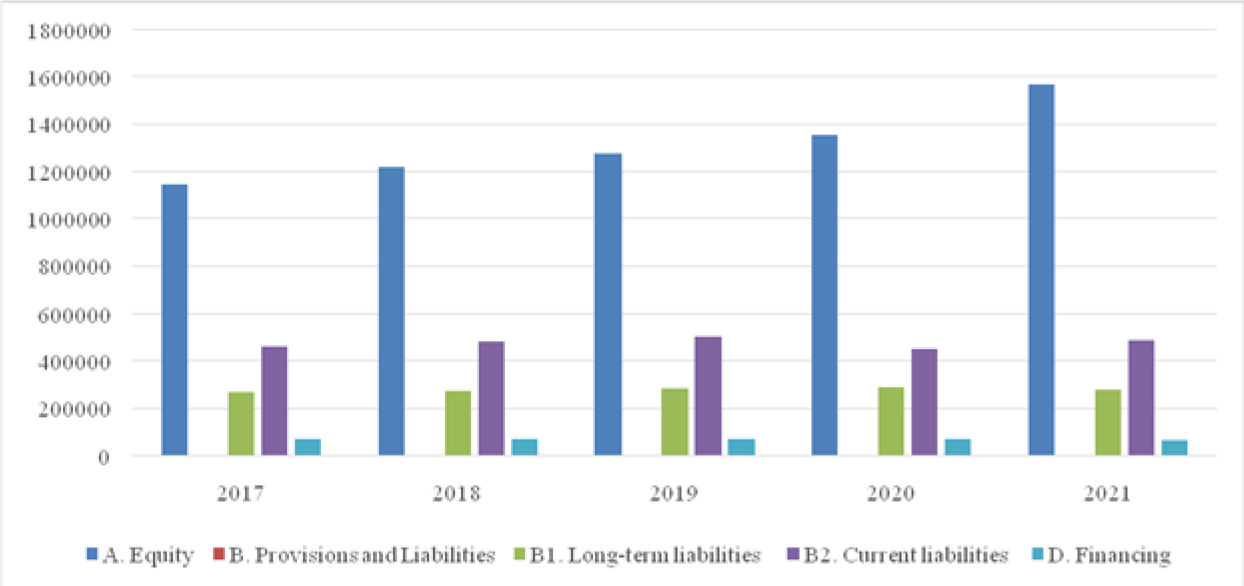

Fig. 1. Return on equity in the Livestock sector
Source: Own design based on the data.

From the data shown in Figure 1, it is clear that the largest relative share in Liabilities on the balance sheet is occupied by equity capital. In the study period, an increase was observed and varied from 58% in 2017 and reached 65% in 2021.

In the next place are the short-term and long-term liabilities, which are relatively constant for the research period and, as a relative, are approximately 23% and 13%, respectively.

Financing and provisions have the lowest value, corresponding to approximately 3% and 0.1%.

Analyzing the above data, one can see the dominance of own capital, which leads to financial independence (autonomy) of enterprises in the agro-industry. This enables enterprises to pay off their long-term debts with their own funds, to attract additional capital without the risk of losing their financial sustainability and to preserve their independence from creditors.

The structural analysis is of great importance because it shows what part of the Equity capital and loan capital are included in the liabilities of the balance sheet and are available to the enterprise. The ratios between the main elements of the capital enable a more complete assessment and analysis of the financial condition of the industry.

CONCLUSIONS

The introduction of digitization in this sphere is a basis for increasing productivity, added value and improving the quality of life. The agricultural sector is increasingly important and relevant due to the increased demand for healthy and biologically pure quality products that are produced through the application of good agricultural practices.

From the scientific research we can withdraw the next main results and conclusions:

-the financial profitability in the Plant production sector increased over the years and reached positive values at the end of the study Higher positive results in the end of the reviewed period were due to a decrease in load factor variances and an increase in revenue profitability variances.

The negative values in the change in Financial profitability in the Livestock sector are due to both the changes in the load factor and the changes in the profitability of income.

-from a structural point of view, it is evident that the own capital occupies the largest relative share in the total capital resource, which leads to financial independence (autonomy) of the enterprises in the agro-industry. Therefore, the higher amount of equity capital, respectively higher capital adequacy, would mean a reduction in the degree of taking on higher risks.

Financial profitability is an important and basic indicator for calculation in any enterprise or industry, as it gives an opportunity to assess the enterprise's ability to bring income from the capital invested in it, and hence how profitable the enterprise's activity is.

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ECONOMIC EFFICIENCY REGARDING CASTOR BEAN (*Ricinus communis* L.) CULTIVATION IN PEDOCLIMATIC CONDITIONS IN THE CENTER OF MOLDOVA, ROMANIA

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Abstract

In Romania, castor bean (Ricinus communis L.*) is not cultivated on large areas, offering beneficial perspectives to those who want to set up a business in the agricultural field. The expansion of surfaces with this species is limited by climatic conditions, and in particular by the fall of early autumn broths, which can compromise the entire production of secondary colds. Climate change in recent years has led to the expansion of the castor cultivation area, which has obtained satisfactory production in the central area of Moldova if all technological links are respected. The research aimed to identify the genotype with the highest adaptability to the pedoclimatic conditions in the area of influence in order to establish the optimal sowing age and the distance between rows on the production and quality of seeds, implicitly in obtaining a net profit. The results obtained from 2018-2020 showed that the best option of cultivation and obtaining high net profit for the pedoclimatic conditions in the center of Moldova is the one for the variety Teleorman sown in second age and 70 cm distance between rows (12,046 lei·ha^{-1} for a production of 1,607 Mg·ha^{-1}).*

Key words: *seed production, sowing age, genotype, net profit*

INTRODUCTION

Castor bean or ricin (*Ricinus communis* L.), one of the most important crops in the *Euphorbiaceae* family, is grown worldwide for its oilseeds that produce the much prized castor oil. Due to its unique chemical properties, castor seed oil has several uses and therefore makes castor an industrially important crop [3].

Ricin is generally spread in the tropical, subtropical and warm temperate regions of the world. It is very common on marginal land, in rural and urban areas, and also at altitudes between 400 and 2,700 m. The probable origin center for castor is North East Africa, that is Ethiopia and Somalia [1] and has four diversity centers, namely, Ethiopia-East Africa, and, North-West and South-West Asia and the Arab Peninsula, the subcontinent of India and China [5, 8, 10, 14, 23]. It is now naturalized on the African continent, Red Sea (on Atlantic coast), Tunisia, South Africa and the islands from the Indian Ocean. It is also cultivated and naturalised cultivated throughout the world, especially in the tropical and subtropical areas of America, Asia and in Europe, in temperate areas [9,11, 16, 21].

In our country, for some reason, both cultivated areas and realized productions have been reduced. Because castor is originally a shrub with a high branching capacity, and Romania is at the northern limit of its culture area, it is necessary to obtain genetic forms with a shorter vegetation period, a lower branching degree, ensuring the stability and constancy of high harvest levels.

The use of castor oil for the production of biodiesel is difficult due to refining costs and high viscosity of the oil. However, because to its high oil content, distinct fatty acid composition (ricinoleic acid), and wide range of tolerance to drought and saline conditions, castor has enormous promise as a source of bioenergy and industrial raw material. [26].

Worldwide, castor oil has been used for medicinal purposes for a long time. Many illnesses and health issues can be treated with it externally, but also as an ally of the beauty of hair and skin. It has a high concentration of unsaturated fatty acids and has strong antioxidant and anti-inflammatory properties. Castor oil helps heal wounds, scratches and bruises, as well as insect stings.

The benefits of castor oil come from its concentration of unsaturated fatty acids. It is used in various cosmetic beauty treatments, but also to prevent, combat or correct various body conditions [4, 24].

High-purity derivatives may be produced from castor seeds due to their high ricinoleic acid content. In ricinoleic acid, the hydroxyl group is a unique and significant chemical reaction site that balances the carboxyl group and double bond. [19, 20].

Castor oil's high solubility in alcohols at room temperature, which also speeds up a number of chemical processes, is another crucial characteristic. [7]. Castor's high viscosity over a wide temperature range makes it a valuable ingredient in lubricants. For the chemical and polymer industries, castor oil is considered one of the most promising renewable raw materials because of its many applications and a range of well-established industrial processes that yield a diverse range of renewable platform chemicals, according to several researchers papers. [18].

At this time, in our country, the production of castor seed obtained from reduced surfaces cannot be used for industrial processing. The vast majority of growers market their seeds for the cultivation of castor as an ornamental plant. The key element for obtaining high castor production and implicitly obtaining a high profit is the observance of all technological links. The optimal sowing age plays an important role in the growth and development of castor in relation to the desired environmental conditions, which leads to a maximum yield [25]. In-depth research is also required to determine the optimal sowing age in a particular geographical area to optimise the quantitative and qualitative seed production of oil plants. Ricin is recommended to be sown until the first decade of May, about the same period as corn [12,13, 22].

Scientific study ought to incorporate the adaptation of agricultural strategies aimed at optimizing castor's productive potential. Adapting an optimum spacing, which is the space between two rows and which, when applied properly, may result in improved soil conservation and increased output, and, more efficient use of soil water and high profit. In addition to providing these advantages, mechanical work can be carried out in the field in order to destroy weeds [2, 15, 17].

It is mandatory to know both the genotypes that have a greater adaptability to the area conditions and the technological elements that lead to the improvement of the culture technology. Finding these technological parameters at castor is of great importance for the quantitative and qualitative increase of production, as well as for the improvement of culture technology. Thus, the results obtained from 2018 to 2020 on these aspects are presented in this paper.

MATERIALS AND METHODS

The research was carried out within the "Moldoveni" Agricultural Society from Neamt county, on a phaeozioma type soil with a medium texture, characterized as being well supplied with phosphorus (77.2 ppm P_{AL}), calcium (13.3 meq$\cdot$100$^{-1}\cdot$g soil), magnesium (1.6 meq$\cdot$100$^{-1}\cdot$g soil), medium supplied with nitrogen (16.3 ppm N-NO_3) and poorly supplied with potassium (124.3 ppm K_2O). Supply in active humus was medium (2.42%), and the soil reaction was slightly acidic (a pH of 5.96) (STRS, 2015).

For the study of climatic conditions, meteorological data collected from the Secuieni Neamt Agricultural Research and Development Station, were used. In the 2017-2020 agricultural years the average annual temperature was 8.9°C, and the annual precipitation amount was 544.3 mm. The multi-annual averages recorded in the period under review were 526.0 mm (2017/2018), 430.3 mm (2018/2019) and 376.0 mm (2019/2020). Deviations from the multi-annual average ranged from - 22 mm to - 172 mm, thus indicating an uneven distribution of rainfall during the growing season.

In the spring of 2018 an experience was placed in the experimental field of the "Moldoveni" Agricultural Society, Neamt with three factors of 4×4×3 type, arranged according to the subdivided plots method, in three repetitions and aimed to the identification of the genotype with the highest adaptability to the climatic conditions in the area of influence and the establishment of the optimal sowing age and the optimal nutrition space.

Studied factors

Factor A: Genotype, with 4 graduations:

- a_1 - Dragon;
- a_2 - Rivlas;
- a_3 - Christian;
- a_4 - Teleorman.

Factor B: Age of sowing, with 4 graduations:

- b_1 - sown in the Ist decade of April;
- b_2 - sown in the IInd decade of April;
- b_3 - sown in the IIIrddecade of April;
- b_4 - sown in the Ist decade of May.

Factor C: Rows spacing with 3 graduations:

- c_1 - 50 cm between rows;
- c_2 - 70 cm between rows;
- c_3 - 100 cm between rows.

The sown area of the experimental plot was 16.8 m^2, of which 8 m^2 were harvested.

Methyl-esterification of the samples used in the analysis was performed by the BF3-MeOH method, which occurs after alkaline hydrolysis. For 20 mg of the oil sample was added 2 mL 0.5 mol·L^{-1} solution of methanol, and the mixture was brought to the temperature of 100°C and heated for 7 min. Once it has reached ambient temperature were added 3 mL of BF3-MeOH with 14% concentration, and then the container was heated again to 100°C for 14% 5 min.

After cooling, 2 mL of hexane and 7 mL of NaCl saturated solution were added, then the solution was put to the extract. The resulting hexane layer (2 mL) was used as a sample solution for GC.

The FAME (fatty acid methyl ester) analysis was performed based on GC-MS QP 2010 using a Shimandzu system equipped with an automatic injector with and without splitting the split/splitless mobile phase flow. The separation was made using a Zebron ZB-FFAP capillary column (60 m × 0.25 mm ID, 0.25 μm film thickness). Helium (He) gas, with a division ratio of 1:10, was used as a carrier with a 1.99 mL/min flow rate.

The injector had a temperature of 250°C, and the furnace temperature was set at 140°C for 10 min, and increased to 250°C at a rate of 7°C/min, then maintaining the final temperature for 10 min. To control the GC-MS operation, the software provided by LabSolution was used [6].

For the analysis of the economic efficiency of the factors studied at castor, the production costs, the gross profit and the net profit were calculated [27].

RESULTS AND DISCUSSIONS

The average of the three years indicates that the Teleorman variety has the highest adaptability to the conditions of the area. Compared to the control variant (average experience) this variety has achieved a distinctly significant production increase (48 Mg·ha^{-1}) (Table 1).

The second sowing era has positively influenced seed production, and its level has been influenced by climatic conditions recorded in the period under review.

During the period under study (2018-2020), the highest production increases (38 Mg·ha^{-1}, respectively 127 Mg·ha^{-1}), compared to the witness were obtained at the various sowns in the first and second ages, it follows that castor is favorable for sowing until the second half of April (Table 2).

At the variant sown in the the I^st decade of May, a production deficit of 157 Mg·ha^{-1} was obtained very significant, compared to the experience witness, what we deduce is that it is necessary to sow castor no later than the second decade of April, because the seeds do not reach maturity (Table 2).

Table 1. Genotype influence on seed production at *Ricinus communis* L. (2018 - 2020 years average)

Genotype	Production (Mg·ha^{-1})	Difference		Signi-ficance
		%	Mg·ha^{-1}	
Dragon	1,343	100.75	10	
Rivlas	1,240	93.02	-93	ooo
Cristian	1,368	102.63	35	*
Teleorman	1,381	103.60	48	**
Average	1,333	100	Control	
LSD 5% = 23.49 Mg·ha^{-1}; LSD 1% = 35.57Mg·ha^{-1}; LSD 0.1% = 57.14 Mg·ha^{-1}.				

Source: Own results.

Table 2. Sowing age influence on seed production at *Ricinus communis* L. (2018 - 2020 years average)

Sowingage	Production (Mg·ha^{-1})	Difference		Signi-ficance
		%	Mg·ha^{-1}	
I^st decade of April	1,371	102.85	38	*
II^nd decade of April	1,460	109.53	127	***
III^rd decade of April	1,325	99.40	-8	
I^st decade of May	1,176	88.22	-157	ooo
Average	1,333	100	Control	
LSD 5% = 34.89Mg·ha^{-1}; LSD 1% = 46.55Mg·ha^{-1}; LSD 0.1% = 60.84Mg·ha^{-1}.				

Source: Own results.

Table 3. Rows spacing influence on seed production at *Ricinus communis* L. (2018 - 2020 years average)

Rows spacing	Production (Mg·ha^{-1})	Difference		Signi-ficance
		%	Mg·ha^{-1}	
50 cm	1,368	102.65	35	*
70 cm	1,423	106.78	90	***
100 cm	1,238	92.85	-95	ooo
Average	1,333	100	Control	
LSD 5% = 28.30Mg·ha^{-1}; LSD 1% = 40.96Mg·ha^{-1}; LSD 0.1% = 61.66Mg·ha^{-1}.				

Source: Own results.

Analyzing the influence of the distance between rows to castor, it follows that at greater distances production deficits are obtained. Thus, when the plant nutrition surface is increased, the branching is stronger, the, and production from the main racem decreases, instead increasing the production of secondary racemes. The density must be such that the production of secondary racemes, which do not always reach maturity, is greatly reduced.

Over the course of three years of experimentation, the average results registered indicate that the highest production was obtained at the variant sown at 70 cm between rows (1,423 Mg·ha^{-1}), which denotes that castor responds favorably to this distance as recommended in the literature (Table 3).

Among the factors that led to the superiority of the variant sown at 70 cm between the rows in the period taken in the study, it should be remembered the following: the possibility of performing mechanical slingshots up to advanced vegetation without affecting the roots and foliar apparatus, creating the possibilities of access of sunlight up to the lower floors of the leaves, earlier capsule harvesting and their uniform maturation.

Comparing with the production obtained at the control variant (average experience) it is noted that at the distance of 100 cm between the rows was obtained production deficit (-95 Mg·ha^{-1}) very significant (Table 3).

The technological factors studied had both positive and negative influences on the chemical composition of castor seeds. Thus, the production of ricinoleic acid ranged from 461.66 kg·ha^{-1} (Rivlas × sown in the I^st decade of May × 100 cm between rows) to 767.05 kg·ha^{-1} (Teleorman × sown in the II^nd decade of April × 70 cmbetween rows) (Table 4).

Compared to the control variant, production increases of ricinoleic acid statistically ensured as very significant were obtained from variants sown in the second age of Cristian varieties (126.82 kg·ha^{-1}) and Teleorman (146.09 kg·ha^{-1}). Also at the second age of sowing, at the varieties Dragon (98.83 kg·ha^{-1}) and Rivlas (70.91 kg·ha^{-1}) sown at the 70 cm between rows, distinct significant differences were obtained (Table 4.).

For all the varieties studied, sown in III^rd decade of April and I^st decade of May, negative production differences ranging between 86.63 kg·ha^{-1} and 159.3 kg·ha^{-1} have been obtained, very significant, distinctly significant and significant (Table 4).

As regards palmitic acid production, it ranged from 3.23 kg·ha^{-1} (Dragon × sown in the Ist decade of May × 100 cm between rows) to 9.94 kg·ha^{-1} (Teleorman × sown in the IInd decade of April × 70 cm between rows). The results showed that the highest amounts of palmitic acid were obtained at the Teleorman variety at almost all the interactions studied (Table 4).\

Table 4. Influence of genotype × sowing age × distance between rowson theproduction of ricinoleic acid andpalmitic acid at *Ricinuscommunis* L. (2018 - 2020 years average)

A - genotype	B - sowing age	C - distance between rows	Seed production (Mg·ha^{-1})	Ricinoleic acid (kg·ha^{-1})	Palmitic acid (kg·ha^{-1})
a$_1$ - Dragon	b$_1$ - Ist decade of April	c$_1$ - 50 cm	1,368	629.32	4.14°
		c$_2$ - 70 cm	1,410	652.94	4.30°
		c$_3$ - 100 cm	1,293	602.30	3.97°°
	b$_2$-IInd decade of April	c$_1$ - 50 cm	1,464	676.59	4.45°
		c$_2$ - 70 cm	1,548	719.79**	4.74
		c$_3$ - 100 cm	1,352	632.63	4.16°
	b$_3$-IIIrd decade of April	c$_1$ - 50 cm	1,320	604.48	3.98°°
		c$_2$ - 70 cm	1,403	646.51	4.26°
		c$_3$ - 100 cm	1,210	560.91	3.69°°
	b$_4$ - Ist decade of May	c$_1$ - 50 cm	1,171	534.33°	3.52°°
		c$_2$ - 70 cm	1,254	575.60	3.79°°
		c$_3$ - 100 cm	1,061	490.17°°°	3.23°°°
a$_2$ - Rivlas	b$_1$ - Ist decade of April	c$_1$ - 50 cm	1,267	597.94	5.11
		c$_2$ - 70 cm	1,320	626.48	5.35
		c$_3$ - 100 cm	1,201	573.60	4.90
	b$_2$ - IInd decade of April	c$_1$ - 50 cm	1,356	642.62	5.49
		c$_2$ - 70 cm	1,451	691.87*	5.91
		c$_3$ - 100 cm	1,252	600.88	5.13
	b$_3$ - IIIrd decade of April	c$_1$ - 50 cm	1,212	569.45	4.86
		c$_2$ - 70 cm	1,305	616.93	5.27
		c$_3$ - 100 cm	1,110	527.80°°	4.51°
	b$_4$ - Ist decade of May	c$_1$ - 50 cm	1,078	504.34°°°	4.31°
		c$_2$ - 70 cm	1,170	550.57°	4.70
		c$_3$ - 100 cm	975	461.66°°°	3.94°°
a$_3$ - Cristian	b$_1$ - Ist decade of April	c$_1$ - 50 cm	1,392	656.75	7.27
		c$_2$ - 70 cm	1,440	683.26	7.56
		c$_3$ - 100 cm	1,317	628.71	6.96
	b$_2$ - IInd decade of April	c$_1$ - 50 cm	1,482	702.31*	7.77*
		c$_2$ - 70 cm	1,568	747.78**	8.28**
		c$_3$ - 100 cm	1,370	657.30	7.28
	b$_3$ - IIIrd decade of April	c$_1$ - 50 cm	1,349	633.59	7.01
		c$_2$ - 70 cm	1,438	679.67	7.52
		c$_3$ - 100 cm	1,245	592.12	6.55
	b$_4$ - Ist decade of May	c$_1$ - 50 cm	1,215	568.24	6.29
		c$_2$ - 70 cm	1,294	608.86	6.74
		c$_3$ - 100 cm	1,103	522.30°°	5.78
a$_4$ - Teleorman	b$_1$ - Ist decade of April	c$_1$ - 50 cm	1,345	670.95	8.70**
		c$_2$ - 70 cm	1,392	698.82*	9.06***
		c$_3$ - 100 cm	1,269	640.99	8.31**
	b$_2$ - IInd decade of April	c$_1$ - 50 cm	1,434	718.56***	9.32***
		c$_2$ - 70 cm	1,521	767.05***	9.94***
		c$_3$ - 100 cm	1,323	671.03	8.70**
	b$_3$ - IIIrd decade of April	c$_1$ - 50 cm	1,301	646.04	8.38**
		c$_2$ - 70 cm	1,391	695.11*	9.01***
		c$_3$ - 100 cm	1,197	602.08	7.81*
	b$_4$ - Ist decade of May	c$_1$ - 50 cm	1,167	577.12	7.48
		c$_2$ - 70 cm	1,245	619.70	8.03*
		c$_3$ - 100 cm	1,055	528.16°°	6.85
		Average (control)	1,300	701	165
Ricinoleic acid - LSD 5% = 63.4 kg·ha^{-1}; LSD 1% = 88.3 kg·ha^{-1}; LSD 0.1% = 105.8 kg·ha^{-1}. Palmitic acid- LSD 5% = 1.53kg·ha^{-1}; LSD 1% = 2.04kg·ha^{-1};LSD 0.1% = 2.85kg·ha^{-1}.					

Source: Own results.

Compared to the experience control variant, very significant production increases were recorded at the interactions between the Teleorman variety × sown in the Ist decade of April × 70 cm between rows (2.93 kg·ha^{-1}), Teleorman variety × sown in the IInd decade of April at 50 between rows between rows (3.19 kg·ha^{-1}), Teleorman variety × sown in the II[nd] decade of April at 70 cm between rows (3.81 kg·ha^{-1}) and Teleorman variety × sown in the III[rd] decade of April × 70 cm between rows (2.88 kg·ha^{-1}).

Very significant negative difference was obtained at Dragon × sown in the I[st] decade of May× 100 cm between rows (2.90 kg·ha^{-1}) (Table 4).

The net profit realized in the analyzed period varied in wide limits from 7,016 lei·ha^{-1} (Dragon × sown in the I[st] decade of May × 100 cm between rows) to 12,046 lei·ha^{-1} (Teleorman variety × sown in the II[nd] decade of April × 70 cm between rows) (Table 5).

Table 5. Economic efficiency of production results2018 - 2020 (years average)

A-Genotype	B - Sowing age	C - Distance between rows	Seed production (kg·ha^{-1})	Production value (lei·ha^{-1})	Total costs (lei·ha^{-1})	Production costs (lei·kg^{-1})	Raw profit (lei·ha^{-1})	Net profit (lei·ha^{-1})
a_1 - Dragon	b_1 - I[st] decade of April	50 cm	1,390	14,817	2,680	1.928	12,137	10,195
		70 cm	1,436	15,308	2,770	1.929	12,538	10,532
		100 cm	1,316	14,029	2,860	2.173	11,169	9,382
	b_2 - II[nd] decade of April	50 cm	1,479	15,766	2,950	1.995	12,816	10,766
		70 cm	1,568	16,715	2,790	1.779	13,925	11,697
		100 cm	1,365	14,551	2,900	2.125	11,651	9,787
	b_3 - III[rd] decade of April	50 cm	1,344	14,327	3,010	2.240	11,317	9,506
		70 cm	1,433	15,276	3,120	2.177	12,156	10,211
		100 cm	1,230	13,112	2,830	2.301	10,282	8,637
	b_4 - I[st] decade of May	50 cm	1,193	12,717	2,940	2.464	9,777	8,213
		70 cm	1,283	13,677	3,050	2.377	10,627	8,926
		100 cm	1,080	11,513	3,160	2.926	8,353	7,016
a_2 - Rivlas	b_1 - I[st] decade of April	50 cm	1,288	13,730	2,680	2.081	11,050	9,282
		70 cm	1,334	14,220	2,770	2.076	11,450	9,618
		100 cm	1,213	12,931	2,860	2.358	10,071	8,459
	b_2 - II[nd] decade of April	50 cm	1,376	14,668	2,950	2.144	11,718	9,843
		70 cm	1,465	15,617	2,790	1.904	12,827	10,775
		100 cm	1,263	13,464	2,900	2.296	10,564	8,873
	b_3 - III[rd] decade of April	50 cm	1,241	13,229	3,010	2.425	10,219	8,584
		70 cm	1,330	14,178	3,120	2.346	11,058	9,289
		100 cm	1,128	12,024	2,830	2.509	9,194	7,723
	b_4 - I[st] decade of May	50 cm	1,091	11,630	2,940	2.695	8,690	7,300
		70 cm	1,180	12,579	3,050	2.585	9,529	8,004
		100 cm	977	10,415	3,160	3.234	7,255	6,094
a_3 - Cristian	b_1 - I[st] decade of April	50 cm	1,415	15,084	2,680	1.894	12,404	10,419
		70 cm	1,461	15,574	2,770	1.896	12,804	10,756
		100 cm	1,341	14,295	2,860	2.133	11,435	9,605
	b_2 - II[nd] decade of April	50 cm	1,504	16,033	2,950	1.961	13,083	10,989
		70 cm	1,593	16,981	2,790	1.751	14,191	11,921
		100 cm	1,390	14,817	2,900	2.086	11,917	10,011
	b_3 - III[rd] decade of April	50 cm	1,369	14,594	3,010	2.199	11,584	9,730
		70 cm	1,458	15,542	3,120	2.140	12,422	10,435
		100 cm	1,255	13,378	2,830	2.255	10,548	8,861
	b_4 - I[st] decade of May	50 cm	1,218	12,984	2,940	2.414	10,044	8,437
		70 cm	1,308	13,943	3,050	2.332	10,893	9,150
		100 cm	1,105	11,779	3,160	2.860	8,619	7,240
Teleorman	b_1 - I[st] decade of April	50 cm	1,429	15,233	2,680	1.875	12,553	10,545
		70 cm	1,475	15,724	2,770	1.878	12,954	10,881
		100 cm	1,355	14,444	2,860	2.111	11,584	9,731
	b_2 - II[nd] decade of April	50 cm	1,518	16,182	2,950	1.943	13,232	11,115
		70 cm	1,607	17,131	2,790	1.736	14,341	12,046
		100 cm	1,404	14,967	2,900	2.066	12,067	10,136
	b_3 - III[rd] decade of April	50 cm	1,383	14,743	3,010	2.176	11,733	9,856
		70 cm	1,472	15,692	3,120	2.120	12,572	10,560
		100 cm	1,269	13,528	2,830	2.230	10,698	8,986
	b_4 - I[st] decade of May	50 cm	1,232	13,133	2,940	2.386	10,193	8,562
		70 cm	1,322	14,093	3,050	2.307	11,043	9,276
		100 cm	1,119	11,929	3,160	2.824	8,769	7,366
Selling price: 10.66 lei·kg^{-1}								

Source: Own results.

The results obtained in the three agricultural years showed that the Teleorman variety, sown at the second epoch and at the distance of 70 cm between the rows, it realized the highest net profit (12,046 lei·ha^{-1}), where the highest seed production was obtained (1,607 lei·ha^{-1}) (Table 5).

CONCLUSIONS

Castor bean seeds have over 200 uses in the medical, pharmaceutical and cosmetic fields.
Studied production factors, respectively genotype, sowing ageand distance between rowshave a special importance onthe production of ricinoleic and palmitic acid.
In Romania *Ricinus communis* L. is cultivated on small areas, which automatically means weak competition and a strong argument in favor of starting a business in the field.
Ricinus communis L. is a productive species, unpretentious to soil fertility, drought and involves not very high expenses for cultivation.
Sowing castor bean seeds at the optimal age has numerous advantages over achieving a significant increase in production.
It is recommended to sow castor bean under the pedoclimatic conditions of the Center of Moldova of the earliest Romanian variety Teleorman, since during the period under study it has achieved the highest seed production. To increase seed production, we recommend sowing castor seeds by mid-April (second sowing age).
Following the researches it is recommend sowing castor bean at a distance of 70 cm between rows, because at greater or smaller distances than this, lower net profits was obtained.

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INNOVATIVE STRATEGIES FOR FOOD WASTE REDUCTION AND THE USE OF MOBILE APPLICATIONS IN THE AGRI-FOOD SECTOR

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Abstract

The FLW phenomenon represents a challenge for all actors in the agri-food chain today, as one-third of the food produced globally is wasted at some point along its journey, with significant economic, social, and environmental consequences. Addressing this issue by finding solutions to minimize food loss and waste represents a priority for both researchers and socioeconomic experts. Based on the gap identified in the literature, the research aims to analyse the impact of using a mobile app in Romania that connects companies that have surplus food or food that is nearing the end of its warranty period with people who need that food and pay low prices for it. Statistical analysis of the data provided by this application reveals that the benefits of using it are multiple, for all actors involved, from redistributing food to segments of the population in need, to reducing the amount of food thrown away and educating and raising awareness of its users.

Key words: *FLW phenomenon, agri-food stakeholders, mobile applications, digitalisation, innovation*

INTRODUCTION

Within contemporary food systems, the issue of food waste and food loss poses significant difficulties [3, 6], undermining global sustainability initiatives [17, 25].
Approximately one-third of the food produced is either lost or wasted throughout different stages of the supply chain, leading to substantial environmental and socioeconomic impacts [35, 53]. These losses are due to a variety of factors, including inadequate storage and transportation, improper handling [29, 67], adverse weather conditions, consumer behaviour, lack of cold storage infrastructure, and rejection due to aesthetic standards [54, 58]. The impact of food waste is far-reaching. In addition to inefficient use of resources, it results in increased greenhouse gas emissions, greater pressure on water and land resources, reduced overall productivity, and negative impacts on local and global economies [16, 27, 31]. Addressing this challenge is critical not only to alleviate hunger [30, 26], but also to reduce the environmental footprint of food production, a high priority within the framework of the circular economy model [12, 41, 98]. Studies focusing on the creation of applications that serve as dual-purpose tools, functioning both as food waste trackers and educational resources to involve all stakeholders throughout the food supply chain, have yet to be identified [87]. Our analysis includes an in-depth examination of the factors influencing the quality of this pioneering mobile app in Romania, its implications, benefits, and user responsiveness, with a focus on the first and only digital application that links stakeholders within the local agri-food chains: Bonapp®.
Therefore, the paper aims to address the following research question:
How the first Romanian food loss and waste app is accepted by consumers
The implementation of the research question in the paper is based on the following research objectives:
1.Weekly and monthly variations of food waste: How do the quantities of orders, unique customers, and active locations fluctuate across different weeks and months? Are there seasonal patterns or trends in these

metrics? 2.Impact of transactions on performance: How does the number of deals affect the number of boxes sold and the number of new customers?

3.Dynamics of operational efficiency: How does the efficiency of the mobile application, measured by the ratio of food boxes to boxes sold, evolve over time? What factors contribute to variations in this efficiency?

4.Long-term growth assessment: How has the mobile application developed over the years in terms of order volume, unique customers and active locations?

5.Social and environmental impact assessment: How do sustainability and social responsibility initiatives manifest themselves in weekly and monthly statistics? What methods can be used to quantify this impact?

These research objectives explore operational dynamics and their direct impact on the promotion of food sustainability, including variations in orders, customer behaviour and the influence of transactions on performance metrics. By integrating findings from similar research into the Romanian context, this study pioneers the understanding of FLW management in emerging markets and contributes to global efforts towards sustainable food systems.

The paper's layout contains a theoretical background segment, offering insights into how app technology holds the potential to catalyse behavioural change. This part is followed by the methodology section, which presents the data used and its statistical analysis. The results section presents the outcomes of the usability evaluation and concludes with a discussion of the findings, managerial, practical, and societal implications, and an outlook on potential future research directions.

Literature Review

The Theoretical Framework

The paper extends previous literature by focusing on both stakeholder theory [9, 43, 100] and the Technology Acceptance Model (TAM) to address phenomena related to food waste. Stakeholder theory suggests that organisations should consider the interests and concerns of different stakeholders in their decision-making processes [48, 42]. For Bonapp®, the relevant stakeholders are the internal shareholders who provide the company with the necessary funding, as well as various farmers, food producers, retailers, consumers, government agencies, NGOs and other relevant entities interested in contributing to adecrease in food loss and waste. The TAM demonstrates to which extent the app users are ready to embrace and adopt a specific technological tool or system [2, 97]. Bonapp®is an application using modern communication methods to manage the over-quantities of food waste produced by this or that stakeholder within the agri-food chain and to enable them to sell those food items (saved from waste) to buyers looking for bargains and affordable prices.

Food Waste and Technological Advances

Green, digital and innovative technologies have emerged as powerful allies in the combat against waste and to substantially decrease food losses [1, 52]. There are several publications tackling efforts to reduce food waste and loss and improve food systems using advanced technologies. Initiatives that address the food system through technology are crucial for sustainability [57, 80]. as emerging technologies such as IoT, AI, and ML enable real-time optimisation through IoT sensors [72]. Circular economy models focus on waste reduction, complemented by Industry 4.0 technologies [33, 56]. Traceability systems, such as blockchain, implemented in the food supply sector, serve to uphold product quality standards and avoid risks associated to fraudulent activities [36, 50]. These technological innovations are increasingly being used not only to prevent losses, but also to recover and recycle food. Recent developments such as digital platforms and social networks [20, 73] have shown promise in reducing waste at source [101] and improving consumer behaviour through increased awareness and education. There has also been research into how food waste can be converted into valuable resources, including energy, biofuels and nutrients, with applications in the agricultural sector [60].

The literature review explored the ever-evolving field of technological advances, examining the pros and cons associated with them in the context of the interaction between users on both sides of the applications (consumers and donors or vendors). This exploration concerns the potential to address the ongoing challenge of improving food security, which also underlies the promotion of sustainable manufacturing systems [64, 85].

The literature review highlights the swift evolution of artificial intelligence and the effective practice of social media tools and online groups [91, 68], all of which are part of day-to-day life and play an important role in preventing and monitoring various types of waste, including food. Considerable investment is being made in user-friendly techniques, especially for mobile applications. These techniques refer to design and development strategies that improve the overall usability and accessibility of the application for its target audience [83, 88]. Here, user-friendliness is crucial to ensure a positive experience: intuitive navigation, responsive design with layout and content adapted to different screen sizes and orientations, but also gesture control, in-app tutorials and real-time or offline/email assistance and user notifications (information on regular updates) or user experience feedback [75, 78]. These tools provide instant data, educational resources, and user engagement features that empower individuals to make informed decisions about food consumption, storage, and disposal [69, 86]. These applications serve a crucial role in promoting sustainable behaviours and instilling a sense of accountability among users by offering insights into the environmental and economic impacts of food waste [96]. Consequently, they greatly contribute to ongoing endeavours aimed at curbing food waste related adverse effects [77]. Moreover, these apps offer an avenue for collaboration between donors, NGOs, and users, facilitating the effective distribution of surplus food to vulnerable populations. By fostering a collective sense of responsibility, these applications advocate for a comprehensive approach to tackling food waste and addressing issues of hunger and food insecurity [30, 64].Besides information on ways to reduce food waste and avoid losses, real benefits exist for app users on both sides, in the form of experimental outcomes for consumers, such as games, quizzes, rewards for earning points, access to affordable good quality food through purchase discounts [37, 66]; on the other hand, producers, distributors, retailers, and donors report significant improvements in product quality and profit margins, inventory optimisation, increased client loyalty, efficient distribution, reduction of storage costs and risk of spoilage [74].

MATERIALS AND METHODS

In today’s society, the Internet plays a crucial role. It facilitates a myriad of activities ranging from videos and online shopping to academic research and remote working [8, 63]. At present, the Internet is faster than ever, particularly in developed nations, enabling seamless activities. According to the World Population Review [93, 99], Romania is one of those nations from this point of view, as its Internet connectivity ranks among the top 10 worldwide [47, 19, 89]. Therefore, the study of the Romanian FLW context holds significance as the conditions in Romania can serve as a prospective benchmark within the international literature related to food waste issues and online applications involving food chain stakeholders.

Efforts can be directed towards understanding and addressing the FLW concerns of each stakeholder group through the acceptance and use of technology, here in the specific form of a mobile app created and implemented in Romania. Bonapp® is the first Romanian food saving application that allows stakeholders, internet users, to successfully purchase online food products from farmers, transformers, restaurants, cafes, bakeries, groceries, and even hypermarkets with discounts ranging from 50% to 80%. It offers the same quality at half the price. The app is free, easy to download from the internet, and features a user-friendly interface. The path to tracking food waste starts with the installation of the Bonapp®application, facilitating users' access to a digital marketplace offering a daily selection of food products. By creating personalised accounts, users engage with the application's interface, navigating through acurated selection of offers. After selecting desired items, users proceed to place orders according to their geographic location, with digital receipts automatically generated to streamline transaction processes. As designated pick-up times approach, users visit designated locations to collect their orders discretely.

On the main page, users can find food products listed by Bonapp® partners and the users can view partner discounts, the number of discounted portions available, and pick-up details directly in the app. Payments can also be made via the app. The latter enforces quality standards for its partners, ensuring that all listed food products are not out of date, altered, and have been stored in optimal conditions. None of the products listed are old or improperly stored. Surprise Boxes are packages listed by the app's partners, the contents of which are not revealed until the buyer receives them. While some may be curious, it's an exciting way to discover new food items.

The research material was represented by a monthly and weekly database provided by the Bonapp® application: number of orders, number of unique clients, number of active locations, number of signed and active leases (locations), number of offers, number of offered and sold boxes, amount of saved food (kg) and quantity of CO_2 saved (kg). The data sourced from the Bonapp® application, spanning from November 2021 to April 2023 and exclusively pertaining to the cities of Bucharest (capital of Romania) and Cluj-Napoca (the second city in terms of population after Bucharest) where the mobile app is accessible, offers diverse insights into understanding Romanian consumers. The analysis underlines their unique relationship with food, aiming to encourage active participation in combating FLW altogether.

To analyse the data collected through the Bonapp® application and to extract valuable information, descriptive statistics were used: the evolution of orders, the evolution of customers, the dynamics of locations versus orders, the evolution of offers versus sales, the ratio of orders to customers ratio and the impact of mobile apps on the environment. To investigate the relationships between the different variables in the dataset and to assess which variable is the best predictor of a particular outcome, the research applied a methodology involving regressions in SPSS (Statistical Package for the Social Sciences, version 20).

According to the nature of the data collected, the use of linear regression was adopted. Therefore, if a prediction had to be made on the price reduction as a function of different factors, such as time of day or type of product, linear regression was the most appropriate.

Linear regression was also run, by using Number of orders as the independent variable (X) and Number of unique customers as the dependent variable (Y).

The following formulas calculated the slope (m) and intercept (b) of the linear regression line:

$$\boldsymbol{m} = \left(\frac{\boldsymbol{N}*\sum(\boldsymbol{x}*\boldsymbol{y})-\sum \boldsymbol{x}*\sum \boldsymbol{y}}{\boldsymbol{N}*\boldsymbol{\Sigma x^2}-\boldsymbol{\Sigma x^2}}\right)^{\boldsymbol{2}} \text{……………………}\mathbf{(1)}$$

$$\boldsymbol{b} = \left(\frac{\sum \boldsymbol{y}-\boldsymbol{m}*\sum \boldsymbol{x}}{\boldsymbol{N}}\right)^2 \text{…………………………..}\mathbf{(2)}$$

where: Σ is the sum, N is the Number of data pairs, x is the Number of orders, and y is the Number of unique customers.

Furthermore, the Pearson correlation coefficient was calculated between the two data sets (“Number of boxes sold” and “Amount of food saved”) using the following formula:

$$\boldsymbol{r} = \frac{\sum(\boldsymbol{X}-\boldsymbol{X\_mean})(\boldsymbol{Y}-\boldsymbol{Y\_mean})}{\sqrt{\sum(\boldsymbol{X}-\boldsymbol{X\_mean})^{\boldsymbol{2}}*\sum(\boldsymbol{Y}-\boldsymbol{Y\_mean})^{\boldsymbol{2}}}} \text{…………….}\mathbf{(3)}$$

where:
X stands for "Number of boxes sold".
Y represents "Amount of food saved (kg)".
The X_mean and Y_mean are the means of X and Y, respectively.

RESULTS AND DISCUSSIONS

The data analysis reveals that there was a consistent upward trend in the number of orders over time, indicating an average overall growth of 1.19 times in the service provided. Furthermore, there was clear evidence of seasonal variations, with a notable increase in orders from September 2022 to March 2023 (2,28 times), possibly linked to various social and/or cultural events or the Christmas/New Year/Valentine sales seasons (Fig. 1).

Fig. 1.Evolution of orders
Source: own processing using data provided by Bonapp® [11].

The most significant month-on-month increase occurred between October and November 2022, when orders rose from 4,466 to 5,006 (12% increase). Finally, March 2023 recorded the highest number of orders, at 6,954 (55.7% increase compared to October 2022), with an average monthly number of orders of approximately 2,934 (Fig. 1). Similarly, there was a positive trend in the number of unique clients (check Fig. 2).

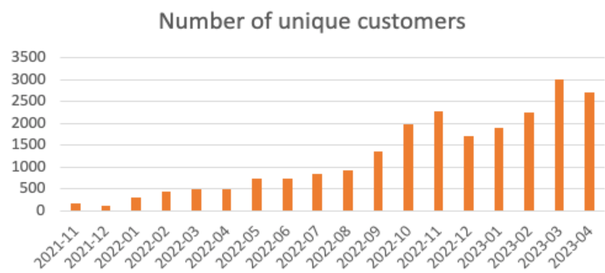

Fig. 2. Customer evolution
Source:own processing using data provided by Bonapp® [11].

This indicates positive growth as it implies an expanding customer base correlating with the rise in orders, which bodes well for the business' prospects. Taking a closer look, one can see engagement through the order-per-customer ratio, representing the average number of orders made by each customer within a month. For instance, in November 2021, this ratio stood at approximately 1.78, reflecting a meaningful level of customer activity. A close correlation was recorded between the growth in orders and the growth in unique customers. This suggests that the increase in order volume was due to the acquisition of new customers. Of notable significance was the period of heightened activity, particularly in September 2022, when both the number of orders and the number of unique customers increased significantly. This could potentially represent the effectiveness of a marketing campaign or the impact of a particular event that drew a high influx of clients.A locations-orders connexion was visible and calculating the ratio of the number of orders to the number of active locations allowed us to see how many orders each active location generated on average in a month. For example, in November 2021, each active location generated an average of 283/27 ≈ 10.48 orders. However, seasonal or monthly variations in data could occur, such as an increase in the number of orders in certain months due to seasonal demand or marketing campaigns (an increase in December 2022 in the number of active locations could be most certainly related to the holiday season). On the other hand, in March 2023, although the number of active locations decreased slightly compared to February 2023 (Fig. 3), the number of orders and unique customers increased significantly (Figs. 1 and 2), suggesting a possible improvement in location efficiency or a focus on the quality of the service.

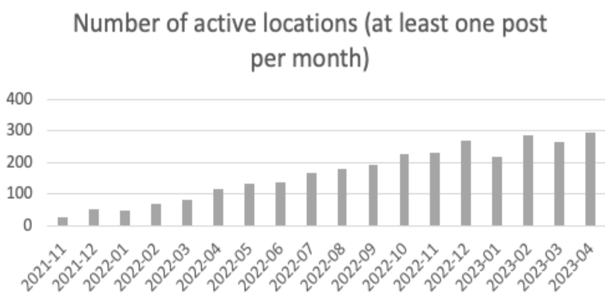

Fig. 3.Dynamics of active locations (before signing of lease).
Source: own processing using data provided by Bonapp® [11].

The connection between offers and orders was obvious (Fig. 4).

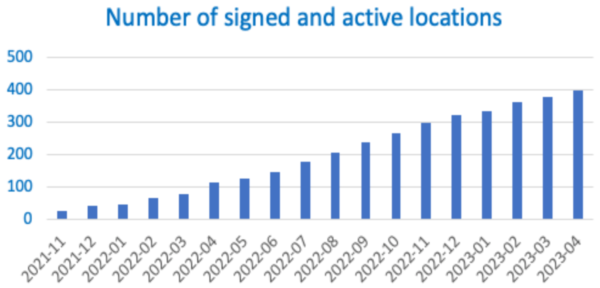

Fig. 4. Situation of signed active locations
Source: own processing using data provided by Bonapp® [11].

Thus, more offers tend to draw in more customers and, in turn, generate more orders. Over the analysed period, to check the effectiveness of online bids, a ratio was calculated between the number of orders and offers. In November 2021, the bidding effectiveness stood at approximately 0.69 orders per bid. Special periods, such as holidays or events, may see an uptick in offers aimed at attracting more customers (Fig. 5).

Fig. 5. Evolution of offers.
Source:own processing using data provided by Bonapp® [11].

This could be a contributing factor to increased orders during certain months or periods of a month. Furthermore, a calculation of the ratio between the number of boxes sold (Fig. 6) and the number of posted boxes gave us an idea of sales efficiency. When the value of this ratio was high (Fig. 7), it meant that a high proportion of post boxes were sold. For example, in November 2021, the sales efficiency was 327/686 ≈ 0.48. In addition, an increase in the number of offers could be correlated with an increase in the number of boxes sold if the offers were attractive to customers. In July and September 2022, significant increases in the number of posted boxes were seen (Fig. 6), accompanied by increases in the number of sold boxes, suggesting either that there was an increase in demand during those months, or/and that the marketing strategies were more effective.

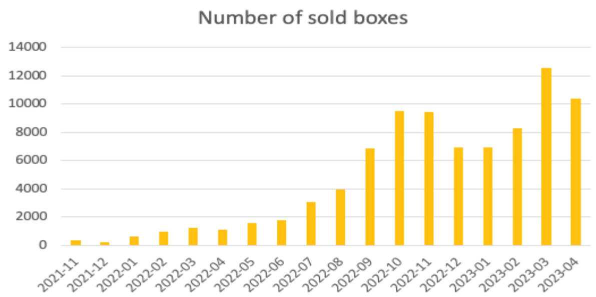

Fig. 6. Evolution of sales
Source: own processing using data provided by Bonapp® [11].

Whilst examining the correlation between customers, orders, and sold boxes, it was noticed that the number of sold boxes was growing faster than the number of unique customers, suggesting an increase in purchases by existing customers.

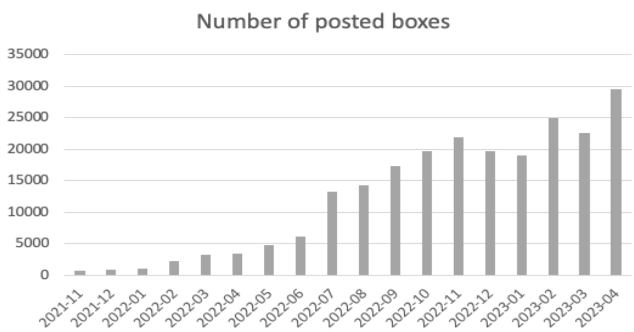

Fig. 7. Analysis of the orders
Source: own processing using data provided by Bonapp® [11].

By saving food and reducing CO_2 emissions, sustainable practices are encouraged. In Fig. 8 and Table 1 below, the 'Amount of food saved' and the 'Amount of CO_2 saved' show the positive climate impact of the application. The amount of food saved as well as the amount of CO_2 saved are correlated with the number of boxes sold. If the relationship is strong, this can be used to predict environmental impact based on sales performance and give a real picture of how efficiently resources are being used to have a positive impact on the environment.

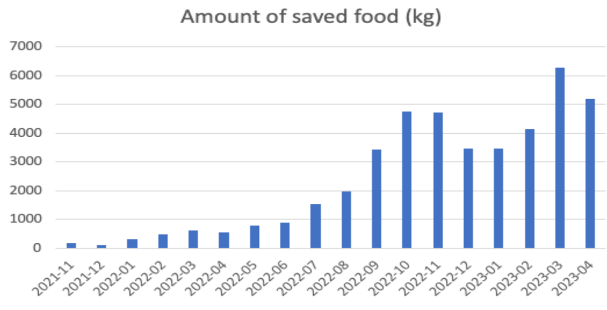

Fig. 8. Analysis of the environmental impact
Source: own processing using data provided by Bonapp® [11].

The result of the calculated Pearson correlation (approximately 0.994) indicated a very strong positive linear relationship between the number of sold boxes and the amount of saved food (an increase in the number of sold boxes translated into an increase in the amount of saved food) (Table 1).

Table 1. Number of sold boxes and amount of saved food

Month	Number of sold boxes	Amount of saved food (kg)
2021-11	327	163.5
2021-12	224	112
2022-01	618	309
2022-02	983	491.5
2022-03	1,193	596.5
2022-04	1,102	551
2022-05	1,596	798
2022-06	1,760	880
2022-07	3,066	1,533
2022-08	3,967	1,983.5
2022-09	6,860	3,430
2022-10	9,467	4,733.5
2022-11	9,405	4,702.5
2022-12	6,897	3,448.5
2023-01	6,923	3,461.5
2023-02	8,284	4,142
2023-03	12,574	6,287
2023-04	10,381	5,190.5

Source: own processing using data provided by Bonapp® [11].

Examining the weekly data and considering all the key metrics, including orders, customers, locations, leases, promotions, boxes, and the quantity of saved food, interesting insights related to the calculated averages could be uncovered. The average number of orders per week is around 742 (check Fig. 9).

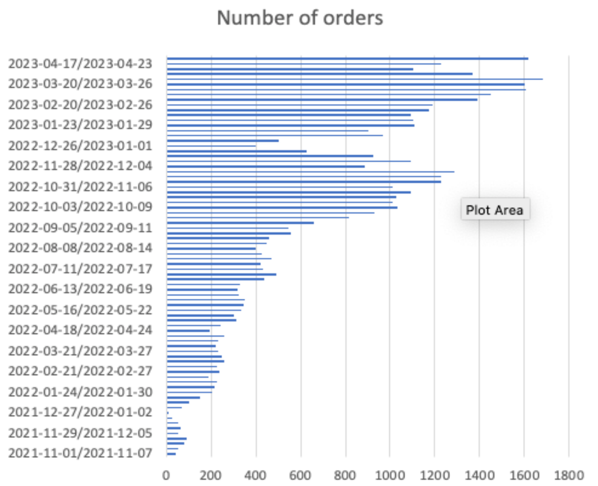

Fig. 9. The average of the weekly number of orders.
Source:own processing using data provided by Bonapp® [11].

Comparably, the average number of unique customers/week (519), the average number of active locations/week (94), the average number of signed and active locations/week (105), the average number of offers/week (1,633),the average number of boxes posted/week (3,829), the average number of boxes sold/week (1,342), the average amount of food saved/week (671 kg) and the average amount of CO_2 saved/week (1,678 kg) were calculated. The results of the linear regression show that, on average, for each unit increase in the Number of Orders, the Number of Unique Customers can be expected to increase by approximately 0.6699 (Fig. 10).

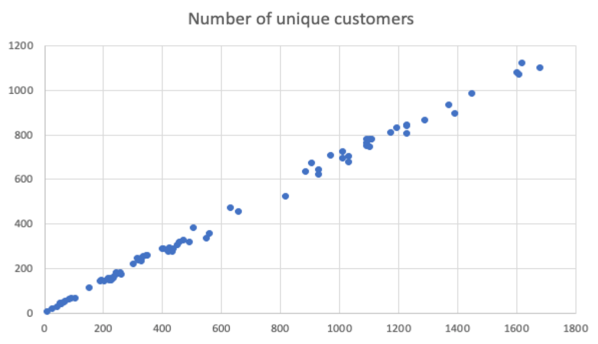

Fig. 10. Customer vs. order regression
Source: own processing using data provided by Bonapp® [11].

At the beginning of the reviewed period, there were 16 active locations in Week 1, and this number increased significantly to 245 in Week 2 of April 2023.

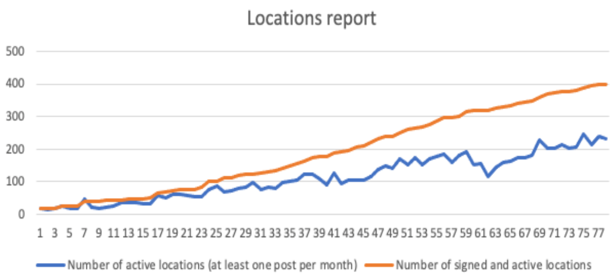

Fig. 11. Dynamics of the number of locations
Source: own processing using data provided by Bonapp® [11].

This indicates an expansion of the network of locations, which contributes to an increase in orders. The number of signed and active leases also increased from 18 to 400 until the end (Fig. 11), showing an increase in partnerships or new contracts with locations. Some seasonal variations were also recorded. In this respect, it was noted that there were weekly variations in the number of orders and unique customers. For instance, a decrease in the number of orders during the Christmas week (19-25 December) and the New Year week (26 December - 1 January) potentially show that customers are less likely to order during holiday times. Moreover, the number of orders was growing at a faster rate than the number of unique customers. This could suggest that existing customers were ordering more frequently or that there was an increase in the average order size. In general, there was a direct relation between the increase in the number of active locations and of orders. Nevertheless, there were weeks where despite the growth in active locations, the number of orders declined. This indicates that factors beyond just location expansion were at play, such as promotions, special events, or other marketing campaigns, influencing order volumes. The widespread appeal of these digital applications is obvious in their ability to address the pressing issue of domestic food waste [4, 14], while also accommodating the changing needs and preferences [24, 32, 38]. As a result, the collaborative efforts of researchers and developers have led to the growing popularity of anti-FLW mobile applications which have become, in various ways, personal assistants for fridge and pantry systematic storage improvement (i.e. Fridge Pal, EatChaFood, LeftoverSwap or AppX [15, 5, 13]).

In line with these results achieved, other researchers have also identified a positive trend in the use of mobile apps to reduce food waste [18, 7], despite the perceived risks related to the users' willingness to download apps, [22, 34, 39], such as: required access to sensitive personal information like the routes visited (geolocalisation permission) [44, 40], pictures taken (required access to the photo gallery) [45, 61], favourite locations (monitoring the main aspects of the user's behaviour and his/her emotional engagement) [46, 28], introduction of bank details for online payment of takeaway orders [55, 51, 65]. Other researchers have also reported that several factors typically influence the adoption of these user-friendly tools, such as seasonality and marketing campaigns that revolve around specific times of the year: Easter, Christmas, Valentine's Day, Thanksgiving, and so on [62, 21].

When comparing these results with those of older studies, it is important to note that some benefits of mobile applications to counter the FLW issue are to be found at every level, for every party concerned, even though the highest financial investment is on the companies' side and not the consumers' one. As tech related investment cost is not always easy to anticipate, some companies may be reluctant to tackle food waste (FW) for commercial reasons: the cost of reducing waste may outweigh the financial benefits with longer payback period. First movers (early adopters) may suffer from lack of ready market for surplus produce (high cost of new market outlets) and maintenance cost, allowing others to learn at their expense [71, 76, 84]. The compensation for all these risks comes from the fact that apps highlight the locations (supermarkets, food stores, etc.), serving as an advertisement that inherently provides a favourable return on investment in the long run [79]. On the consumer side, advantages at purchase, like discounts, vouchers (end-of- day boxes – the advantage of the surprise factor) and the possibility of discovering new tastes through orders are obvious, even though risks (seen by companies) should not be underestimated: reluctance to change and adoption of new habits, fear of reduced quality for food nearing its end-date, new waste-to-value food (neophobia) [31, 94, 90], risks associated to non-compliance with the full GDPR regulation [92, 70].

All in all, the Bonapp.eco application is a promoter of sustainable production and consumption, offering numerous managerial, practical, and social implications. From a managerial perspective, companies can optimise their anti-food waste policies, leading to substantial budget savings by managing food surplus, as opposed to the more costly waste management methods. This offers economic, social, ethical, and environmental advantages, aligning with the companies' Corporate Social Responsibility (CSR) goals. Also, broadband internet and internet connectivity provide excellent prospects for the development of offline businesses, which can seamlessly transition online and naturally flourish. Simultaneously, online businesses can strengthen their market presence by integrating social platforms within their operations.

Integrating mobile apps into food waste management has several noteworthy implications for businesses. First and foremost, it increases visibility and marketing opportunities by showcasing a company's commitment to reducing food waste, attracting environmentally conscious consumers, and bolstering the brand's image. In addition, mobile apps and other technological tools contribute to operational efficiency through real-time inventory management, demand forecasting, and supply chain optimisation, minimising overstocking and reducing waste across various industries [95, 81]. These apps also engage consumers in the fight against food waste by providing information on sustainable practices, offering discounts on surplus items, and encouraging responsible consumption habits. This not only leads to cost savings in the supply chain management, but also creates new revenue streams by selling surplus food at discounted prices – all of these being principles of circular economy [82, 23].

One way to improve the Bonapp.eco application could be a future bartering policy for leftover foods, offering a simple solution to minimise waste: companies can list their surplus items and connect with other companies interested in exchanging food, as suggested in the literature [59, 10].

Finally, there are certain limitations to this study: the Bonapp.eco business management team must comply to all current GDPR regulations, which prevented us from obtaining demographic data on the application's users to correlate it with purchasing behaviour. Additionally, the supplier database lacks detailed company profiles.

CONCLUSIONS

The research provided valuable experience and findings that can serve as a guide for future app development projects, with the goal of fostering a more sustainable lifestyle among consumers. It also shows the extent to which such applications (beyond their lucrative goal) are beneficial to all agri-food chain parties concerned and enforce the participation of several of the shareholders and stakeholders within the agri-food chain.

The research indicates that by leveraging educational tools, such as a mobile app, and employing modern theoretical models such as the stakeholder theory and the TAM model, the food system can achieve sustainability. The data-driven insights generated by mobile apps into consumer behaviour and preferences can inform waste reduction strategies and targeted marketing efforts. Embracing mobile apps aligns companies with evolving regulations and consumer expectations for food waste reduction, providing a competitive advantage. Ultimately, this approach fosters brand loyalty, as consumers are more likely to support companies that demonstrate a commitment to sustainability.

For users, there are economic, social, and environmental benefits. The app enhances access to high quality, sometimes niche, products that users might not otherwise be able to afford. It helps educate all actors of the agri-food chainin order to keep food waste figures down and foster a culture of waste prevention. The use of mobile apps in food waste issues offers the access to cost-saving opportunities, such as discounts and special deals on surplus or near-expiry food items, enhancing their purchasing power. These apps contribute to raise awareness by educating users and encouraging responsible consumption habits.

The convenience of browsing and purchasing food items through the app reduces barriers to accessing surplus or discounted products. Personalised recommendations based on user preferences enhance the shopping experience and minimise over-buying. Apps also facilitate community-driven initiatives and the provision of data-driven insights, transparent supply chain information, and community building features further empower users to make informed, ethical, and sustainable choices, creating a sense of belonging to a like-minded community of active stakeholders.

Stakeholder theory disrupts conventional analytical frameworks by proposing that the needs of stakeholders should take precedence at the outset of any action, much as the contemporary philosophical perspectives bring forward the civil society and interactions among individuals.

Bonapp.eco is relevant to all players in the agri-food chain and addresses farmers, processors, distributors and end customers. Bonapp enables the redistribution of food boxes that cannot be consumed/sold at a given moment and, through this mediation, find a recipient. Without this innovative application, significant quantities of food would be wasted. Bonapp.eco is living proof that the needs of users can be met with the help of technology (TAM) and the involvement of other stakeholders. The research shows that there is an acceptance of the use of this application and, implicitly, of the technology on which it is based. During the analysed period, customer growth was approximately 17 times, from 159 unique customers to 2708 unique customers. Based on co-communication and information processing technology, the Bonapp application is still easy to use for the stakeholders, and the number of users has increased in a relatively short period of time.

Based on the results obtained, further research could focus on studying the correlations between the number of active locations and the amount of saved food and CO_2 saved. Such studies require detailed data collection and modern methods to ensure the accuracy and representativeness of the collected data, such as data related to the amount of food saved and CO_2 emissions from each active location over time. Another example would be the regression analysis which could show whether an increase in the number of active locations leads to a proportional increase in the amount of food saved and a visible reduction in CO_2 emissions.

Regarding other potential future research directions, investigating the long-term effects of using the application in both business and consumer settings could provide valuable information. Understanding how this technology can be integrated into broader sustainability initiatives and its scalability across different industries would be essential. Furthermore, exploring the impact of food waste reduction apps on greater environmental issues is a path worth taking for future investigations.

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NATURAL POPULATION GROWTH IN BULGARIAN RURAL AREAS IN THE PERIOD 2011-2021

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Abstract

An attempt is being made to analyze the geodemographic picture in the rural areas (RA) of Bulgaria within a ten-year period. The authors of the scientific publication are based on the fact that the human population located in the smaller administrative territorial units (neighbourhoods, villages and small towns in terms of area and population) is of key importance for the functioning of social activities, which are basic for economic development in the country. The purpose of the scientific research is to investigate and analyze the natural growth (NG) of the population in the RA of Bulgaria for the period between the two national censuses 2011-2021. The results will present the temporary geodemographic picture of rural municipalities. Methodology in the scientific article is based on the definition of RA in the EU and Bulgaria. It is applied to the NUTS classification for grouping the above-mentioned regions of the country, calculation of the natural increase of the population by years is based on the methodology of the National Statistical Institute (NSI) of the Republic of Bulgaria. The visualization of the process - NG of the population in the RA is presented in tables and figures, in which the dynamics of the numerical values for a certain period in per million (‰) and their change during the study are indicated.

Key words: *geodemography, rural areas, natural increase, NUTS, Bulgaria*

INTRODUCTION

The policy for the development of rural areas (RA) in the EU is dictated by the accompanying facts, namely that approximately 45% of the population of the 27 member countries live in the RAs, which covers 91% of the territory. Rural areas cover approximately 82% of the country's territory and 35-38% of its population [5, 9]. The age structure of the population is less favorable than that of the city, due to the relatively low share of people of working age. A problem with the retention of the young population in childbearing age is also emerging [7]. Working conditions are mainly related to agriculture, forestry and non-agricultural activities, which are based on the natural conditions in these areas. All this has a direct impact on geodemographic processes in rural municipalities in Bulgaria [2].

The natural increase (NI) of the population represents the characteristic of the natural movement of the population in a global, regional and local plan for a certain period of time. The general trend of the NI has a downward trend of development, with the values in the country, and in particular the RA, being in negative values. The entire geodemographic picture for the NG decreasing values, and especially for the RA of the country for the entire study period. This can be defined as the geo-demographic state of the population over a period of time. This can be linked to direct socio-economic factors: birth rate, death rate, religion, migrations and others. On the other hand, the indirect processes affecting the NG are: epidemics, wars, environmental and others.

On national level, the coefficient of the NI since 1990 has a negative value of 0.4 ‰, and in 1997, it reached minus 7 ‰ and remained within the limit of the contested indicator [1]. Negative values were characteristic until the end of the twentieth century, and the trend for the country continued in the coming decades. This situation creates problems in the entire geodemographic picture of the country and directly affects the socio-economic status [8]. The age structure of the population has a strong influence on natural growth. It reflects the alternation of the generations of the ancestors with those of the children, not the generations of the parents with those of the children. The natural increase gives a geodemographic picture of the generations over one.

The development of regional policy in the EU concentrates on a set of spatial priorities, including: economically and socially underdeveloped regions, restructuring of urban and industrial areas, underdeveloped economic areas, construction of ecological industrial zones, socio-economic development of RA, raising the living status of the population in peripheral areas and a number of other activities, for the purpose - The EU Regulatory Commission with decision № 1059/2003 gives NUTS status [12].

Based on the classification presented above and the Law on Regional Development (LRD, 2008), the following administrative-territorial units are distinguished in Bulgaria: NUTS 0 - Republic of Bulgaria, NUTS 1 - two statistical zones, NUTS 2 - six statistical regions, NUTS 3 - 28 regions and LAU 1 - 265 municipalities, with 231 designated as rural areas for the entire country. For 2021, in Bulgaria, rural areas cover 89,910 km² or 81% of the country's territory, with an average population density of 74.6 p/km², for the RA of Bulgaria it is 35 p/km², or below the average indicators for the country and the EU.

In this context, the purpose of this study is to review the natural population growth in Bulgarian rural areas and seek for exact reasons to the depopulation of the RA. More precisely the reviewed areas will be: population, birth of children, mortality and population growth.

MATERIALS AND METHODS

The authors analyze the NG picture of the population in the RA of the country according to the NUTS classification over a period of ten years, with the last national census coinciding with that of the EU. The material provides an overview of the population, birth rate and death rate for the same period indicated above with the aim of a clearer geodemographic picture related to the rural areas of the country and the subsequent research and analysis of natural growth, again for the same period and spaces.

In the study and analysis of the material, the authors are based on the definition of RA adopted in Bulgaria: ***"...rural areas - the municipalities of (LAU 1), in which there is no settlement with a population of more than 30,000 people..."*** [11]. The authors refer to the Law on Regional Development of 31.08.2008, [3].

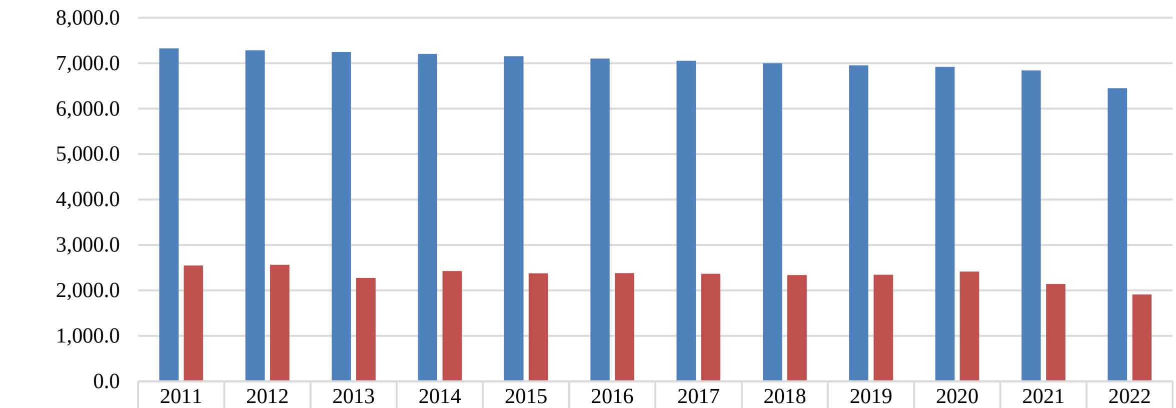
The coefficient of natural growth (CNG), the number of live births (LB), the number of deaths (D) and the average annual number of the population (AP) within a year are part of the following formula:

$$CNG = (LB - D) / AP * 1,000 \quad ....(1)$$

For the study and analysis, the authors refer to the NUTS classification, applicable in the country, statistical information from National Statistical Institute, NSI, geodemographic methodology, comparative and mathematical analyses, as well as their own calculations. Microsoft Word and Excel were used in the analyses and conclusion.

RESULTS AND DISCUSSIONS

During the different time periods including the geographical-historical processes related to the change of the territory of Bulgaria, the NG of the population has changed based on the above-mentioned processes. State border changes or wars directly affect the NG [6]. The processes of birth and death have a specific influence on the NG of a certain territory. [13]. In a period of eighty-five years 1900 - 1985, from 3,744,283 people, the population grew to 8,948,649 people or by 41.84%, (the largest number for the last 145 years) for Bulgaria. The population of the country increased until 1985 of the XX century. After this stage there is a decline that continues to the present day. In 1990, for the first time NSI reported a population decline with a negative sign of 0.4‰. For 2001, the national population was 7,932,984, down 1,015,665 from its peak in the 1980s. In 2011, the first national census was carried out (over 85% of the population was counted electronically), which was synchronized with the rest of the EU member states, NSI statistics reported 7,364,570 people. The last national census of 2021 reported 6,838,937 people on the territory of the country.



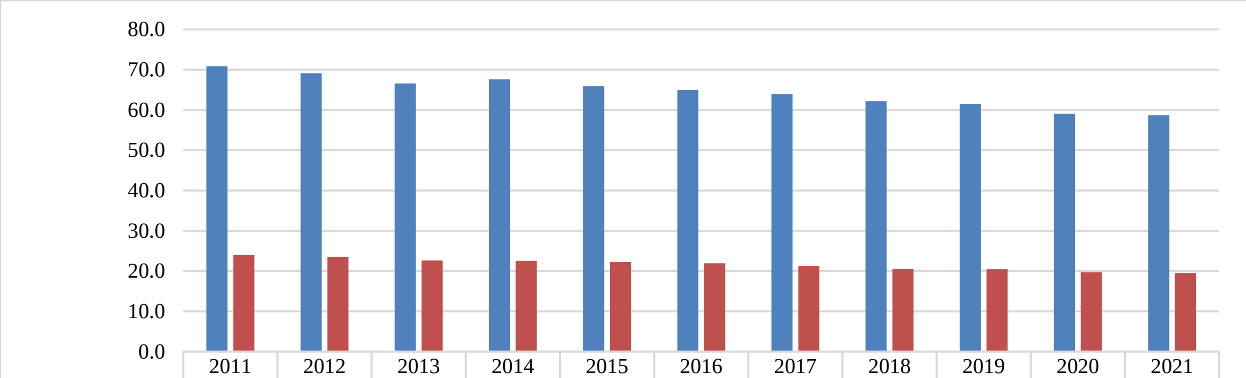
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulgaria	7,327.2	7,284.6	7,245.7	7,202.2	7,153.8	7,101.9	7,050.0	7,000.0	6,951.5	6,916.5	6,838.9	6,447.7
RA Bulgaria	2,548.7	2,561.9	2,271.8	2,425.4	2,376.9	2,378.5	2,364.9	2,338.2	2,342.1	2,413.8	2,140.5	1,909.7

Fig. 1. Population in Bulgaria and the SR in the period 2011-2022, in (thousands)
Source: [10].

The analysis visualized in Fig. 1, the number of the population in the country for the period 2011-2022 decreased to 879.5 thousand, with the trend following downward numerical values. With the biggest drop in population reported in the last three years of the study with 503.8 people, this is the period of the global Covid epidemic where there is a higher mortality rate among the population. Population decline continues, the trend is negative in the RA of the country and smaller settlements. At the beginning of the study, the population in the RA of the country was over two million, but at the end it was significantly less, approximately 25% decreased in the above-mentioned areas. In the last years of the research in RA, a high population decline is reported. The main reason for the reduced number of the population not only in the country, but also in the RA, is the lack of a protectionist policy on the part of the state, aimed at preserving the geodemographic background.

The natural reproduction of the population is a biological process, which subsequently turns into a social phenomenon. Fertility in women begins on average from the age of 15 and can last up to 50 years. During this time, each woman can give birth to 10 to 12 children (in theory). In men, the biological ability to create generations can last beyond 75 years. Birth rate refers to the purity of the birth of children, as measured by various geodemographic indicators: total birth rate, female fertility rate, etc. Reproduction of the population can be: simple, narrowed or expanded, it depends on the various indicators of the coefficients. It is generally accepted that the intensity of the birth process is the number of live births per thousand people.

Birth is a geodemographic indicator that is largely related to the ethnoculture of a particular ethnic group. The socio-economic status of a woman in the last 30-40 years largely determines the number of children. During the study period, between the two national censuses, births in the country decreased every year, the change in the mentality of the Bulgarian people during the transition period (which has not ended), leads to a downward movement of the trend. In ten years, births for the whole country have decreased by 12,168 people or 17.17% (Fig. 2). For the RA of Bulgaria, births follow the national downward trend. Again for the same period, the decrease is 4,542 people or 18.01%. The reasons are identical, also characteristic of smaller administrative-territorial units.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bulgaria	70.8	69.1	66.6	67.6	66.0	65.0	64.0	62.2	61.5	59.1	58.7
RA Bulgaria	24.0	23.5	22.6	22.5	22.2	21.9	21.2	20.5	20.5	19.7	19.5

Fig. 2. Births in Bulgaria and in rural areas for 2011-2021, in (thousands)
Source: [10].

Mortality is the other major component in geodemographic, which is used to characterize the population (deceased) globally and locally over a period of time. This is primarily a physiological process of the human organism, during which the life cycle is interrupted. It is an inevitable factor, both for the individual and for society. On the other hand, mortality helps to change generations in a certain period of time. During the different socio-economic stages that the country went through from the end of the 19-th century to the present day, the death rate has moved within different limits. Relatively low values of mortality, which remained within the limits of 14.5 ‰, were reported from the mid-1930s to 1945. After the mentioned period until 1964, the death rate decreased at a smooth pace, reaching 7.9‰. Values were relatively stable until 1974, when an average of 10 ‰ was reported. After this stage in 1997, the highest mortality rate in the recent history of the country was recorded at 14.7 ‰ as a result of the changes [16].

After 2000, the death rate for the country was 14.1‰ for men 15.5‰ and women 12.6‰. The high mortality after the mid-70s of the 20th century until today is due to geopolitical factors dictated abroad. [1].

During the study period of mortality in Bulgaria, the values for every single year increased, and in ten years the trend increased by 40 thousand people.

For 2016, the analysis indicates a decrease in mortality compared to the previous research periods. In the following stages for 2018/2019 years, the trend is downward, this coincides with the World Pandemic.

In the following years, the authors' research shows a high trend of mortality in the country.

For the RA of Bulgaria, the mortality rate is high and this geodemographic indicator is preserved throughout the study period. A downward trend, again reported in 2018 and 2019, when compared to the parallel one (there is a coincidence with the World Pandemic)

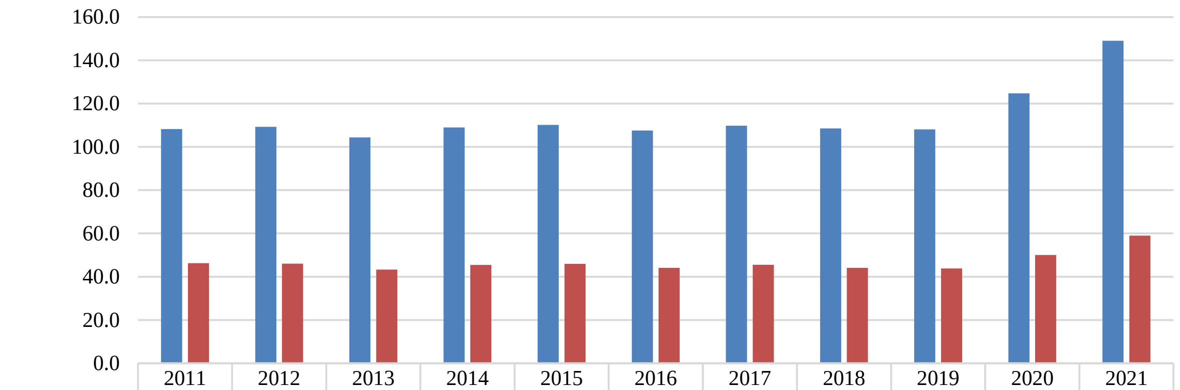
A rise in negative mortality rates is reported at the end of 2021, the trend reports a growth of 16%. (Fig. 3).

The high death rate for the country is due to a protectionist policy on the part of the state.

The growth of human population in general is a key point for the prosperity of a nation in its socio-economic growth.

Natural growth is part of geodemography as an element and its change depends on a number of socio-economic indicators and factors at the local or global level. This geodemographic process represents the difference in birth and death rates and is part of the physiological human cycle, from conception to biological end.

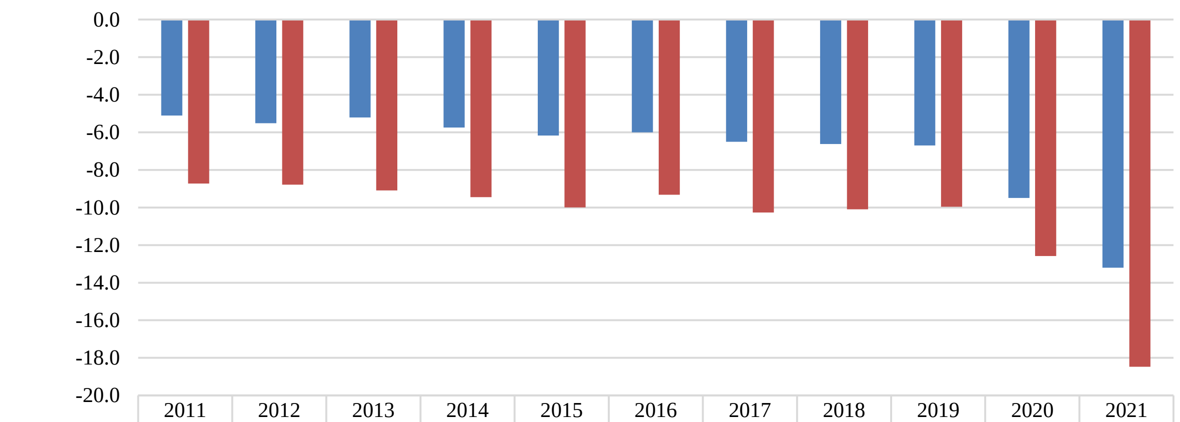
The coefficient of NI is the characteristic of natural reproduction, but it is influenced by the sex-age structure. It can be measured in absolute difference between the number of births and deaths.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bulgaria	108.3	109.3	104.3	109.0	110.1	107.6	109.8	108.5	108.1	124.7	149.0
RA Bulgaria	46.2	46.0	43.3	45.5	46.0	44.1	45.5	44.1	43.8	50.1	59.0

Fig. 3. Mortality in Bulgaria and in rural areas for 2011-2021, in (thousands)
Source: [10].

Natural increase reflects the replacement of generations of ancestors with those of children, not generations of parents with those of children. Again, according to Uranis [15], the coefficient of NI is formed in seven groups: 1) no increase - below 0 ‰ 2) very low to 2.9 ‰ 3) low from 3 to 5.9 ‰ 4) medium from 6 to 9.9 ‰ 5) high from 10 to 19.9 ‰ 6) extremely high from 20 to 29.9 ‰ 7) maximum over 30 ‰ (Fig. 4).



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bulgaria	-5.1	-5.5	-5.2	-5.7	-6.2	-6.0	-6.5	-6.6	-6.7	-9.5	-13.2
RA Bulgaria	-8.7	-8.8	-9.1	-9.4	-10.0	-9.3	-10.3	-10.1	-10.0	-12.6	-18.5

Fig. 4. Natural increase in Bulgaria and in rural areas for 2011-2021, in (‰)
Source: [10].

The natural increase is shown by the ratio of the population of a territory, as in this case, the statistical analysis for Bulgaria reports negative values for the entire study period. Within ten years, the trend grew in a negative direction as visualized in Fig. 4, the country's population decreased by -8.1 ‰. For 2016, there was a minimal drop in population from the previous year. Negative values are also reported in the period 2018/2019, compared to the previous years of the study for Bulgaria, we note that the last year coincides with the Covid 19 epidemic. At the end of 2021, NG has the highest negative values, over – 3.7‰. According to the Urbanism scale, the country falls into the lowest group ***"no growth - below 0 ‰"*** for the entire period of study in Bulgaria of the NI. For the RA of Bulgaria, NG follows the national trend, negative growth for the entire study period. Within ten years from 2011 to 2021, NG in a negative trend has increased by – 9.8‰. The trend is noticed in the RA of the country in 2016, there is a minimal decrease in the population from the previous years, this order is also reported in 2018 and 2019, compared to previous years of research, again including the last year of the Covid pandemic in Europe. For 2021, NG has the highest negative values, over 11.1 ‰ compared to the previous analyzed periods. According to the urbanism scale, the RA of Bulgaria falls into the lowest group ***"no growth - below 0 ‰"*** for the entire NG study period.

CONCLUSIONS

The natural increase gives an accurate idea of a momentary geodemographic picture in this case of the RA of Bulgaria for the period indicated above. The basic element is the number of the population, for the country during the period of the study there was a decline, as well as in RA. The main reason can be pointed to the lack of a protectionist policy the possibilities of the country as protection, includes all social, economic and geostrategic possibilities for preserving and increasing the population of the country, as well as controlling the migration flow [4] of the population group of fertile age. The population in the RA of the country is decreasing, which leads to the depopulation of large areas [14]. In the coming decades, the problem of overpopulation in peripheral areas and urbanized areas will deepen due to geopolitical reasons. Imposing a new "paradigm" to get out of the geodemographic crisis is urgent and necessary for the country.

Births have decreased, the trend is noticeable both at the national level and in rural areas. The reasons for the negative values are social, economic and the missing protectionist policy, but it can also be explained in the mentality of women in recent decades. An increase in births is a vital process that can compensate for high mortality, but not migration processes. Retention of the childbearing population in the SR of the country can be achieved by strengthening socio-economic processes and infrastructural activities. The natural features in rural municipality (RM) are not used as intended, this is a potential that is subject to study and application in practice.

High prudence appears as a geodemographic indicator (there are negative indicators throughout the period), which is part of the national strategy for the country and rural areas. Before the research period, the mortality rate for Bulgaria and the adjacent RAs was high - the reason is the lack of protective security, but here one can also add the low socio-economic status of the population and its aging in the peripheral areas. Lack of protectionist policy on the part of the state, ethno-cultural features in the region's RM and other related to the lifestyle of the population. Natural increase is the key moment that determines the geodemographic picture of the studied territory for a fixed time. In this case, for a ten-year period, the NI in the country and the RA of the same is negative. According to the scale of the Swedish demographer Urbanism, the studies fall into the lowest group ***"no increase - below 0 ‰".*** The basic reason for reaching this situation is the absolute abdication of state and lack of protectionist policy on the part of state institutions. The change should occur only when the management model is changed. formatting.

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FINANCIAL INDEPENDENCE IN RURAL MUNICIPALITIES IN BULGARIA

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Abstract

Bulgaria is a unitary country and municipalities are the only subnational level of self-governance. It is important to have stability and independence in local finances to provide services of high quality. This research`s main goal is to evaluate the level of financial independence in rural municipalities in Bulgaria by monitoring the main revenue flow to the municipal budget - through local taxes. There are a few methods used in the process of evaluation, like mathematical synthesis, comparative analysis, and deduction. The research is using the European NUTS classification, Bulgaria`s Law on Regional Development, statistical information from the National Statistical Institute, and the Ministry of Finance. Results are going to show where is the weak point in the municipal local finances to gain more independence and how they can increase their revenue. This will allow them to distribute better their financial flows and invest in activities and services that are necessary for their municipality type.

Key words: *rural municipalities, local taxes, decentralization*

INTRODUCTION

The independence of local self-government is an important part of the identity of the municipalities and a possibility for their development. To achieve this independence, municipalities need to perform some changes. If we look on this problem from another angle, we can give more power and independence to the local governments but in the same time we have to make sure they are monitored.

Financial independence is particularly important in rural municipalities, as they are taking about 80% of the territory of Bulgaria [5, 14]. The main income in a municipality is from local taxes and fees. This being said, the income can be easily increased by changing the tax rates, which will lead to the revenue increase in rural municipalities.

One of the most important part in the municipal budget, as we speak for revenues, is the share of the local taxes and fees. There are different taxes and fees in Bulgaria and all of them are with different weight to the taxpayers. This is of key importance, because the greater their share is, the more self-sufficient and independent that municipality could be. In municipalities of different sizes, the share of own revenues in the total revenues is different, and it varies from about 10% to 60-70% in some municipalities. It is of great importance in municipalities with larger own revenues to increase collection and revenue potential [9]. Currently, there is big difference between urban and rural municipalities on their taxes and fees collection. According the law in Bulgaria each municipality is defining its own tax rate, so they can control the expected revenues from taxes and fees in their budgets. With the delegated power to the municipality council to define the tax rates and fees, it is possible each rural municipality to conduct its own tax policy. Such policy in poor regions could be pointed to set lower tax rates and have higher collectability or another approach is to have higher rates in richer regions and follow strictly the low in order to keep the collectability high as well. The rate of real estate tax is determined by ordinance of the municipal council within of 0.1 and 4.5 per thousand on the tax assessment of the real estate [1].

During this century, a huge number of scientists and inventors contributed to the development of human civilization [4, 6]. The COVID-19 pandemic crisis has affected all

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sectors of the economy. The achievement of the strategic development goals and the financial provision of the municipalities is possible through the municipal budget [7]. It has an income and expenditure part and without its own budget the municipalities cannot exist separately. Realistically set incomes on an annual basis and expenses according to the possibilities of the municipalities allow optimal use of resources.

The revenue part of the municipal budget is subject to careful planning by the relevant directorate in the municipality and has the task of predicting all revenues in the following areas:

•local taxes;
•local fees;
•services and rights provided by the municipality;
•management and disposal of municipal property;
•fines and property sanctions;
•interest, penalties and other non-tax income

The expected revenues from local taxes and fees are calculated and defined by municipality employees according to the active “Law for local taxes and fees” and also the determination and administration of local fees and service prices on the territory of the given municipality [11].

The expenditure part of the municipal budget is balanced, providing budget credits for financing local and state-delegated activities. Their structure could be classified by function as follows:

•Function "General State Services"
•"Defense and Security" function
•Education function
•"Health" function
•"Social security, support and care" function
•Function "Housing construction, BKS and environmental protection"
•Function "Leisure, culture and religious activities"
•"Economic activities and services" function
•"Expenses not classified in other functions" function
•All capital budget
•Reserves for urgent needs

The implementation of the municipal budget is organized by the mayor of the municipality through the mayors of town halls, districts and through the heads of budget units financed by and through the municipal budget [2].

The adoption of the municipal budget and the determination of the amount of local taxes and fees for the next calendar year takes place according to a certain schedule. Of course, there may be exceptions, since municipal budgets are adopted after the republican budget has been approved in the National Parliament. In this way, it is possible to set correct parameters regarding the expected transfers from the republican to the municipal budget. At the beginning of the month of November of the previous year, a summary of the budget claims, analysis and verification, development of an expenditure plan, preparation of a program for revenues (includes proposals for determining the amount of local fees and service prices) [8].

Both, real estate tax and vehicle tax are regulated by the Law for local taxes and fees [1].

Real estate tax

Real estate tax is levied on buildings and independent objects within buildings located on the territory of the country, as well as on land located within the building boundaries of settlements and settlements, and on land outside them, which according to a detailed development plan have the purpose under Art. 8, item 1 of the Law on Territorial Planning and after changing the purpose of the land, when this is required by the order of a special law.

Vehicle tax

All vehicles registered for movement on the road network in the Republic of Bulgaria and aircraft registered in the state register for civil aircraft are subject to vehicle tax. Taxpayers are the owners of the vehicles (individuals or legal entities).

The purpose of this research is to review the two local taxes with the greatest weight in municipal revenues and to assess whether the size of municipalities has a relationship with tax collection, i.e. in the larger municipalities, whether there is a higher collection or the opposite statement would be proven.

MATERIALS AND METHODS

In the study and analysis of the material, the authors are based on the definition of RA adopted in Bulgaria: "...rural areas - the municipalities of (LAU 1), in which there is no settlement with a population of more than 30,000 people..." [10, 13], refers to the Law on Regional Development of 31.08.2008, Chapter Two - Territorial Basis of Regional Development, Art. 4. (2), (4) and (5), (Supplement - NP № 21 of 2020, in force from 13.03.2020) [3].

The analysis of local taxes and fees covers a period of 5 years (2018-2022) and is focused on two main taxes with the largest share of revenue in municipal budgets, namely Real Estate Tax and Vehicle Tax. The data in the considered period are processed in the following two directions:

-collectability rate

-correlation coefficient

❖**Local tax collection rate**

To track tax collections as a nominal value over a 5-year period under consideration and to compare tax collections as a percentage against the possibility of a maximum collection of 100%.

For this purpose, it is possible to use the following formula:

$$T_C = \frac{C_{TC}}{P_{TC}} \times 100\% \text{.............................(1),}$$

where:

T_C – tax collection rate

C_{TC} – real tax revenues

R_{TC} – all possible earnings

❖ **Correlation coefficient for the collection of MDT in relation to the size of the municipality**

With this coefficient we can verify if there is relation between **the collection of local taxes** and the **population of the municipality**.

The following formula is used to calculate the correlation coefficient:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \text{.......... (2),}$$

where:

r = correlation coefficient

n = number of observations

x = 1st variable

y = 2nd variable

In the analysis of the correlation coefficient, the following permissible values are applied (Table 1).

Table 1. Correlation degree values

Degree of correlation	Positive correlation	Negative correlation
weak	$0 \leq r < 0.2$	$-0.2 < r \leq 0$
significant	$0.2 \leq r < 0.5$	$-0.5 < r \leq -0.2$
strong	$0.5 \leq r < 0.8$	$-0.8 < r \leq 0.5$
very strong	$0.8 \leq r$	$r \leq -0.8$

Source: Pearson's interpretation.

RESULTS AND DISCUSSIONS

Taking into account the Program for the development of rural areas in Bulgaria and the set goal of examining the financial autonomy of rural municipalities, the population is divided into rural and urban areas. Visually, this distribution is available in Table 2 together with the exact number and division of municipalities (rural/urban) for the considered period of 5 years.

From the subdivision of municipalities, a decrease in the average number of inhabitants in a municipality is noticeable, both in those of the rural type and in those of the urban type. For the five years of the period under review, there was a population decline of about 8% in rural municipalities and about 6% in urban-type municipalities. The population of the capital is decreasing and the population of the country will also reach 6,447,710 people in 2022, which is a decrease of 8% compared to 2018.

The research is focussed on the rural municipalities which are taking around 80% of all municipalities in Bulgaria. For the period of the study this means between 221 and 224 municipalities in total.

Table 2. Number of municipalities by year and population

Groups		MUN 2018	AVE POP in 1 MUN	MUN 2019	AVE POP in 1 MUN	MUN 2020	AVE POP in 1 MUN	MUN 2021	AVE POP in 1 MUN	MUN 2022	AVE POP in 1 MUN
1	Under 30,000 population- rural municipalities	222	10,374	222	10,275	222	10,364	221	10,088	224	9,569
2	Over 30,000 population - urban municipalities	42	80,214	42	79,563	42	78,748	43	76,792	40	75,600
3	Capital	1	1,328,120	1	1,328,790	1	1,308,412	1	1,307,439	1	1,280 334
All municipalities		**265**	**26 415**	**265**	**26 232**	**265**	**26 100**	**265**	**25 807**	**265**	**24,331**

Note: MUN = municipalities. AVE POP = average population
Source: Visualization of data from NSI and Ministry of Finance, Bulgaria [8,12].

From the presented data (Fig. 1), we can say that there is a higher collection of real estate tax than on vehicles in rural municipalities. There is an increase in collection during the period under review, with a positive difference of 5.82% in 2022 for real estate tax in rural areas compared to 2018. The vehicles tax, on the other hand, kept similar values almost throughout the considered period, with the lower results in 2020.

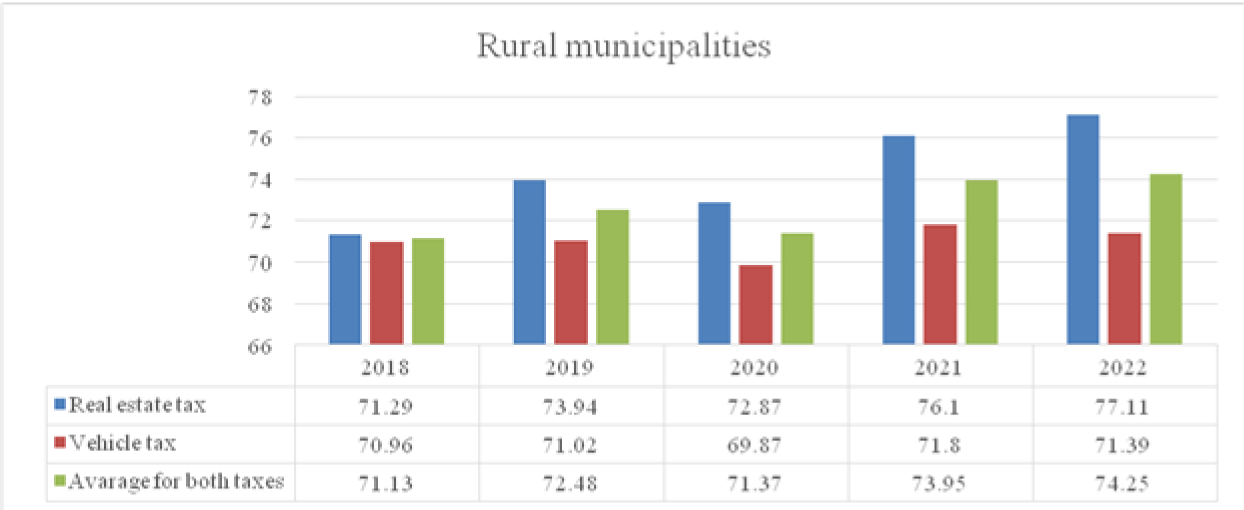

Fig. 1. Average collection of real estate tax and vehicle tax in rural municipalities, %
Source: [8,12].

According the data from Figure 1 and 2 we can conclude that there is higher collectability of real estate tax, which was realized in urban municipalities, and at the end of the period, collectability is higher that the beginning of the period with more than 4%.
Vehicle tax maintained the same trend and remained almost unchanged over the five-year period under review, hovering in the 69-71% range.
Comparing the data on the collection for rural and urban municipalities (Figs. 1 and 2), it can be found that in the urban municipalities there is a higher collection of the two most significant local taxes.
On average, between 2% - 3% better collection of both taxes is observed in urban municipalities compared to rural ones.
In order to verify the relationship between tax collection and the number of population in rural municipalities, it is necessary to perform calculations according to the formula described in the methodology.
Figure 3 presents the property tax data and the calculated correlation coefficient for the period under consideration by year.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
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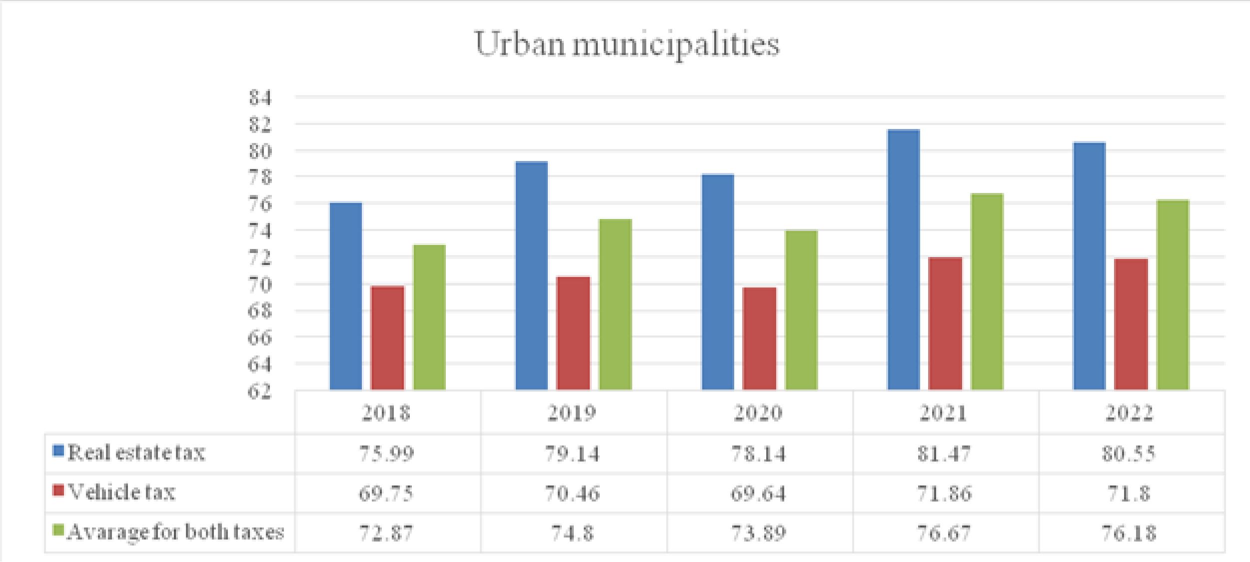

Fig. 2. Average collection of real estate tax and vehicle tax in urban municipalities, %
Source: Visualization of data from NSI and Ministry of Finance, Bulgaria [8, 12].

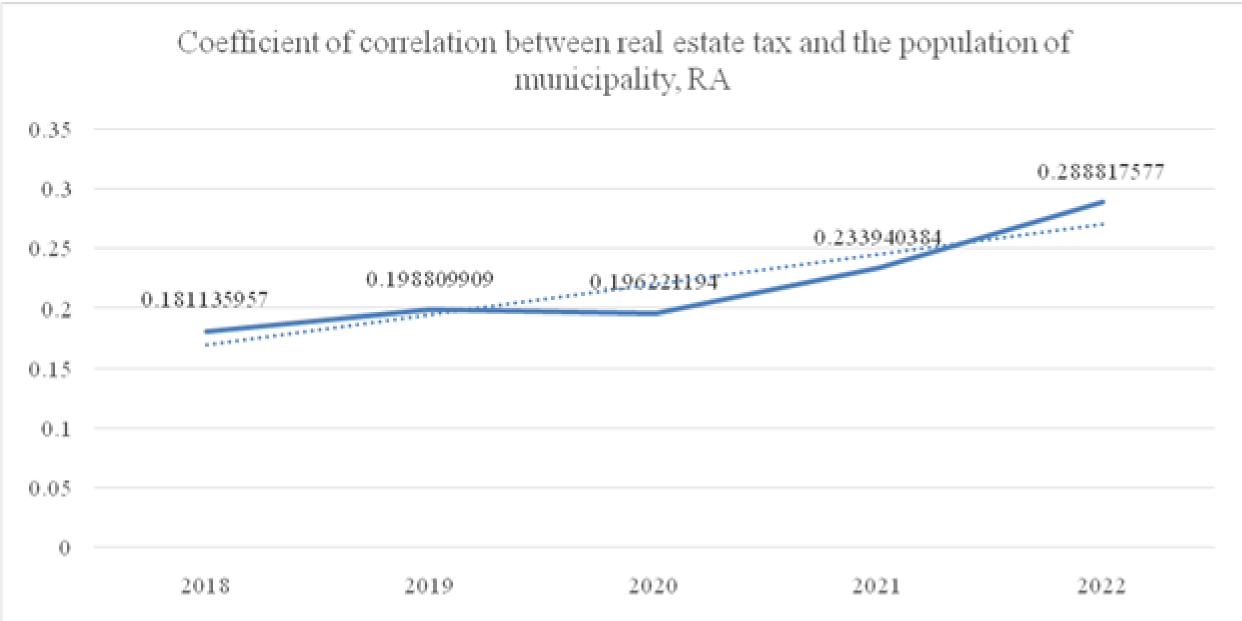

Fig. 3. Coefficient of correlation between real estate tax and municipality population, RA
Source: Visualization of data from NSI and Ministry of Finance, Bulgaria [8, 12].

The following generalizations could be made from the data presented:

-The relationship between the collection of real estate tax in rural municipalities and the number of inhabitants is positive and weak until the middle of the considered period, and in the last two years of the period, it becomes significant with a coefficient of 0.29, which falls into the second group according to the accepted scale of measurement.

The positive relationship between the two variables means that the larger a municipality is, the more likely it is that the real estate tax collection will be higher.

Figure 4 presents the results for the correlation coefficient between vehicle tax and population in rural municipalities. The results show that the relationship between the two variables is weak, but still positive. We observe the lowest correlation coefficient in the middle of the period (2020), with a result of 0.10. At the end of the period, the data reports approaching the next "significant" group on the measurement scale with a score of 0.17.

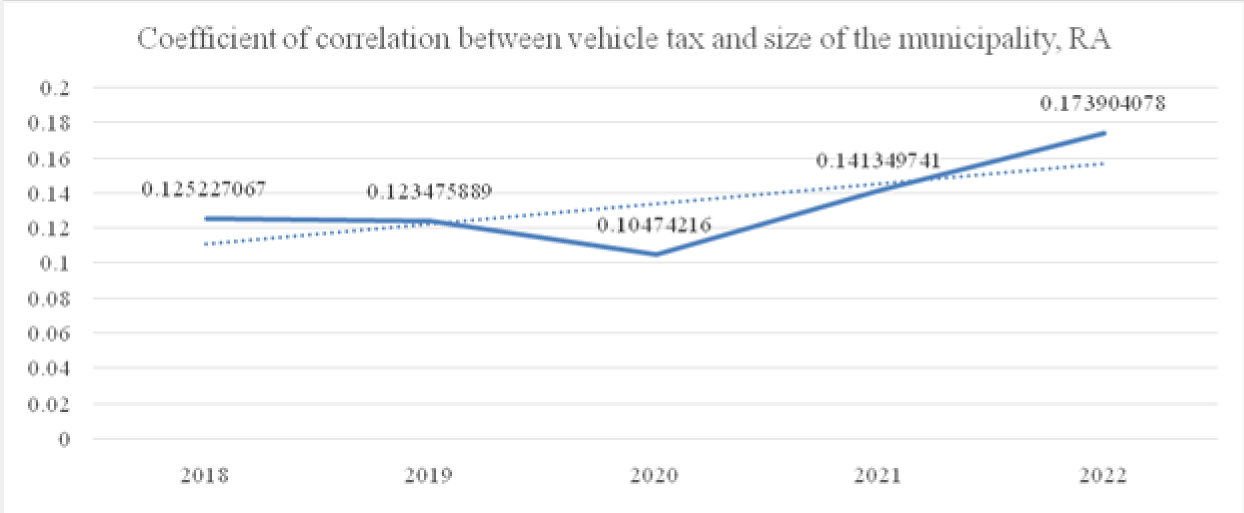

Fig. 4. Coefficient of correlation between vehicle tax and municipality population, RA
Source: Visualization of data from NSI and Ministry of Finance, Bulgaria [8,12].

We can conclude that there is positive correlation between the population and tax collectability. For the real estate tax, we have significant connection and as higher the population is in one municipality, higher the collectability is. Regarding the vehicle tax, the connection is weaker.

CONCLUSIONS

Given the results of the correlation coefficient and the size of the population in the municipalities where a significant positive relationship has been observed in recent years, it could be considered to merge the smaller municipalities, which by law must have a minimum population of 6,000 people in order to exist as a separate entity. Currently in Bulgaria, about 31% of the municipalities do not meet this condition.

From the data analysis so far, the following conclusions can be drawn:

-Real estate tax collection is as high as 77% in rural areas, which means that local revenue potential is lost and could be increased by about a quarter on average. In comparison, the same tax has a higher collection in urban municipalities with a population of more than 30,000 people.

-Vehicle tax collection rates are similar in rural and urban municipalities. The correlation coefficient shows a weak positive relationship between population size and collection.

Reforms in rural municipalities should be aimed at consolidating and delegating more powers from the central to local authorities in order to continue the process of decentralization and to give a greater opportunity for rural municipalities to generate their own revenues. This would lead to a more complete utilization of the pledged revenues and provision of better quality services to the citizens living on the territory of the rural municipalities. An appropriate follow-up study could link average gross wages in municipalities and tax collections.

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DEVELOPING A MODEL BASED ON A STATISTICAL ANALYSIS OF FOOD LOSS AND WASTE PATTERNS

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Abstract

Reducing food loss and waste on each level of agrifood chain is a responsible action, thus each stakeholder on the agrifood chain must create actions that are related to food waste prevention. In this matter, this paper presents an analysis of a statistical study run on a sample of respondents related to food loss and waste on a consumer level of agrifood chain. The study takes into account both quantity and quality parameters and serves as a provider of training data for a model which will be developed based on prediction. Another important aspect of the paper is related to the determination of food loss and waste economical Another crucial aspect discussed in the paper concerns identifying economic behavioural patterns associated with food loss and waste throughout various levels of the agrifood chain. This data will be instrumental in training models for those respective levels. The study emphasizes the significance of raising awareness and taking action to minimize food waste across all phases of the agricultural and food distribution process. It also emphasizes the necessity of developing models and strategies to effectively approach this challenge.

Key words: *food loss and waste, statistical, model, agrifood chain*

INTRODUCTION

With growing pressure to ensure a sustainable and efficient agri-food chain [3], minimizing food loss and waste has become a critical issue on both a regional [16] and global scale. This problem goes beyond just economics [6] and social impact [11]. It significantly affects the environment as well [2], by the consumption of precious resources and the contribution to greenhouse gas emissions. Furthermore, understanding the behavioral factors that contribute to food loss and waste is a key approach in tackling this challenge [10, 8].
This paper focuses on the analysis of food loss and waste behavior at the level of consumers in the agri-food chain. By conducting an extensive statistical analysis, the study seeks to gain more in-depth insights into household food management practices and identify the factors that influence the generation of food waste [7]. The study examines both quantity [1] and quality of food waste to provide a comprehensive picture of consumer food management behaviour.
An important aspect of this work is related to the use of the results of the statistical study for the development of a prediction model [9]. Various models concerning food loss and waste have been discussed in existing literature [5, 14, 15], focusing particularly on patterns of food loss and waste [4]. The forthcoming model will utilize data acquired

for training purposes and aims to forecast the extent of food loss and waste at the consumer level.

The paper will also identify and study economic behavioral patterns related to food loss and waste at other levels of the agri-food chain, thus providing additional training data for the prediction model.

This study is a continuation of the research on the topic of food loss and waste management presented in our pervious articles [12, 13.]

MATERIALS AND METHODS

This paper describes the main findings resulted after the compilation of the responses given at a questionnaire related to food waste behavioural patterns and their analysis. The questionnaire is part of the ReWaFA study, related to food loss and waste (FLW) phenomenon analysis alongside the agrifood chain. The results will be computed to construct a training dataset for an upcoming prediction model concerning food waste, the methodology of which will be briefly outlined in a section of this paper and further elaborated in future research papers. In this matter, the main purpose of the analysis presented is the determination of patterns related to food waste, especially related to the consumer component of the agrifood chain, and the computation of the main indicators that will be taken into account for a future prediction model.

The ReWaFA study analysis methodology

As said, the main purpose of the ReWaFA study is centred on the study of FLW alongside the agrifood chain. For this specific period of the study development, the research focus was set on the final components of the agrifood chain, i.e., the consuming component. This phase of the study was aimed at examining consumer behaviour concerning food loss and waste. To achieve this, an online questionnaire was employed, comprising structured inquiries regarding the frequency of food purchases, methods of food storage, the level of awareness about food waste, and other pertinent aspects of food behaviour.

The development of this phase had several steps:

S1. *The design of the questionnaire*: this step consisted in the development of the structure and morphology of the questionnaire. It was structured on specific sections, related to demographic data, consuming processes, food habits and measures taken to reduce food waste. The questions were predominantly single (category-based) and multiple-choice (preference and situational) questions and the final consideration was made using an open question.

S2.*The sampling process*: The sample of participants was selected using convenient random sampling, resulting in a total of 365 responses.

S3.*The implementation of the questionnaire*: the questionnaire was distributed online through a variety of social media platforms and via e-mail to participants from various geographical regions of Romania (according to NUTS-2 development regions), thus ensuring a relatively even distribution of responses.

S4.*The response analysis*: several direct observations were made and correlations were explored in this phase of the study.

This study examined several factors that may influence food waste behaviour, including frequency of food shopping, food storage methods, level of awareness of food waste, planning of shopping and food consumption, attitudes and eating behaviours, socio-economic level and demographic factors.

These factors were considered essential in building a classification model to better identify and understand consumer behaviour in relation to agri-food waste.

The study was conducted in accordance with ethical procedures, ensuring anonymity and confidentiality of respondents. Limitations of the study included possible sample representativeness issues and subjectivity in reporting food waste behaviour.

The prediction model methodology

The prediction model represents the exploratory phase of the model. In this context, the prediction model aims to identify specific patterns of food loss and waste associated with the consumer segment of the agrifood chain. The primary anticipated outcomes revolve around discerning distinct patterns of the food loss and waste phenomenon during the consumption phase. For this specific purpose, the next steps were taken into consideration:

S1.*Data selection*: from all the given responses, the specific characteristics of the model will be selected.

The characteristics are the indicators that will be the base of the prediction.

S2.*Data pre-analysis*: in this step, several statistical correlations between selected data can be explored and determined. These correlations may form a categorical structure that may delimit specific behavioural patterns, used in the output process (e.g., clusters or classes as patterns, used for prediction).

S3.*Data pre-processing*: this step consists in the transformation of the selected data (e.g., normalization, encoding).

S4.*Dataset split*: the obtained dataset is split in two subsets: training set and testing set (usually in 80-20 or 70-30 proportions).

S5.*Model building*: using the selected method (either decision trees, ML-based methods or neural networks), the respective instrument is built and trained with the training data.

S6.*Model assessment*: the built model is assessed based on the determination of specific KPI indicators which are measured based on the testing data.

S7.*Model interpretation*: the resulted model is interpreted and its parameters are optimized.

In this regard, starting from specific selected characteristics believed to influence food loss and waste behaviour, and using the collected data, the patterns associated with food loss and waste are obtained, either numerical (a predicted quantity of food waste) or categorical (a cluster of food waste behavioural pattern).

RESULTS AND DISCUSSIONS

We will make an analysis related to the responses given to the built questions. The first questions are related to demographic data.

Fig. 4 presents the structure of the sample related to age categories.

We can see that the respondents situate largely in the 18-35 age category.

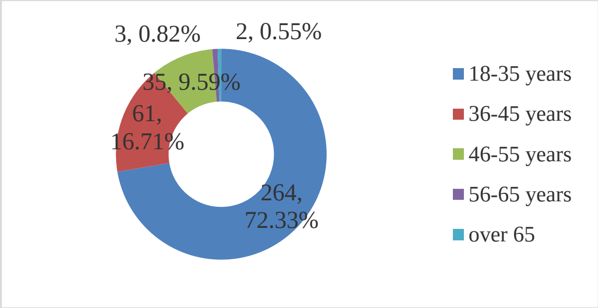

Fig. 4. The classification of respondents by age group
Source: data processing from online questionnaire.

Fig. 5 presents the classification by gender. We can observe that the structure of the sample related to gender is almost balanced, with a slight increase to feminine gender.

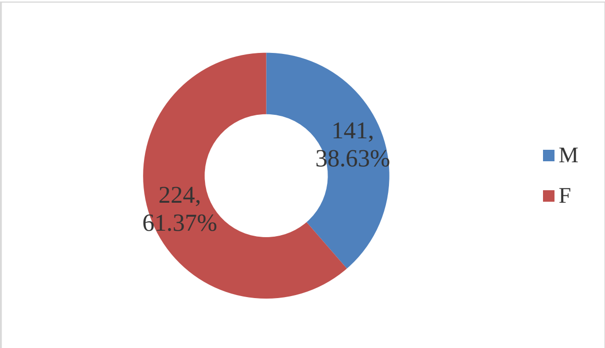

Fig. 5. The classification of respondents by gender
Source: data processing from online questionnaire.

Next, Fig. 6 presents the data related to the latest form of education of the respondents.

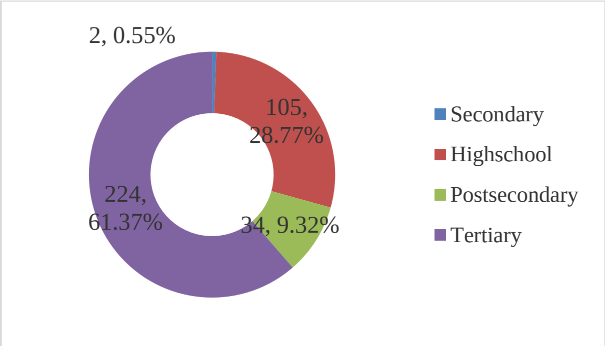

Fig. 6. The classification of respondents by latest form of education
Source: data processing from online questionnaire.

We can observe that the majority of the respondents has as latest form of completed education tertiary levels, related to university education (e.g., bachelor's degree, master's

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Vol. 24, Issue 2, 2024
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degree).
Next, Fig. 7 presents the data related to the geographical distribution of the respondents.

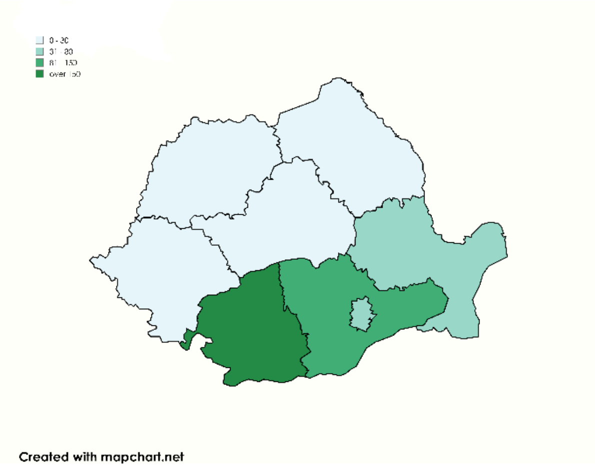

Fig. 7. The classification of respondents by NUTS-2 regions
Source: data processing from online questionnaire.

We can observe that a significant proportion of respondents originate from the South-West Oltenia development region.
Next, Fig. 8 presents the data related to the socio-economic status of respondents.

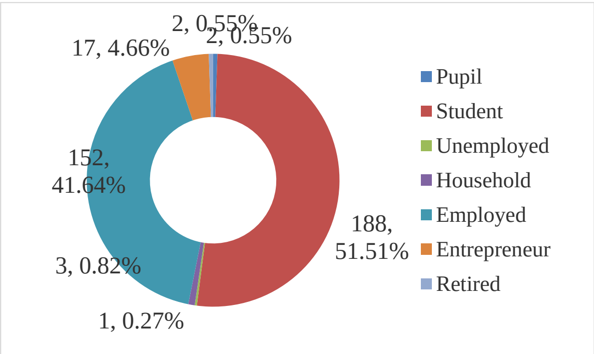

Fig. 8.The classification of respondents by income
Source: data processing from online questionnaire.

The primary two respondent categories comprise employees and students, with a minor representation from entrepreneurs.
Next, Fig. 9 presents the data related to the income of the respondents.
We can observe that the primary two income categories among the respondents correspond to incomes below Lei 5,000.
Next, Fig. 10 presents the data related to the residence of the respondents. We can observe that a slightly majority of the respondents is established in the urban environment (approximately 65%).

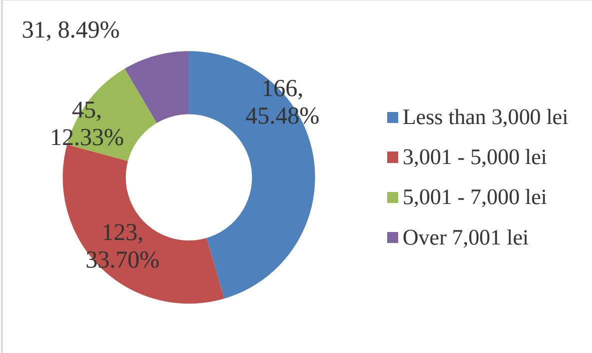

Fig. 9. The classification of respondents by income
Source: data processing from online questionnaire.

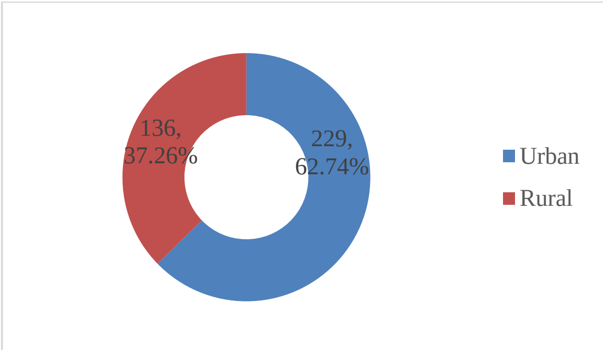

Fig. 10. The classification of respondents by residence
Source: data processing from online questionnaire.

Fig. 11 presents the frequency of the purchasing events reported to a monthly period. We can observe that many respondents have a frequent habit of buying food, resulting a predominant frequency of 6 to 8 food purchasing events per month.

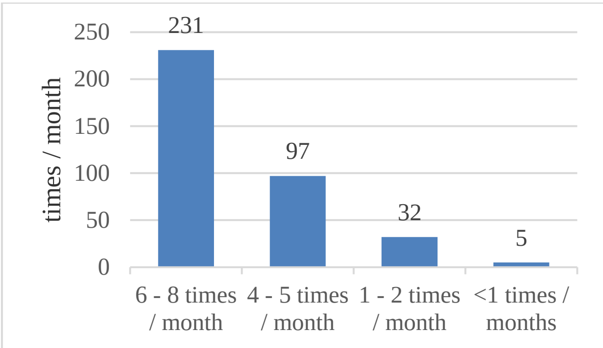

Fig. 11. The frequency of food purchase events
Source: data processing from online questionnaire.

The next graph, shown in Fig. 12, presents the amount of financial resources spent monthly on food. The majority of the respondents spend an amount of money between 500 and 1,000 lei, between 10% and 20% of the total average income, as computed based on data in Fig. 9.

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Vol. 24, Issue 2, 2024
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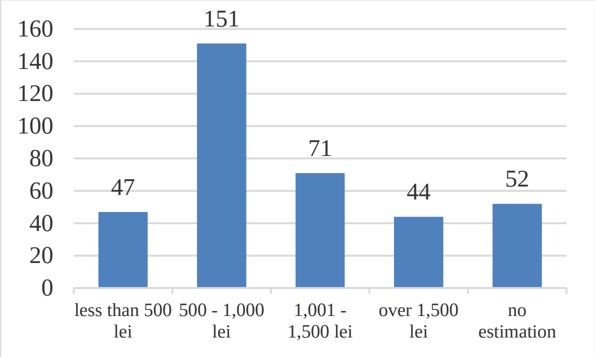

Fig. 12. The amount of money spent on food monthly
Source: data processing from online questionnaire.

Next, Fig. 13 presents the main categorical causes identified by the respondents for FLW. The three main causes are related to food that is perishable or in large amounts.

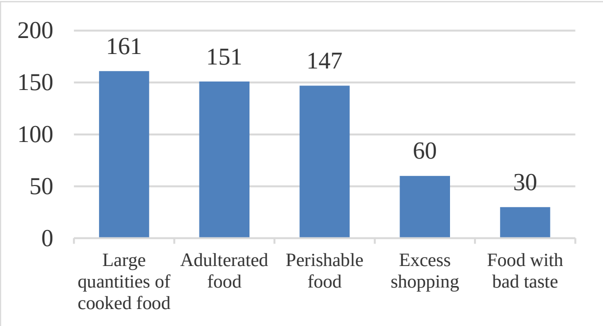

Fig. 13. The main causes of the food waste identified among the respondents
Source: data processing from online questionnaire.

In the next figure, Fig. 14, the distribution of buyers on main purchasing locations of agrifood are presented.

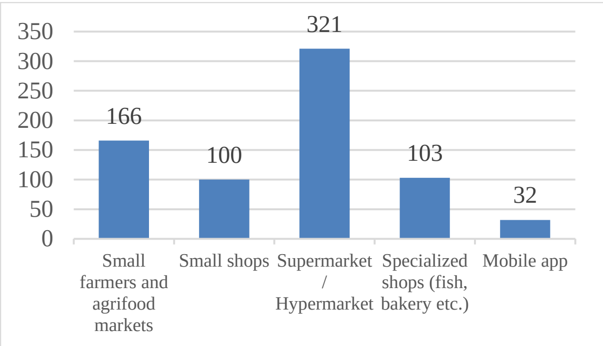

Fig. 14. The main places where respondents purchase food
Source: data processing from online questionnaire.

The vast majority of the respondents purchase their agrifood from supermarkets or hypermarkets, followed by small farmers and agrifood markets.

Fig. 15 presents the perceived amount of food waste from the total amount of purchased food.

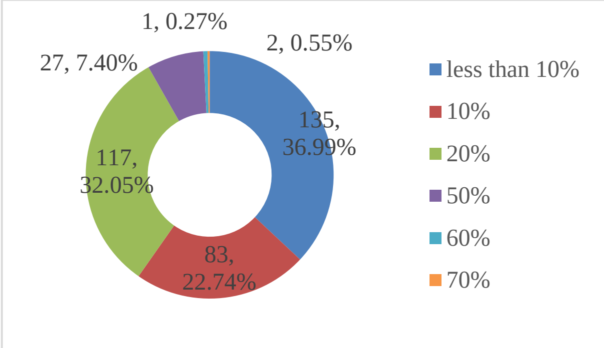

Fig. 15. The perceived percent of food waste monthly
Source: data processing from online questionnaire.

The majority of the respondents (over 90%) perceive a proportion of waste food below 20% from the total amount of purchased food. Fig. 16 presents the amount of respondents that waste prepared or unconsumed food. The proportion of the respondents who throw prepared or unconsumed food is almost balanced with the one who does not have this habit.

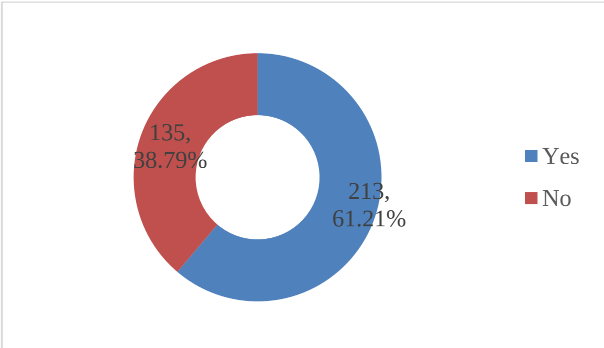

Fig. 16. Proportion of respondents who waste cooked or unconsumed food.
Source: data processing from online questionnaire.

Next, Fig. 17 presents responses related to specific clauses describing habits of food waste.

As we can see, the average respondent frequently throws away leftovers, but one seldom preserve them for a later usage. However, a part of them is frequently directed to pets. Also, the habit of purchasing food with a longer shelf life is usual and one moderately does selective recycling.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
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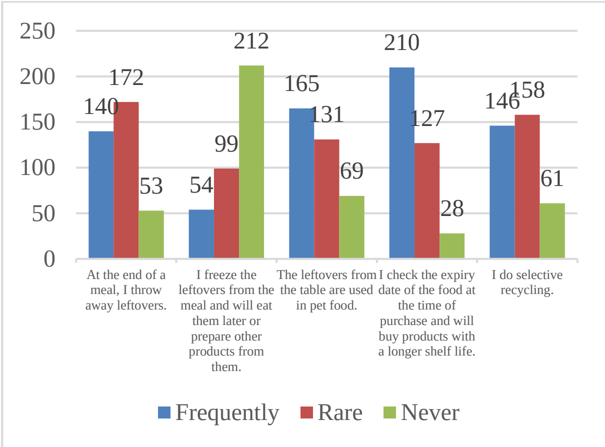


Fig. 17. Responses given to specific affirmations related to food waste
Source: data processing from online questionnaire.

Next, Fig. 18 presents the main wasted food categories. As seen, the vast majority of wasted food is related to cooked food, the rest of the categories having a balanced proportion in the food waste bin.

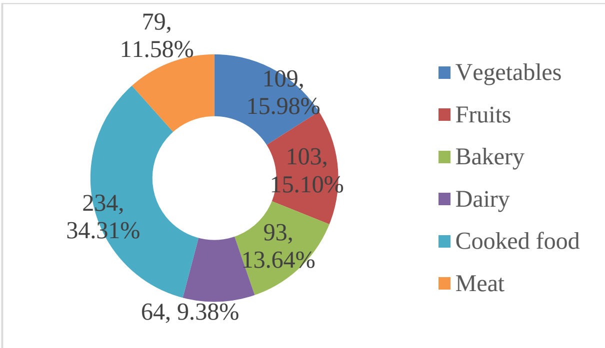


Fig. 18. The main categories of wasted food.
Source: data processing from online questionnaire.

Next, Fig. 19 presents the importance given by the respondents to specific purchasing process aspects.

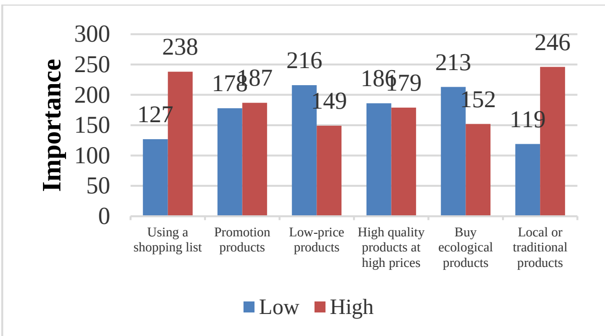
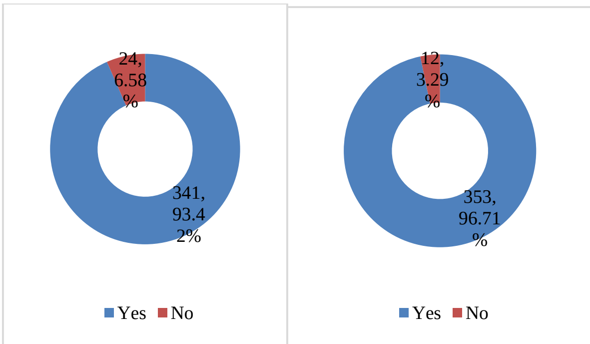


Fig. 19. Important aspects taken into account by buyers in the purchasing process
Source: data processing from online questionnaire.

As we can see, the most important aspects of the purchasing process perceived as important are the usage of a shopping list and the purchasing of local and traditional products, the least important being the purchase of the ecological products, the low price of some products and the purchase of high quality products at high prices.

Next, Fig. 20 presents approaches related to food waste behaviour.

As evident from the data, nearly 95% of the participants are aware of the food waste phenomenon, and over 95% have expressed their intention to reduce food waste on an individual basis.



(a) (b)

Fig. 20. Responses to the question: (a) Did you hear about food waste? (b) Do you want to reduce food waste in the future?
Source: data processing from online questionnaire.

Next, Fig. 21 presents chosen measures for food waste prevention. The main identified cause from the given three for the food waste is considered to be the purchase of a balanced amount of food with the individual or household needs.

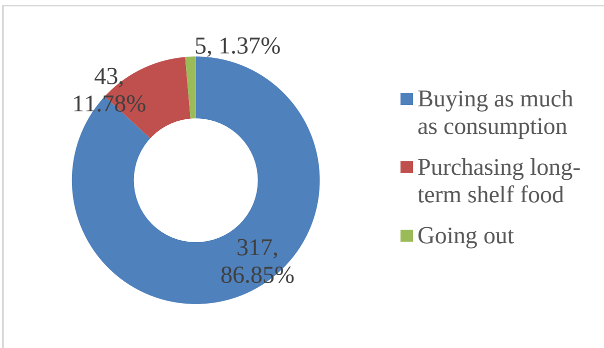


Fig. 21. Identified measures of reducing food waste quantities.
Source: data processing from online questionnaire.

Next, Fig. 22 presents the perception of food waste responsibles. The majority of the respondents identified household consumption as the main generator of food waste, followed by supermarkets, hypermarkets and restaurants.

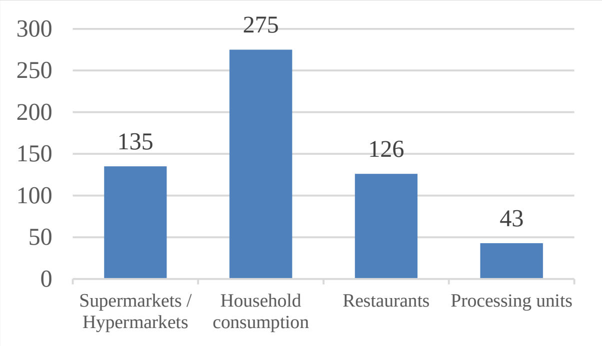


Fig. 22. Identified responsibles for food waste.
Source: data processing from online questionnaire.

Finally, Fig. 23 presents the acceptance proportion of respondents to three given affirmations.

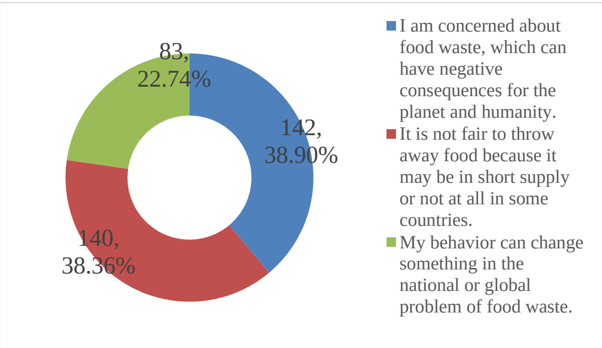


Fig. 23. Various opinions related to food waste.
Source: data processing from online questionnaire.

As observed, respondents equally consider all statements regarding the impact of food loss and waste, food balance, and personal involvement in preventing food loss and waste.

In conclusion, we can establish that that respondents are aware of the food loss and waste phenomenon and are readily inclined to personally engage in optimizing both food and financial resources.

The significance of developing a prediction model for food loss and waste cannot be overstated. It encompasses a complex process that includes gathering and analyzing data, establishing prediction goals, and selecting the suitable machine learning algorithm. The ultimate goal of this model is to forecast and measure the extent of food loss and waste across various settings, spanning from individual households to a global scale. It can be used to identify key factors influencing food waste and to propose effective strategies and interventions to reduce it. The process of creating such a model involves analyzing and interpreting data, developing and evaluating predictive models, and integrating the results into decisions and policies relevant to food waste management. The detailed description of the model and results after its implementation will be presented in a future research paper.

CONCLUSIONS

The study presented offers an analysis of a statistical study undertaken on a sample of respondents concerning food loss and waste within the agri-food chain at the consumer level. It encompasses both quantitative and qualitative parameters and serves as a provider of training data for a forthcoming model intended for prediction purposes. Another significant facet of the document pertains to establishing economic behavioural models concerning food loss and waste across other levels of the agri-food chain. These models will serve as training data for the aforementioned model across the remaining levels of the agri-food chain.

In essence, the findings highlight the importance of awareness and action in reducing food waste at all levels of the agri-food chain, as well as the need to develop specific models and strategies to address this complex issue. Through the collection and analysis of data, the study contributes to the understanding of food waste behaviour and the identification of key factors that influence this phenomenon, thus providing a solid basis for developing effective solutions and policies to combat food waste.

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DIGITAL INNOVATIONS IN CATTLE-BREEDING - OPPORTUNITIES AND CHALLENGES FOR SUSTAINABLE DEVELOPMENT OF THE RURAL AREAS IN BULGARIA

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Abstract

The article explores the transformative effect of the digital innovations in the agrarian sector (in particular ruminant breeding) by tracking both the opportunities, and the challenges, which they represent for the sustainable development of the modern agriculture. Integration of digital technologies in cattle-breeding becomes more and more common, offering potential solutions for increasing of the efficiency, productivity and ecological sustainability. The change towards digitalization brings different challenges, varying from problems related to accessibility to concerns, related to data security and ethical consequences. Based on the existing literature and empirical evidence, this research provides complete analysis of the current conjuncture of the digital innovations in livestock industry, assesses the potential benefits from them and explores the barriers preventing their broad acceptance. The conclusions contribute to nuanced understanding of the role, which the digital technologies play in shaping the future of the sustainable agriculture and the rural areas in Bulgaria. The implemented retrospective analysis shows that the problematic agricultural holdings can be encompassed by digitalization only if serious financial investments are made.

Key words: *digitalization, cattle breeding, sustainable development, innovations, rural area*

INTRODUCTION

The modern agricultural sector experienced deep transformation, characterised by comprehensive digital revolution, which fundamentally changed the traditional agricultural methodologies. The technological progress became integral part of this change of the paradigm, serving as a catalyst for innovations in different aspects of the agricultural practices. Among the sectors, significantly affected by this technological coup is ruminant breeding, which is fundamental component of agricultural industry and which stands out with significant adaptation of digital innovations. The research tries to enter the details of this digital metamorphosis in cattle breeding, aiming at the same time to comprehensively analyse both the opportunities, and the challenges, stemming from integration of the digital technologies. The main focus of this research is outlining the consequences of digital innovations in cattle-breeding aiming at sustainable development in agriculture.

The digitalization in agriculture is a multilateral phenomenon, comprising different technologies such as sensors, analysis of data and taking of informed decisions. Cattle-breeding, being one of the most complex components in agriculture uses these digital instruments in different occasions in its practices. This includes precision livestock farming, decision making, based on data and application of ecologically sustainable practices. Integration of such technologies is expected not only to revolutionize the operative aspects in cattle breeding, but also to contribute significantly to the broader goals for sustainability in agricultural sector.

The increase of the digital innovations in the cattle-breeding sector is accompanied by numerous potential opportunities, which require analysing. Internet of Things (IoT) is combination of technological moments and conditions, which form the future of mankind. Its concept is based on identified, connected devices, which gather data and store it in an information cloud, which is processed by smart algorithms [16]. The Precise Livestock Farming (PLF) uses a set of digital instruments, such as sensors and GPS technology for observation of specific animals, providing the farmers with information in real time about the animal health and behaviour [5].

This level of precision facilitates the optimized strategies for feeding, early detection of health problems and improved overall management of the herd, which results in efficiency and productivity. Decision making, based on data, is another main aspect, which provides farmers with the opportunity to gather, analyse and interpret huge quantities of data for taking of informed decisions [26]. Such based on data approaches allow optimization of resources, prevention of diseases and improved overall management of the cattle breeding agricultural holdings.

The inclusion of digital technologies promises to encourage ecological sustainability. Monitoring and real-time control, facilitated by these technologies, can contribute to decrease in the loss of resources, optimization of the efficiency of the fodder diet and minimization of greenhouse gas emissions, related to farming large ruminant cattle [5].

Since agriculture fights with the imperatives for sustainability, the digital innovations in cattle-breeding are outlined as a potential solution for bringing the sector in conformity with the goals for environment management.

Nevertheless, despite these promising opportunities, the integration of digital technologies in the sector of cattle-breeding is not challenge-free. The access and the financial opportunity are the main problems, especially in the developing regions, where financial limitations and poor infrastructure hinder the wide acceptance of digital solutions. The considerable preliminary expenses related to acquiring and implementation of these technologies, impose barriers, which can increase the existing inequalities between the farmers.

Moreover, the increased usage of digital instruments creates concerns about data security and personal privacy. Collecting and storing of huge and sensitive data about the individual animals and agricultural practices impose strict measures for cyber security to protect this information from unauthorised access and potential abuse [14]. The ethical consequences of digital innovations in livestock farming are expected to be significant, too, and they will comprise questions such as humane treatment of animals, preservation of biological diversity and potential displacement of the traditional agricultural practices.

In this context, the purpose of this study is to evaluate the current status of implementation of the digital technologies in animal farming in Bulgaria and EU and their relation with sustainable agricultural development.

MATERIALS AND METHODS

The research is based on scientific developments, related to precision digital technologies, both invasive, and non-invasive; biological and biometric sensors; and block-chain technologies, aiming at control of specific technological processes in the sphere of livestock farming, focusing on breeding of different cattle categories. General scientific research methods (including information-logical analysis of scientific and technical information) were used and applied. In order to implement complex analysis of the technological tendencies in cattle-breeding materials for market research and implementation of smart and precision technologies were applied. Descriptive and retrospective analyses were applied to consider the different aspects of application of digital technologies in cattle-breeding. For this purpose different data for the period 2016-2022 was considered and explored, which included information from Bulgarian, European and global cattle-breeding. Structured and systematized information is extracted mainly from publications, official scientific articles, reports and abstracts. The results of the analysis provide summarised concept for application of digital technologies in the veterinary practice and cattle-breeding. The technological tendencies, challenges and opportunities, as well as the market reaction were analysed in comparison with the global and the national tendencies in the respective period. Since the research is based on already published and accessible data additional ethical approvals were not required. All used sources are adequately cited in conformity with the requirements for ethical scientific practice.

Limitations of the research include limitation to the accessible information and time period. Nevertheless, the used methods allow trustworthy analysis of the existing tendencies and opportunities in the sphere of digital technologies in cattle-breeding. This methodology provides a frame for analysis of the questions, related to implementation of digital technologies in cattle-breeding, as well as objective and complex approach towards this dynamic sector of agricultural activity.

The main aim of this research is to examine the current condition of implementation of the digital technologies among the farmers and the agricultural producers-cattle breeders in Bulgaria and EU and their relation with sustainable agricultural development.

The research provides answers to the following **key questions**:

-What opportunities exist for using digitalization for increasing the efficiency and sustainability of breeding ruminants?

-Which are the main challenges which hinder the vast entry of digital technologies in this segment in the agrarian sector?

-What is the current level of implementation of digital technologies in the Bulgarian cattle-breeding?

To achieve these goals we used research approach with miscellaneous methods, including: quantitative researches for measurement of the degree of acceptance of digital technologies; quality interviews and observations on the spot for differentiation of the nuances in the challenges in front of farmers, as well as the perceived opportunities in the sector.

The article quotes abstracts of research works of Bulgarian and foreign authors. Summarizations and conclusions were done. Parts of the results are shown with the help of figures and tables.

RESULTS AND DISCUSSIONS

For the implementation of the set tasks we direct our attention towards the opportunities, which digitalization offers for increasing the efficiency and sustainability of breeding ruminants. Then we examine the main challenges of broad introduction of digital technologies in front of this segment in the agrarian sector. Finally, we analyse the current level of implementation of the digital technologies in the Bulgarian cattle-breeding.

Digital technologies in cattle-breeding

The digital technologies change the sector for cattle breeding by introducing revolutionary changes in the traditional methods of work. This transformation comprises numerous aspects - from health care of the animals to resource management and it is based on the following key technologies and innovations: RFID (radio frequency identification) tags; GPS technology; IoT (Internet of Things) sensors; Automatic milking systems; Precision livestock farming (PLF); Block-chain technology; Drones and analysis of data and farm management software (Figure 1).

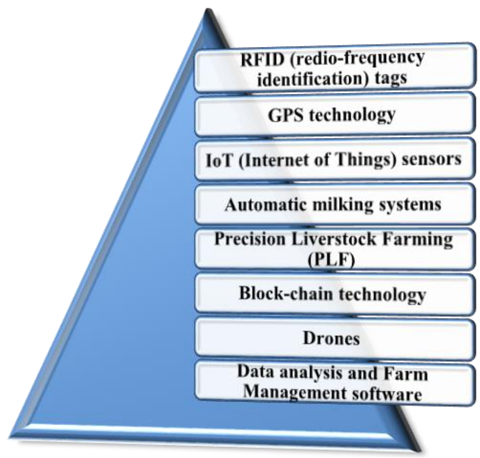

Fig. 1. Digital innovations in cattle-breeding
Source: the authors' conception.

RFID tags, attached to the cattle ears are devices, containing unique identification information. Biometric sensors successfully observe cattle water consumption. A research done by [27], using RFID tags and accelerometers, shows with 95% precision the correct classification of the cattle behaviour models during water consumption. The applications of RFID technology in cattle-breeding are diverse. It is mainly used for tracing different cattle categories, which allows the farmers to observe the location and the behaviour of the individual animals. Moreover, RFID tags facilitate health monitoring by allowing collection of data in real time for each animal. They are applied in the equipment and inventory management and contribute to the efficient arrangement of data related to cattle [26].

GPS technology

Application of the technology of the global positioning system (GPS) in the breeding and control of horned cattle is significant progress in animal-breeding science, providing new vision for the behaviour of the animals and their interaction with the environment. A research conducted by the Animal Research Centre of the University of Kentucky uses GPS for tracing of the location of the animals in different pasture zones, and in this way it improves the understanding of the behaviour of both domestic and wild animals in extensive pasture environment [6]. GPS tracking and detection of movement improve the option of conducting researches and to control herds in vast and cross pastures [4].

In addition to the observation and the welfare, the GPS technology further contributes to the efficiency of breeding programmes. By analysing the movement and interaction models of the cattle, the farmers can obtain information about the behaviour and the preferences of pairing in the herd. Such information is precious for optimization of the strategies for breeding for improvement of the genetic qualities and increasing of the productivity [20].

IoT (Internet of Things) sensors

The concept for Internet of Things as collection of innovative technologies is based on identified, interconnected devices (sensors, computer configurations, communication devices, etc.), capable of collecting data and storing it in the cloud of information, which is processed by smart algorithms. IoT helps the livestock breeders to observe different processes in agricultural holdings by means of sensors, capable of measuring the solar radiation, the atmospheric pressure, the physiological growth, the changes in the internal environment of the body, the temperature, etc., helping at the same time for obtaining of correct technological solutions [28].

Automatic milking systems

The automated systems for milking represent a significant change in the approach towards milk production. Introduced at the beginning of 90-s of the previous century, these systems made revolution in dairy industry by automation of the milking process, decreasing in this way the labour costs and increasing the efficiency of milking. The sensor technologies have the ability to provide certain autonomy by replacing some of the technological tasks, and this is observed mainly in the robotized systems for milking of cows. The robotized systems for milking use specific sensors, which record the behaviour of the cow during milking and feeding [16].

Precision Livestock Farming (PLF)

Precision Livestock Farming (PLF) includes integration of modern technologies such as sensors, robotics and data analysis for precise observation and management of cattle. This approach comprises different technological variants of cattle-breeding, including feeding, breeding and health management. Large set of data shall be applied, followed by error checks and quality control, to guarantee the quality of the technological process. Precision technologies become more and more popular in the dairy industry, because they apply remote monitoring of cows' health and allow timely pathogen response [14].

[22] examined the automated detection and recording of cows' vocalizations in the herd, with reported and analysed sensitivity in 87% of them and characteristic specificity in 94% of them, as a potentially important method for monitoring and analysis of proestrus and oestrus of individual animals. Feeding and energy balance are important for the efficient milk production by specialized milk breeds. The circulating levels of non-esterified fatty acids (NEFA) show negative energy balance and can be symptom of considerable risks for

health, which must be examined. Biosensors, monitored by NEFA, are in a process of development and have the potential to be extremely useful in dairy agricultural holdings [23].

Block-chain technology

The block-chain technologies present milk cattle-breeding as transparent, stable and predictable in the eyes of the client. They are a decentralized, preliminary encrypted transaction book, where every transaction creates a „node". The nodes are arranged in records, known as "blocks", and they are related to hemcodes and form a "chain". The block-chain technology has four basic characteristics – it is distributed, transparent, unchanging and democratic [21].

Data transfers in block-chain are implemented between machines and the data is automatically updated. In cattle-breeding this is done because every animal receives unique, individual identification. This identification number will remain valid for the animal during its whole life aiming at data collection in the farm or the holding, where it lives and was bred, it will register its transportation to the slaughterhouse, it will be used in the after-slaughterhouse examination, control of the meat products transport, reliability of the packing and characteristics of the retailer. Block-chain technologies are still at an early stage of their development. They present farmers and agricultural producers as transparent and responsible in front of the consumer for the way their products reach the market. Block-chain technology is particularly useful for observation of the food quality or use of antibiotics via the available scanning devices for creation of history of the animals [18].

Drones

Using drones for tracing the herds slowly gains popularity in different countries. Australia and Israel already use drones at a large extent for observation of the herds. The drones can be used for tracking and determining the number of the animals. They can fly fast around stables or over the pasture at any time and take pictures or video clips. These pictures can help easy detection or visualization of cattle, their number or any other activity in the farm [25]. For observation and tracking the drones can use built-in technology for thermal detection, which can find any animal using its body temperature. The drones provide clear thermal images, which easily differentiate between one animal and another. Flying is done at 90-270 feet over the herd. Such drones use pointing down stereo cameras for tracking of movement. They can be used to determine the location and orientation of the cattle [3].

Analysis of data and farm management software

Integration of analysis of data and farm management software in animal-breeding facilitate efficient agricultural operations, improve decision- making processes and contribute to sustainable agricultural practices. Software applications for farm management comprise an extensive set of instruments, intended to manage all aspects of the farm processes. They include record keeping, financial management, inventory management, cattle tracing and crops monitoring. They often provide opportunities for data collection, analysis and visualization, which allows the farmers to comprehend the models and the tendencies in their holding [19]. In the future, the farm management software will probably increase the integration of advanced technologies such as artificial intelligence (AI), machine training and Internet of Things (IoT). These technologies could allow automated and smart systems for decision making as further improvement of the efficiency and the sustainability of agricultural practices [15].

These technological innovations show us that the future of the livestock farming is in the sphere of smart and connected solutions, which optimize the production processes, improve the welfare of the animals and facilitate the management of agricultural holdings. With their help the livestock breeding sector can not only increase its productivity, but also develop in a way, which is sustainable and in harmony with the environment and the social requirements of the modern world.

Challenges in front of the digital cattle-breeding

While the digital technologies offer numerous advantages in cattle breeding, their acceptance and integration comes with different challenges. Some of these basic challenges include: Implementation costs, Literacy of the farmers; Lack of integration between the systems; Data management; Limited connectivity in the rural areas; Ethical considerations (Figure 2).

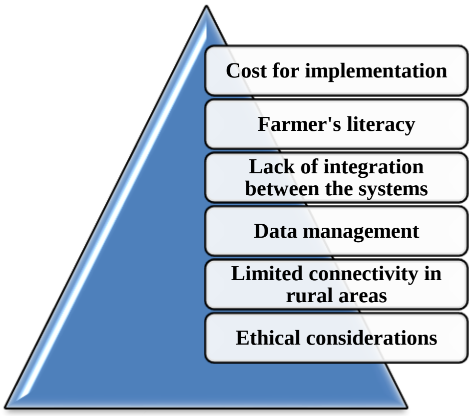

Fig. 2. Challenges in front of digital cattle-breeding
Source: the authors' conception.

Implementation costs

The implementation costs for digitalization in livestock farming are a multilateral question, which includes initial investment, current operating cost and potential long-term savings or rate of return. The integration of digital technologies, including RFID tags, IoT sensors and automated systems, represents a considerable barrier, due to the necessary considerable initial investment. This financial barrier is a challenge, especially for small farmers, who can encounter limitations, hindering their ability to accept these technologies efficiently [26].

Literacy of the farmers

The educational level among the farmers is one of the greatest challenges for application of the new technologies. The necessary knowledge include educational and technical abilities for management of the instruments. Training increases the ability of the farmers to process information and this way to take decisions, using technologies for smart agriculture [11]. The farmers in the developing countries are predominantly uneducated and unqualified, due to lack of desire to obtain knowledge or any other new technological cognition [13]. Quite often this is the reason for the farmers to prefer the traditional agriculture to smart agriculture [12]. Farmers must be digitally literate to increase the advantages of the technologies for smart agriculture and at the same time the agro-technological companies should guarantee that the farmers easily understand the limitations of the technology [10].

Lack of integration between the systems

The integration of systems in technologies for smart agriculture is a critical area, which requires additional refinement to efficiently comprise production, management and instruments for decision making. The state of affairs of the smart agriculture often demonstrates incoherent approach, in which the different systems diverge with one another, which results in inefficiency and not optimal data usage. One of the main challenges in this area is the lack of interoperability between the different technological systems. This results in a scenario, where the data, collected from different sources, cannot be efficiently consolidated or analysed in a uniform way, which in this way limits the opportunities for complete decision making [26]. For example – a system, collecting data for soil moisture, may not integrate in a problem-free way with another system, monitoring the meteorological models, despite the obvious correlation of these factors during taking of agricultural decisions. Moreover, the gap between agricultural and information sciences aggravates this problem. There is urgent necessity of increased communication and cooperation between academic circles and interdisciplinary groups for development of integrated solutions in livestock farming [1]. Such cooperation can lead to development of more holistic systems, which will efficiently combine agricultural knowledge with cutting-edge information technologies.

Data management

Farmers encounter problems with data organization and analyses, obtained from sensors. A major part of them does not know how to use the information and how to systemize data in a more accessible form. To a larger extent this is related to the lack of integration between the different systems, as well as the insufficient level of literacy. Agricultural producers, consultants, etc., participating in the production process, shall provide greater accessibility to data and information in order to improve the exchange of experience and knowledge among them. Such data type is beneficial for both the other farmers, and for the end users.

Limited connectivity in the rural areas

Many rural areas, where ruminant breeding predominates, may have limited access to high-speed internet and connectivity. This lack of infrastructure presents a challenge, especially for the digital technologies, relying on constant data transfer. Functionality in real time can be interrupted, which will affect the efficiency of certain technologies in these regions [26].

Ethical considerations

The main ethical problem in digitalization in livestock farming is the risk for increase of unemployment. Since machines and automated systems replace manual labour, this leads to decrease of the number of workplaces for agricultural employees. This change can lead to considerable social-economic challenges, especially in rural areas, where agriculture is the main employment source [7]. Introduction of advanced technologies, such as drones and sensors, creates ethical considerations, especially related to animal welfare and data privacy. Achieving balance between the technological progress and ethical considerations is crucial for the sustainable acceptance of digital innovations. Farmers shall orient themselves in the ethical dimensions of implementation of technologies, which directly affect the welfare of personnel and animals.

A balance between the technological progress and its social, economic and ethical consequences is of key importance for the sustainable development of the sector. Partnerships among farmers, technological companies, academic institutions and governments can play an important role in overcoming these challenges and encouragement of innovative and efficient solutions in the sphere of breeding ruminants.

Condition and perspectives of the digital environment in Bulgaria

Searching for opportunities for increasing the degree of sustainability in Bulgarian agriculture, respectively the rural areas, we analyse the place of Bulgaria in the European Union.

Bulgaria occupies the second to last place among the 27 EU Member States in the European Commission Digital Economy and Society Index (DESI) in 2022. Bulgaria’s DESI score grew at an annual average of 9% over the past five years, but this is not sufficient to catch up with the other EU Member States.

On digital skills Bulgaria remains significantly below the EU average, having a score of 32,6 versus the EU average of 45,7. In order to reach the EU target until 2030, the country needs to step up efforts, as more than two thirds of its population lack basic digital skills. Bulgaria also underperforms on the proportion of ICT specialists in comparison with the average indicator in the EU.

On Connectivity, Bulgaria score very well on Fibre to the premises coverage (85% of households), which significantly exceeds the average indicator in the EU of 50%. Despite the low prices, both fixed and mobile broadband take-up remains low.

On the business side, the adoption of digital technologies by small and medium enterprises remains almost half the EU average. Only 6% of Bulgarian firms use big data, 10% - cloud services and 3% - artificial intelligence (AI), which is considerably below the EU 2030 targets of 75% for each technology. To support business digitalisation, Bulgaria is making use of European Digital Innovation Hubs [9].

The components of the European Commission Digital Economy and Society Index (DESI) are: human capital, connectivity, integration of digital technology and digital public services (Figure 3).

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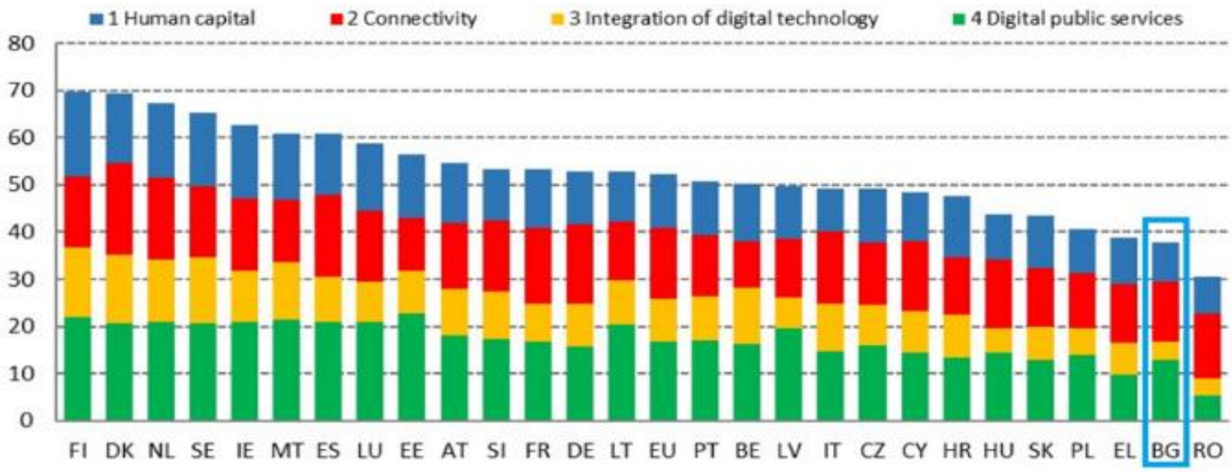

Fig. 3. Ranking according to the index for introduction of digital technology in the economy and the society (DESI) for 2022.
Source: DESI, report for Bulgaria 2022 [9].

Human capital

In the Human capital dimension, Bulgaria ranks 26th out of the 27 EU countries. Only 8% of individuals have above basic digital skills, which is considerably below the 26% EU average, and only 31% of the population have at least basic digital skills (versus the 54% EU average). Only 7% of enterprises provided ICT training to their staff in 2020, significantly below the EU average of 20%. However, Bulgaria scores well on female ICT specialists (representing 28% of all ICT specialists versus an EU average of 19%). Moreover, the proportion of ICT higher education graduates is also high in Bulgaria. (Table 1).

Table 1. Human capital 2020-2022

Human capital	Bulgaria			EU
	2020	2021	2022	2022
At least basic digital skills % individuals	No data	No data	31	54
Above basic digital skills % individuals	No data	No data	8	26
At least basic digital content creation skills % individuals	No data	No data	44	66
ICT specialists % individuals in employment aged 15-74	3.1	3.3	3.5	4.5
Female ICT specialists	28	28	28	19
Enterprises providing ICT training	10	7	7	20
ICT graduates	3.8	4.0	4.6	3.9

Source: DESI, report for Bulgaria 2022 [9].

The Bulgarian Recovery and Resilience Plan includes measures that are entirely or partially linked to digital skills. They have a total digital budget of about EUR 299 million. The measures mainly address challenges linked to education and digital skills training for adults.

Connectivity

In 2021, Bulgaria exceeded the average values of the EU concerning high speed next generation broadband access (93% against 90% in the EU) and the coverage of the fixed very high capacity networks (85% against 70% in the EU), using technology for fiber-optic lines to the buildings. Using this technology, coverage increased from 75% in 2020 to 85% in 2021, and it increased from 49% to 61% in the rural areas but Bulgaria remains significantly behind the EU in terms of distribution of the fixed broadband internet (63% of the households against 78% in the EU) and of the fixed broadband access with speeds at least 100 Mbps (22% against 41% in the EU). Distribution of broadband access with speeds of 1 Gbps is extremely low (0.42%).

Regarding the mobile broadband access, the parameters are also below the average level for the EU. Only 25% of the radio frequency spectrum for 5G is distributed (in comparison with 56% in the EU), and the 5G network coverage comprises 40% of the populated regions (against 66% in the EU). Using mobile broadband internet on the part of the population is 73%, in comparison with 87% in the EU. Despite the low level of distribution of the fixed and the mobile internet, prices of broadband internet access in Bulgaria are relatively low, and the country is ranked 5th in the index of prices of broadband access (Table 2).

Table 2. Connectivity 2020-2022

Connectivity	Bulgaria			EU
	2020	2021	2022	2022
Overall supply of the fixed broadband internet access-% households	58	59	63	78
Supply of the fixed broadband internet access with speed at least 100 Mbps-% households	11	15	22	41
Supply of internet with speed at least1 Gbps-% households	0,26	0,27	0,42	7,58
Next generation high-speed broadband access coverage -% households	84	88	93	90
Coverage of fixed very high capacity networks (VHCN)- % households	65	75	85	70
Fiber-optic lines to the buildings coverage -% households	65	75	85	50
Radio frequency spectrum for 5G - supplied spectrum as % of the total harmonised radio frequency spectrum for 5G	0	25	25	56
5G network coverage -% populated places	No data	0	40	66
Supply of mobile broadband internet access-% people	60	60	73	87
Index for the price of the broadband internet access-Result (0—100)	72	78	86	73

Source: DESI, report for Bulgaria 2022 [9].

Bulgaria's Recovery and Resilience Plan includes considerable measures concerning the digital connectivity.

The total budget in this area amounts to around 272 million Euro.

The measures are oriented mainly towards the challenges, related to the efficacious use of radio frequency spectrum and efficient political and regulatory frame [9].

Implementation of digital technologies

Integration of digital technologies in the business processes continues to be a problem for Bulgaria, which is ranked 26th of the EU Member States.

Use of cloud services (10%), artificial intelligence (3%) and big data (6%) on the part of the businesses in Bulgaria is one of the lowest in the EU. Only 25% of the small and medium enterprises (SME) have basic level of digital intensity, and they also lag behind in the online sales, where merely 10% of the SME carry out online sales – around half of the average for the EU (Table 3).

The plan includes a number of measures, which purpose is to help the enterprises in adapting their work to the digital environment, and some of these measures are improvement of the quality of the scientific researches and the innovations, investments for implementation of the modern technologies, like for example, creation of quantum platform (0.5 million Euro).

Digital public services

Bulgaria's indicators in the sphere of the digital public services are low as it ranks 25th in the EU. Barely 34% of the internet users use the electronic services of the government.

The country scored 58 points out of 100 possible for the amount of data, filled-in automatically online in the public service forms, which is below the average indicator for the EU of 64 points. Regarding the access to the digital public services for citizens, Bulgaria has a result of 59 points, while for the enterprises - 76 points, and both are below the average level for the EU. Use of open data in Bulgaria is also slightly below the EU average (Table 4).

Table 3. Implementation of the digital technologies 2020-2022

Implementation of digital technologies	Bulgaria			EU
	2020	2021	2022	2022
SME with at least basic level of digital intensity-% SME	No data	No data	25	55
Electronic data sharing -% enterprises-% enterprises	23	23	22	38
Social media -% enterprises	10	10	13	29
Big data-% enterprises	7	6	6	14
Computer services in the cloud-% enterprises	No data	No data	10	34
Artificial intelligence-% enterprises	No data	No data	3	8
ICT for ecological sustainability-% enterprises with average/high intensity of ecological measures using ICT	No data	68	68	66
Electronic invoices-% enterprises	13	10	10	32
SME, doing online sales -% SME	7	8	10	18
Turnover from e-commerce-% turnover SME	2	3	4	12
Trans-border sales online-% SME	3	3	4	9

Source: DESI, report for Bulgaria 2022 [9].

Table 4. Digital public services

Digital public services	Bulgaria			EU
	2020	2021	2022	2022
Users of services of the electronic government -% internet users	36	36	34	65
Pre-filling of forms - Result (from 0 to 100)	No data	No data	58	64
Digital public services for citizens- Result (from 0 to 100)	No data	No data	59	75
Digital public services for enterprises- Result (from 0 to 100)	No data	No data	76	82
Open data % of the maximum result	No data	No data	78	81

Source: DESI, report for Bulgaria 2022 [9].

Bulgaria's Recovery and Resilience Plan includes measures, related to the electronic management and the digital public services. The total budget in this area amounts to around 985 million Euro. The measures are oriented towards the digitalization of the public administration, as well as of the forms in the judicial sphere and of the court orders. Furthermore, improvement of the electronic health care and of the digital innovations in the health care are supported [9].

Smart livestock farming in Bulgaria

Smart Livestock Farming Programme provides for creation of innovative methods and instruments for smart and efficient development of the livestock farming with reduced human resources and reduced impact upon the environment. Research workers and livestock breeders will have an easy and controlled online access to instruments, resources and cooperation related to high performance computation information and communication technologies. They will be able to connect and to store data, as well as have access to virtual, research work eco-systems and customers' networks [24]. **International factors,** pre-conditioning the development of digitalization in cattle-breeding are:

-Pan-European network of centres for digital services;

-EU strategy of the for building up of European market;

-EC's proposal for digitalization in different spheres.

The Smart Livestock Farming Programme in Bulgaria needs to develop scientific methodology, systems and instruments for modelling of the main processes in the livestock farming, and namely: breeding, feeding, milking and cleaning in the livestock farming, monitoring of the physiological condition of the animals, effect of the climate, environment, etc. Another important goal of the Programme is to develop a „methodology for the genetics and reproduction in the livestock farming".

The Programme includes a total of 12 basic panels: Robotized milking systems; Robotized systems for animals and agricultural holdings; Smart systems for genetic progress; Smart systems for monitoring and analysis of productivity of pastures and meadows; Cyber-physical systems for monitoring; Cyber-physical systems for smart management of livestock breeding complexes; Unmanned aerial vehicles; Service robots and drones for storage and/or delivery of ready products;

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Stock management; ICT technologies in the financial, economic and accounting activities; Digital teaching technologies, working with young talents and special target groups; Smart waste management as part of the circular economy (Figure 4).

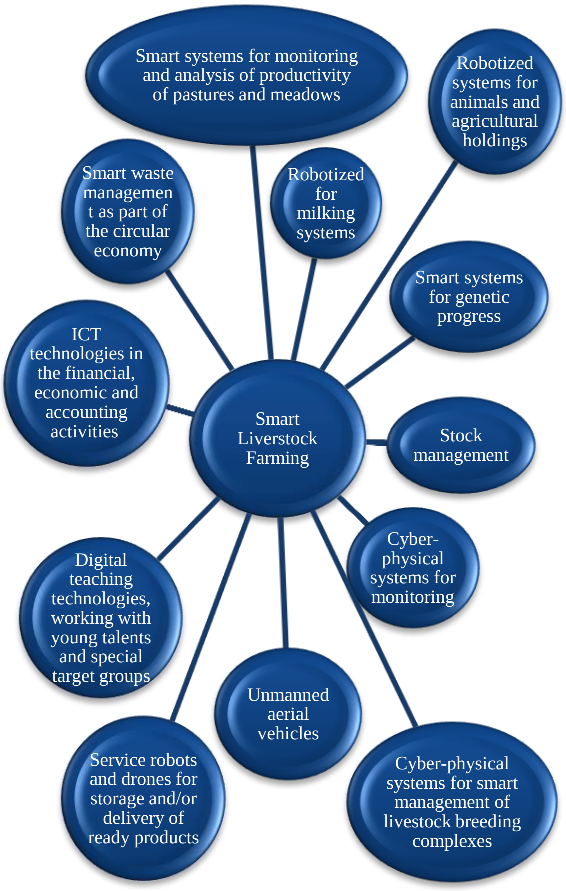

Fig. 4. Smart livestock farming
Source: Vasileva, 2022.

The National Strategic Plan for Agriculture and Rural Development 2023-2027 aims at encouraging the sharing of knowledge and innovations. To further expand the Agriculture Knowledge and Innovation Systems (AKIS) a coordination body will be created on a national level. Information seminars will be organised in order to introduce the farmers to the opportunities provided by the CAP Strategic Plan. The plan supports activities, related to education and training of farmers, through sharing of knowledge, training and provision of consultancy services. 290,000 people are expected to make use of this. Increasing the broadband internet is also provided for in this plan.

Based on data from the agrostatistics in 2016, in Bulgaria we had 98,033 agricultural holdings and farms, but in 2022, they were reduced to 71,947, or the reduction amounts to 28,086agricultural holdings for the period of 6 y ears. These agricultural holdings and farms till a total of 3 million and 959 thousands of hectares of land of the territory of our country [2].

According to a Bulgarian scientist, the farmers, agricultural producers and managers of large livestock breeding structures in Bulgaria fear mainly of the cost they are to incur for the implementation of digital technologies. On the basis of an inquiry in Bulgaria it was found that there are farms and agricultural holdings, which use and flexibly apply the digital technologies. They are around 14-16% of all holdings and they implemented mainly GPS navigation systems. A small number of municipalities in Bulgaria developed strategies for implementation and deployment of digital technologies. This process continues although with some delays. Our country is ranks last but one together with Greece for 2021 in the Integral Digital Economy and Society Index -DESI. Only Romania is ranked after us [17].

The Smart Livestock Farming Programme is a pioneering approach to the modernisation of the livestock breeding sector, and it focuses on the implementation of innovative technologies and methods for efficient management of resource, reduction of the influence on the environment and optimization of the production process with reduced use of human resources. To speed up this process of digitalization and to guarantee its successful implementation, national specifics and institutional environment are to be taken into consideration and appropriate strategies must be developed on a local level. In this context, the efforts of the EU and the national bodies for elaboration and application of strategies for digitalization and innovations in the rural areas are of crucial importance for the future of the smart livestock farming in Bulgaria and Europe.

CONCLUSIONS

Cattle-breeding in Bulgaria is the main sub-sector of the livestock farming for introduction of technological novelties and applications. These technologies facilitate the precision livestock farming, and allow real time monitoring of health and behaviour, improve the management of the resources and the overall management of the farm. The digital innovations contribute also to the sustainability of the environment through optimization of the resource use and reduction of greenhouse gas emissions.

Adoption of digital technologies is faced before considerable challenges, including high implementation cost, lack of literacy of the farmers, problems with the integration between different systems and complex data management. These barriers are particularly well manifested in the developing regions, where financial and infrastructural limitations exist.

Position of Bulgaria in the European Digital Economy and Society Index (DESI) shows the need of improved digital skills and ICT infrastructure, which will bring it in line with the standards of the EU. The country faces challenges when achieving the goals of the EU for digital transition among the SME and the population, as a whole. Overcoming these challenges requires coordinated efforts, including financial investments, educational initiatives and cooperation between sectors. This approach will contribute to the guarantee that the benefits of digitalization in livestock farming will be implemented in a sustainable and fair way. Findings reveal a promising future for the digital innovations in the livestock farming, with an emphasis on the smart, connected solutions, which optimize the production processes, improve the animal welfare and are brought in conformity with the ecological and social requirements of the modern world.

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PROFITABILITY OF SUNFLOWER CULTURE ON A CAMBIC CHERNOZEM IN WESTERN ROMANIA

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Abstract

The aim of this study consists in the optimization of some technological links of major importance for the sunflower culture to develop some technological recommendations, which allow obtaining high and efficient productions. The research was carried out over a period of 3 years, on a cambic chernozem. The methods refer to the effect of some technological factors on sunflower production and some of its morphological components in the pedoclimatic conditions of the outskirts of Timișoara, Romania. The effects of some technological factors on production were studied and analysed, obtaining useful information to optimize the technology of some hybrids in soil and climate conditions like those in Timișoara. Results showed that the 59,524 g.g./ha variant ($N_{50}P_{50}K_{50}$, scarification+ploughing) produced the most – 2,612 kg/ha in 2022 and 3,417 kg/ha in 2020. Also, the $N_{50}P_{50}$K50 variant at 24 cm per row ranked in the best 5 variants, recording productions of 2,507-3,145 kg/ha. The analysis of the economic efficiency of the production in different technological variants allows an adequate management of the costs to maximize the profit in accordance with market requirements. The researches related to this study fall under the concerns of obtaining useful information that will allow the achievement of superior, high-quality, and sustainable productions under the conditions of current climate changes.

Key words: *economic efficiency, cambic chernozem, density, fertilization, sunflower culture*

INTRODUCTION

Sunflower, originally from North America, is widespread in culture due to its adaptability to different soil and climate conditions. Sunflower seeds are an important source of nutrients, minerals, antioxidants, and vitamins, showing anti-oxidant, anti-microbial, anti-diabetic, anti-inflammatory, and wound healing effects [11, 16, 20, 22, 28, 29, 31].

Sunflower is also an important honey plant in the northern hemisphere [6], providing bees with both nectar and pollen [26]. In the climate conditions of Romania, in favourable years, even 100 kg of honey/ha can be produced. The reproductive system based on self-incompatibility and pollen structure prevents anemophilic pollination in sunflower. In the absence of pollinators, the percentage of seed formation is only 10-20% while, under the effect of pollination by insects, it increases up to 90%, producing high yields of seeds and oil [7, 30, 33, 36].

The sunflower inflorescence has a special aesthetic and ornamental value, presenting various sizes and colours, and there are numerous cultivars for this purpose [1].

Sunflower has a high allelopathic potential inhibiting the growth of many weed species [2, 15, 34]. The phytotoxic activity on weeds is due to some compounds called helianols – A, D, and E [16]. It also has a high phytoremediation potential, being one of the most studied plants in this sense [12; 20; 25; 27]. Numerous studies have shown that sunflower can contain, degrade, or eliminate heavy metals [3, 13, 14], polycyclic aromatic hydrocarbons [10], and polychlorinated biphenyls [9] from soil and water. Studies have shown that heavy metals such as lead, copper, zinc, cadmium, and cobalt accumulate in high concentrations both in stems and roots, while in seeds the accumulation is much lower. As such, it can be used effectively and simultaneously for the phytoremediation of contaminated soils and as a renewable source of energy [17, 18, 20, 22, 32, 35].

Sunflower is considered a drought tolerant species and, as such, an opportunity for cultivation in regions where soil water resources are limited [10, 19, 21, 36, 38]. Due to temperature requirements, sunflower cultivation is currently limited to southern Europe and in parts of central and eastern Europe. In the conditions of the global temperature increase, the expansion of the culture towards the northern areas is also probable [23, 37]. Currently, it is extended in culture up to 62°N, in areas with a favourable climate in southern Finland; but, in the future, because of climate change, some very early hybrids could be cultivated up to 65°N [22, 23, 24].

With the current climate changes and their maintenance, it is estimated that, in 2030, the production of sunflower in Eastern European countries such as Romania, Hungary, and Bulgaria will decrease by 10-30% because of the increase in temperature, evapotranspiration, and the decreasing level of precipitations [5, 8, 34]. Sunflower is a much more environmentally friendly crop [5, 6], considering the greenhouse gas emissions which are 900 kg CO_2/ha, compared to rapeseed (2,700 kg CO_2/ha), wheat (2,800 kg CO_2/ha), maize (3,300 kg CO_2/ha), sugar beet (2,700 kg CO_2/ha).

The production per plant can be increased through selection of the cultivated genotypes or through technological measures that increase the height of the plants, the diameter of the calathidium, and the number of seeds, considering the high heritability of these production components [5, 39]. The production is affected by various foliar, stem, or calathidium diseases, which can reduce the harvest level by 20-50%. The greatest losses occur when infections occur before flowering [18] while, on the background of a late sowing, the infections are moderate [19].

In this context, the aim of this research is the optimization of some technological aspects in sunflower culture in order to establish some technological recommendations, which could result in high and efficient productions.

MATERIALS AND METHODS

A series of information from literature is systematized regarding the nutritional and therapeutic value of sunflower culture, respectively the effect of ecological and technological factors on production.

The particularities of the sunflower culture in the current context of climate change are also analysed.

The production potential of the NK Neoma hybrids was realized based on a trifactorial experiment of the 4 x 3 x 3 type, organized in three repetitions, with plots of 42 m^2 with six rows of 10 m, with density as the primary factor, with fertilization as the secondary factor, and with soil works as the tertiary factor.

Table 1. Characteristics of the trifactorial experiment

D. Density	F. Fertilisation	T. Soil Works
D_1 – 49.261g.g./ha, 70x29 cm D_2 – 53.908g.g./ha, 70x26.5 cm D_3 – 59.524g.g./ha, 70x24 cm D_4 – 66.756g.g./ha, 70x21.4 cm	F_1 – $N_0P_0K_0$ F_2 – $N_{50}P_{50}K_0$ F_3 – $N_{50}P_{50}K_{50}$	T_1 – Ploughing T_2 – Scarification T_3 – Scarification+Ploughing

Source: Own experiment.

The research took place in Timișoara during 2020-2022, on a moderately glazed, weakly decarbonated, loam-clayey cambic chernozem.

The soil has the following physico-chemical properties: humus 2.97%; nitrogen index 2.98; phosphorus 51 ppm; potassium 148 ppm; total porosity 53.55%; and aeration porosity 21.84%.

On each plot (replica), 10 plants were chosen and the following measurements were made: calathidium diameter (cm); the number of seeds in the calathidium; and the weight of the seeds in the calathidium (g). Based on the values obtained, descriptive statistical indices related to the different technological factors were calculated: arithmetic mean, error of the mean, and coefficient of variation.

To determine the significance of the differences between the different combinations of technological factors, the data were processed statistically, through variance analysis and the t-test for bifactorial analyses organized in subdivided plots. The presentation of the meaning of the differences was done both by symbols (*; ^{0}) and by letters, considering the differences between the variants associated with different letters to be significant [4, 38].

The evaluation of the production and some of its morphological components in different technological variants was carried out by means of some parameters according to the linear regression analysis according to the Eberhart-Russell mathematical model [7]:

$$F_{ij} = \mu + g_i + b_i t_j + \delta_{ij} + e_{ij} \text{......................(1)}$$

where:

F_{ij} – average of variant *i* in year j; μ – general average: g_i – the effect of variants *i*; t_j – the effect (index) of year *j*; b_i – linear regression coefficient between F_{ij} and t_j; δ_{ij} – F_{ij} deviations from the regression line; e_{ijk} – the error associated with variant *i* in year *j*.

- The regression coefficient b_i which indicates the value by which the average of a technological variant changes when the average of a certain year increases or decreases by one unit. For option *i* the regression coefficient is:

$$b_i = \sum F_{ij} t_j / \sum t_j^2 \text{ ....(2)}$$

- Variance of regression deviations:

$$s_\delta^2 = \frac{1}{n-2}\left[\left(\sum F_{ij}^2 - \frac{\left(\sum F_{ij}\right)^2}{n}\right) - \frac{\left(\sum F_{ij} t_j\right)^2}{\sum t_j^2}\right] - \frac{\sigma_E^2}{r}$$

....(3)

where:

n – number of years; *r* – number of repetitions; σ_E^2 - error variance.

RESULTS AND DISCUSSIONS

Influence of some technological links on sunflower production in 2020

The technological links were established according to the type of soil, considering its texture. In this way, the three methods of tillage were established, respectively: ploughing, Scarification and Scarification + ploughing.

In 2020, as regards the combined effect of the three technological links (Table 2), it was found that only in the case of the density of 59,524 g.g./ha, soil works had a significant influence on production while, at the density of 49,261 g.g./ha, the effect was considerably lower. On the background of the density of 49,261 g.g./ha, it can be observed that fertilization with $N_{50}P_{50}K_0$ determined significant increases in production between 574 kg in the case of land preparation by Scarification and ploughing, respectively 983 kg/ha in the case of unilateral application of Scarification. Also, the $N_{50}P_{50}K_{50}$ variant had an important and significant effect on production, related to increases from 574 kg/ha for the association of Scarification with ploughing, up to 834 kg for the use of Scarification. Additional fertilization with potassium had small and insignificant effects on production.

Table 2. Influence of some technological links on sunflower production in 2020 (Density, in germinating grains/ha)

Density 49,261 g,g,/ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	1,714 b	1,615 b	1,816 b
$N_{50}P_{50}K_0$	2,476 a	2,598 a	2,390 a
$N_{50}P_{50}K_{50}$	2,393 a	2,449 a	2,420 a
Density 53,908 g,g,/ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	1,903 b	1,687 b	1,965 b
$N_{50}P_{50}K_0$	2,593 a	2,659 a	2,620 a
$N_{50}P_{50}K_{50}$	2,612 a	2,609 a	2,736 a
Density 59,524 g,g,/ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 2,228 b	xy 1,990 b	y 1,853 b
$N_{50}P_{50}K_0$	x 3,067 a	x 2,972 a	x 3,215 a
$N_{50}P_{50}K_{50}$	xy 3,145 a	y 3,012 a	x 3,417 a
Density 66,756 g,g,/ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	2,332 b	2,058 b	2,148 b
$N_{50}P_{50}K_0$	3,008 a	3,077 a	3,163 a
$N_{50}P_{50}K_{50}$	3,107 a	3,104 a	2,996 a

$DL_{5\%}$ =277 kg/ha $DL_{1\%}$=368 kg/ha $DL_{0.1\%}$=428 kg/ha (a.b). Soil works - $DL_{5\%}$=280 kg/ha $DL_{1\%}$=374 kg/ha $DL_{0.1\%}$=488 kg/ha (x. y). $DL_{5\%}$=290 kg/ha $DL_{1\%}$=385 kg/ha $DL_{0.1\%}$=500 kg/ha

Source: Own calculation.

In the case of a density of 53,908 g.g./ha, regardless of the method of soil preparation, fertilization with nitrogen and phosphorus allowed obtaining significant increases in production, between 655 and 972 kg/ha. Against the background of NPK fertilization, production increases were 709-922 kg compared to the unfertilized version, associated with small and insignificant variations compared to NP-based fertilization.

At a density of 59,524 g.g./ha, on non-fertilized agricultural land, the preparation of the soil by ploughing allowed a significant increase in production by 375 kg/ha, while the $N_{50}P_{50}K_{50}$ variant, along with the combined application of ploughing and scarification, resulted in obtaining a significant increase in production of 405 kg compared to simple scarification. Regardless of the land preparation method, fertilization had a significant effect on production, associated with increases between 839-917 kg/ha in the case of ploughed soil and, respectively, 1,362-1,564 kg/ha for the combined option of scarification and ploughing.

At a density of 66,756 g.g./ha and fertilization with $N_{50}P_{50}K_0$, significant increases in production were obtained between 676 kg/ha in the case of land preparation by ploughing and, respectively, 1,015-1,019 kg/ha in the case of the other soil works. Also, the $N_{50}P_{50}K_{50}$ variant had an important and significant effect on production, from 775 kg/ha when ploughing, up to 1,046 kg/ha for combining scarification with ploughing. Meanwhile, additional fertilization with potassium had low and insignificant effects on production.

Influence of some technological links on sunflower production in 2021

In the year 2021, as seen from the data presented in Table 3, plant density, fertilization, and tillage had a real, distinctly significant influence on sunflower production, given the homogeneity of environmental conditions at the level of experience.

Fertilization resulted in a significantly higher increase of the production (77.69%), compared to the influence registered by density (4.30%) and, respectively, by soil works (3.34%). Likewise, single, or double interactions between the factors showed significant influences on production, with close, but considerably smaller, contributions than their separate effects.

Table 3. The influence of the variant on some technological links in the sunflower crop in 2021

Variation source	SP	GL	S^2	F test
Total	1,870,2297	107		
Replicas	50,198	2	25,099	0.98
Density	888,530	3	296,177	11.53**
Density error	154,064	6	25,677	
Fertilisation	13,445,581	2	6,722,791	208.59**
Density x Fertilisation	678,656	6	113,109	3.51*
Fertilisation error	515,673	16	32,230	
Soil work	412,380	2	206,190	8.96**
Density x Soil work	493,710	6	82,285	3.58**
Fertilisation x Soil work	365,596	4	91,399	3.97**
Density x Fertilisation x Soil work	593,231	12	49,436	2.15*
Work error	1,104,678	48	23,014	

Source: Own calculation.

Production results at the level of experience were influenced, to a degree of about 9.76%, by other sources of variation, uncontrollable by the experimental device.

Average production values under the effect of different densities (Table 4) show an amplitude of 232 kg, with limits from 2,016 kg/ha for a density of 49,261 g.g./ha to 2,248 kg/ha for the density of 66.756 g.g./ ha, against the background of low variability (4.95%). Changing the crop density by reducing the area of a plant from 0.203 to 0.186 m^2 determined a significant increase in production of 6.60% equivalent to 133 kg/ha; in exchange, the intensification of the crop by reducing the distance between plants from 29 to 24 cm had a high efficiency being associated with an increase in production of 11.51%.

Increasing the crop density by reducing the distance between plants from 24 to 21.4 cm had a negative effect on production, causing a significant decrease of 198 kg/ha.

Table 4. Effect of density on sunflower production in 2021

53,908 – 49,261	2,149	2,016	106.60	133*
59,524 – 49,261	2,248	2,016	111.51	232**
66,756 – 49,261	2,050	2,016	101.69	34
59,524 – 53,908	2,248	2,149	104.61	99
66,756 – 53,908	2,050	2,149	95.39	-99
66,756 – 59,524	2,050	2,248	91.19	-198^{00}

Source: Own calculation.

Considering the cumulative effect of fertilization (Table 5), average production values were found with limits from 1,653

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Vol. 24, Issue 2, 2024
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kg/ha in the unfertilized variant to 2,508 kg/ha in the case of the $N_{50}P_{50}K_{50}$ variant.

Table 5. Effect of fertilization on sunflower production in 2021

Fertilisation	Means (kg/ha)		Relative values (%)	Difference/Significance
$N_{50}P_{50}K_0 - N_0P_0K_0$	2,186	1,653	132.24	533***
$N_{50}P_{50}K_{50} - N_0P_0K_0$	2,508	1,653	151.72	855***
$N_{50}P_{50}K_{50} - N_{50}P_{50}K_0$	2,508	2,186	114.73	322***

$DL_{5\%}$=90 kg/ha $DL_{1\%}$=124 kg/ha $DL_{0.1\%}$=170 kg/ha
Source: Own calculation.

In general, fertilization with nitrogen and phosphorus determined a very significant increase in production by 533 kg/ha, equivalent to an increase of about 32%. Also, NPK-based fertilization positively influenced production, generating an increase of about 52%, respectively, 855 kg/ha. Additional fertilization with potassium allowed an increase in production of about 15%, equivalent to 322 kg/ha.

Regarding the unilateral effect of tillage (Table 6), the production in 2021 showed an amplitude of variation of 150 kg/ha, with average values between 2,047 kg/ha in the case of ploughing and 2,197 kg/ha in the case of scarification, under the conditions of a reduced variability of 3.58% between the three basic works.

Table 6. Effect of tillage on sunflower yield in 2021

Soil work	Means (kg/ha)		Relative values (%)	Difference/ Significance
Scarification – Ploughing	2,197	2,047	107.33	150***
(Scarification+ Ploughing) – Ploughing	2,104	2,047	102.78	57
(Scarification+ Ploughing) – Scarification	2,104	2,197	95.77	-93^0

$DL_{5\%}$=72 kg/ha $DL_{1\%}$=96 kg/ha $DL_{0.1\%}$=125 kg/ha
Source: Own calculation.

Overall, in 2021 (Table 6), based on the use of scarification, a very significantly higher production was recorded compared to ploughing, associated with an increase of 7.33%. Against the background of the reduced level of water in the soil in the spring of 2021, the combination of scarification and ploughing had a negative effect on production causing a significant reduction of about 4.3%.

Regarding the interaction between densities and fertilizations (Table 7), it was found that, on unfertilized agricultural land, the increase in crop density from 49,261 to 53,908 g.g./ha had a small and insignificant effect on production, but by changing the density from 53,908 to 59,524 g.g./ha, there was a significant increase in production of 237 kg/ha. Later, the increase in the thickness to the level of 66,756 g.g./ha was associated with a reduction in production by 150 kg/ha.

Table 7. Effect of density and fertilization on sunflower production in 2021

(g.g./ha)	Fertilisation				
	$N_0P_0K_0$	$N_{50}P_{50}K_0$	$N_{50}P_{50}K_{50}$	$\bar{x} \pm s_{\bar{x}}$	$S_{\%}$
49,261	x 1,561 b	y 2,111 ab	x 2,375 b	2,016±71	18.26
53,908	z 1,575 b	y 2,264 a	x 2,608 a	2,149±88	21.28
59,524	z 1,812 a	y 2,285 a	x 2,647 a	2,248±72	16.59
66,756	z 1,662 ab	y 2,085 b	x 2,403 b	2,050±65	16.44
$\bar{x} \pm s_{\bar{x}}$	1,653±27	2,186±28	2,508±30	2,116±38	
$S_{\%}$	9.85	7.47	7.10	18.51	

Densities - $DL_{5\%}$=179 kg/ha $DL_{1\%}$=247 kg/ha $DL_{0.1\%}$=340 kg/ha (a,b). Fertilisations - $DL_{5\%}$=170 kg/ha $DL_{1\%}$=230 kg/ha $DL_{0.1\%}$=310 kg/ha (x, y, z)
Source: Own calculation.

Under the effect of fertilization with $N_{50}P_{50}K_0$, a variation in yields is observed from 2,085 kg/ha for the density of 66,756 g.g./ha to 2,285 kg/ha for the density of 58,524 g.g./ha. For this agrofund, the use of plant nutrition areas of 0.168-0.186 m^2 allowed significant increases in production compared to the density related to an individual area of 0.15 m^2.

With $N_{50}P_{50}K_{50}$ application, the production recorded an amplitude of 272 kg, with the limits between 2,375 at the density of 49,261 g.g./ha and, respectively, 2,647 for the density of 59,524 g.g./ha. And, in the case of this agricultural fund, it was found that the use of densities related to distances between plants in a row of 26.5 and 24 cm showed high efficiency, materialized by significant increases in production of 8.5-11.5% compared to densities related to some spaces between plants of 21.4 and 29 cm.

Fertilization showed a lower effect on the production of plants grown at densities of 49,261 g.g./ha, where fertilization with NP and, respectively, NPK generated increases in production of 35-52% compared to the control variant, when the additional fertilization with potassium allowed a 12.5% increase in production. And, in the case of other densities, a significant increase in production is observed due to fertilization with nitrogen + phosphorus or nitrogen + phosphorus + potassium, associated with increases between 26.10-46.08% for the density of 59,524

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Vol. 24, Issue 2, 2024
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g.g./ha and 43.74-65.58% for the one of 53,908 g.g./ha. Also, for the three densities, a significant effect of additional fertilization with potassium can be found, realized through increases of 318-344 kg/ha.

Table 8. Effect of density and tillage on sunflower production in 2021

Density (g.g./ha)	Soil work				
	Ploughing	**Scarification**	**Scarification+ Ploughing**	$\overline{x} \pm s_{\overline{x}}$	S%
49261	y 1,896 b	x 2,121 b	xy 2,030 bc	2,016±71	18.26
53908	x 2,108 a	x 2,190 ab	x 2,148 ab	2,149±88	21.28
59524	y 2,154 a	x 2,304 a	xy 2,286 a	2,248±72	16.59
66756	xy 2,029 ab	x 2,171 ab	y 1,951 c	2,050±65	16.44
$\overline{x} \pm s_{\overline{x}}$	2,047±58	2,197±+64	2,104±73	2,116±38	
S%	17.01	17.36	20.76	18.51	

Densities - $DL_{5\%}$=148 kg/ha $DL_{1\%}$=199 kg/ha $DL_{0.1\%}$=263 kg/ha (a,b,c). Soil works - $DL_{5\%}$=144 kg/ha $DL_{1\%}$=1926 kg/ha $DL_{0.1\%}$=251 kg/ha (x, y)
Source: Own calculation.

Regarding the effect of the interaction between densities and tillage on production (Table 8), it follows that, in the variant where it was ploughed, increasing the crop density by reducing the distance between plants from 29 to 26.5 and 24 cm, respectively, was associated with significant increases of production between 11.18 and 13.61%. Subsequently, reducing the distance between plants from 24 to 21.4 cm determined a small and insignificant variation in production by 6%.

When using scarification, a progressive increase in production was noted against the background of the increase in crop density from 49,261 to 59,524 g.g./ha, associated with a significant increase of 8.62%. The reduction of plant nutrition area from 0.168 to 0.15 m^2 determined an insignificant decrease in production by about 133 kg/ha.

The plants cultivated at the density of 59,524 g.g./ha more efficiently capitalized on the agrofund represented by the association of scarification with ploughing, registering significant increases in production between 12.61% compared to the density of 49,261 g.g./ha and 17.17% compared to the density of 66,756 g.g./ha ha. At the same time, against the background of these basic soil works, it was observed that changing the distance between plants in a row from 21.4 to 26.5 cm allowed a significant increase in production by 10.1%.

Tillage had a low and insignificant effect on the production of plants grown at the density of 53,908 g.g./ha and, respectively, a significantly higher effect on the productivity of plants grown at the density of 49,261 g.g./ha. The plants grown at distances of 29 and 24 cm more effectively capitalized on the arable land prepared by scarification, achieving significant increases in production of 6.97-11.87% compared to the plants grown on the arable land prepared by ploughing. In the case of the plot of 66,756 g.g./ha, against the background of a lower reserve of water in the soil, it was found that the preparation of the land by scarification favoured a significant increase in production by 11.27% compared to the use of scarification in association with ploughing.

Table 9. Effect of fertilization and tillage on sunflower yield in 2021

Fertilisation	Soil work				
	Ploughing	**Scarification**	**Scarification+ Ploughing**	$\overline{x} \pm s_{\overline{x}}$	S%
$N_0P_0K_0$	x 1,641 c	x 1,714 c	x 1,603 c	1,653±27	9.85
$N_{50}P_{50}K_0$	y 2,102 b	x 2,308 b	y 2,149 b	2,186±28	7.47
$N_{50}P_{50}K_{50}$	y 2,397 a	x 2,568 a	x 2,560 a	2,508±30	7.10
$\overline{x} \pm s_{\overline{x}}$	2,047±58	2,197±+64	2,104±73	2,116±38	
S%	17.01	17.36	20.76	18.51	

Fertilisations - $DL_{5\%}$=132 kg/ha $DL_{1\%}$=176 kg/ha $DL_{0.1\%}$=229kg/ha (a,b,c). Soil works - $DL_{5\%}$=125 kg/ha $DL_{1\%}$=166 kg/ha $DL_{0.1\%}$=217 kg/ha (x, y)
Source: Own calculation.

Considering the combined effect of fertilization and tillage on production in 2021 (Table 9) in the case of the unfertilized agrofund, basic tillage had the lowest influence on the level of production, against the background of small and insignificant variations. Thus, in the case of the treatment with $N_{50}P_{50}K_0$, it can be observed that scarification showed a significantly superior effect, against the background of production increases of 7.39-9.80% compared to the other two basic soil works. Land preparation by applying simple scarification or in combination with ploughing favoured a more efficient utilization of $N_{50}P_{50}K_{50}$ fertilization, materialized by significant increases in production of about 6.8%.

Regardless of the basic soil works, fertilization showed a significant effect on production producing increases of 28.09-34.65% for the $N_{50}P_{50}K_0$ variant and 46.07-

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59.70%, respectively, for $N_{50}P_{50}K_{50}$. Against the background of fertilization with nitrogen and phosphorus, additional fertilization with potassium generated a significant increase in production between 11.26% for the agricultural land prepared by scarification and, respectively, 19.12% when scarification was applied in association with ploughing.

Considering the combined influence of density, fertilization, and tillage on production (Table 10), for a density of 49,261 g.g./ha, a reduced and insignificant effect of tillage was observed both in the case of the unfertilized agrofund and in the case of applying the treatment with $N_{50}P_{50}K_{50}$. On the land prepared by scarification, the plants used the nitrogen and phosphorus treatment more effectively compared to the plants grown on the land prepared by ploughing.

Table 10. Influence of some technological links on production in 2021

Densities 49,261 g.g./ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,452 b	x 1,631 b	x 1,600 c
$N_{50}P_{50}K_0$	y 1,990 a	x 2,240 a	xy 2,103 b
$N_{50}P_{50}K_{50}$	x 2,246 a	x 2,492 a	x 2,387 a
Densities 53,908 g.g./ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,697 c	xy 1,590 c	y 1,437 c
$N_{50}P_{50}K_0$	x 2,170 b	x 2,348 b	x 2,275 b
$N_{50}P_{50}K_{50}$	y 2,458 a	xy 2,633 a	x 2,732 a
Densities de 59,524 g.g./ha			
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,702 c	x 1,875 b	x 1,860 c
$N_{50}P_{50}K_0$	x 2,184 b	x 2,405 a	x 2,266 b
$N_{50}P_{50}K_{50}$	x 2,575 a	x 2,633 a	x 2,732 a
Density	**66,756 g.g./ha**		
Fertilisation	Soil work		
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,712 b	x 1,761 c	x 1,514 c
$N_{50}P_{50}K_0$	xy 2,065 a	x 2,237 b	y 1,952 b
$N_{50}P_{50}K_{50}$	x 2,309 a	x 2,514 a	x 2,387 a

Fertilisations - $DL_{5\%}$=264 kg/ha $DL_{1\%}$=352 kg/ha $DL_{0.1\%}$=458 kg/ha (a,b,c). Soil works - $DL_{5\%}$=249 kg/ha $DL_{1\%}$=332 kg/ha $DL_{0.1\%}$=434 kg/ha (x, y, z). $DL_{5\%}$=260 kg/ha $DL_{1\%}$=345 kg/ha $DL_{0.1\%}$=447 kg/ha
Source: Own calculation.

Fertilization showed a lower influence on production on the land prepared by ploughing and a higher influence in the case of plants grown on the land where scarification was applied in association with ploughing. In the case of agrofunds where ploughing or scarification was used, fertilization determined production increases of about 37-55%, when potassium had a positive effect on production but not statistically guaranteed. The plants grown on the land where scarification was applied in combination with ploughing made more efficient use of both nitrogen and phosphorus fertilization and additional potassium fertilization, recording increases of 31.43-49.19%, under the conditions of a significant effect of potassium of 13.50%.

Against the background of plant cultivation at the density of 53,908 g.g./ha, soil works did not significantly influence the efficiency of the treatment with $N_{50}P_{50}K_{50}$ while, on the non-fertilized agrofund, the use of ploughing favoured a significant increase in production by 18.09%. The plants utilized the fertilization with $N_{50}P_{50}K_{50}$ more effectively on the land prepared by scarification and ploughing compared to the land where only ploughing was used. The influence of fertilization on production was higher than at the previous density, with significant production differences between the three variants. Thus, the treatment with nitrogen and phosphorus determined increases of 27.87-47.67%, and fertilization with NPK was associated with increases of 44.84-90.11%, compared to the non-fertilized version. Also, the positive effect of additional fertilization with potassium was materialized by significant increases of 8.76-20.08%.

Under the conditions of a density of 59,524 g.g./ha, the basic tillage had little influence on the level of production, against the background of insignificant variations between 173 kg on the unfertilized agrofund and 221 kg on the $N_{50}P_{50}K_{50}$ agrofund. Fertilization had a significant effect on production, more pronounced in the variants where ploughing was practiced or its association with scarification, causing increases of 406-482 kg/ha for the $N_{50}P_{50}K_{50}$ variant and about 875 kg for $N_{50}P_{50}K_{50}$. Against the background of the treatment with nitrogen and phosphorus, the additional fertilization with potassium generated a significant increase in production between 391 for the agricultural land prepared by ploughing and, respectively, 466 kg/ha in the case of the agricultural land where scarification was applied in association with ploughing. In the case of land preparation by scarification, fertilization had positive effects on production, associated with increases of 530-758 kg/ha, against the background of an insignificant influence of potassium.

In the case of the density of 66,756 g.g./ha, a reduced and insignificant effect of the soil works was observed both in the case of the unfertilized agrofund and in the case of the application of $N_{50}P_{50}K_{50}$. On the soil prepared by scarification, the plants used the fertilization with nitrogen and phosphorus more efficiently compared to the plants grown on a scarified soil in association with ploughing. Fertilization showed a lower influence on production on the land prepared by ploughing and a higher influence in the case of plants grown on the land where scarification was applied in association with ploughing. In the case of the agrofund where ploughing was used, fertilization determined increases in production of about 353-597 kg/ha, in the conditions where potassium had a positive effect on production, but not statistically ensured. The plants grown on the lands where scarification was applied made more efficient use of both nitrogen and phosphorus fertilization as well as the additional potassium fertilization, recording gains of 438-873 kg/ha, under the conditions of a significant effect of potassium of 435 kg/ha.

Influence of some technological links on sunflower production in 2022

In the year 2022, the analysis of the variance components (Table 11) shows that only density and fertilization had a real and statistically assured influence on the production, against the background of a reduced and insignificant influence of both soil works and environmental conditions at the level of replicas. Fertilization showed a significantly higher influence (58.33%) than tillage (19.93%) and soil work (0.28%). The simple interactions between the three factors showed significant influences on production achievement, associated with contributions of 1-2%.

The results obtained under the effect of the three factors were influenced to an extent of about 15.44% by other uncontrollable sources through the experimental device.

Table 11. The influence of the variant on some technological links in the sunflower crop in 2022

Variation source	SP	GL	S^2	F test
Total	10,532,387	107		
Replicas	49,461	2	24,731	1.30
Density	1,965,868	3	655,289	34.35**
Density error	114,469	6	19,078	
Fertilisation	5,321,178	2	2,660,589	100.52**
Density x Fertilisation	510,182	6	85,030	3.21*
Fertilisation error	423,495	16	26,468	
Soil work	21,084	2	10,542	0.49
Density x Soil work	343,918	6	57,320	2.65*
Fertilisation x Soil work	214,114	4	53,529	2.47*
Density x Fertilisation x Soil work	529,568	12	44,131	2.04*
Work error	1,039,050	48	21,647	**84.56**

Source: Own calculation.

Regarding the cumulative effect of density, in 2022 (Table 12) average production values were found with the limits of 2,016 kg/ha in the case of the 49,261 g.g./ha variant and 2,336 kg/ha in the case of the 59,524 g.g./ha variant, against the background of low variability (7.12%). The increase in crop density from 49,261 to 53,908 g.g./ha had a small and insignificant effect on production, associated with an increase of about 4.5%.

By changing the density from 53,908 to 59,524 g.g./ha, a significant increase in production of about 11% was recorded, equivalent to 229 kg/ha. Later, the intensification of the culture up to the level of 66,756 g.g./ha was associated with an insignificant variation of the production.

Table 12. Effect of density on sunflower production in 2022

Density (g.g./ha)	Means (kg/ha)		Relative values (%)	Difference/Significance
53,908 – 49,261	2,107	2,016	104.51	91
59,524 – 49,261	2,336	2,016	115.87	320***
66,756 – 49,261	2,311	2,016	114.63	295***
59,524 – 53,908	2,336	2,107	110.87	229***
66,756 – 53,908	2,311	2,107	109.68	204**
66,756 – 59,524	2,311	2,336	98.93	-25

Source: Own calculation. $DL_{5\%}$=92 kg/ha $DL_{1\%}$=139 kg/ha $DL_{0.1\%}$=224 kg/ha

Considering the unilateral effect of fertilization, it was observed that the production (Table 13) recorded an amplitude of 505 kg/ha with values ranging between 1,882 kg/ha in the case of the unfertilized variant and 2,387 kg/ha in the case of the use of $N_{50}P_{50}K_{50}$, under the conditions a variability of 12.4% between treatments.

Fertilization with NP and, respectively, NPK, generated production increases of 22.7-26.8% compared to the untreated variant, while additional potassium fertilization allowed an insignificant variation in production by 3.4%.

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Table 13. Effect of fertilization on sunflower yield in 2022

Fertilisation	Means (kg/ha)		Relative values (%)	Difference/ Significance
$N_{50}P_{50}K_0 – N_0P_0K_0$	2,309	1,882	122.69	427***
$N_{50}P_{50}K_{50} – N_0P_0K_0$	2,387	1,882	126.83	505***
$N_{50}P_{50}K_{50} – N_{50}P_{50}K_0$	2,387	2,309	103.38	78

$DL_{5\%}$=81 kg/ha $DL_{1\%}$=112 kg/ha $DL_{0.1\%}$=154 kg/ha
Source: Own calculation.

Under the effect of different soil works, the production showed a very small range of variation of 3-8 kg/ha, with values ranging between 2,188 kg/ha on the agricultural land where ploughing was applied and 2,196 kg/ha in the case of land preparation by scarification and ploughing, under conditions of extremely low variability between the three basic works (Table 14). The application of different soil works had very close, respectively, significantly equal effects, on production, not statistically differentiated.

Table 14. Effect of tillage on sunflower yield in 2022

Soil work	Means (kg/ha)		Relative values (%)	Difference/Significance
Scarification – Ploughing	2,193	2,188	100.23	5
(Scarification+ Ploughing) – Ploughing	2,196	2,188	100.37	8
(Scarification+ Ploughing) - Scarification	2,196	2,193	100.14	3

Source: Own calculation.

The combined effect of density and fertilization on production (Table 15) shows that, in the case of agrofund fertilized with nitrogen and phosphorus, only the reduction of the distance between plants from 29 to 26.5 cm generated significant production variations of 7.7%, while changes in the distance between plants from 26.5 to 21.4 cm had small and insignificant influences.

Table 15. Effect of density and fertilization on sunflower yield in 2022

Density (g.g./ha)	Fertilisation				
	$N_0P_0K_0$	**$N_{50}P_{50}K_0$**	**$N_{50}P_{50}K_{50}$**	$\bar{x} \pm s_{\bar{x}}$	S%
49,261	y 1,665 b	x 2,120 b	x 2,264 b	2,016±54	13.94
53,908	y 1,774 b	x 2,283 a	x 2,265 b	2,107±50	12.32
59,524	z 2,036 a	y 2,400 a	x 2,572 a	2,336±48	10.60
66,756	y 2,053 a	x 2,433 a	x 2,446 a	2,311±42	9.41
$\bar{x} \pm s_{\bar{x}}$	1,882±33	2,309±27	2,387±28	2,193±27	
S%	10.52	6.99	7.05	12.93	

Densities - $DL_{5\%}$=152 kg/ha $DL_{1\%}$=206 kg/ha $DL_{0.1\%}$=277 kg/ha (a,b). Fertilisations - $DL_{5\%}$=163 kg/ha $DL_{1\%}$=224 kg/ha $DL_{0.1\%}$=308 kg/ha (x, y, z)
Source: Own calculation.

On the unfertilized farmland and in the case of $N_{50}P_{50}K_{50}$ application, it was found that the densities of 59,524 and 66,756 g.g./m^2 favoured the highest productions, associated with significant increases compared to the other two densities, not statistically differentiated.

The plants cultivated at the density of 59,524 g.g./ha used fertilization at a higher level, thus registering significant increases of 364-536 kg/ha, against the background of a significant effect of 172 kg/ha of potassium. Under the conditions of the other crop densities, fertilization with $N_{50}P_{50}K_0$ determined significant increases in production between 380 kg/ha in the case of the density of 66,756 g.g./m^2, respectively 509 kg/ha for the density of 53,908 g.g./m^2. Also, the $N_{50}P_{50}K_{50}$ variant had an important and significant effect on production, related to increases from 393 kg/ha for the density of 66,756 g.g./ha up to 599 kg for the use of the density of 49,261 g.g./ha. Potassium fertilization had small and insignificant effects on the production of plants grown at distances of 21.4, 26.5 and 29 cm per row.

Regarding the effect of density on production in different fertilization conditions (Table 15) in the case of unfertilized agrofund, the amplitude (388 kg/ha) and variability (10.52%) between plots were higher, recording production increases of 14.77-23.3% by cultivating plants at densities of 59,524-66,756 g.g./ha. Against the background of fertilization with $N_{50}P_{50}K_0$ and $N_{50}P_{50}K_{50}$, the effect of crop density was less but significant, recording, at densities of 59,524-66,756 g.g./ha, an increase in production of 5.12-14.76% compared to the first two densities.

Table 16. Influence of some technological links on sunflower production in 2022

Density (g.g./ha)	Soil work				
	Ploughing	**Scarification**	**Scarification+ Ploughing**	$\bar{x} \pm s_{\bar{x}}$	S%
49,261	x 2,010 b	x 2,017 b	x 2,023 c	2,016±54	13.94
53,908	x 2,069 b	x 2,081 b	x 2,173 b	2,107±50	12.32
59,524	x 2,303 a	x 2,382 a	x 2,322 a	2,336±48	10.60
66,756	x 2,372 a	x 2,294 a	x 2,266 ab	2,311±42	9.41
$\bar{x} \pm s_{\bar{x}}$	2,188±50	2,193±45	2,196±48	2,193±27	
S%	13.78	12.25	13.08	12.93	

Densities - $DL_{5\%}$=138 kg/ha $DL_{1\%}$=184 kg/ha $DL_{0.1\%}$=242 kg/ha (a,b,c,d). Soil works - $DL_{5\%}$=140 kg/ha $DL_{1\%}$=186 kg/ha $DL_{0.1\%}$=243 kg/ha (x, y, z)
Source: Own calculation.

About the influence of the soil works, it was found that, no matter the space between the plants, the method of land preparation had a small and insignificant contribution to the achievement of production against the

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background of a lower level of precipitation at the beginning of the vegetation period.

Based on the preparation of the land by ploughing, the establishment of the crop at 21.4-24 cm between plants allowed obtaining production increases of 11.3-18% compared to the other two plots, respectively increases of 277-365 kg/ha for the agrofund where scarification was applied. In the case of land preparation by scarification and ploughing, the effect of density on production is higher. Thus, it was found that the plot of 59,524 g.g./ha favoured significant production increases of 6.85-14.78% compared to the plots of 49,261-53,908 g.g./ha. Also, reducing the space between plants from 29 to 26.5 cm was associated with an increase in production of 7.42%.

Considering the combined effect of fertilization and tillage on production in 2022 (Table 17) in the case of unfertilized agrofund, basic tillage had the lowest influence on the level of production against the background of small and insignificant variations. Thus, in the case of the treatment with $N_{50}P_{50}K_0$, it can be observed that scarification showed a significantly superior effect against the background of production increases of 7.39-9.80% compared to the other two basic soil works. The preparation of the land by simple scarification alone or in association with ploughing favoured a more efficient use of fertilization with $N_{50}P_{50}K_{50}$, materialized by significant increases in production of about 6.8%.

Considering the interaction between tillage and fertilization (Table 16), it follows that, on the unfertilized agrofund, tillage had the highest influence on production, against the background of an amplitude of 206 kg/ha. Thus, under these conditions, soil preparation by ploughing allowed a significant increase in production by 11.20% compared to the variant where only scarification was applied. The association of scarification with ploughing did not determine significant production variations compared to the unilateral application of the two works. Against the background of the application of $N_{50}P_{50}K_0$ and $N_{50}P_{50}K_{50}$, the soil works did not significantly influence the production, which presented very small and irregular amplitudes of variation.

Table 17. Effect of fertilization and tillage on sunflower yield in 2022

Fertilisation	Soil work				
	Ploughing	**Scarification**	**Scarification+Ploughing**	$\overline{x} \pm s_{\overline{x}}$	$S_{\%}$
$N_0P_0K_0$	x 1,853 b	x 1,920 b	x 1,872 b	1,882±33	10.52
$N_{50}P_{50}K_0$	x 2,329 a	x 2,282 a	x 2,316 a	2,309±27	6.99
$N_{50}P_{50}K_{50}$	x 2,382 a	x 2,378 a	x 2,399 a	2,387±28	7.05
$\overline{x} \pm s_{\overline{x}}$	2,188±50	2,193±45	2,196±48	2,193±27	
$S_{\%}$	13.78	12.25	13.08	12.93	

Fertilisations - $DL_{5\%}$=125 kg/ha $DL_{1\%}$=166 kg/ha $DL_{0.1\%}$=216 kg/ha (a,b,c). Soil works - $DL_{5\%}$=121 kg/ha $DL_{1\%}$=161 kg/ha $DL_{0.1\%}$=211 kg/ha (x, y, z)
Source: Own calculation.

As for the effect of tillage on production for each fertilization agrofund (Table 17), it can be observed that, in the case of the three fertilization options, the amplitudes of variation between tillage were small and insignificant, between 21 kg for the treatment with $N_{50}P_{50}K_{50}$ and 67 kg for the non-fertilized agrofund.

Under the conditions of land preparation by ploughing, fertilization generated an amplitude with limits from 1,853 kg/ha for the control variant to 2,382 kg/ha for the $N_{50}P_{50}K_{50}$ variant. As such, fertilization allowed obtaining significantly higher productions by over 25.69%. Against the background of land preparation by scarification, the variability between treatments was between 1,920 and 2,378 kg/ha, with significant increases of 18.85-23.85% because of fertilization with two and, respectively, three macroelements. In the case of using scarification in combination with ploughing, fertilization treatments determined a variation in production of 527 kg/ha. Nitrogen and phosphorus fertilization caused a significant increase in production by 23.72%, while nitrogen, phosphorus and potassium fertilization allowed a 28.15% increase in production.

Considering the effect of the interaction between densities, fertilizations, and tillage on production in 2022 (Table 18), it was found that no matter the space between plants or the fertilization treatment applied, tillage had a low and insignificant influence on plant growth and development of sunflower, respectively, their productivity. The amplitude between soil works was 58-203 kg/ha for the density of 49,261 g.g./m^2, 107-171 kg/ha for the density of 53,908 g.g./m^2, 61-165 kg/ha in the case of the density of 59,524 g.g./m^2 and, respectively, 103-188 kg/ha for the density of 66,756 g.g./ha.

Under the conditions of the density of 49,261 g.g./ha, it can be observed that fertilization with nitrogen and phosphorus determined significant increases in production from 311 kg/ha in the case of land preparation by scarification up to 572 kg/ha, in the case of application of scarification in association with ploughing. Also, fertilization with NPK had an important and significant effect on production, generating increases between 390 and 756 kg/ha. Additional potassium fertilization had low (79-184 kg/ha) and insignificant effects on production. Against the background of the density of 53,908 g.g./ha, fertilization showed a significant effect on production causing increases of 27.46-29.3165% for $N_{50}P_{50}K_0$ and, respectively, 24.08-33.35% for $N_{50}P_{50}K_{50}$.

Table 18. Influence of some technological links on production in 2022

Fertilisation	Soil work		
Density 49,261 g.g./ha			
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,631 b	x 1,783 b	x 1,580 b
$N_{50}P_{50}K_0$	x 2,114 a	x 2,094 a	x 2,152 a
$N_{50}P_{50}K_{50}$	x 2,284 a	x 2,173 a	x 2,336 a
Density 53,908 g.g./ha			
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,747 b	x 1,730 b	x 1,844 b
$N_{50}P_{50}K_0$	x 2,259 a	x 2,205 a	x 2,386 a
$N_{50}P_{50}K_{50}$	x 2,200 a	x 2,307 a	x 2,288 a
Density 59,524 g.g./ha			
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 1,996 b	x 2,055 b	x 2,057 c
$N_{50}P_{50}K_0$	x 2,405 a	x 2,480 a	x 2,315 b
$N_{50}P_{50}K_{50}$	x 2,507 a	x 2,612 a	x 2,595 a
Density 66,756 g.g./ha			
	Ploughing	**Scarification**	**Scarification+Ploughing**
$N_0P_0K_0$	x 2,040 b	x 2,111 b	x 2,008 b
$N_{50}P_{50}K_0$	x 2,538 a	x 2,350 a	x 2,412 a
$N_{50}P_{50}K_{50}$	x 2,539 a	x 2,420 a	x 2,378 a

Fertilisations - $DL_{5\%}$=249 kg/ha $DL_{1\%}$=332 kg/ha $DL_{0.1\%}$=431 kg/ha (a,b,c). Soil works - $DL_{5\%}$=242 kg/ha $DL_{1\%}$=322 kg/ha $DL_{0.1\%}$=421 kg/ha (x, y, z). $DL_{5\%}$=244 kg/ha $DL_{1\%}$=324 kg/ha $DL_{0.1\%}$=420 kg/ha
Source: Own calculation.

Against the background of fertilization with nitrogen and phosphorus, additional fertilization with potassium generated a differentiated and insignificant variation in production associated with an increase of 4.63% for the agrofund prepared by scarification and, respectively, a reduction of production by 2.6-4.1% for the other two basic soil works.

In the case of growing plants at the density of 59,524 g.g./ha, fertilization showed a lower influence on the production on the land prepared by ploughing and scarified and a higher influence in the case of scarified in association with ploughing. In the case of agrofunds where ploughing or scarification was used, fertilization determined increases in production of 409-557 kg/ha, while potassium had a positive effect (102-132 kg/ha) on production but not statistically ensured. The plants grown on the land where scarification was applied in combination with ploughing made more efficient use of both nitrogen and phosphorus fertilization and additional potassium fertilization, recording increases of 258-538 kg/ha, under the conditions of a significant effect of potassium of 280 kg/ha.

Under the conditions of the density of 66,756 g.g./ha, it was found that, regardless of the method of land preparation, fertilization with $N_{50}P_{50}K_0$ had a significant effect on the production associated with increases between 11.32 when using scarification and, respectively, 24.41% when using ploughing. Also, it was observed that the plants more efficiently capitalized on the fertilization with $N_{50}P_{50}K_{50}$ on the arable land where ploughing was applied, obtaining a significant increase of 24.46%, compared to the arable land related to scarification, where the production increase was 14.64%. The individual effect of potassium was reduced, generating insignificant production variations of + 1.5-3%.

CONCLUSIONS

During the study carried out in the period 2020-2022 on a cambic chernozem from Timișoara, Romania, the following were found:

- Fertilization had the highest contribution to production variability, being between 58.33% in 2022 and 78.55% in 2020.

- The density of the culture showed an influence on production between 4.30% in 2021 and 19.93% in 2022.
- Soil works recorded the lowest contribution to production, with values from 0.06% in 2020 to 3.34% in 2021.
- Reducing the distance between plants in a row from 29 to 26.5 cm determined significant increases in production in the period 2020-2021 associated with increases of 133-168 kg/ha. Under the conditions of 2022, the increase in density from 49,261 to 53,908 g.g./ha had a small and insignificant effect on production, associated with a 4.5% increase.
- By changing the density from 53,908 to 59,524 g.g./ha, a significant production increase of 10.87-16.46% was recorded in 2020 and 2022, equivalent to 229-391 kg/ha. The increase of the distance between plants in a row from 26.5 to 24 cm under the conditions of 2021, was associated with an insignificant variation in production of 99 kg/ha.
- The increase in crop density from 59,524 to 66,756 g.g./ha had, in 2020 and 2022, a small and insignificant effect on production, causing a variation of 10-25 kg/ha. Under the conditions of 2021, reducing the distance between plants from 24 to 21.4 cm had a negative effect on production, causing a significant decrease of 198 kg/ha.
- Fertilization with nitrogen and phosphorus determined a significant increase in production, with increases of 22.7% in 2022 and 45.21% in 2020, equivalent to increases of 427-828 kg/ha;
- Fertilization with $N_{50}P_{50}K_{50}$ generated significant increases in production from 26.8% in 2022 to 51.72% in 2021, associated with increases of 505-891 kg/ha.
- The application of potassium in a dose of 50 kg/ha against the background of fertilization with $N_{50}P_{50}$ had a small and insignificant effect on production in 2020 and 2022. In the less favourable conditions of 2021, the additional fertilization with potassium allowed an increase in production of about 15% equivalent to 322 kg/ha; at the level of the entire experiment, it was found that, against the background of climate conditions in 2020 and 2022, the type of soil preparation did not significantly influence sunflower production. In the conditions of 2020, amid the use of scarification, there was a higher production in line with ploughing, associated with an increase of 7.33% and 150 kg/ha, respectively.
- Regarding the average productions for the various technological links, it was observed that the variant 59,524 g.g./ha – $N_{50}P_{50}K_{50}$ – scarification+ploughing recorded the highest productions (2,612 kg/ha in 2022 and 3,417 kg/ha in 2020). Also, the $N_{50}P_{50}K_{50}$ variant, in the case of plants grown at 24 cm per row, ranked in the best 5 variants, recording productions of 2,507-3,145 kg/ha.
- The $N_{50}P_{50}K_{0}$ variant of the plants grown at a density of 59,524 g.g./ha on the land prepared by scarification and ploughing achieved superior productions in the favourable conditions of 2020 associated with significantly lower productions in the less favourable conditions of 2021-2022. Against the background of the absence of mineral fertilization with macroelements, the production recorded variations between 1,437 and 1,875 kg/ha in 2021 and, respectively, 1,806-2,523 kg/ha in 2020.

Considering the averages for different technological variants over the entire period of the study, it is found that the highest productions of 2,742-2,915 kg/ha were obtained under the effect of the density of 59,524 g.g./ha and fertilization with $N_{50}P_{50}K_{50}$ in association with different soil works, the respective productions being significantly superior to 57% of the technological links.

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ECONOMIC EFFICIENCY OF SUNFLOWER PRODUCTION DEPENDING ON TECHNOLOGY

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Abstract

The purpose of this paper is to present an analysis of the economic efficiency of sunflower production in the pedoclimatic conditions specific to the outskirts of the city of Timișoara different technological options in the period 2020-2022. The experiment was trifactorial (of the 4 x 3 x 3 type), with 3 factors: D – density; F – fertility; T – technology. Ten plants were chosen from each plot and a series of measurements were made. Based on the values obtained, descriptive statistical indices related to the different technological factors were calculated, namely: arithmetic mean, error of the mean and coefficient of variation. The results showed that the profit had a variation between 849 RON/ha in the case of plants grown at a density of 49,261 g.g./ha on unfertilized agrofund prepared by scarification + ploughing and 1,990 RON/ha for plants grown at a density of 59,524 g.g./ha on the agricultural land fertilized with N50P50K0 and prepared by ploughing. In 55% of cases, the technological variants produced a profit of over 1,500 RON/ha. The research related presented in this paper concerns useful information that will allow superior, high-quality, and sustainable productions under the conditions of the current climate changes.

Key words: *economic efficiency, production, technological factors, sunflower*

INTRODUCTION

In sunflower, which is a C3 type plant, the increase in CO_2 concentration is associated with an increase in the efficiency of the use of solar radiation, water, and soil nitrogen, thus producing a greater amount of biomass and seeds on the background of an increase in the rate of photosynthesis [16, 17, 18, 21, 19, 20, 31,32]. This beneficial effect of increasing CO^2 concentration is valid up to the level of about 750 ppm [29]. Recent studies have demonstrated that an increase in CO_2 concentration from 370 to 760 ppm causes certain changes such as an increase of about 60% in the net rate of photosynthesis, a reduction of stomatal conductance by 7%, a reduction in evapotranspiration by 0.074 l/m2/h, and an increase in water use efficiency from 4.36 to 10.56 mg CO_2/l H_2O [6, 9, 28].
As such, in the future, on the background of increasing CO_2 concentration, sunflower will be very efficient in converting CO_2 into carbohydrates and reducing water consumption on the background of increasing the rate of photosynthesis, biomass by 24-68%, and even production by 35-45 % [1, 25, 30, 32]. Regarding the chemical composition of the seeds, it was shown that an increase in CO_2 concentration from 370 to 550 ppm was associated with a reduction in protein content by 13% and an increase in carbohydrates by 13% and by 15% in oil content and unsaturated fatty acids, respectively [2, 4, 22, 25, 26, 27].
The beneficial effects of increasing CO_2 concentration are counterbalanced by the negative effects of increasing global temperature and reducing the level of precipitation, phenomena associated with current climate change [4, 5, 7].
In the conditions of the current climate change, it is necessary to create new hybrids with adaptability to thermal shocks and water stress, which allow sustainable productions. In this sense, it is possible to optimize breeding programs in the direction of increasing productivity under climate stress conditions, using the information from sunflower genome sequencing and the great diversity of the genus Helianthus as a source of genes for adaptive characters [11, 15, 20, 24].

To compensate the reduction of the vegetation period with the increase in global temperature, the early sowing of later hybrids with the ability to germinate at lower temperatures is necessary [12, 14].

The purpose of this paper is to present an analysis of the economic efficiency of sunflower production in a trifactorial experiment regarding density, fertility and technology in the pedoclimatic conditions specific to the outskirts of the city of Timișoara in the period 2020-2022.

MATERIALS AND METHODS

A series of information from the literature related to sunflower culture, applied technologies, and the effect of ecological and technological factors on production have been used.

The cultivated hybrid was NK Neoma and the production potential was realized based on a trifactorial experiment (of the 4 x 3 x 3 type), located in the outskirts of Timișoara. This experiment was organized in 3 replicas, each on six rows of 10 m in length. The economic efficiency of sunflower production was analysed for each technology: density, fertilization, and tillage, as follows: each technology: density, fertilization, and tillage, as shown in Table 1.

Table 1. The characteristics of the experiment regarding density, fertilization and tillage

D. Density	F. Fertilisation	T. Technology
D_1 – 4,9261 g.g./ha;	F_1 – $N_0P_0K_0$;	T_1 – Ploughing;
D_2 – 5,3908 g.g./ha;	F_2 – $N_{50}P_{50}K_0$;	T_2 – Scarification;
D_3 – 5,9524 g.g./ha;	F_3 – $N_{50}P_{50}K_{50}$;	T_3 – Scarification+Ploughing.
D_4 – 6,6756 g.g./ha.		

Source: Own experiments.

Studies were carried out during 2020-2022.

Each plot, or replica, had different thicknesses, from 21.4 cm to 29 cm between plants in a row and 70 cm between rows. Ten plants were randomly selected from each plot and a series of measurements were taken. Based on the values obtained, descriptive statistical indices related to the different technological factors were calculated: arithmetic mean, error of the mean, and coefficient of variation.

The evaluation of the stability of the production and some of its morphological components for different technological variants was carried out by means of some parameters following to the linear regression analysis according to the Eberhart-Russell mathematical model in which: [3, 7, 8, 10].

$$F_{ij} = \mu + g_i + b_i t_j + \delta_{ij} + e_{ij} \quad \text{....................(1)}$$

where:

F_{ij} – average of variant i in year j; μ – general average: g_i – the effect of variants i; t_j – the effect (index) of year j; b_i – linear regression coefficient between F_{ij} and t_j; δ_{ij} – F_{ij} deviations from the regression line; e_{ijk} – the error associated with variant i in year j.

To calculate the profit rate, depending on the total cost, the following formula was used [13]:

$$R_{Pr/CT} = \frac{Pr}{CT} * 100 \quad \text{..(2)}$$

where:

R Pr/CT – profit rate depending on the total cost, Pr – profit, CT – total cost.

The regression coefficient b_i which indicates the value by which the average of a technological variant changes when the average of a certain year increases or decreases by one unit. For option *i* the regression coefficient is [3]:

$$b_i = \sum F_{ij} t_j / \sum t_j^2 \quad \text{.................................(3)}$$

Variance of regression deviations:

$$s_\delta^2 = \frac{1}{n-2}\left[\left(\sum F_{ij}^2 - \frac{\left(\sum F_{ij}\right)^2}{n}\right) - \frac{\left(\sum F_{ij} t_j\right)^2}{\sum t_j^2}\right] - \frac{\sigma_E^2}{r} \quad \text{...(4)}$$

where:

n – number of years; *r* – number of repetitions; σ_E^2 - error variance.

The data on meteorological parameters for the period 2020-2022 for the town of Timișoara are provided by the Meteorological Station in Timisoara.

RESULTS AND DISCUSSIONS

Thermal and pluviometric regime

Most of the basic meteorological parameters (according to the Banat-Crișana Regional Meteorological Centre), which were

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considered, were: thermal regime, pluviometric regime, and wind regime.

From the point of view of the rainfalls regime (Figures 1 and 2) during the analysed period, the least precipitation was recorded in the spring of 2020, the year in which, in April, there were only 7 l/m^2, and in May 29 l/m^2, which led to certain decreases in sunflower production.

In the year 2020, the total amount of precipitation was 540 l/m^2, while the year 2022 stood out with a value of 470 l/m^2. The fall of 2020 was rainy, in the last four months an amount of 250 l/m^2 was recorded. The highest amount of precipitation was in September, 121.6 l/m^2, and the lowest rainfall was in March, 3.9 l/m^2 and in June, 18.4 l/m^2.

For the analysed interval, it can be observed that, in the month of July, the average values exceeded 22^{o}C, the highest value being recorded in 2021, which was 25.7^{o}C.

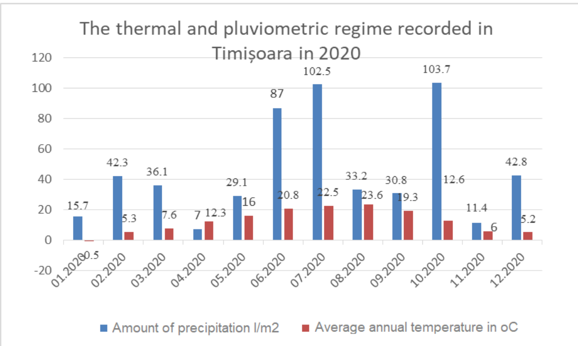

Fig. 1. Thermal and pluviometric regime recorded in Timişoara in 2020
Source: Meteorological Station in Timisoara [23].

Spring came a bit earlier and warmer than in other areas of the country. Temperature oscillations occurred with colder periods under the influence of air masses from the north and north-east, but also warmer periods due to the activity of Mediterranean cyclones.

Thus, late frosts and isolated frost occurred on the coldest mornings even at the beginning of May, but also hot days in June.

Also, in the spring, the first convective manifestations appeared with stormy phenomena, torrential rains, and hail. Average temperatures gradually increased from 5-6^{o}C at the beginning of spring to 16-17^{o}C at the beginning of summer. Seasonal averages range between 7 and 11^{o}C.

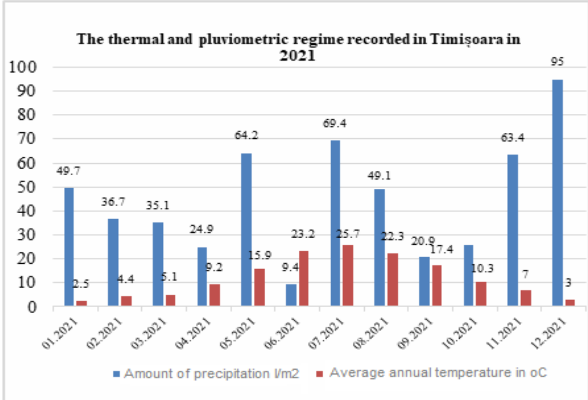

Fig. 2. Thermal and pluviometric regime recorded in Timişoara in 2021
Source: Meteorological Station in Timisoara [23].

Summer was dominated by formations related to the Azorean anticyclone and the Mediterranean cyclones, starting early, sometimes even in May and lasting until September. For the analysed interval, it can be observed that, in Timişoara, in the month of July, the average values exceeded 22^{o}C, the highest value being registered in 2021, 25.7^{o}C. That year, 16 hot days were recorded in Timişoara during the summer months.

The annual values of the atmospheric pressure (Figure 3) had a multiannual average of 984.4 mb, which represented the atmospheric pressure at the station level, i.e., the pressure read at the barometer, to which temperature and gravity corrections were applied.

In 2020, an average below the value of 980 mb was recorded, which means a more intense cyclonic activity and, implicitly, a higher number of cases for the respective years with manifestations of the wind.

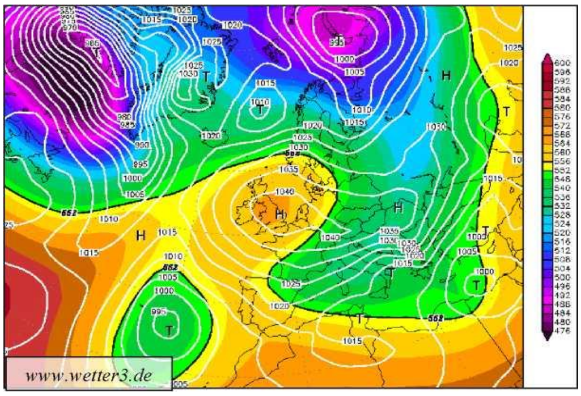

Fig. 3. Atmospheric pressure at ground level and geopotential at 500 hPa in January 2020
Source: Meteorological Station in Timisoara [23].

For the analysed interval, it can be observed that, in Timișoara, in the month of July, the average values exceeded 22°C, the highest value being registered in 2021, 25.7°C.

Sunshine duration is an indicator representing the time interval during a day in which the sun shines in the sky. It consists in determining the number of hours during which the sun illuminated the meteorological platform and its surroundings and it depends on cloudiness, latitude, seasons, and altitude. The annual average, in Timișoara, was around 2,000-2,100 hours, a range also found in the period analysed for the three years.

Analysis of economic efficiency for different technological options in sunflower in Timisoara during 2020-2022

Considering the economic efficiency indices of sunflower cultivation in Timișoara from the favourable soil and climate conditions of the year 2020 and the technological variant applied (Table 2), it was observed that the profit registered variations in the range of 695 RON/ha at the density of 59,524 g.g./ha (D_3) on the non-fertilized agricultural land prepared by scarification + ploughing and 1,752 RON/ha on the agricultural land $N_{50}P_{50}K_0$ and prepared by ploughing.

Thus, in 2020, the maximum amplitude of the economic efficiency on the unfertilized + ploughing agricultural land was recorded for the density of 66,756 g.g./ha (D_4), generating a profit of 1,808 RON/ha. Also, positive results were recorded on the agricultural land fertilized with $N_{50}P_{50}K_0$ and prepared by ploughing or scarification at densities of 59,524÷66,756 g.g./ha, generating profit rates of 151÷164% associated with profits of 1,808÷1,847 RON/ha.

Under the conditions of cultivation at densities of 49,261 g.g./ha (D_1), for the non-fertilized + scarification + ploughing agro-fund, a profit of 701 RON/ha was recorded, respectively 1,413 RON/ha for the scarification + fertilisation agro-fund with $N_{50}P_{50}K_0$. Under these conditions, the rate of profit associated with the variant $N_{50}P_{50}K_0$ + scarification + ploughing was 50.64% and, in the case of combining scarification + fertilization with $N_{50}P_{50}K_0$, 127.64%.

With a density of 53,908 g.g./ha (D_2) for the non-fertilized scarification + ploughing agro-fund, a profit of 827 RON/ha was recorded, compared to 1,454 RON/ha when associating scarification + $N_{50}P_{50}K_0$. In this case, the profit rate registered an increase from 68.30% associated with the treatment with $N_{50}P_{50}K_0$ + scarification + ploughing to 129.13% in the case of fertilization with $N_{50}P_{50}K_0$ on the agricultural land prepared by scarification.

Table 2. Economic efficiency indices of sunflower in Timisoara in 2020 for different technological links

Technological links	Yield (kg/ha)	Income (RON/ha)	Costs (RON/ha)	Profit (RON/ha)	Profit rate/ha (%)
$D_1F_1T_1$	1,714	1,663	761	902	118.53
$D_1F_1T_2$	1,615	1,567	781	786	100.64
$D_1F_1T_3$	1,816	1,762	1,061	701	66.07
$D_1F_2T_1$	2,476	2,402	1,087	1,315	120.97
$D_1F_2T_2$	2,598	2,520	1,107	1,413	127.64
$D_1F_2T_3$	2,390	2,318	1,387	931	67.12
$D_1F_3T_1$	2,393	2,321	1,258	1,063	84.50
$D_1F_3T_2$	2,449	2,376	1,278	1,097	85.84
$D_1F_3T_3$	2,420	2,347	1,558	789	50.64
$D_2F_1T_1$	1,903	1,846	779	1,066	136.84
$D_2F_1T_2$	1,687	1,636	799	837	104.75
$D_2F_1T_3$	1,965	1,906	1,079	827	76.64
$D_2F_2T_1$	2,593	2,515	1,106	1,410	127.48
$D_2F_2T_2$	2,659	2,579	1,126	1,454	129.13
$D_2F_2T_3$	2,620	2,541	1,406	1,136	80.79
$D_2F_3T_1$	2,612	2,534	1,277	1,257	98.43
$D_2F_3T_2$	2,609	2,531	1,297	1,234	95.14
$D_2F_3T_3$	2,736	2,654	1,577	1,077	68.30
$D_3F_1T_1$	2,228	2,161	802	1,359	169.45
$D_3F_1T_2$	1,990	1,930	822	1,108	134.80
$D_3F_1T_3$	1,853	1,797	1,102	695	63.06
$D_3F_2T_1$	3,067	2,975	1,128	1,847	163.74
$D_3F_2T_2$	2,972	2,883	1,148	1,735	151.13
$D_3F_2T_3$	3,215	3,119	1,428	1,691	118.42
$D_3F_3T_1$	3,145	3,051	1,299	1,752	134.87
$D_3F_3T_2$	3,012	2,922	1,319	1,603	121.53
$D_3F_3T_3$	3,417	3,314	1,599	1,715	107.25
$D_4F_1T_1$	2,332	2,262	831	1,431	172.20
$D_4F_1T_2$	2,058	1,996	851	1,145	134.55
$D_4F_1T_3$	2,148	2,084	1,131	953	84.26
$D_4F_2T_1$	3,008	2,918	1,157	1,761	152.20
$D_4F_2T_2$	3,077	2,985	1,177	1,808	153.61
$D_4F_2T_3$	3,163	3,068	1,457	1,611	110.57
$D_4F_3T_1$	3,107	3,014	1,328	1,686	126.96
$D_4F_3T_2$	3,104	3,011	1,348	1,663	123.37
$D_4F_3T_3$	2,996	2,906	1,628	1,278	78.50

Source: Own calculation.

Under the conditions of using the same density (59,524 g.g./ha) (D_3), conditioned by the processing method, the profit recorded the following maximum values: non-fertilized agricultural land, scarification + ploughing, 695 RON/ha; agricultural land ploughed and fertilized with $N_{50}P_{50}K_0$, 1,847 RON/ha. Under these conditions, the profit rate showed an evolution within the limits of 63.06% to 169.45%.

The application of the density of 66,756 g.g./ha (D_4) depending on the processing method generated the following profit: non-fertilized agricultural land, scarification + ploughing, 953 RON/ha; in the variant of the association of scarification + $N_{50}P_{50}K_0$, 1,808 RON/ha. Therefore, the profit rate registered an increase from 78.50% due to the use of scarification + ploughing associated with $N_{50}P_{50}K5_0$, up to 172.0% in the case of the control variant where it was ploughed.

Regarding the economic efficiency indices for different densities in the conditions of 2020 (Table 3), depending on density, the profit rate registered the following evolution: from 87.56% for 49,261 g.g./ha to 126.88% for 59,524 g.g./ha. Subsequently, the increase in density (66,756 g.g./ha) is associated with the reduction of the profit rate (122.27%).

Table 3. Indices of economic efficiency of sunflower in Timisoara in 2020 for different technological links

Technological links		**Yield (kg/ha)**	**Income (RON/ha)**	**Costs (RON/ha)**	**Profit (RON/ha)**	**Profit rate/ha (%)**
Density (g.g./ha)	**49,261**	2,208	2,142	1,142	1,000	87.56
	53,908	2,376	2,305	1,161	1,144	98.53
	59,524	2,767	2,684	1,183	1,501	126.88
	66,756	2,777	2,694	1,212	1,482	122.27
Fertilisation	**$N_0P_0K_0$**	1,942	1,884	900	984	109.33
	$N_{50}P_{50}K_0$	2,820	2,735	1,226	1,509	123.08
	$N_{50}P_{50}K_{50}$	2,833	2,748	1,397	1,351	96.71
Tillage	**Ploughing**	2,548	2,472	1,068	1,404	131.46
	Scarification	2,475	2,400	1,069	1332	124.60
	Scarification+ Ploughing	2,546	2,469	1,349	1,121	83.10

Source: Own calculation.

The research showed that, in the non-fertilized variant, the effect of density on economic efficiency was low, associated with a profit of 984 RON/ha, compared to a profit rate of 109.33%, compared to the agro-fund fertilized with $N_{50}P_{50}K_{50}$, generating a profit of 1,509 RON/ha attached to a profit rate of 123.08%. Implicitly, the soil tillage/crop density interaction recorded a maximum profit of 1,404 RON/ha with a rate of 11.46% on the agrofund prepared by ploughing and a minimum of 1,121 RON/ha with a rate of 83.10% on the agricultural land prepared by scarification + ploughing (Table 3).

From the point of view of the profit, fertilization induces an increase in profit, generating 1,509 RON/ha while, at densities of 49,261 g.g./ha, the effect is decreasing, 1,000 RON/ha, close to that of the non-fertilized variant, where it used to be 984 RON/kg.

In terms of the profit rate, the biggest differences between the fertilized variants associated with a variation of 87.56% were observed at the density of 49,261 g.g./ha; in exchange, at the density of 59,524 g.g./ha, fertilization generated a smaller variation, i.e., 126.88%.

Fertilization had a higher effect on the profit in the agricultural land where scarification was used, realized by an amplitude of 1,332 RON/ha; in exchange, in the agricultural land prepared by ploughing, the difference was only 1,404 RON/ha. The profit rate showed a higher variation between fertilizations (131.46%) on the farm where ploughing was applied and a lower one (83.10%) in the case of the farm where scarification was used in association with ploughing.

The evolution of the profit rate on the soil works segment recorded values between 83.10÷131.46%.

Table 4. Indices of economic efficiency of sunflower in Timişoara in 2021 for different technological links

Technological links	**Yield (kg/ha)**	**Income (RON/ha)**	**Costs (RON/ha)**	**Profit (RON/ha)**	**Profit rate/ha (%)**
$D_1F_1T_1$	1,452	1,960	807	1,153	142.87
$D_1F_1T_2$	1,631	2,202	827	1,374	166.14
$D_1F_1T_3$	1,600	2,160	1,107	1,053	95.02
$D_1F_2T_1$	1,990	2,687	1,134	1,553	136.94
$D_1F_2T_2$	2,240	3,024	1,154	1,870	162.04
$D_1F_2T_3$	2,103	2,839	1,434	1,406	98.05
$D_1F_3T_1$	2,246	3,032	1,305	1,727	132.34
$D_1F_3T_2$	2,492	3,364	1,325	2,040	153.96
$D_1F_3T_3$	2,387	3,222	1,605	1,618	100.81
$D_2F_1T_1$	1,697	2,291	828	1,463	176.70
$D_2F_1T_2$	1,590	2,147	848	1,299	153.18
$D_2F_1T_3$	1,437	1,940	1,128	812	71.98
$D_2F_2T_1$	2,170	2,930	1,154	1,776	153.90
$D_2F_2T_2$	2,348	3,170	1,174	1,996	170.08
$D_2F_2T_3$	2,275	3,071	1,454	1,618	111.28
$D_2F_3T_1$	2,458	3,318	1,325	1,994	150.49
$D_2F_3T_2$	2,633	3,555	1,345	2,210	164.31
$D_2F_3T_3$	2,732	3,688	1,625	2,063	126.95
$D_3F_1T_1$	1,702	2,298	852	1,446	169.72
$D_3F_1T_2$	1,875	2,531	872	1,659	190.25
$D_3F_1T_3$	1,860	2,511	1,152	1,359	117.97
$D_3F_2T_1$	2,184	2,948	1,178	1,770	150.25
$D_3F_2T_2$	2,405	3,247	1,198	2,049	171.03
$D_3F_2T_3$	2,266	3,059	1,478	1,581	106.97
$D_3F_3T_1$	2,575	3,476	1,349	2,127	157.67
$D_3F_3T_2$	2,633	3,555	1,369	2,186	159.68
$D_3F_3T_3$	2,732	3,688	1,649	2,039	123.65
$D_4F_1T_1$	1,712	2,311	883	1,428	161.72
$D_4F_1T_2$	1,761	2,377	903	1,474	163.23
$D_4F_1T_3$	1,514	2,044	1,183	861	72.78
$D_4F_2T_1$	2,065	2,788	1,209	1,578	130.52
$D_4F_2T_2$	2,237	3,020	1,229	1,791	145.72
$D_4F_2T_3$	1,952	2,635	1,509	1,126	74.62
$D_4F_3T_1$	2,309	3,117	1,380	1,737	125.87
$D_4F_3T_2$	2,514	3,394	1,400	1,994	142.43
$D_4F_3T_3$	2,387	3,222	1,680	1,542	91.80

Source: Own calculation.

Regarding the evolution of economic efficiency conditioned by the constant technological options in 2021 (Table 4), it can be observed that most of the technological options registered a rate of profit above 100.

For Profit, a minimum of 812 RON/ha was found for the $D_2F_1T_3$ option and a maximum of 2,210 RON/ha for $D_3F_3T_2$, considering that only two variants reached values below 1,000 RON/ha (812 and 861 RON/kg, respectively).

Considering the profit and the profit rate in the climate conditions of 2021, a high economic efficiency was highlighted (2,210 RON/ha corresponding to a profit rate of 164.31%) in the technological variant $D_2F_3T_2$, evolution also recorded in the case of the variant $D_3F_2T_2$ (2,049 RON/ha/171.03%), respectively $D_3F_3T_1$ (2,127 RON/ha 157.67%).

In the case of the variant $D_2F_2T_2$ also, superior economic results were obtained with a profit of 1,996 RON/ha and a profit rate of 170.08%.

On the $D_1F_1T_3$ agricultural fund, the profit recorded values between 1,053 RON/ha and 2,040 RON/ha in the $D_1F_3T_2$ variant where D_1 (49,261 g.g./ha) was constant. Regarding the profit rate, an increase from 95.02% in the D_{1F1T3} variant to 166.14% in the case of $D_1F_1T_2$ was observed.

Under the conditions of growing plants at a density of 53,908 g.g./ha (D_2), the profit shows an increase in the range of 812 RON/ha for the agricultural fund $D_2F_1T_3$ and 2,210 RON/ha for the agricultural fund $D_2F_3T_2$, respectively. In these growing conditions, the profit rate varied from 71.98% for $D_2F_1T_3$ to 176.70% in the case of the $D_2F_1T_1$ agricultural fund.

Under the effect of the density of 59,524 g.g./ha (D_3), the profit recorded values within the limits of 1,359 RON/ha (minimum) for the $D_3F_1T_3$ agricultural fund and 2,186 RON/ha (maximum) for the $D_3F_3T_2$ variant. Combined with the profit rate, a minimum of 106.97% is observed for $D_3F_2T_3$ and a maximum of 190.25% in the case of the $D_3F_1T_2$ agricultural fund.

Under the conditions of the technological variant D_4 (66,756 g.g./ha), the profit was within the limits of 861 RON/ha for the $D_4F_1T_3$ agricultural fund, respectively 1,994 RON/ha for the $D_4F_3T_2$ agricultural fund. In these technical conditions, the profit rate evolved from 72.78% for the $D_4F_1T_3$ variant, to 145.72% in the case of the $D_4F_2T_2$.

Considering the unilateral, compared effect of density (Table 4), it can be observed that the impact of plant density on crop profit was proportional to the applied fertilization, being higher (1,940 RON/ha) in the case of the $N_{50}P_{50}K_{50}$ variant and lower (1,282 RON/ha) for unfertilized agricultural land. The amplitude of the profit rate between densities was lower (118.91%) in the unfertilized agrofund and higher (134.16%) in the $N_{50}P_{50}K_{50}$ variant. The soil works showed a reduced influence on the profit related to different densities, within the limit of 1,365÷1,646 RON/ha. The differences between the densities in terms of the profit rate were higher in the case of the application of scarification in association with ploughing and lower, for the other agrofunds.

Table 5. Economic efficiency indices of sunflower cultivation in Timisoara from 2021 for different technological links

Technological links		Yield (kg/ha)	Income (RON/ha)	Costs (RON/ha)	Profit (RON/ha)	Profit rate/ha (%)
Density (g.g./ha)	**49,261**	2,016	2,721	1,189	1,533	128.93
	53,908	2,149	2,901	1,209	1,692	139.95
	59,524	2,248	3,035	1,233	1,802	146.15
	66,756	2,050	2,768	1,264	1,503	118.91
Fertilisation	**$N_0P_0K_0$**	1,653	2,231	949	1,282	135.10
	$N_{50}P_{50}K_0$	2,186	2,951	1,275	1,676	131.45
	$N_{50}P_{50}K_{50}$	2,508	3,386	1,446	1,940	134.16
Tillage	**Ploughing**	2,047	2,763	1,117	1,646	147.36
	Scarification	2,157	2,912	1,118	1,794	160.46
	Scarification+Ploughing	2,047	2,763	1,398	1,365	96.99

Source: Own calculation.

Regarding the economic efficiency indices for different fertilizations, a gradual increase in the profit of this crop was observed from 1,282 to 1,940 RON/ha by applying fertilization with nitrogen and phosphorus or nitrogen, phosphorus, and potassium. The effect of fertilization on the economic efficiency of the crop was less in the case of the density of 66,756 g.g./ha associated with a variation of the profit of 1,503 RON/ha and the profit rate of 118.91%, while on the background of the density of 53,908 g.g./ha the profit varied by 1,692 RON/ha, and at 49,261 density, the profit rate had the highest amplitude (128.93%) between fertilizations. Considering the interaction with the soil works, fertilization showed a higher influence on the economic efficiency in the case of the agricultural fund prepared by scarification, where there was a variation of the profit of 1,794 RON/ha and the profit rate of 160.46%, while on the agricultural fund prepared by ploughing, the variations were 1,646 RON/ha, i.e., 147.36%. Considering the economic efficiency indices from the year 2022 (Table 6), it can be observed that the profit rate recorded a variation between 69.53% for the technological variant $D_1F_1T_3$ and 171.37% for $D_3F_1T_2$. The profit showed a variation between 849 RON/ha in the case of plants grown at a density of 49,261 g.g./ha on unfertilized agricultural land prepared by scarification + ploughing and 1,990 RON/ha for plants grown at a density of 59,524 g.g./ha on fertilized land with $N_{50}P_{50}K_0$ and prepared by ploughing. In 55% of cases, the studied technological variants presented a profit of over 1,500 RON/ha.

Thus, in 2022, the highest economic efficiency was obtained by using the density of 59,524 g.g./ha on non-fertilized agricultural land where scarification was used, which allowed a profit of 1,932 RON/ha associated with a profit rate of 129.75%.

Also, a high economic efficiency was found in the case of plants grown at a density of 66,756 g.g./ha (D_4) on unfertilized agro-funds and prepared by ploughing or scarification, which allowed profit rates of 72.53-168 .97% associated with profits of 1,310-1,990 RON/ha. When growing plants at a density of 49,261 g.g./ha (D_1), the profit showed an amplitude between 849 RON/ha for the non-fertilized agricultural land where the association of scarification + ploughing was applied and 1,574 RON/ha for the agricultural land prepared by ploughing + fertilisation with $N_{50}P_{50}K_{50}$. The rate of profit in these crop conditions varied from 69.53% for the combination of scarification + ploughing on unfertilized agricultural land to 148.25% in the case of scarification on unfertilized agricultural land.

Table 6. Indices of economic efficiency of sunflower in Timişoara in 2022 for different technological links

Technological links	Yield (kg/ha)	Income (RON/ha)	Costs (RON/ha)	Profit (RON/ha)	Profit rate/ha (%)
$D_1F_1T_1$	1,631	2,137	921	1,216	132.03
$D_1F_1T_2$	1,783	2,336	941	1,395	148.25
$D_1F_1T_3$	1,580	2,070	1,221	849	69.53
$D_1F_2T_1$	2,114	2,769	1,247	1,522	122.05
$D_1F_2T_2$	2,094	2,743	1,267	1,476	116.50
$D_1F_2T_3$	2,152	2,819	1,547	1,272	82.22
$D_1F_3T_1$	2,284	2,992	1,418	1,574	109.10
$D_1F_3T_2$	2,173	2,847	1,438	1,409	97.98
$D_1F_3T_3$	2,336	3,060	1,718	1,342	78.11
$D_2F_1T_1$	1,747	2,289	944	1,344	142.37
$D_2F_1T_2$	1,730	2,266	964	1,302	135.06
$D_2F_1T_3$	1,844	2,416	1,244	1,172	94.21
$D_2F_2T_1$	2,259	2,959	1,270	1,689	132.99
$D_2F_2T_2$	2,205	2,889	1,290	1,598	123.87
$D_2F_2T_3$	2,386	3,126	1,570	1,555	99.04
$D_2F_3T_1$	2,200	2,882	1,441	1,441	100.00
$D_2F_3T_2$	2,307	3,022	1,461	1,561	106.84
$D_2F_3T_3$	2,288	2,997	1,741	1,256	72.14
$D_3F_1T_1$	1,996	2,615	972	1,643	169.03
$D_3F_1T_2$	2,055	2,692	992	1,700	171.37
$D_3F_1T_3$	2,057	2,695	1,272	1,422	111.80
$D_3F_2T_1$	2,405	3,151	1,298	1,852	142.68
$D_3F_2T_2$	2,480	3,249	1,318	1,930	146.43
$D_3F_2T_3$	2,315	3,033	1,598	1,434	89.74
$D_3F_3T_1$	2,507	3,284	1,469	1,815	123.55
$D_3F_3T_2$	2,612	3,422	1,489	1,932	129.75
$D_3F_3T_3$	2,595	3,399	1,769	1,630	92.14
$D_4F_1T_1$	2,040	2,672	1,008	1,664	165.08
$D_4F_1T_2$	2,111	2,765	1,028	1,737	168.97
$D_4F_1T_3$	2,008	2,630	1,308	1,322	101.07
$D_4F_2T_1$	2,538	3,325	1,334	1,990	149.17
$D_4F_2T_2$	2,350	3,079	1,354	1,724	127.32
$D_4F_2T_3$	2,412	3,160	1,634	1,525	93.33
$D_4F_3T_1$	2,539	3,326	1,506	1,821	120.92
$D_4F_3T_2$	2,420	3,170	1,526	1,645	107.81
$D_4F_3T_3$	2,378	3,115	1,806	1,310	72.53

Source: Own calculation.

On the background of the density of 53,908 g.g./ha (D_2), the profit recorded values between 1,172 RON/ha for the non-fertilized agricultural land where scarification associated with ploughing was used and 1,689 RON/ha for the variant represented by the association of ploughing + $N_{50}P_{50}K_0$. Regarding the profit rate, an amplitude of 72.14% is observed for the $N_{50}P_{50}K_{50}$ combination based on the use of scarification + ploughing up to 135.06% in the case of ploughing the unfertilized agrofund.

With the density of 59,524 g.g./ha (D_3), the profit recorded levels between 1,422 RON/ha for the non-fertilized agricultural land where the association of scarification + ploughing was applied and 1,930 RON/ha for the agricultural land prepared by scarification + fertilized with $N_{50}P_{50}K_0$.

The rate of profit in these conditions varied from 89.74% for the agricultural land fertilized with $N_{50}P_{50}K_0$ where the combination of scarification + ploughing was applied, up to 171.37% in the case of the unfertilized agricultural land prepared by scarifying. Under the effect of the density of 66,756 g.g./ha (D_4), the profit recorded values with limits between 1,310 RON/ha for the agricultural fund fertilized with $N_{50}P_{50}K_{50}$ where scarification + ploughing was used and 1,990 RON/ha for the variant represented by the combination of ploughing + $N_{50}P_{50}K_0$. Regarding the profit rate, an amplitude of 72.53% is observed for the combination of the $N_{50}P_{50}K_{50}$ variant based on the use of scarification + ploughing, up to 168.97% in the case of unfertilized agricultural land where scarification was used. Regarding the economic efficiency indices for different densities in the conditions of 2022 (Table 7), it can be observed that the profit rate was between 102.84% for the density of 49,261 g.g./ha and 126.16% for the density of 59,524 g.g./ha.

Thus, considering the unilateral effect of crop density, a gradual increase in the economic efficiency of this crop can be seen by changing the density from 49,261 to 59,524 g.g./ha, subsequently the increase in plant density being associated with a slight reduction in profit.

Table 7. Indices of economic efficiency of sunflower in Timisoara in 2022 for different technological links

Technological links		Yield (kg/ha)	Income (RON/ha)	Costs (RON/ha)	Profit (RON/ha)	Profit rate/ha (%)
Density (g.g./ha)	**49,261**	2,016	2,641	1,302	1,339	102.84
	53,908	2,107	2,761	1,325	1,435	108.30
	59,524	2,336	3,060	1,353	1,707	126.16
	66,756	2,311	3,027	1,389	1,638	117.93
Fertilisation	**$N_0P_0K_0$**	1,882	2,465	1,068	1,397	130.81
	$N_{50}P_{50}K_0$	2,309	3,025	1,394	1,631	117.00
	$N_{50}P_{50}K_{50}$	2,387	3,126	1,565	1,561	99.74
Tillage	**Ploughing**	2,188	2,867	1,236	1,631	131.96
	Scarification	2,183	2,860	1,237	1,623	131.20
	Scarification+ Ploughing	2,188	2,866	1,517	1,349	88.92

Source: Own calculation

Considering the interaction with the soil works, the density of the crop showed a higher influence on the economic efficiency in the case of the agricultural fund prepared by scarification where a variation of the profit of 1,339 RON/ha and the profit rate of 102.84% was observed, while on the agricultural land prepared by scarification + ploughing, the amplitudes were 1,349 RON/ha, i.e., 88.92%.

The economic indices for the fertilized variants, from the point of view of profit, showed that fertilization showed a higher influence on the background of the density of 53,908 g.g./ha, and less at 66,756 g.g./ha.

Considering the unilateral effect of tillage in Table 6, it is observed that the effect on crop profit was more evident in the case of the density of 66,756 g.g./ha and less for the density of 53,908 g.g./ha. The amplitude of the profit rate between soil works was lower at the densities of 49,261-53,908 g.g./ha and higher for the densities of 59,524-66,756 g.g./ha. The economic efficiency of the soil works was inversely proportional to the level of fertilization, obtaining a high variation in the case of the unfertilized agrofund and lower on the agrofund fertilized with $N_{50}P_{50}K_{50}$. Regarding the economic efficiency for different densities, in the period 2020-2022 it was found that the climate conditions had the highest influence on the economic indices related to the density of 49,261 g.g./ha. In the respective crop conditions, the profit recorded values between 1,000 RON/ha in 2020 and 1,533 RON/ha in 2021, while the profit rate varied from 91.32 to 128.93%.

For the density of 53,908 g.g./ha, the same trend is observed on the background of profit levels from 1,144 RON/ha in 2020 to 1,692 RON/ha in 2021 associated with a profit rate between 98.53% and 139.95%.

With a density of 59,524 g.g./ha, the profit recorded values between 1,501 RON/ha in 2020 and 1,802 RON/ha in 2021, while the profit rate varied from 126.88 to 146.15%.

With a density of 66,756 g.g./ha, a smaller variation was found from one year to the next on the background of profit levels from 1,482-1,503 RON/ha in 2020-2021 to 1,707 RON/ha in 2022 associated with a rate of the profit between 122.27-117.93% in 2021-2022 and 118.91% in 2020. As such, it is found that the effect of the climate conditions on the economic efficiency of the crop has decreased as the plant density increases, while obtaining the better indices at the density of 59,524 g.g./ha.

Considering the economic efficiency indices for different fertilization plans, it is observed that, on the non-fertilized agrofund, the profit rate was between 113.48% in 2020 and 140.15% in 2021, while the profit varied from 984 in 2020 to 1,631 RON/ha in 2022.

Under the conditions of fertilization with $N_{50}P_{50}K_0$, a smaller variation of the economic indices from one year to the next is noted, on the background of profit levels from 1,509 RON/ha in 2020 to 1,676 RON/ha in 2021 associated with a profit rate between 117.00% in 2022 and 131.45% in 2021.

When applying $N_{50}P_{50}K_{50}$, the profit recorded values between 1,351 RON/ha in 2020 and 1,940 RON/ha in 2021, while the profit rate varied from 96.71% to 135.83%. The impact of the variation of climate conditions on the economic efficiency of the crop was higher on the agrofund fertilized with $N_{50}P_{50}K_{50}$ and lower in the case of the treatment with $N_{50}P_{50}K_0$.

Fertilizers with nitrogen, phosphorus and potassium had a high effect on the economic efficiency of the crop in 2021, while those with nitrogen and phosphorus were used more efficiently from an economic point of view in the conditions of 2020 and 2022.

Considering the economic efficiency for different soil works, it was found that the climate conditions showed the highest influence on the economic indices on the agricultural land prepared by scarification, where the profit recorded values between 1,332 RON/ha in 2020 and 1,794 RON/ha in 2021, while the profit rate varied from 124.60 to 160.46%.

For the agricultural fund prepared by ploughing, profit levels are observed from 1,404 RON/ha in 2020 to 1,646 RON/ha in 2021 associated with a profit rate between 131.46 and 147.36%.

In the case of the agricultural fund where ploughing + scarification was used, the profit recorded values between 1,121 RON/ha in 2020 and 1,365 RON/ha in 2021, while the profit rate varied from 83.10% to 96.99%. As such, it was found that the effect of climate conditions on the economic efficiency of the crop was less on the agricultural land prepared by ploughing, in the conditions of obtaining the best indices on the agricultural land prepared by scarification, respectively a lower economic efficiency in the case of the agricultural land prepared with ploughing + scarification.

CONCLUSIONS

From a climate point of view, the analysed period (2020-2022) was characterized as follows:

- Regarding the rainfall regime, the least precipitation was recorded in the spring of 2020, the total amount of precipitation was 540 l/m^2, while the year 2022 stood out with a value of 470 l/m^2.
- Regarding temperatures, the highest temperature was recorded in July 2021, which was 25.7^{o}C. Average temperatures gradually increase from 5-6^{o}C at the beginning of spring to 16-17^{o}C at the beginning of summer. Seasonal averages ranged between 7 and 11^{o}C.
- Regarding the atmospheric pressure, the multiannual average is 984.4 mb. In 2020, an average below the value of 980 mb was recorded, which means a more intense cyclonic activity and, implicitly, many cases with intense wind.

Depending on the technological links and climate conditions, the economic efficiency indices had different values, from one year to the next, as follows:

In the climate conditions of 2020, the economic efficiency, on the unfertilized + ploughing agro-fund for the density of 66,756 g.g./ha (D_4) generated a profit of 1,808 RON/ha. Positive results were also recorded on the agricultural land fertilized with $N_{50}P_{50}K_0$ and prepared by ploughing or scarification at densities of 59,524÷66,756 g.g./ha, which generating profit rates of 151÷164%, associated with profits of 1,808÷1,847 RON/ha. At densities of 53,908 g.g./ha, unfertilized, scarification + ploughing, a profit of 827 RON/ha was recorded compared to 1,454 RON/ha in the option of associating scarification + $N_{50}P_{50}K_0$. In this case, the profit rate registered an increase from 68.30% associated with the treatment with $N_{50}P_{50}K_{50}$ + scarification + ploughing, to 129.13% in the case of fertilization with $N_{50}P_{50}K_0$ on the agricultural land prepared by scarification. Regarding the economic efficiency indices for different densities in 2020, the profit rate registered an evolution from 87.56% for 49,261 g.g./ha, to 126.88% for 59,524 g.g./ha. The increase in density (66,756 g.g./ha) is associated with the reduction of the profit rate (122.27%).

Regarding the evolution of economic efficiency in 2021, most of the technological variants recorded a profit rate above 100. The profit recorded a minimum of 812 RON/ha for the $D_2F_1T_3$ variant and a maximum of 2,210 RON/ha for $D_3F_3T_2$. The profit and profit rate were high (2,210 RON/ha corresponding to a profit rate of 164.31%) in the $D_2F_3T_2$ variant and in the case of the $D_3F_2T_2$ variant (2,049 RON/ha/171.03%), respectively $D_3F_3T_1$ (2,127 RON/ ha/157.67%), with a profit of 1,996 RON/ha and a profit rate of 170.08%. With densities of 53,908 g.g./ha, the profit shows an increase of 812 RON/ha for the $D_2F_1T_3$ agricultural fund, respectively of 2,210 RON/ha for the $D_2F_3T_2$ agricultural fund. Under these conditions, the profit rate varied from 71.98% for $D_2F_1T_3$, up to 176.70% in the case of the $D_2F_1T_1$ agricultural fund, while at a density of 59,524 g.g./ha, the profit was between 1,359 and 2,186 RON/ha and the profit rate between 106.97% for $D_3F_2T_3$ and 190.25% for $D_3F_1T_2$. Considering the unilateral, comparative effect of density, the amplitude of the profit rate between densities was lower (118.91%) in the unfertilized agrofund and higher (134.16%) in $N_{50}P_{50}K_{50}$. Soil works showed a reduced influence on the profit related to different densities, between 1,365 and 1,646 RON/ha.

The economic efficiency indices for different fertilizations registered a gradual increase in the profit of this crop from 1,282 to 1,940 RON/ha by applying fertilization with nitrogen and phosphorus or nitrogen, phosphorus, and potassium. The effect of fertilization on the economic efficiency of the crop was less in the case of the density of 66,756 g.g./ha associated with a variation of the profit of 1,503 RON/ha and the profit rate of 118.91%, while on the background of the density of 53,908 g.g./ha profit varied by 1,692 RON/ha, and at 49,261 density, the profit rate had the highest amplitude (128.93%) between fertilizations.

In 2022, the profit rate recorded a variation between 69.53% for the technological variant represented by $D_1F_1T_3$ and 171.37% for $D_3F_1T_2$.

The profit showed a variation between 849 RON/ha and 1,990 RON/ha for the plants grown at the density of 59,524 g.g./ha on the agrofund $N_{50}P_{50}K_0$ + ploughing. In 55% of cases, the studied technological variants presented a profit of over 1,500 RON/ha.

Thus, in the climate conditions of the year 2022, the highest economic efficiency was obtained by using the density of 59,524 g.g./ha on the unfertilized agro-fund where scarification was used, which allowed a profit of 1,932 RON/ha associated with a profit rate of 129.75, as well as in the case of plants grown at a density of 66,756 g.g./ha (D_4), on unfertilized agrofunds and prepared by ploughing or scarification, which allowed obtaining profit rates of 72.53-168.97% associated with profits of 1,310-1,990 RON/ha. At densities of 59,524 g.g./ha (D_3), the profit recorded levels between 1,422 RON/ha and 1,930 RON/ha and the profit rate varied from 89.74% to 171.37% in the case of unfertilized and scarified agricultural land.

Regarding the economic efficiency indices for different densities in the conditions of 2022, it is observed that the profit rate was 102.84% for the density of 49,261 g.g./ha and 126.16% for the density of 59,524 g.g./ha. There is a gradual increase in the economic efficiency of this crop by changing the density from 49,261 to 59,524 g.g./ha, subsequently the increase in plant density being associated with a slight reduction in profit. Considering the interaction with soil works, the crop density showed a higher influence on the economic efficiency in the case of the agricultural land prepared by scarification of 1,339 RON/ha and the profit rate of 102.84%, while on the agricultural land prepared by scarification + ploughing the amplitudes were 1,349 RON/ha, i.e., 88.92%.

The economic indices for the fertilized variants showed that fertilization had a higher influence on the background of the density of 53,908 g.g./ha, and lower at 66,756 g.g./ha.

Regarding the economic efficiency for different densities, in the period 2020-2022 it was found that the climate conditions showed the highest influence at densities of 49,261 g.g./ha, when the profit recorded values between 1,000 RON/ha in 2020 and 1,533 RON/ha in 2021, while the profit rate varied from 91.32 to 128.93%.

For the density of 53,908 g.g./ha, the same trend was observed, on the background of profit levels from 1,144 RON/ha in 2020 to 1,692 RON/ha in 2021 associated with a profit rate between 98.53% and 139.95%. With a density of 59,524 g.g./ha, the profit recorded values between 1,501 RON/ha in 2020 and 1,802 RON/ha in 2021, while the profit rate varied from 126.88 to 146.15%.

With a density of 66,756 g.g./ha, a smaller variation is found from one year to the next, on the background of profit levels from 1,482-1,503 RON/ha in 2020-2021 to 1,707 RON/ha in 2022 associated with a rate of the profit between 122.27-117.93% in 2021-2022 and 118.91% in 2020. Thus, the effect of climate conditions on the economic efficiency of the crop decreased as the plant density increased, on the background of obtaining the most good indices at the density of 59,524 g.g./ha.

Taking into account the indices of economic efficiency for different fertilization plans, it was observed that, on the unfertilized agrofund, the profit rate was between 113.48% in 2020 and 140.15% in 2021, while the profit varied from 984 in 2020 to 1,631 in 2022, while under conditions of fertilization with N50P50K0, a smaller variation of the economic indices from one year to the next was noted on the background of profit levels from 1,509 RON/ha in 2020 to 1,676 RON/ha in 2021 associated with a profit rate between 117.00% in 2022 and 131.45% in 2021. Nitrogen, phosphorus, and potassium fertilizers had a high effect on the economic efficiency of the crop in 2021, while those with nitrogen and phosphorus were capitalized more efficiently from an economic point of view in the conditions of 2020 and 2022.

Considering the economic efficiency for different soil works, it was found that the climate conditions showed the highest influence on the economic indices on the agricultural land prepared by scarification, where the profit recorded values between 1,332 RON/ha in 2020 and 1,794 RON/ha in 2021, while the profit rate varied from 124.60 to 160.46%. For the agricultural fund prepared by ploughing, profit levels were from 1,404 RON/ha in 2020 to 1,646 RON/ha in 2021 associated with a profit rate between 131.46 and 147.36%. If ploughing was used in combination with scarification, the profit recorded values between 1,121 RON/ha in 2020 and 1,365 RON/ha in 2021, while the profit rate varied from 83.10% to 96.99%.

As such, it was found that the effect of climate conditions on the economic efficiency of the crop was less on the agricultural land prepared by ploughing, in the conditions of obtaining the best indices on the agricultural land prepared by scarification, respectively a lower economic efficiency in the case of the agricultural land with ploughing + scarification.

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LOCALIZATION OF TOURIST BUSINESS IN THE RURAL TERRITORY OF BULGARIA

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Abstract

The purpose of this publication is to offer an analysis of the possibilities for diversification of the local economy by exploring the attitudes of stakeholders towards the localization of alternative tourism within the territorial scope.
The study is based on the following methods and information sources: analysis and summary of literature, graphical and schematic representation of characteristics and trends, comparative analysis, questionnaire survey. Main results - The regional specificities in the individual territories of Bulgaria have been established. Possibilities for stimulating types of tourism specific to individual regions, have been identified. The potential of individual territories for diversifying economic activities have been revealed. In conclusion, it can be said that the development of various initiatives related to alternative tourism is essential for the local economy. Also in view of the general development of other sectors and diverse activities in the municipalities, in order to offer a quality service, respectively to achieve positive effects on local economic development, it is necessary to take into account all aspects of the interrelationships of the various forms of alternative tourism with a number of socio-economic activities at the local level.

Key words**:** *rural areas, alternative tourism, economic diversification, localization*

INTRODUCTION

Interest in the management and development of Bulgarian rural territories has been significant for many years. In the past, these areas were characterized by well-established economic activities, vitality, good social and demographic development. After the industrialization, the migration processes to the urban economy and employment in cities naturally increased. In in the current situation of economic system transformations, the interest in rural territories and the opportunities for unleashing their full potential has reawakened. By initiative of the Economic and Social Council, on 24 February 2023, an opinion was issued regarding “Vital and sustainable rural areas in Bulgaria in the context of the long-term vision of the EU”. It emphasizes that the “attention is again focused on rural areas as a place of ecological lifestyle and new opportunities for social and economic revival” [7].

The conceptual foundations of rural management and planning in Bulgaria are discussed in the publications of a number of Bulgarian authors in Bulgarian and foreign scientific journals. For example, some of the authors are exploring opportunities to improve the economic and social effects of rural development, through alternative employment models and diversification of the sources of income from multifunctional agriculture [4], [6]. The issues related to rural households, income, diversification of agriculture, potential of digital ecosystems, prospects for entrepreneurial initiatives and the benefits of the development of renewable energy sources have been discussed in publications by scientists from the three main economic universities in Bulgaria [11], [29], [2], [26]. Often, the attention is focused on the rural development perspectives in the context of sustainability, as well as the issues of sustainable development of business organizations and their sustainable functioning [12], [8], [10]. The focus is more and more shifted to the alternative options for achieving sustainability in rural areas, through the application of sustainable business models and diversification of economic activities outside the field of agriculture [22], [16], [20]. At the same time, Nikolova and Linkova study the problematic aspects in agricultural development and the difficulties that small and family farms are facing it terms of selling their production on the Bulgarian market [17], [23]. In the context of increased European funding, in the two periods of the Rural Development Programme - RDP (2007-2013 and 2014-2020), the Bulgarian scientists are studying their development in terms of innovation, strategies, human capital, rural economy, markets, utilization of plant biomass, etc. [33], [13], [31], [32], [14], [15], [30].

In recent years, the fundamental studies have focused the attention on the search of optimal solutions for development of rural territories in the conditions of transformation towards a sustainable economy. The studies examine the theoretical and methodological foundations in the pursuit of increasing their sustainability, as well as the importance of territorial approaches for achieving integrated and balanced regional and local development [18], [24]. The problems of sustainable development of agribusiness and rural areas are covered in the scientific publications of a scientific-research team with an approved for financing project application on the topic "Development of rural territories in the conditions of transformation towards a sustainable economy" (2021-2025). The project is funded by the Bulgarian National Science Fund at the Ministry of Science and Education and the project team includes members from the "D. A. Tsenov" Academy of Economics – Svishtov, the University of National and World Economy – Sofia, and University of Economics – Varna (the three main universities of economics in Bulgaria). In this regard, there is an ongoing analysis and assessment of various aspects that are essential for maintaining high levels of sustainability in local regional development. Some of the studies are related to the NUTS 3 classification of the regions and are focused on utilized agricultural area [19], demographic processes in rural areas [3], analysis and assessment of infrastructure potential in rural areas [27], added value on farms [5], etc. A comparative environmental risk analysis was carried out for individual planning regions in Bulgaria [34] and a reasoned innovative model of organic farming was proposed as an opportunity for sustainable development of rural areas in Bulgaria [28]. The human capital in rural areas is also a subject of attention, since it is a big problem in the Bulgarian conditions and considering the demographic collapse in recent years [25].

The creative pursuits of the project team are based on the conviction that, despite the growing interest in the analysis and assessment of the consequences and the interaction between authorities and organizations from different sectors of the economy, the research in relation to the change of economic systems and the imposition of sustainable regional models regarding the development and management of rural territories should be more comprehensive and in-depth.

Due to the dynamic development of regions, periodic and systematic studies should be performed in order to harmonize the regional development policy, and in particular – the development of rural territories in the direction of sustainability needs to be achieved on the basis of the implementation of well-thought-out development policies aimed at preserving the environment and biodiversity, including the production of food that is safe for health, etc.

The research is oriented towards the search for answers and possible solutions to certain social challenges with the aim of balanced development of the rural territories and sustainability of the economic, social, environmental and management aspects within its scope. In view of the Horizon Europe Programme [9] established for achievement of the UN's global Sustainable Development Goals by 2030, it should be considered that part of the transformation towards a more sustainable future is directly related to solving a number of problems that are naturally transferred to rural areas as well.

A study of Bulgarian authors and the derived classification of regions (NUTS-3) in Bulgaria proves that it is possible to form valid clusters consisting of certain types of regions, based on indicators for agricultural development and main categories of utilized agricultural areas. The proposed typology can be used for development of sectoral policies that ensure balanced regional development in the field of agriculture. This research approach is universal and can be applied in other EU countries based on a harmonized methodology for collecting statistical data [19].

Our choice of this specific topic and the formulation of its research purpose and tasks was predetermined by the insufficient research on the problems related to management and development of rural territories in the Bulgarian economy, on the background of institutional transformations and discrepancies in the maintenance and support resources available to the targeted programs, as well as the adopted formal rules. The unrevealed potential for development of alternative tourism in Bulgaria determines our interest in view of the possibilities to diversify the economic activities in rural areas, adding an important contribution to the local population and generating revenue from different target groups of tourists.

As mentioned above, the implementation of a fundamental scientific research project, based on which we implement various activities, is still ongoing. The scientific team defends the argument that*: the development of rural territories is predetermined by a variety of factors that have positive and negative impact and therefore adequate policies shall be adopted for their sustainable management and development.*

The main **research objective in this publication** is to offer an *analysis of the possibilities for diversification of the local economy by exploring the attitudes of stakeholders towards the localization of alternative tourism within the territorial scope.*

The tasks that are subject of attention in the study are several. These are:

(i)Analysis of trends in the development and management of rural territories in Bulgaria based on literary sources;

(ii)Survey of the attitudes of businesses towards the localization of alternative tourism in individual statistical regions;

(iii)Survey of the attitudes of administrative authorities and NGOs towards the localization of non-mass tourism on the basis of the planning areas;

(iv) Comparison and evaluation of the attitudes of business, administrative authorities and NGOs;

(v) Developing reasoned and systematic conclusions about the localization of alternative tourism as a contribution to the local economy and the community within the territorial scope.

MATERIALS AND METHODS

The study is based on the following analytical methods: analysis and summary of literature, graphical and schematic representation of characteristics and trends. The strength of the relation in the respondents' answers is measured by the correlation coefficients of Kramer and Pearson. The research model is based on distribution of surveys among representatives of the business, on the one hand, and representatives of the administrative authorities and NGOs, on the other. This allows for the possibility to explore the attitudes in a two-way direction and to provide comparative analysis by including identical questions. The survey was carried out in the period May 2023 – January 2024 and consisted of online forms that were filled in by representatives of different municipalities and districts according to planning regions.

RESULTS AND DISCUSSIONS

Substantial characteristics and trends in the development of rural territories in Bulgaria

The Strategic Plan for the Development of Agriculture and Rural Areas in Bulgaria - 2023-2027 is based on achieving long-term impact [35]. On the one hand are the optimal positioning of farmers and the implementation of environmentally friendly agricultural practices with multiple effects, and on the other hand – the development of rural territories in the conditions of transformation towards a sustainable economy. This foundational document brings to the fore the need to build the necessary conditions for a substantial improvement in the quality and conditions of life in rural areas, as well as for sustainable development and management of the local economy in a long-term temporal aspect. It builds on and further develops the ideas from the 2014-2020 programming period, forming expectations for achieving greater performance.

In the contemporary dynamic environment and conditions of life, despite the efforts of state authorities to support rural development and to minimize the negative factors, the expectations for the implementation of a "top-down" approach are still present. On the other hand, local communities that place greater value on the "bottom-up" approach are much stronger and demonstrate that it has a greater effect on stabilizing the local economy and on the community well-being. This explains also the regional differences between municipalities and the interest in "returning to the village" in some of them, while others remain threatened by depopulation.

In general, rural areas in Bulgaria are characterized by demographic problems, lack of labour force and human potential, population ageing, etc. Nevertheless, due to various factors, including the pandemic crisis of 2020, the increased environmental awareness and responsible attitude of groups of people, as well as the pressure on some professions, etc., there is a surge of young intelligent people who are changing their attitudes towards rural communities and are looking for peace away from the urban environment. As a result of this, an increasing number of families with young children, and not only, choose to live in villages, thus developing various business initiatives of a social, educational and other nature. More important is their conscious attitude to the natural environment and its contribution to the rural economy.

Naturally, in a retrospective look at the development of the Common Agricultural Policy (CAP), its impact should be considered in multiple directions – sustainable agricultural development, income policy, increasing the competitiveness of the area, implementing incentives for young farmers, maintaining and improving knowledge, developing skills and competences, using environmentally friendly agricultural practices, achieving real measurable environmental and social effects, etc.

According to the old definition in the "National Plan for Development of Agriculture and Rural Areas" based on the RDP, rural municipalities are all municipalities, which do not include a settlement with a population of more than 30,000 people.

In the new National Strategic Plan for the Development of Agriculture and Rural Areas in Bulgaria, what is distinctive about the definition of "rural area" is that it covers only municipalities on whose territory there is no settlement with a population of more than 15,000 people.

In some locations, the diversification of activities in rural areas through the development of tourism has a significant impact on the employment and income of the population, increasing the quality of life and the competitiveness of the Bulgarian economy. In these areas, it is possible to develop non-traditional tourism, which is different from the mass tourism. At this stage, the following types of alternative tourism are subject to most dynamical development in rural areas: *rural, agrarian and ecotourism*. They have a specific impact on local development, and in particular – on the socio-economic environment, the employment opportunities and the income of the population in the typical rural areas. This type of tourism allows farmers to expand their activities and increase their capital by adding value to their products. Diversification of activities in rural areas through development of tourism provides an opportunity for realization of entrepreneurial initiatives and stimulation of food production and local crafts, especially in areas where agriculture is not the main source of income. The strong connection and interdependence between economic actors in these key economic sectors is expressed in the successful combination of the interests of all stakeholders in the process of governance and development of the specific territory/region [20].

During the COVID-19 pandemic, the tourism sector was subjected to numerous restrictions, which inevitably affected domestic and international travel as well as income from tourism activities. At the same time, there was a tendency for increased visits to small family hotels and guest houses in rural areas.

Despite the above, in recent years there are more and more local initiatives for implementing projects with European funding, for improving the infrastructure potential, community centre activities, guest houses, etc. Successful in this regard are the local action groups applying the Leader approach. These processes have provoked the interest in studying the attitudes of stakeholders in rural territories with an aim to increase their levels of sustainable development. Undoubtedly, a contribution in this respect is also the availability of untapped resource potential in certain territories. Important aspect here is the harmonization and interaction of all stakeholders that add value along the chain in the process of achieving and raising the standard of living of the local population.

Survey of attitudes of the business, the administrative authorities and the NGOs towards the localization of alternative tourism

The participants in the process of formation and realization of the agro-tourist product are: *institutions; local authorities and communities; suppliers of tourist package components; "producers" of tourist products; tourists; tour operators and agencies* [21]. In the survey of the attitudes of businesses, administrative authorities and non-governmental organizations (NGOs) towards the opportunities for positioning an alternative tourism business, the question asked was: ***"How do you assess the importance of the economic sector of "alternative tourism (including rural tourism, ecological tourism, wine tourism, etc.)" for the strategic development of your municipality?".***

In surveys, very often a nominal or ordinal scale is used to describe the studied phenomena and processes, which have more than two definitions (varieties). In such cases, the correlation between the factor and the resultant variable is analysed by the correlation coefficients of interconnection. These coefficients are calculated on the basis of χ^2 and φ^2 – the characteristics between which the following relationship exists: $\varphi^2 = \frac{\chi^2}{N}$. The method of chi-squared seeks the answer to the question of whether the alleged relationship is not accidental, but statistically significant, and is manifested in the studied set of units [1].

Chi-squared (χ^2) is calculated with the following formula:

$$\chi^2 = \sum_{i=1}^{k}\left[\frac{\left(f_{ij}-\hat{f}_{ij}\right)^2}{\hat{f}_{ij}}\right]\text{...............................}(1)$$

where:

f_{ij} signifies the actual frequencies, $\hat{f}_{ij} = \frac{\sum f_{i\cdot}\sum f_j}{\sum\sum f_{ij}}$ expresses the theoretical frequencies, and $\boldsymbol{k}$ is the number of groups. For the application of the chi-squared method, a two-dimensional distribution was prepared, and for this purpose the units were simultaneously grouped according to the meanings of the answers to the respective survey questions. The correlation coefficients of Kramer and Pearson were used to establish the strength of the relation. They vary from zero to one and are calculated according to the formulas:

Cramer coefficient

$$V = \sqrt{\frac{\chi^2}{\sum\sum f_{ij}\, min \quad (k_1-1)(k_2-1)}};\text{...............}(2)$$

Pearson coefficient $\boldsymbol{C} = \sqrt{\frac{\boldsymbol{\varphi^2}}{\boldsymbol{1+\varphi^2}}}$..................(3)

Figure 1 represents the distribution of respondents (representatives of the business) according to the planning region and the answers given to the question in the "Strategic Development" section of the questionnaire, about the way they assess the importance of alternative tourism for the strategic development of the municipality in which their business operates.

Figure 1 represents the distribution of respondents (representatives of the business) according to the planning region and the answers given to the question in the "Strategic Development" section of the questionnaire, about the way they assess the importance of alternative tourism for the strategic development of the municipality in which their business operates.

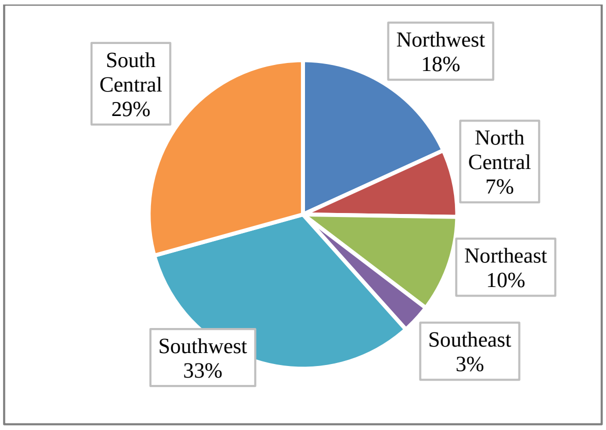

Fig. 1. Distribution of the surveyed representatives of the business, according to the planning region and their opinion on the importance of developing alternative tourism

Source: Authors' own calculations based on survey data.

It is evident that in the six planning regions in Bulgaria (NUTS2) the relative share of respondents representing the Southwest Planning Region is the highest (33%). This is explained by the fact that the development of alternative tourism in the region is favoured by the uniqueness of natural features, as well as by its strategic geographical location.

The potential of spa, cultural and business tourism is widely developed, as well as rural and ecological tourism, especially in the Blagoevgrad region (the villages of Leshten, Kovachevitsa, etc.). Therefore, it is quite logical that the respondents from this region have a larger share, compared to the representatives of the other regions. This region is the object of increased and constant interest from potential tourists of various nationalities. Respectively, the number of business structures is increasing, as well as the interest in developing a business related to alternative tourism (family hotels, guest houses, etc.).

The values for the South Central Region are approximately the same (29%), and a characteristic feature of this region is the perspective for development of alternative tourism due to the favourable natural resource potential, such as the Central Balkan National Park, the Rhodope Mountains, the ancient Thracian city of Perperikon, the Thracian sanctuaries (Tatul, Starosel, Hisarya, etc.), the mineral springs. This region ranks first among the others in the development of rural and ecological tourism.

It should be noted that the respondents from the Northwest Region occupy an intermediate position and third place (18%) in the relative share of attitudes towards the development of businesses related to alternative tourism. Being a vulnerable region with the least contribution to the country's overall GDP and the most underdeveloped in terms of economics for long period of time, it is of great importance that business representatives show interest in the development of tourism. A probable reason for this is that attention is focused on the resource potential of the given region, which has so far not been used sufficiently to diversify the local economy and to explore potential entrepreneurial niches.

The poor representation of respondents from the Southeast region (3%) can be explained by the intensive construction of hotels on the Bulgarian Black Sea coast and the recent environmental problems associated with Natura 2000. Nevertheless, this region also has the potential to develop alternative tourism (wine, hunting, ecotourism, etc.).

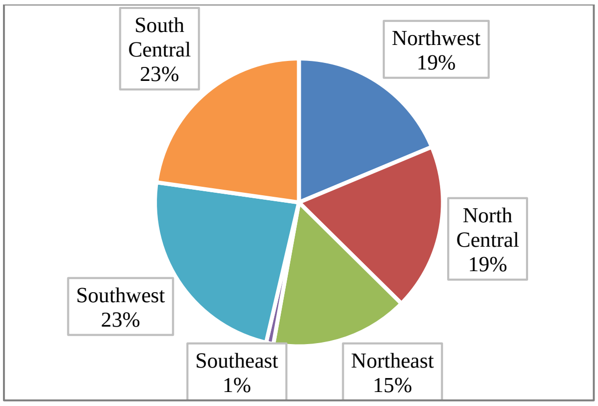

Fig. 2. Distribution of surveyed representatives of the administration and the NGOs according to the planning region and their opinion on the importance of developing alternative tourism

Source: Authors' own calculations based on survey data.

The Kramer coefficient is V = 0.26116, which indicates a weak correlation between the planning region and the opinion of business representatives on the importance of alternative tourism development. The Pearson coefficient C = 0.412141 implies a moderate correlation between the planning region and the opinion of business representatives on the importance of alternative tourism development.

The second figure (Figure 2) illustrates the respondents representing the administration and the NGOs according to the planning region and their opinion on the important role of alternative tourism and its development.

The trend in the percentage of respondents from administrative authorities and NGOs shows insignificant differences compared to that from the previous visualization representing the attitudes to development of business activities in the individual planning regions. The only significant difference is the higher share of respondents from the North Central Region (19%).

The Kramer coefficient V = 0.23746 indicates a weak correlation between the planning region and the opinion of administration and NGO representatives on the importance of alternative tourism development. The Pearson coefficient C = 0.380376 illustrates a moderate correlation between the planning region and the opinion of administrative and NGO representatives on the importance of alternative tourism development.

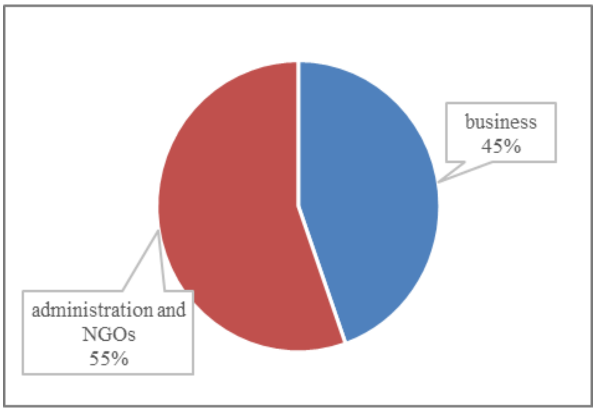

Fig. 3. Distribution of the surveyed representatives of the business and the administration and NGOs according to the planning region and their opinion on the importance of developing alternative tourism
Source: Authors' own calculations based on survey data.

The distribution of the surveyed representatives of business, administration and non-governmental organizations regarding the importance of alternative tourism and its development in the respective regions is presented in the following figure (Figure 3).

When examining the relationship between the distribution of respondents according to their belonging to a given region and their opinion about importance of alternative tourism development, it was concluded that both correlation coefficients - the Kramer coefficient V = 0.126212 and the Pearson coefficient C = 0.125219 indicate a weak relationship, i.e. between the representatives of the business and the administration and NGOs there are no significant differences in opinion on the importance of alternative tourism development in their municipalities, which means that its development is important and will reveal new opportunities for increasing local economic activity, etc.

In this case, we should add that localization is determined not only by natural, landscape and cultural values, but also by the desire and attitudes of local authorities, entrepreneurs, NGOs and associations, i.e. the will of all stakeholders. The results testify to the urgent need for adoption of adequate policies for implementation of the integrated management plans of each municipality. The goal is to achieve integrated territorial development in accordance with the resource potential and the possibilities for diversification of the rural economy. The possible ways to achieve this are expressed not only in the development of alternative tourism, but also in the use of the maximum possible potential of the territory, as well as the search and implementation of appropriate solutions for business localization and collaboration between all interested parties who can contribute for the development of local communities.

CONCLUSIONS

In conclusion, it can be said that according to the representatives of business, administration and non-governmental organizations, the development of various initiatives related to alternative tourism is of essential importance for the local economy. Also in view of the general development of other sectors and diverse activities in the municipalities, in order to offer a quality service, respectively to achieve positive effects on local economic development, it is necessary to take into account all aspects of the interrelationships of the various forms of alternative tourism with a number of socio-economic activities at the local level. The development in the direction of sustainability of rural territories depends to a significant extent on the effective diversification of both industrial activities and economic activities in them. Therefore, it is necessary to trace the aggregate impact of the economic activities, which are characteristic of each region and which contribute to solving significant problems. They are ultimately in direct relation with the current social challenges in the context of changing economic systems, as well as with the integrated development of individual rural territories, through the search and implementation of sustainable solutions.

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RESEARCH ON WEED CONTROL IN AN OAT CROP

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Abstract

Oats are more competitive with weeds than most other crops, especially when both the seed rate, due to its high twinning capacity, and the sowing season that will provide the oat crop with the vigor it needs to compete against weeds, through a good growth of roots and foliage, which will be reflected in their shading. With all these advantages, weed control is an essential and timely factor in obtaining a high production and quality of oats. The purpose of the present work was to determine the reserve of weed seeds in the soil, since their number and germinating ability make the soil the main source of weeding of agricultural crops, namely oats; the structure of soil weeding was also determined and the positive effect of applying the herbicide Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) against annual and perennial dicotyledonous weeds at a dose of 40 g/ha post-emergence was observed. The research was carried out on the Ovidiu variety, during the vegetation period of 2021 in Mircea Vodă commune, Brăila county. The degree of weeding in the oat variety Ovidiu decreased, as a result of the application of the Granstar® Super herbicide, from 147.2 weeds/m^2 to 6.1 weeds/m^2. The application of the Granstar® Super herbicide led to a very significant increase in production in the case of the Ovidiu oat variety, of 380 kg/ha.

***Key words**: weeds, control, herbicide, oat*

INTRODUCTION

Herbicide use is more and more widespread around the world and is of particular importance in the context of dealing with the lack of labor in agriculture [7]. The intelligent use of herbicides as a curative method has often replaced the need to use different types of tillage for weed control [25].

The need to continue research on reducing the degree of weeding is current, because the chemical industry provides farmers with new herbicides and, on the other hand, until now no herbicide has been created that destroys the entire spectrum of weeds existing in a crop.

Particular importance must be given to the preparation of optimal technologies for combating annual and perennial weeds for each crop, depending on the existing approved herbicides, the level of infestation, the spectrum of weeds and, last but not least, the regional climatic conditions [6, 3, 17].

Weeds are present in all field crops, regardless of the areas in which they are grown, and the losses they cause consist in decreasing yields, increasing production costs and degrading product quality [22].

Weeds have a greater negative impact on yields than insects and diseases. Worldwide weeds are responsible for significant crop yield losses in the order of 10% per year [15].

Weeds are problematic in any agricultural crop as that they it causes important economic losses, because weeds compete with crops mainly for nutrients, water and light [31]. In agriculture, the damage caused by weeds is of various sizes, irreparable and diversified. The magnitude of losses is related to weed spectrum, timing of weed emergence in the crop, weed density and stage of crop development relative to the competition period [21].

In Romania, crop yields can be reduced quantitatively by values between 20% and 60% [19].

The effectiveness of the operation to combat weeds in cereal crops depends to a large extent on the knowledge of the biological particularities of the various species, and the main objective is represented by the elimination of weed competition below the level of the damage threshold throughout the vegetation period, in order to reduce water consumption and nutrients by them, so that the cultivated plants develop normally, in order to obtain high productions/ha, qualitative and at the level of the biological potential of the cultivated hybrids and varieties [20].

The application of herbicides is an important strategy so that the culture emerges victorious from this competition at the expense of the weeds [14]. Weed control techniques must to achieve a balance between cost of control and crop yield loss, in the present case it is oats, and the herbicide contributes to the achievement of economic and agricultural objectives [29]. The application of herbicides must be done in accordance with good agricultural practices, rules drawn up by the EU and approved by the Ministry of Agriculture and Rural Development [12,16, 27]. In 2020, Romania used the lowest amount of pesticides/ha, respectively 0.8 kg a.s. [24].

Oats are all the more competitive with weeds when the seed rate is respected, due to its greater capacity for twinning. Sowing at the optimum time provides oat with the necessary vigor to compete against weeds, as there is a dynamic growth of roots and leaf surface (they can create a dense canopy) that shade the soil well [1, 4]. Canopy size varies with cultivar height, so taller oat varieties tend to have a larger canopy. In addition, a larger canopy positively influences photosynthetic energy, reflected in increased production[30].

Increasing seed rate almost always increases crop yields and reduces weed biomass when present [13]. In oats, it was found that a doubling of plant density as a result of increasing seed density/m^2 from 250 to 500 favored an average yield increase of 5% in weeded plots [26].

Currently, weed control in oat crops is more difficult to achieve because there is a limited range of herbicides available compared to other grass cereal crops. In addition, herbicides applied post-emergence to oats are intended to combat dicotyledonous, broad-leaved weeds.

The exact knowledge of the critical situations, the infested surfaces, the dominant species in different soils, allow the farmer to plan in advance the necessary mechanical means, fuel, herbicides, etc., for a high-performance management of weeds, with minimum expenses and with maximum certainty for the success of this decisive action for the level and quality of the harvest, under conditions of minimal environmental pollution [23].

The adoption of herbicides for weed control, which experienced a very strong advance in the 1950s and 1960s, helped to lower production costs and at the same time increase crop yields, as herbicides were cheaper and more effective than hand weeding [7].

In this context, the purpose of the research carried out in the experimental field was to combat the weeds present in the oat crop, by applying the phytosanitary treatment with the Granstar® Super herbicide at the optimal time, respecting the dose recommended by the manufacturer and without having a negative impact on the environment.

MATERIALS AND METHODS

Field experiments were conducted in 2021 to evaluate herbicide efficacy Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) against annual and perennial dicotyledonous weeds and impact on yields of spring oat Ovidiu variety.

Application dose against annual and perennial dicotyledonous weeds in oats of Granstar® Super herbicide: 40 g/ha + 250 ml/ha Trend® adjuvant, which has the role of increasing the effectiveness of the herbicide, as it increases adhesion and facilitates the penetration of the active substance into the tissues, post-emergent, from the appearance of the first 2 leaves-BBCH 12, until the appearance of the standard leaf-BBCH 39 [33, 34,11].

Ovidiu is a spring oat variety created at the Lovrin Agricultural Research and Development Station, approved in 2019.

The Ovidiu spring oat variety is characterized by a high and stable production capacity (approx. 5,000 kg/ha, and its genetic potential is over 7,000 kg/ha), having good to very good resistance to agroclimatic conditions, especially in drought and heat, it is resistant to falling.

It has a percentage of crude protein of 14% - 16%, the mass of one thousand grains (TGM) of 30-35 g, and the hectoliter mass (HLM) is high: 45 -50 kg. The average number of grains in the panicle is approx. 100 [32].

The research was carried out in the oats experimental fields from Mircea Vodă commune, Brăila county at 45°7′40″ latitude and 27°22′37″ longitude, in natural conditions during the vegetation period of 2021.

The soil is chernozem type.

Weed mapping is a basic method in modern agriculture and consists in the quantitative and qualitative determination of the degree of weediness of the soils of an agricultural farm [2, 9].

After mapping the weeds, the obtained results are entered into the tables and based on this operation executed with responsibility and competence, it will be possible to scientifically substantiate the measures to combat the weeds on the farm [8,10].

Climate is one of the dynamic components of the environment, which greatly influences the appearance of weeds [28].

In the research area, the climate is type Dfb (Köppen formula), D: continental climate with hot summers and cold winters; f: summers wetter than winters; b: the temperature of the warmest month > 22ºC and the temperature of the coldest month below - 4ºC.

The climate is continental, with arid nuances. Average annual temperature of 10.5°C. Average annual precipitation is approx. 500 mm and are distributed unevenly during the year [18].

In the present work, we used the numerical quantitative method (expedited and accurate) to map the weeds in the oat culture, which consisted in counting the weeds for each species on a sample area of 1 m^2/point.

The experience regarding the influence of the Granstar® Super herbicide in combating weeds in oats was of a monofactorial type, with 2 variants: V1-unherbicated control; V2-herbicide with Granstar® Super.

RESULTS AND DISCUSSIONS

Determination of weed species and the degree of weediness in oats

The determinations were carried out 3 days before the application of the Granstar® Super herbicide, in 5 points/plot (Table 1), and the determinations regarding the effectiveness of the herbicide application were carried out 3weeks before the harvest (Photo 1), in 2 points/plot according to the recommendations of the specialists [5].

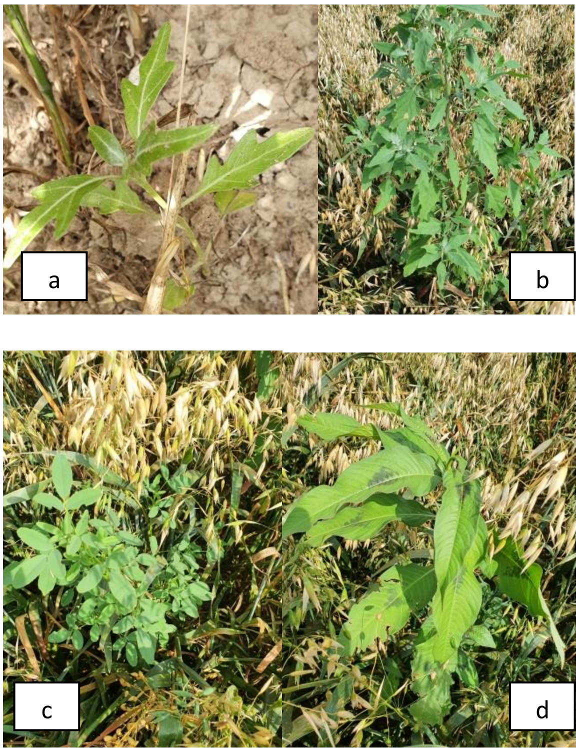

Photo 1. a) *Sonchus arvensis*, b) *Chenopodium album*, c) *Medicago sativa*, d) *Polygonum persicaria*
Source: Original photo taken by Popa A.

As can be seen, in oat culture, in 2021, 7 species of annual dicotyledonous weeds were identified: *Brassica nigra*, *Chenopodium album*, *Galium aparine*, *Polygonum persicaria*, *Polygonum aviculare*, *Polygonum convolvulus* and *Xanthium italicum*, two weed species perennial dicots: *Cirsium arvense* and *Sonchus arvensis*, an annual monocot: *Setaria* sp. and *Medicago sativa*, which is classified in the present case as a perennial dicotyledonous weed.

The average number of weeds, before the herbicide,was 147.2 plants/m^2.

Observing the data from the participation column, it is concluded that the species *Setaria* sp. (28.53%) and *Polygonum* *aviculare* (25.95%) are dominant, and the species *Galium aparine* (14.0%), *Brassica nigra* (10.33%) and *Chenopodium album* (8.83%) are codominant species.

Species whose constancy (k%) exceeded 60% show that they are present in most of the soil and depending on them the type of herbicide is chosen.

Only *Xanthium italicum* had a sporadic presence in the plot, which is explained by the low constancy of 20%.

The specification of the botanical class is of practical importance since it must be taken into account when choosing the herbicide that perennial dicotyledonous weeds are more difficult to destroy than annual dicotyledonous weeds. All the information resulting from the determinations and calculations performed (phenophase, sum and average of species, participation, constancy and botanical class) give a complete picture of the situation in the researched plot for the establishment of control measures.

Table 1. The weed species determined in the oat culture, (16.IV.2021) – preceding maize crop (original)

Species	Phenophase Height (cm)	Determination points					Sum of species (s)	Species average (a)	Participation (p%)	Constancy (k%)	Botanical class
		1	2	3	4	5					
Brassica nigra	A6	10	22	18	11	15	76	15.2	10.33	100	Da
Chenopodium album	A3	2	14	11	22	16	65	13.0	8.83	100	Da
Cirsium arvense	A6	5	12	10	10	5	42	8.4	5.7	100	Dp
Galium aparine	A12	35	28	20	20	-	103	20,6	14.0	80	Da
Medicago sativa	A20	1	1	-	2	-	4	0.8	0.54	60	Dp
Polygonum persicaria	A8	3	6	2	-	4	15	3.0	2.04	80	Da
Polygonum aviculare	A8	42	35	36	48	30	191	38.2	25.95	100	Da
Polygonum convolvulus	A6	10	5	-	-	7	22	4.4	2.99	60	Da
Setaria sp.	A1	42	21	32	65	50	210	42.0	28.53	100	Ma
Sonchus arvensis	A4	1	3	2	-	-	6	1.2	0.82	60	Dp
Xanthium italicum	A4	-	-	-	2	-	2	0.4	0.27	20	Da
		151	147	131	180	127	736	147.2	100.0		

Legend: A-plant without reproductive organs.
Source: Original results.

The influence of Granstar® Super herbicide in the control of weeds in oats

The time of application of the Granstar® Super was in the phenophase of 4 internodes of oats.

Agrophytotechnical measures from land preparation to harvesting were the same in all variants.

To highlight the role of herbicide application, two insecticide treatments were applied in the variants in combination with two fungicides, so that pests and diseases do not influence the productions.

In 2021, we recorded a very significant increase in production, of 3.8 q/ha in the herbicide variant with Granstar® Super 50 SG (Table 2).

Table 2. Ovidiu oat variety production, following herbicide application in 2021 (original)

Variant	Productions		Difference q/ha	Significance
	q/ha	%		
Control	45.1	100	-	-
Granstar® Super	48.9	108.43	3.8	***
DL 5%(*)= 1.4 q/ha; DL 1%(**)= 2.6 q/ha; DL 0.1%(***)= 3.1 q/ha.				

Source: Original results.

The average number of weeds, after herbicide, was 6.1 plants/m^2.

In 2021, good results were obtained in terms of weed control, due to the fact that the elimination was successful and thus the main objective, the reduction of the degree of infestation, was achieved.

CONCLUSIONS

The application of the herbicide Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) did not cause phytotoxic symptoms for the cultivated oat variety - Ovidiu.

Although oats can be competitive against weeds, the application of herbicides favored the increase of production.

It is very important to consult the herbicide label for the most up-to-date product information.

It is of particular importance to respect the recommended dose of herbicide application, as well as the time of application, which contributes to avoiding pollution of the environment and production, with positive effects on the health of the final consumer, animals or people.

To ensure effective weed control, their maximum height must also be taken into account, without harming the oat plants either (avoid the occurrence of phytotoxicity).

The control and management of the weeding condition occupies an important role in the technological links of any culture.

Despite the fact that there is a systematic and sustained fight against weeds, they continue to decrease the quality of production and damage their quality.

Herbicide phytosanitary treatment is an important part of oat production.

Effective crop monitoring will help farmers make the right decisions about when to apply herbicides.

Accurate knowledge of infested areas and dominant species allows farmers to plan in advance the required mechanical equipment, fuel and herbicides for successful weed control with minimal environmental pollution.

Before weeding, the average degree of weeding was 147.2 weeds/m^2, and after the application of the Granstar® Super herbicide- 40 g/ha, the average degree of weeding was only 6.1 weeds/m^2, at the time of determination, 3 weeks before harvest.

Following the application of phytosanitary treatment with the Granstar® Super herbicide, a superior efficacy of 95.86% was recorded.

The existence of some weeds among the oat plants, before harvesting, is attributed to their later emergence.

Biotic factors (weed species) play a limiting role in the oat culture, materialized by the quantitative decrease of 380 kg/ha of production, in the present experience.

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RESEARCH ON THE EFFECTIVENESS OF SOME INSECTICIDES IN COMBATING PESTS IN AN OAT CROP

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Abstract

The behavior of oat varieties against harmful insects is an essential agronomic property. In the protection of plants in general and in oat culture, in the present case, insecticides will be applied only at the times when they are needed and in the optimal doses. In addition to respecting the technological links (quality ploughing, crop rotation, sowing in the optimal season), combating oat pests is a priority to minimize quantitative and qualitative production losses. In this work, the identified harmful species are presented: Sitobion avenae, Helicoverpa armigera, Haplodiplosis marginata, Haplothrips tritici, Agrotis segetum, Phorbia fumigata and mites,as well as the effectiveness of insecticide treatments based on cypermethrin 100 g/liter (Faster 10 CE), lambda-cyhalothrin 50 g/liter (Karate Zeon® 50 CS) and deltamethrin 100 g/liter (Decis® Expert 100 EC) against them. The research was carried out under conditions of natural infestation of the Ovidiu variety, during the vegetation period of 2021 in Mircea Vodă commune, Brăila county. Among these species, the greatest abundance was represented by the species Sitobion avenae. The effectiveness of the insecticide treatments applied to the oat crop was reflected in a very significant increase in production of 325 kg/ha in the case of the Karate Zeon® 50 CS product, a distinctly significant increase of 279 kg/ha in the case of the Decis® Expert 100 EC product and a insignificant increase, of 130 kg/ha, in the case of the product Fastac 10 CE.

Key words: *oats, pests, insecticides, effectiveness*

INTRODUCTION

Spring oats (*Avena sativa* L.), is an annual grass belonging to the family *Poaceae* and is planted for a late summer harvest.

Oats were initially cultivated as a green manure for wheat and barley crops [2].

At present, oats can be used to produce oatmeal or oat flour used for oat cakes or oat bread, but less than five percent of the world crop is used as human food, while most of the oats are used as livestock feed (horses and young stock of other animal species and poultry) [29].

Oats is an important cereal in Romania, besides maize, wheat, barley, both in conventional and organic agricultural cultivation system [17].

It is assumed that insects have been around for approx. 250 million years. Of the over 1 million species worldwide, approx. 10,000 eat crops, and of these, about 700 species cause the most damage to agricultural crops [34].

Although the first substances with an insecticidal effect date back to the time of Homer, around 1000 BC, it was only after the Second World War that the first synthetic organic insecticides appeared [33]. Worldwide losses caused by insects are about 18 (20-37)% of production [13, 20].

The grow population of the world will cause an increased global demand for food and more intensive food production is associated with more intensive use of insecticides [30].

Along with population growth, the amount of pesticides used in agriculture will increase (a 2.7-fold increase is estimated in 2050 compared to 2000), which could create problems for people and the environment. In order to reduce the risks, the most optimal solutions will be chosen to combat harmful insects, and the insecticides used must be safe, affordable, and effective at the same time [28].

Although oat are not targeted by a great species number of insects some of them such as cutworms, wireworms and aphids can all cause damage to oat [22].

Farmers usually face a oat harvest management problem due to loss caused by a variety of insect pests [19].

Production fluctuations recorded in oat culture are greatly influenced by the appearance of harmful insects and the variability of climatic conditions in its cultivation areas [21].

In this context, the purpose of the research carried out in the experimental field was to combat the pests present in the oat crop, by applying the phytosanitary treatment with Faster 10 CE (cypermethrin 100 g/liter), Karate Zeon® 50 CS (lambda-cyhalothrin 50 g/liter) and Decis® Expert 100 EC (deltamethrin 100 g/liter) insecticides at the optimal time, respecting the dose recommended by the manufacturers in the context of sustainable agriculture [5, 6, 11].

MATERIALS AND METHODS

To run this experiment, application doses approved in Romania against harmful insects in oats of Karate Zeon® 50 CS insecticide: 0.15 l/ha, Faster 10 CE: 0.15l/ha, and for Decis® Expert 100 EC: 62.5 ml/ha.

Karate Zeon® is a contact insecticide that, in addition to the quick and shock effect against pests, offers the longest period of protection, thanks to Zeon®technology [32].

Faster is an insecticide with a mode of action through contact and ingestion, having a broad spectrum of action on a diversity of insect species, with a high potential for damage in field crops. The approval of Faster 10 CE insecticide expired on 01.02.2023, with a grace period for the use/exhaustion of stocks from farmers, until 01.08.2024 [4].

Decis® Expert acts by contact and ingestion on harmful insects in the larval and adult stages. Deltamethrin is a synthetic pyrethroid that paralyzes the insect's nervous system and has a rapid knockdown (shock) effect of the insects, while also having a repellent and anti-feeding effect, thereby protecting the treated plants [8].

Field experiments were conducted in 2021 to evaluate insecticides efficacy Faster 10 CE, Karate Zeon® 50 CS and Decis® Expert 100 EC against harmful species and impact on yields of spring oat Ovidiu variety.

Ovidiu is a spring oat variety created at the Lovrin Agricultural Research and Development Station, approved in 2019.

The Ovidiu spring oat variety is characterized by a high and stable production capacity of approx. 5,000 kg/ha [1].

The research was carried out in the oats experimental fields from Mircea Vodă commune, commune located in the central-western part of Brăila county, on the right bank of the Buzău river, at 45°7′40″ latitude and 27°22′37″ longitude, in natural conditions during the vegetation period of 2021 [35].

The soil is chernozem type, favorable for growing oats.

Recent apparent global climate change may pose a threat to global food production (including that from oats) through direct effects on plant growth and changes in the prevalence and distribution of insect pests [9, 24].

Oats are a plant of temperate climates [2].

Climate is one of the dynamic components of the environment, which greatly influences the appearance of insects [36].

Climatic conditions and plant protection management are essential factors in obtaining high productions from a qualitative and quantitative point of view [15, 31, 37].

The main climatic parameters (maximum, minimum and average temperatures; atmospheric relative humidity and amount of precipitation) recorded during the oat vegetation period, which influence the emergence and development of harmful insects, can be found in Figures 1-4.

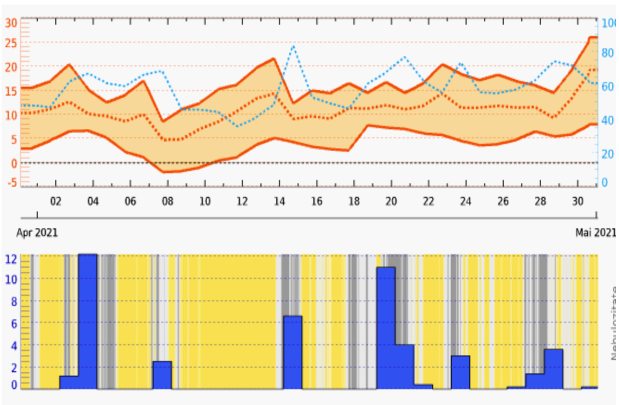

Fig. 1. Graph: top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). April, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

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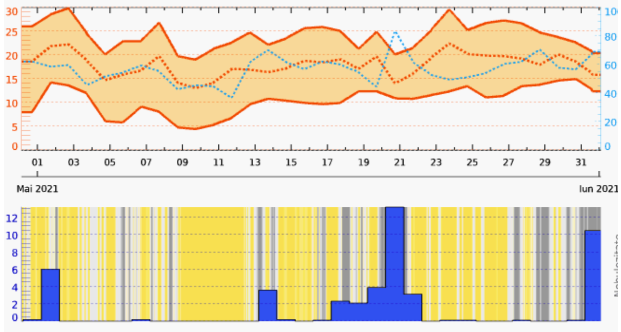

Fig. 2. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). May, 2021.
Source: Source: Meteoblue.com, Archive Meteo București [18].

The modification of abiotic factors manifested in the conditions of climate warming by the installation of particularly warm periods, in the spring-summer months, favors the development of the populations of a narrow spectrum of species, which become dominant and dangerous through numerical increases, reflected in strong attacks [16].

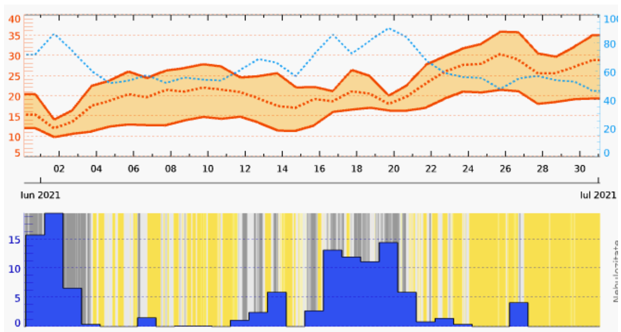

Fig. 3. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). June, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

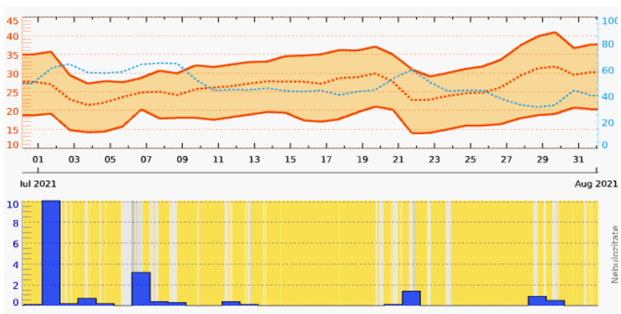

Fig. 4. Graph top: temperatures (red) and relative air humidity (light blue); Graph down: precipitation (mm). July, 2021.
Source: Meteoblue.com, Archive Meteo București [18].

The experience regarding the influence of insecticides in combating harmful insects in oats was of a monofactorial type, with 4 variants: V1-control variant (not treated with insecticide); V2-treatment with Faster 10 CE;V3-treatment with Karate Zeon® 50 CS insecticide; V4-treatment with Decis® Expert 100 EC insecticide.

Sampling was carried out with the help of the entomological net by "mowing", i.e. by a fixed number of movements (30 double mowings representing 10 m^2, and the collected insects form a sample), over the place where the insects are found.

The experiment was arranged in a randomized block design, with 4 repetitions for each variant. The harvestable surface of the plot was 50 m^2 [27].

In order to identify the existing insect species and the number of specimens, 10 oat plants were harvested from each experimental plot, which were brought to the entomology laboratory of the Faculty of Agriculture within USAMV Bucharest [4].

The importance of oat pests in Mircea Vodă commune (Brăila) was highlighted by noting the numerical abundance and percentage structural weight of the main groups of arthropod fauna harvested during 2021.

The species were determined with the help of specialized catalogues [7, 25].

The statistical interpretation of the experimental results was carried out by analysis of variance [10].

RESULTS AND DISCUSSIONS

The identified species

Most specimens found belonged to the species -*Sitobion avenae* Fabricius-english grain aphid (Photo 1).

The greatest damage caused by *Sitobion avenae* Fabriciusis recorded between ear emergence and flowering. Direct damage is recorded by feeding on oat stalks, leaves, and spikelets (which causes some of the nutrients to decrease), and indirect damage consists of honeydew excretion (reflected by reduced photosynthesis) and virus transport [12].

In the control variants, without the application of insecticides, specimens of the predatory aphid species *Tachyporus hypnorum* Fabricius were also detected (Photo 2).

Photo 1. English grain aphid
Source: original (Popa A.).

Photo 2. *Tachyporus hypnorum*
Source: original (Popa A.).

Among the polyphagous species we identified: - pupae and adults of *Phorbia fumigata* Meigen-*late wheat shoot fly* (Photo 3). However, the larvae of this species do not harm oats [3].

Photo 3. *Phorbia fumigata*:pupa and adult
Source: original (Popa A.).

- larvae and adults of the species *Haplothrips tritici* Kurdyumov-wheat thrips (Photo 4). It is a monovoltine species, which spends about two months on the rachis or inflorescences of the host plant.

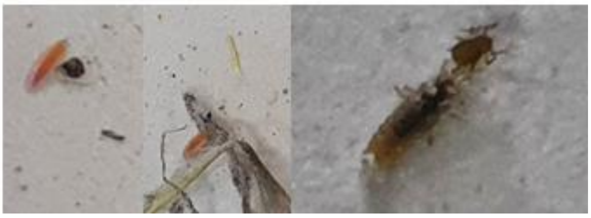

Photo 4. *Haplothrips tritici*:larvae and adult
Source: original (Popa A.).

Larvae stings cause the affected organs to turn white, and in the case of berries, they lose weight [26].

- larvae species *Helicoverpa armigera* Hübner- old world bollworm (Photo 5, left), and and the larvae of the species *Haplodiplosis marginata* Roser-red straw worm (Photo 5, right).

Oats are one of the 120 host species of *Helicoverpa armigera* [23].

Photo 5. Left: larva of *Helicoverpa armigera*; right: larva of *Haplodiplosis marginata*
Source: original (Popa A.).

The red straw worm prefers oats less. The attack of the larvae, which are located along the internodes in the area between the sheath and the stem, consists in the decrease of the height of the plant, the stagnation of the spike and a premature ripening resulting in a reduced number of grains.

- mites (Photo 6, left) present on oat plants can cause economic damage only after the natural enemies have been eliminated through the use of insecticides, and larva of *Agrotis segetum* Denis & Schiffermüller-common cutworm (Photo 6, right). The larvae can attack the roots and lower stems of oat.

Photo 6. Left: Mite (*Arachnida*); right: common cutworm
Source: original (Popa A.).

The influence of insecticides in the control of harmful insects in oats

Agrophytotechnical measures from land preparation to harvesting were the same in all variants.

To highlight the role of insecticides application, it was weeded in the variants and two fungicide treatments were applied, so that weeds and diseases do not influence the productions.

Regarding the abundance of harmful species, the most specimens belonged to the species *Sitobion avenae* (27 specimens/plant, which represents a weight of 40.29% of the total species), in second place was *Haplothrips tritici* (18 specimens/plant, with 26.86% weight), and in third place, *Haplodiplosis marginata* (16 specimens/plant, with 23.88% weight). A sporadic presence, of only 1 specimen/plant and a weight of 1.5%, was recorded by the mites, *Helicoverpa armigera* and *Agrotis segetum* (Table 1).

Table 1. Abundance of harmful species in control variant, before the application of insecticides

Species	Order	No. specimens/ plant	Share (%)
Sitobion avenae	*Hemiptera*	27	40.29
Phorbiafumigata	*Diptera*	3	4.47
Haplodiplosis marginata		16	23.88
Haplothrips tritici	*Thysanoptera*	18	26.86
Helicoverpa armigera	*Lepidoptera*	1	1.5
Agrotis segetum		1	1.5
Mites	*Araneae*	1	1.5

Source: original results.

The time of application of the insecticides was in the phenophase of flag leaf sheath swolle-BBCH 45 [14].

Table 2. Ovidiu oat variety production, following insecticides application in 2021

Variant	Productions		Difference q/ha	Significance
	q/ha	%		
Control	45.1	100	-	-
Karate Zeon®	48.35	107.2	3.25	***
Decis® Expert	47.89	106.19	2.79	**
Faster 10 CE	46.4	102.88	1.3	*
DL 5%(*)=1.3 q/ha; DL 1%(**)= 2.5 q/ha;DL 0.1%(***)= 3.0 q/ha.				

Source: original results.

In 2021, we recorded a very significant increase in production, of 3.25 q/ha in the variant with the application of the Karate Zeon® insecticide, a distinctly significant increase of 2.79 q/ha in the variant with the application of the Decis® Expert insecticide and a insignificant growth, of only 1.3 q/ha in the variant with the application of the Faster 10 CE insecticide (Table 2).

CONCLUSIONS

It is very important to consult the insecticides label for the most up-to-date products information.

It is of particular importance to respect the recommended dose of insecticides application, as well as the time of application, which contributes to avoiding pollution of the environment and production, with positive effects on the health of the final consumer, animals or people.

Insecticides phytosanitary treatment represent an important part of oat production.

Effective oat crop monitoring will help farmers make the right decisions about when to apply insecticides and the number of treatments/vegetation period.

Accurate knowledge of insect species allows farmers to plan in advance the required mechanical equipment, fuel and insecticides for successful harmful insects control with minimal environmental pollution.

The presence of harmful insects represents a risk situation in oat culture.

Sitobion avenae is oane of the most important oat pests from an economic viewpoint, because cause yield loss nearly every year.

Most of the insects present in the oat culture (*Phorbia fumigata*, *Haplothrips tritici*, *Helicoverpa armigera*, *Haplodiplosis marginata*, mite species, common cutworm) are only occasional pests and cause economic damage sporadically, when the climatic conditions are favorable for outbreaks to occur.

The presence of the entomophagous species *Tachyporus hypnorum* in the oat crop, from sunrise to harvest, contributes to the natural biological limitation of aphids.

Protecting against oat field pests is critical to avoid production losses.

The application of insecticides favored the increase of oat production.

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INITIATING A BUSINESS FOR ESTABLISHING A MODERN QUINCE CULTIVATION IN SOUTHWESTERN ROMANIA – A PROFITABLE SOLUTION FOR THE FUTURE

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Abstract

The quince is a fruit tree species that occupies 2% of the total orchard area in Romania. It can be utilized considering that quince is a fruit species used for ornamental purposes, for protective hedges, as a pollen-rich plant, for obtaining rootstock seedlings, in medicine, and the food industry. Following the identification of eco-pedological factors influencing the growth and development of quinces and the implementation of the stages underlying quince cultivation technology, it has been demonstrated that, in the pedoclimatic conditions of South Western Romania, establishing and exploiting a quince orchard is a highly profitable and interesting business with low investment and high returns. This fruit species yields abundantly, produces a large quantity of fruits, the production costs are low and can be recovered in a short time, the inter-row spaces can be used for intermediate crops, and the attractive selling price and the scarcity of quinces on the market provide the entrepreneur with an attractive income, making the business economically efficient.

Key words: *quince culture, business, profitability, Oltenia region, Romania*

INTRODUCTION

The quince is an ancient species cultivated for about 4,000 years, with its fruits highly appreciated by the Greeks and Romans for both fresh consumption and processing [10]. The seeds, fruits, and flowers are also used therapeutically. The quince species originated from the island of Crete, the city of Cydon, giving rise to the genus name *Cydonia* = quince [1]. Currently, Turkey is the leading producer of quince, contributing a quarter of the world's fruit production, followed by China, India, Morocco, Argentina, Lebanon, Serbia, and Montenegro. In terms of continents, Asia takes the lead in production with 68.9%, followed by Europe with 12.5%, Africa 9%, America 9.4% and Oceania 0.2% .

In Romania, quince cultivation covers 2% of the total orchard area, primarily grown isolated or in mixed trees with other varieties in orchards near homes, spanning 883 hectares and yielding 6,540 tons in 2017. In the Oltenia region, local varieties are cultivated. Large cultivation areas that existed in former collective, state agricultural farms enterprises (with the acronyms C.A.P. or I.A.S.) were destroyed due to the land reform laws or to the fire blight disease, which was reported in Romania after 1991 [22].

In the germplasm collection organized in Romania, there are 78-80 quince genotypes represented by native and foreign varieties and selections. The varieties differ in terms of ripening period and fruit shape: flattened spherical or apple-shaped (from Constantinople); spherical or globular (from Afumaţi); cylindrical (from Delta, rusty coloured); conical-truncated or pear-shaped (Campion, from Jariştea) [24].

Originally cultivated in subtropical regions of Iran and the Caucasus, the quince is a thermophilic plant that thrives in cultivation without being affected during winter in regions where the average annual temperature ranges from -15 to +9°C [2, 4, 6,]. To achieve a healthy and abundant fruit production, the soil must be properly prepared before planting, ensuring adequate watering, and regular fertilization [3, 7].

The environmental requirements of the quince are as follows [5, 6, 8, 15]:
- Light - quinces are a species that is demanding and sensitive to light and warmth; they prefer expansive or slightly sloped, luminous areas exposed to sunlight
- Temperature - this species is the most demanding regarding temperature, being more sensitive to frost than apple and pear trees; it develops properly at an average annual temperature higher than 9.5°C;
- Water - quinces have a shallow root system and require a significant amount of water during the growing season (precipitation of 600-650 mm/year or irrigation) [3, 4, 16];
- Soil - quinces are particular about soil conditions, prefers fertile soils rich in nutrients, well-drained, water-permeable, and with a porous texture that allows the development of a deep and branched root system; they thrive in loamy, clay-loam, and clayey soils; they do not tolerate values above 8% active $CaCO_3$ because chlorosis may occur; easily tolerate alkaline or acidic soils but do not thrive in very poor or compacted soils; clayey soils are considered the best for quince growth due to their high water and nutrient retention capacity [7, 8]

In the pedoclimatic conditions of the southwestern Romania, establishing and exploiting a quince orchard is a highly profitable business, because is yielding abundant fruit, and the selling price, coupled with the limited availability of quinces on the market provide the entrepreneur with a substantial income [1, 2, 4].

Quince trees bear fruit early and consistently, in contrast to apple and pear trees. Depending on the variety, they produce between 45 and 120 kg of fruit per year, equivalent to 12,000-22,000 kg per hectare [4, 6].

Quince utilizations

A quince orchard can be exploited effectively since the quince is a pomological species used for [3, 4, 9, 10, 12, 19]:
-Ornamental purposes;
-Protective hedges (as a companion species);
-Rich in nectar for bees (the flowers bloom late, rich in nectar);
-Obtaining rootstock seedlings (from seeds);
-Medicinal and textile industries (utilizing the mucilaginous substance extracted from the seed coats);
-Consumption, fresh fruit;
-Food industry (for the preparation of jams, jellies, preserves, compotes, marmalade, liqueurs, brandy, and other valuable products).

The biochemical and nutritional composition of quinces is complex and varies depending on pedoclimatic conditions, cultivation location, weather conditions throughout the year, and the quince variety [11]:
-Water = 77.18 - 85.89%
-Sugars (glucose, fructose, and sucrose) = 5.57-20.7%
-Total acidity (malic and citric organic acids) = 0.59-1.76%
-Cellulose, tannic substances (tannins) = 0.19-0.56%, protein substances = 0.26-1%
-Pectin substances = 0.55 – 1.13% (high content, favouring gelation, making it a valuable raw material for preparing preserves, jams, and marmalade)
-Carbohydrates = 11%, fats = 0.1%, lipids = 0.50%, folic acid = 1%
-Ca = 10 mg%, Mg = 8 mg%, Fe = 0.60 mg%, Zn = 1%, Se = 1%, K = 20 mg%
-Vitamin C (more than apples, pears, and cherries) = 8.28 - 34.02 mg/100g
-Vitamins B_1 = 1%, B5 = 1.5%, and B_6 = 3%
-Mineral substances (ash) = 0.28 – 0.55%
-Ash alkalinity = 2.40 – 7.2%
-Energy value = 56.44 – 83.69 cal.

The quince cultivation technology is based on the following stages [3, 5, 7, 8, 20, 23]:

Land Preparation

It relies on soil operations, representing the set of agricultural activities conducted to prepare and maintain the soil for obtaining a qualitative and quantitative quince production. Striking a balance between mechanized and manual work is crucial to ensure a good and sustainable quince yield.

The key stages include soil evaluation (to determine quality, properties, and the nutritional needs of the plant), ploughing, harrowing, cultivation, levelling, and seeding.

Orchard Maintenance

It is based on the following agricultural tasks: black ploughing, interrupted black ploughing, combined black ploughing, and inter-row mulching or cover cropping (Photo 1).

Photo 1. Quince orchard maintenance
Source: [14, 23].

Pruning and crown formation
This stage aims to ensure normal growth and fruiting of quince trees and the development of a proper trunk [20]. The most commonly used crown forms for quince trees are: espalier, open vase, delayed flat vase, and free bush (Photo 2).

Photo 2. Pruning techniques and crown types for quince trees
Source: [14, 20].

Irrigation
It is necessary frequently and with small amounts of water, considering that quince trees have a shallow root system, tolerating temporary soil moisture excess, but they do not thrive well in such conditions. Drip irrigation is recommended, with water flow rates ranging from 2-6 liters per hour, reaching a depth of 30-50 cm [3, 7, 8].
Fertilization
It is a fundamental practice with significant repercussions on the quantity and quality of the quince production. It is applied differentially based on the age of the trees, fruit production, and soil type. Depending on the tree's age, the following fertilizer doses are applied [3, 6, 7, 8, 15]:
- in the first year of vegetation = 100 kg/ha of potassium salt
- in the second year = 200 kg/ha of ammonium nitrate, 250 kg/ha of superphosphate, and 160 kg/ha of potassium salt
- in the subsequent years = moderate doses of fertilizer, including 10-20 tons/ha of manure every three years, 60 kg/ha of N, 60 kg/ha of P_2O_5, and 40 kg/ha of K_2O.

Fertilization with P_2O_5, K_2O, Ca, Mg and trace elements are applied based on the laboratory analysis results and on foliar analysis.
Given that Gorj County has an excellent climate for quince cultivation, and the demand for organic products is increasing in the export market, surpassing the supply, there is an opportunity to cultivate and sell quinces in fresh and processed state, in the form of brandy and jelly, and the establishment of a modern quince plantation, with certified planting material, brings major benefits and represents a solution for the future [2, 4, 17].
In this context, the purpose of this paper is to demonstrate that the business of establishing and exploiting a quince orchard, in the pedoclimatic conditions of South-Western Romania, is very profitable both for the development of the entrepreneur and for bringing added value to the respective rural area.

MATERIALS AND METHODS

Initiating a business in the cultivation of quinces under CAEN code 0124 (cultivation of seeded fruits) involves establishing an organic quince orchard in southwestern Romania, Gorj County, as well as cultivating and commercializing of them. The products will be intended for both export and the domestic market, for sale in fresh condition or utilization in various traditional products [4, 10, 12]. The land allocated for the quince plantation is arable land located in the outskirts of the Bălești commune, Gorj County, with a total area of 2.73 hectares = 27,300 square meters, divided into 3 plots

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according to the cadastral measurements. Over time, there have been no soil scarification works, and the land has become compacted, necessitating comprehensive soil preparation works for the planting and establishment of the organic quince farm in an intensive system (Map 1).

Map 1. Location of the agricultural land where the quince orchard will be established
Source: [13].

The pedoclimatic characteristics of the Bălești commune, Gorj County, indicate very favourable conditions for quince cultivation [22, 18]:

-Nf (natural favourability) = 2.83, Pf (potentiated favourability) = 3.48

-Warmest month: July, with an average temperature of 20.5°C, coldest month: January, with an average temperature of -2.1°C

-Absolute maximum temperature: 39.5°C, absolute minimum temperature: -29.0°C

-Average annual precipitation: 615.7 mm, average annual temperature: 10.1°C

-Most frequent winds: from the south, southwest, and north (the last one with the highest intensity).

For the establishment of a quince orchard, it is necessary to conduct a soil study and soil mapping of the cover soil, determining the eco-pedological factors that influence the growth and development of the quince trees. Depending on the soil properties and the terrain characteristics (such as topography and hydrology), the suitability of the soil-terrain system for establishing the plantation is assessed.

Basic pedological information required for establishing the quince orchard is derived from the relief (slope, exposure), soil (texture, structure, humus content), and hydrology (water table level, groundwater nature) [1, 3, 6].

Morphological and physico-chemical properties that determine and limit soil fertility are established through a suitability study, considering indicators related to climate and soil conditions [7, 15].

The soil is then classified into suitability classes.

For the establishment of a quince plantation, the suitability class of agricultural land is Class I (land with excellent suitability, suitable for any agricultural use, with no limitations for use as orchards) (Table 1) [22].

Table 1. Criteria for Class I suitability of the land where the quince orchard will be established

Soil thickness	>100	Reaction	5.3-7.7	Landslides	Absent
Edaphic volume	Very high >101	Vertical character of the soil	No	Ground coverage with boulders or rocks	Absent
Salinization	Non-salinized	Slope of the land	0.10	Depth of the water level	Very high >3.0 m
Alkalinization	Non alkalized	Degree of non-uniformity	Uniform	Lateral drainage of groundwater	Good
Depth	≥ 101	Surface erosion	Non-eroded	Volume of non-gleyed soil	Very big > 91
Volume of non-pseuso-gleyed soil	Non-alkalinized	Flood-prone	Non-flooded		

Source: [22].

To determine the essential physical and hydro physical properties of the soil (apparent density, texture percentage, granulometry, penetration resistance, hydraulic conductivity), soil samples were collected in their natural or unaltered state (using metal cylinders) from three depth levels, up to a depth of 100 cm, which corresponds to the rooting depth of quince trees (Table 2) [18].

Table 2. Physical properties of the soil determined based on analyses and collected samples

Depth (cm)	Apparent density AD (g/cm³)	Penetration resistance PR (kg/cm²)	Hydraulic conductivity HC (mm/hour)
15-20	1.25	14	2.6
40-60	1.42	19	1.7
60-80	1.51	22	0.8

Source: [18].

Considering the adaptability to soil and climate type, the Bereczki variety will be planted. This variety belongs to the *Rosaceae family*, *Cydonia oblonga* species, and is a vigorous, self-fertile tree that does not require pollination [2, 5, 9].
It is highly productive, producing fruits that exceed 600 g, the fruits are broadly pear-shaped or inversely ovoid, with wide ribs, irregular surface, and a more or less delimited neck [4, 6, 10].
The skin is yellow-lemon in colour, covered with a brown-grey furry outer coating. The pulp is yellowish, juicy, acid-sweet, intensely aromatic, slightly astringent, and excellent for industrial processing (Photo 3) [6,12,19, 21].

Photo 3. The quince variety Bereczki, which will be cultivated and valorized
Source: [21].

The modern plantation will have a tree density of 994 trees/ha, totalling 2,714 quince trees for the entire planted area, with a planting scheme of 2.5 m/4.0 m.
The plantation will be irrigated, and the irrigation water will come from a well drilled to a depth of 50 m, with a flow rate of 2-3 l/s (according to the hydrological study), an irrigation flow rate of 10 m³/h, and will be stored in a storage lagoon [15,17, 23].

Table 3. Data about the quince orchard established in Bălești commune, Gorj County, Romania

Indicator	Value
Natural favourability	2.83
Potentiated favourability	3.48
Cultivated area	2.73 ha
Density (plants/ha)	994
Cultivation system	I
Type of culture	ecologic
Planting distances (m)	2.50 m/ 4.00 m
Planting system	north-south
Total number of trees	2,714 pieces
Irrigation system	drip irrigation
Support system, hail net, rain net	no

Source: the authors' calculations.

Drip irrigation will be applied for 80-90 days per year, with a total water consumption of 4,800 m³/year. Galvanized wire mesh and precast concrete espaliers will be used for fencing.
Equipment and machinery will be acquired to mechanize the activities [7, 15, 23].
Data about the quince orchard established in Bălești commune, Gorj County, Romania, are presented in Table 3.

RESULTS AND DISCUSSIONS

The estimated production at maturity is 14,200 kg/ha, achieved in the 10th year after planting (Year 1 = 0 kg, Year 2 = 0 kg, Year 3 = 3,000 kg, Year 4 = 5,000 kg, Years 5-10 = 6,000 – 10,000 kg) [3, 5, 6].
To demonstrate the economic efficiency of establishing and maintaining the quince orchard, the following items are presented:
- Technical-economic indicators for establishing the quince orchard (Table 4)
- Technical-economic indicators for maintaining the quince orchard in Year I and II (Table 5)
- Preliminary cost estimate for land preparation and establishment of the quince plantation (Table 6)
-Preliminary cost estimate for shrub maintenance in the first year after planting (Table 7)
- List of materials needed for establishing and maintaining the quince orchard (Table 8).

Table 4. Technical-economic indicators for establishing the quince orchard

Work name	Quantity / UM	Work Cost (euro/ha)	Total cost (euro)
Design, soil analysis, technical assistance	2.73 ha	620	**1,692.6**
Localized irrigation Equipment	2.73 ha	3,500	**9,555**
Localized irrigation equipment installation	2.73 ha	500	**1,365**
Land preparation	2.73 ha	840	**2,293.2**
Fertilization and soil disinfection. including:	2.73 ha	1,238	**3,379.74**
Mechanical and manual work	2.73 ha	430	1,173.9
Manure	2.73 ha	450	1,228.5
Other expenses	2.73 ha	358	977.34
Planting material	2,714 pieces	2.52	**6,839.28**
Planting (complete work). including:	2,714 pieces	1.05	**2,849.7**
Mechanical and manual work	2,714 pieces	0.95	2,578.3
Other expenses	2,714 pieces	0.1	271.4
Total standard costs for the entire area			**27,974.52**
Total standard costs per ha			**10,247.07**

Source: the authors' calculations.

Table 5. Technical-economic indicators for maintaining the quince orchard for Year I and II

Work name	Quantity / UM	Unit price (euro/ha)	Manual works	Mechanical work and raw materials	Total Cost (euro)
Disking/Cultivating the space between rows x 4	2.73 ha	24	-	65.5	65.5
Working the soil with an off-centre milling cutter with palpator x 4	0.82 ha (30 % x ha)	30	-	24.6	24.6
Training pruning	2,714 pieces	0.02	54.2	-	54.2
In-green interventions	2,714 pieces	0.02	54.2	-	54.2
Chipping branches resulting from pruning	2.73 ha	30	-	81.9	81.9
Phytosanitary treatments with Ecocert certified products x 4	2.73 x 4 ha	84	-	917.2	917.2
Fertilization - application of organic fertilizers	2.73 ha	150	-	409.5	409.5
Total expenses for the entire area / year			108.4	1,498.7	**1,607.1**
Total expenses for the entire area / Year I + Year II			216.8	2,997.4	**3,214.2**
Total expenses / ha / year			39.7	548.9	**588.6**

Source: the authors' calculations.

Table 6. Preliminary cost estimate for land preparation and establishment of the quince plantation

Calculation Element / Quantity	UM	Quantity
Transport and application of organic fertilizers 20 t/ha x 2.73 ha	t	54.6
Deep ploughing > 30 cm or soil loosening	ha	8.56
Discing the ploughed land twice before planting 2.73 ha x 2	ha	5.46
Staking the land for planting stakes x units	pcs.	2,714
Excavating the planting trench	pcs.	2,714
Creating trenches for stratification 50 x 50 m	ml	10
Stratifying bushes in the prepared trenches	cs.	2,714
Transporting bushes from a tree nursery from 100 km distance	km	200
Adding manure to the bottom of the planting pit 3 kg x 2,714	kg	8,142
Drawing soil over the manure in the pit and compacting	pcs.	2,714
Shaping the bushes and muddying the roots	pcs.	2,714
Transporting and distributing bushes from the planting pit	pcs.	2,714
Planting bushes in the prepared pits (complete work)	pcs.	2,714
Discing the spaces between the rows of trees, twice 2.73 ha x 2	ha	5.46
Watering after planting, 10 liters of water per tree	cm	27.14
Training pruning of the crown after planting	pcs.	2,714

Source: the authors' calculations.

Economic indicators for the organic quince plantation in an intensive system, with an average production of 30 t/ha, expected to be sold at approximately 1 euro/kg, in fresh condition, for consumption during the season (Table 9).

The costs related to the establishment and maintenance of the quince orchard until it starts bearing fruit are:

- orchard establishment costs = 27,974.52 euro
- orchard maintenance costs year I = 1,607.1 euro
- orchard maintenance costs year II = 1,607.1 euro

Total = 31,188.72 euro.

The quince plantation starts bearing fruit from the 3rd year, with the production reaching a quantity of 30 tons/ha of fruits.

However, not all the trees bear fruit, so in the first 3 years, the average is 10 tons/ha (with zero production in the first two years). From the 10th year, the quantity can reach up to 50 tons/ha [3, 5, 6,10].

Table 7. Preliminary cost estimate for maintaining the bushes in Year I from planting

Calculation Element / Quantity	UM	Quantity
Large hoeing on the tree row (20% of the area) 2.73 x 0.20 = 0.546	ha	0.546
Manual hoeing with a hoe on the row (2 times/year) 2.73 x 2 = 5.46	ha	5.46
Filling gaps (10% complete work) 2,714 pcs. x 10 % = 271.4	pcs.	271.4
Watering the trees 10 l water/tree	cm	27.14
Intensive ploughing between rows	ha	4.60
Hoeing between rows (4 times/year) 0.5 x 4 = 2	ha	2
Seeding perennial herbs between rows 0.5 ha x 40 kg/ha= 20 kg	ha	20
Mowing grass between rows (2 times/year) 0.5 ha x 2 = 1ha	ha	1
Applying phytosanitary treatments (5 times/year) 0.5 ha x 5 = 2.5 ha	ha	2,5
Preparing solution for spraying (5 treatments) 0.5 ha x 1,000 l/ha x 5 .= 2,500 l	l	2,500

Source: the authors' calculations.

Table 8. List of materials needed for the establishment and maintenance of the quince orchard

Preparation and establishment of quince orchard	
Organic fertilizers	20,000 kg / ha/ year = 20,000 kg x 2.73 ha = 5.46 t
Surface/area	2.73 ha
Wooden stakes	2,714 pcs.
Planting material	2,714 pcs.
Water for watering the trees	10 l water / tree = 27.14 cubic meters
Maintenance orchard year I	
Planting material	10 % x 2,714 pcs. = 271.4 pcs.
Organic fertilizers	20,000 kg / ha/ an = 20,000 kg x 2.73 ha = 5.46 t
Perennial herbs	40 kg / ha = 40 kg x 2.73 ha = 109.2 kg
Ecocert pesticides	2 kg / ha = 2 kg x 2.73 = 5.46 kg
Maintenance orchard year II	
Ecocert pesticides	2 kg / ha = 2 kg x 2.73 = 5.46 kg
Organic fertilizers	20,000 kg / ha/ an = 20,000 kg x 2.73 ha = 5.46 t
Water for watering trees	10 l water / tree = 27.14 cubic meters

Source: the authors' calculations.

For the quantity obtained from the 3rd year, the quince production will be processed (traditional product: palinka) to recover the expenses, considering that 1 liter of palinka is obtained from 10 kg of quinces [12,19]:

- 30 tons of quinces = 30,000 kg of quinces = 3,000 liters of palinka
- 1 liter of quince palinka is sold at the price of 40 euros
- 3,000 liters x 40 euros = 120,000 euros

Following the processing of quinces into palinka and its sale at a price of 40 euros/liter, an income of 120,000 euros is recorded, from which the expenses are amortized.

Starting from the 4th year, the income increases through the processing and commercialization of the traditional quince jam product, as well as through the sale of fresh quinces [12,19].

The production in the 4th year reaches a quantity of 35 tons/ha of quinces, capitalized as follows:
-20 tons for palinka = 20,000 kg of quinces = 2,000 liters of palinka → 2,000 liters x 40 euros = 80,000 euros
-10 tons for quince jam = 10,000 kg of quinces = 10,000,000 g → 50,000 jars of 200 g → 50,000 jars x 5.6 euros = 280,000 euros
-5 tons of fresh quinces = 5,000 kg of quinces → 5,000 kg of quinces x 1.2 euros = 6,000 euros.
According to the highlighted calculations, a revenue of 366,000 euros is recorded in the 4th year.
The business of establishing a quince plantation is of interest, with low investment, high profitability, and substantial profit, for the following reasons [6, 7, 15, 17, 22]:
-The cost of obtaining the production is low;
-It can be recovered in a short time
-During the period until the orchard starts bearing fruit, the spaces between rows can be used for intermediate crops (root vegetables, peas, cabbage, strawberries, potatoes);
-Quince trees can reach economic exploitation ages of 25-30 years;
-Quince trees start bearing fruit 3-4 years after planting;
-At the maximum maturity age of 10 years, quince trees yield 70-120 kg per tree;
-Selling price ranges from 1-3 euros/kg of quinces, depending on the marketing period (in-season or off-season) for consumption, and 0.4-0.5 euros/kg for industrial processing;
-The price for 1 liter of quince palinka ranges from 25-40 euros.

Table 9. The economic indicators for the organic quince plantation in an intensive system, exploited for consumption, in a fresh state in the season

Specification	UM	ha	Total area (2.73 ha)
Operation duration (OD)	years	30	
Exploitation duration (ED)	years	25	
Total investment value (TI), of which:	euro	10,247.07	27,974.52
Design / Technical Assistance / Pedological Study	euro	620	1,692.6
Land preparation	euro	840	2,293.2
Material expenses	euro	6,813.23	18,600.12
Labor costs	euro	1,543.84	4,214.7
Mechanical expenses	euro	430	1,173.9
Annual expenses (AE) for:	euro	770.9	2,106
Annual operation and maintenance	euro	593	1,620
10% unforeseen direct expenses	euro	59,3	162
10% indirect expenses	euro	59,3	162
10% annual amortization share	euro	59,3	162
Annual production value (V): V = P (average production) x SP (selling price) = 30.000 kg/ha x 1 euro /kg	euro /year	30,000	81,900
Annual gross profit GP = V – AE	euro	29,229.1	79,794
Tax T = 16 % x GP	euro	4,676.6	12,767
Profit annual net (NP)Annual net profit NP = GP - T	euro	24,552.5	67,027
Annual profit rate R= NP /AE x 100	euro	3,184.9	3,182.6
Investment recovery terms (after starts producing) T= TI/GP	ani	0.49	0.4
Total profit over the exploitation period (TeP) TeP = GP x ED	euro	613,812.5	1,675,675
Economic return on investment RoI= TeP/TI x 100	%	59.9	59.9

Source: the authors' calculations.

The SWOT analysis of the business regarding the cultivation and utilization of the organic quince orchard in the Bălești commune, Gorj county, Romania is presented in Table 10.
The marketing plan is based on:
-Product strategies (choosing the most productive variety; verifying the quality of the finished products; using organic fertilizers to obtain organic products) [15].
-Pricing strategies (initially setting the product price below the market price, with subsequent increases).
-Placement strategies (ensuring the market with the necessary quantities; drawing

attention to market preferences; establishing a recognizable market image; maintaining constant contact with the customer; providing information about the benefits of consuming quinces and their derived products).

-Promotion strategies (media advertising; promotions; presenting products in an attractive manner; website; announcements; radio advertising spots; mass-media advertisements; promotions in shopping centres; brochures, posters, informational meetings).

Table 10. SWOT Analysis for the cultivation and utilization of the organic quince orchard in the Bălești Commune, Gorj County, Romania

Strengths	Weaknesses	Opportunities	Threats
-Stable activity in a well-established industry -Production of products meeting EU standards -Quality quince variety -Ideas for the future development of the business -Continuous customer engagement -Aspiration for business recognition and growth	- Newly established company - Newly planted orchard - Lack of experience - Limited financial resources - Lack of promotion	-Growing demand in both domestic and international markets -Increasing demand for organic products -Opportunity to access grants, subsidies, and non-refundable funds -Business security due to the growing consumption of natural products among the population	-Competition -High dependence on unstable weather conditions (hail, drought, strong infection with fire blight *Erwinia amylovora*) -Emergence of diseases and pests resistant to applied treatments -Existence of exported products -Risk of landslides

Source: the authors' calculations.

CONCLUSIONS

-The quince belongs to the *Rosaceae Juss* family, *Pomoideae Focke* subfamily, *Cydonia Mill* genus, represented by a single species, *C. oblonga Mill*. In the organized germplasm in Romania, there are 78-80 quince genotypes, represented by native and foreign varieties and selections.

-In the pedoclimatic conditions of Gorj County, Romania, establishing and exploiting a quince orchard is a highly profitable business because this fruit tree species bears fruit very well, produces abundant fruits, and the selling price, coupled with the scarcity of quinces on the market, provides the entrepreneur with a good income.

-The quince orchard can be valorised since the quince tree is used for ornamental purposes, protective hedges (as an accompanying species), as a nectar-rich plant, for obtaining rootstock seedlings, in medicine and in the textile industry, and for consuming in fresh or in the food industry.

-For establishing a quince orchard, a pedological study and mapping of the soil cover must be conducted to determine the eco-pedological factors influencing the growth and development of quinces.

-The preparation of the land for establishing the quince orchard is based on soil work, representing the set of agricultural operations carried out for the preparation and maintenance of the soil to obtain a qualitative and quantitative quince production.

-The business in quince cultivation involves establishing an organic quince orchard in Bălești commune, Gorj County, Romania, as well as cultivating and selling the quinces. The products will be intended for export and the domestic market, for sale in fresh condition or utilization in various traditional products (palinka, jam, fruit preserves).

-Establishing a modern quince plantation with certified planting material brings significant benefits and represents a solution for the future.

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NEW TRENDS IN THE GLOBAL AND EUROPEAN UNION RAW SILK TRADE IN THE PERIOD 2013-2022

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Abstract

The purpose of this research was to identify the main tendencies in raw silk trade at the global level and in the EU main producing and trading countries like China and India in Asia, and Italy, France, Romania, Germany and Spain in the EU. To attain this goal, the data referred to the last decade divided into two sub-periods 2013-2017 and 2018-2022 for allowing the comparison and quantification of the differences. The methodological procedures included the use of fixed basis indices, absolute and relative differences among sub-periods, comparison, trend regression equations and R square served as statistical tools to process the data from ITC and OEC World. The results pointed out the decline by 43.2% in world raw silk production which attained 91 thousand MT in 2022 vs 2013. The global raw silk export decreased from USD 3.12 Billion in 2013 to USD 1.91 Billion in 2022 (-38.8%), while the import went down by 38.8% from USD 2.41 Billion to USD 1.65 Billion (-31.54%). In consequence, trade balance remained positive at USD 0.26 Billion in 2022, but being 2.5 times smaller than in 2013. In the EU, in 2022, raw silk export was USD 0.46 Billion (-46.5% lower vs 2013), while import value attained USD 0.62 Billion (-37.4% vs 2013), resulting a negative balance of - USD 0.16 Billion. China maintained its top position as a silk producer and exporter, with a positive trade balance, but negative in 2020-2022. The Asian competitors India, Uzbekistan and Vietnam increased production and their trade as well. The EU is a very important raw silk importer, so that its trade balance is negative (-USD 0.16 Billion in 2022). Italy is a remarkable top silk importer in the world, and France, Romania, Germany and Spain are also representatives. Silk textiles remain of high attraction for fashion industry, a reason to expect as production and commerce to flourish in the future, as in the EU is a new orientation to reduce the wastes caused by fast fashion based on synthetic fibers and to encourage the production of healthier and environment friendly natural fibers like silk which has to sustain fashion, textile and apparel industries.

Key words**:** *silk, export, import, trade balance, trends, world and EU, main trading countries*

INTRODUCTION

Global production of fibers destined to fashion, textile and apparel industries has rapidly grown in the last two decades. In the year 2022 it reached 116 million tonnes being 2.32 times higher than in the year 2000 when it accounted for 50 million tonnes. Taking into account the population and the growth rate of the average consumption per capita, in the year 2030, it is expected to attain 147 million tonnes [22].

The high share of the synthetic fibers has a significant negative impact on the environment quality in terms of high water consumption, carbon dioxide footprint, pesticide consumption, micro plastic elimination increasing wastes in landfills, polluting the ocean and sea waters and disturbing the ecosystems [3, 5].

The global synthetic fibers market reached USD 77 million in 2022 and it is predicted to increase to USD 116 million by 2030 [27].

In the competition among the textile fibers, the synthetic fibers (polyester, rayon, spandex, acryl, microfibers) won the highest share as they are easier to be produced, production cost is smaller, their aspect perfectly imitates the natural fabrics, they are resistant to water and spots, the offer of clothes is of a large diversity and price enough low which led to the so called "fast fashion" agreed by consumers [4].

In 2022, the natural fibers market accounted for USD 4.9 million and it is expected to grow at USD 9.91 million CAGR of 7.3 % by 2032 [23].

According to the European Environment Agency, in 2020, the average annual textile consumption per person was 26 kg, of which 11 kg textiles are thrown [24].

The high consumption of synthetic textiles has increased wastes, diminished water resources and spread million tonnes of microplastics in the oceans, affecting human health, animals and ecosystems.

That is why the EU and not only proposed to diminish the quantity of synthetic wastes and according to the circular economy, the textile industry has to be more oriented to achieve products with a longer life cycle and which could be also recycled [19].

More than this, consumers have to adopt a new behaviour meaning to buy less clothes, but of higher quality, which means a new trend to "slow fashion" and also to purchase more sustainable clothes, made of natural fibers which are environmentally friendly, healthy for human body in any season, and also very resistant [20].

Silk and wool are the natural fibers of animal origin widely produced at the global level [2, 16].

Grace to its special features, silk is "the queen" of the natural fibers destined for high quality and luxury products (clothes and not only) of a large variety and multiple uses.

Silk special fineness, pleasant touch, unique shining and elegance determined the demand to grow continuously and production of fabrics and clothes as well [17].

The largest amount of silk is produced from silkworm cocoons, whose production is well carried out in more than 60 countries, being a field of agricultural activity with many economic, social and environment benefits for the rural population [11, 13].

The rearing of silkworms is a profitable business for small farmers, bringing them a decent profit and improving their living standard [8, 10].

Mulberry silk is the most produced and commercialized silk fiber [13, 15].

In 2022, silk market size was evaluated at USD 18.14 Billion and for 2030 it is provided to reach USD 30.29 Billion, which means a higher production and an intensified international commerce with raw silk, fabrics and clothes which have to better satisfy consumers' needs and increase profit of the businessmen dealing with silk industry [21].

Trade and especially its component export is very important to assure economic growth i any country [9].

In this context, the present study is focused on silk trade, analyzing its trends in the decade 2013-2022 for which the statistical data are available and comparing export, import and trade balance in two sub-periods: 2018-2022 versus 2013-2017 in order to identify the absolute and relative differences at the global, EU level and also in the main producing and trading countries: China and India in Asia and also in the EU in Italy, Romania, France, Germany and Spain.

MATERIALS AND METHODS

The study is a synthetic statistical overview based on the official data provided by International Sericicultural Commission, International Trade Centre, Silk Market Reports, European Parliament Reports, the recent literature including scientific papers published in well known research journals, handbooks on textile fibers etc.

At the beginning of this study, it is presented the dynamics of raw silk production at the world level and also in the main producing countries: China, India, Uzbekistan and Vietnam.

Then, in the largest part of the study, it is approached the silk trade at the international level pointing out export, import and trade balance.

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More detailed results regard silk trade of China and India, as the most representative silk producers and traders in Asia, and also in the EU: Italy, Romania, France, Germany and Spain.

The methodological aspects are referring to:

-the analysis in the period 2013-2022, and also in two sub-periods 2013-2017 and 2018-2022;

-fixed basis and structural indices were determined to interpret what happened between the level of the analyzed indicator at the end of the period compared to its level at the beginning of the interval;

-identifying the main trends using illustrative graphics which display regression equations and R square;

- the value of export, import and trade balance was highlighted both on the whole interval and also by the two sub-periods, and finally as average value;

- calculation of the absolute and relative differences between the sub-period 2018-2022 and the sub-period 2013-2017;

-the obtained results are synthetically presented in tables accompanied by corresponding comments.

The conclusions summarize the results and the authors' vision concerning the evolution of silk market.

RESULTS AND DISCUSSIONS

Global raw silk production

Before analyzing raw silk trade, it is compulsory to start with the analysis of production at the world level in the main producing countries.

In the analyzed interval, global silk production has registered a decline from 160 thousand MT (metric tonnes) in 2013 to 91 thousand MT in 2022, meaning a reduction by 43.2% (Fig. 1).

Figure 1 has a wave shape reflecting an increase from the year 2013 to the peak level of 202 thousand MT silk production recorded in the year 2015, but then, the curve declines year by year to the minimum of 86 thousand MT in the year 2021 and in the final year 2022, it is noticed a slight upward trend to 91 thousand MT.

Summing the production obtained in every year In the whole decade, it resulted an amount of 1,448,143 MT of raw silk, which means an annually average of 144,814.3 MT.

The R square value 0.82 shows that the variation of silk production at the global level was determined in the largest proportion by the time changes across the selected interval for this analysis, which is a continuation of the previous studies focused on silk production and trade.

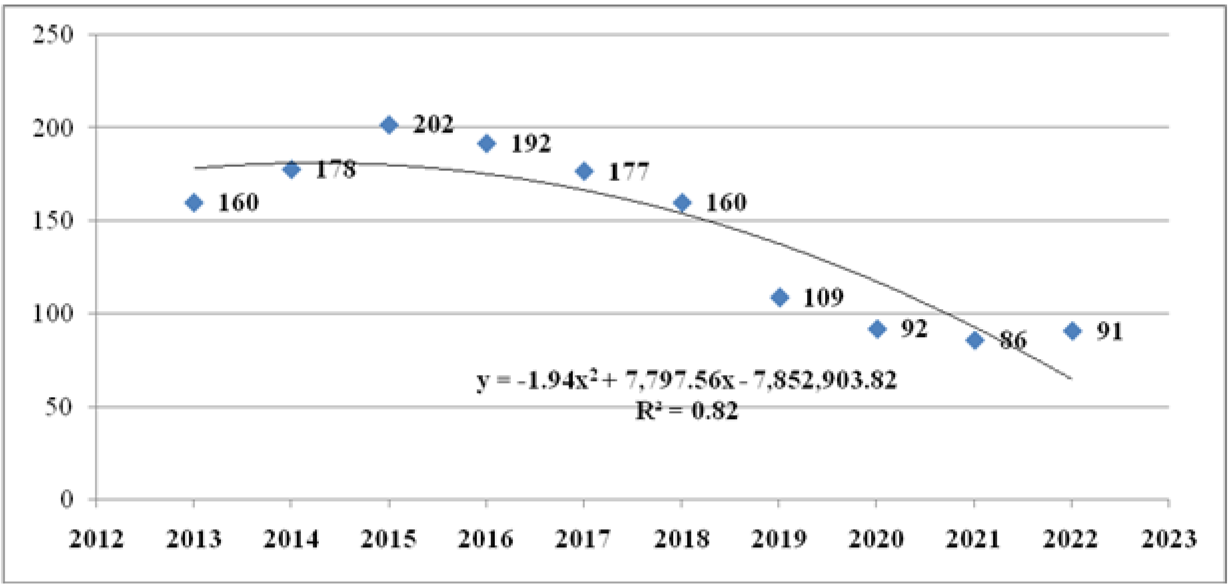

Fig. 1. Global raw silk production, 2013-2022 (Thousand Metric Tons)
Source: Own design based on the data from ISC, 2024 [6].

In the sub-period 2018-2022, at the global level, the raw silk production was by -40.9% smaller than in the sub-period 2013-2017 (Table 1).

Table 1. Global raw silk production in the interval 2013-2022 by sub-period (Metric tonnes)

Period	Specification	Production (MT)	Average annual production (MT)
2013-2017	Total	909.886	181,977.2
2018-2022	Total	538,257	107,651.4
2013-20122	Total	1,448,143	144,814.3
2018-2022 vs. 2013-2017	Absolute difference (MT)	-317,629	-44,325.8
	Relative difference (%)	-40.9	-40.9

Source: Own calculation based on the data from International Sericicultural Commission, 2020 and 2024 [6].

The level of raw silk production is sustained by the contribution of different countries, but the main contributors are China, India, Uzbekistan and Vietnam, which accounts for about 98% of the world production.

Raw mulberry silk has many destinations being utilized, first of all, for being transformed in various types of clothes like: blouses, shirts, suits, formal dresses, ties, scarves, collars, gloves, jackets, pijamas, linjerie, sundresses, kimonos. A part of comforters and sleeping bags as well as other fabric materials such as: plain silk, deluxe, satin, chiffon, chinnons, crepe, broacades, dupions could be made of mulberry silk [25].

China registered a deep decrease of the raw silk production from 130,000 MT in 2013 to 50,000 MT in 2022, meaning - 61.545. In the whole interval, the country produced 1,084,659 MT. By sub-period, the highest decline was registered in 2018-2022, being by 407,341 MT and respectively by 54% smaller than in the sub-period 2013-2017. In China, silk worms rearing contributed to the production of the mulberry silk which has the highest share among the raw silk sorts.

From antiquity, the Silk Road and Then the New silk road have sustained the China's economy. However, silk road stopped since 2015, as China's agriculture has developed faster other sub-sectors in this field.

But, China has remained the global leader in producing and exporting silk and silk products.

The other top producing countries *India, Uzbekistan and Vietnam* are in a completely different situation. In 2022, all together, produced an amount of 190,862 MT raw silk representing 56.3% of China's production.

In these three countries, raw silk production increased in the last decade 2013-2022, so that in the whole interval, India achieved 322,326 MT, Uzbekistan 15,684 MT and Vietnam 6,966, all together meaning 344,976 MT, representing 31.8% of China total production accounting for 1,094,659 MT.

In the sub-period 2018-2022, *India* carried out a surplus of 30,346 MT raw silk versus 2013-2017, meaning +20.7%.

India comes on the 2nd position after China as one of the most important of silk producer and exported in the world.

The well know Indian silk "sarees" are famous traditional, elegant and colourful clothes for women who wear them in special occasions.

But, India is well known for its silk garments, made-ups, fabrics, yarns, carpets, shawls, scarves, cushion covers and accessories [25].

Uzbekistan achieved in the same interval a surplus of 4,212 MT raw silk, meaning +73.4% compared to the sub-period 2013-2017.

Sericiculture is an important branch of agriculture in this country which desires to develop new strategies in the silkworm rearing and silk industry and using foreign experts' experience to improve cluster system [18].

Uzbekistan produce various silk products such as: fabrics, clothes, hats, home decorations, and carpets [26].

Vietnam produced an additional amount of raw silk in the sub-period 2018-2022 of 2,190 MT, meaning +91.7% versus 2013-2017.

Even though the difference is still high between India, Uzbekistan and Vietnam, on one side, and China, on the other side, the competition in producing raw silk has become stronger and stronger (Table 2).

Table 2. Raw silk production in the top producing countries China, India, Uzbekistan and Vietnam, 2013-2022 and by sub-period (MT)

Country	Period	Specification	Production (MT)	Average annual production (MT)
China	2013-2017	Total	746,000	149,200
	2018-2022	Total	338,659	67,731.8
	2013-2022	Total	1,084,659	108,465.9
	2018-2022 vs 2013-2017	Absolute difference (MT)	-407,341	-81,468.2
		Relative difference (%)	-54.7	-54.7
India	2013-2017	Total	145,990	29,198
	2018-2022	Total	176,336	35,267.2
	2013-2022	Total	322,326	32,232.6
	2018-2022 vs 2013-2017	Absolute difference (MT)	+30,346	+6,069.2
		Relative difference (%)	+20.7	+20.7
Uzbekistan	2013-2017	Total	5,736	1,147.2
	2018-2022	Total	9,948	1,989.6
	2013-2022	Total	15,684	1,568.4
	2018-2022 vs 2013-2017	Absolute difference (MT)	+4,212	+842.4
		Relative difference (%)	+73.4	+73.4
Vietnam	2013-2017	Total	2,388	477.6
	2018-2022	Total	4,578	915.6
	2013-2022	Total	6,966	696.6
	2018-2022 vs 2013-2017	Absolute difference (MT)	+2,190	+438
		Relative difference (%)	+91.7	+91.7

Source: Own calculation based on the data from International Sericicultural Commission, 2020 and 2024 [6].

In the year 2023, a kilogram of mulberry raw silk is sold at the average price of USD 62.5 in China and at USD 54.18 in India.

Global raw silk trade

Despite that silk represents a very small fraction of the world textile fiber market, accounting for less than 0.2%, the silk and the goods made of silk are highly traded.

The high demand from the textile, cosmetics and medicinal and pharmaceutical industries are stimulating silk market growth.

Having in mind the production decline, we are expecting that raw silk trade to decrease, a fact which is confirmed by the statistical data.

Despite that both export and import value decreased, the positive aspect is that export value exceeds the import value, so that the silk trade has a positive trade balance at the global level in the analyzed interval 2013-2022.

The raw silk export value, cumulated on the ten analyzed years, accounted for USD 21.47 Billion, meaning USD 2.15 Billion per year (Table 3, Fig.2).

Table 3. Global raw silk export, import and trade balance, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	12.64	10.15	+2.49
	Average	2.53	2.03	+0.50
2018-2022	Total	8.83	7.28	+1.55
	Average	1.77	1.46	+0.31
2013-2022	Total	21.47	17.43	+4.04
	Average	2.15	1.74	+0.41
2018-2022 vs. 2013-2017	Absolute difference	-3.81	-2.87	-0.94
	Relative difference (%)	69.85	71.72	62.24

Source: Own calculation based on the data from ITC, 2024 [7].

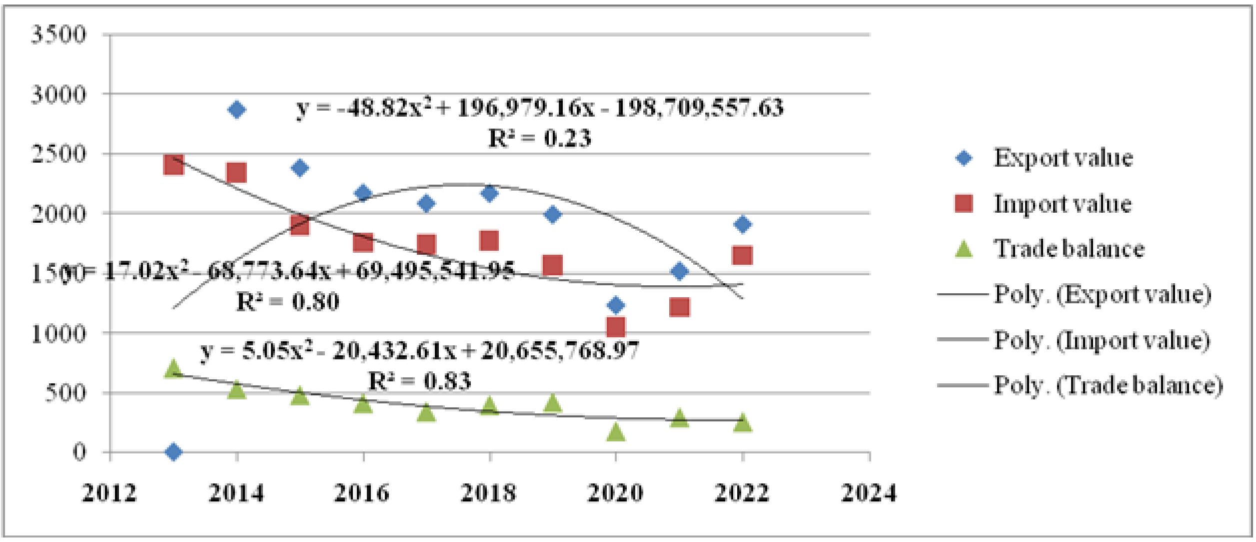

Fig. 2. Global raw silk export, import and trade balance, 2013-2022 (USD Billion)
Source: Own design based on the data from ITC, 2024 [7]..

The import value summed on the same interval reached USD 17.43 Billion, and making the difference between export and import, it resulted USD 4.04 Billion trade balance and the situation by sub-period is shown in Table 3 and Fig. 2.

Raw Silk trade value in China

China is the world leader in silk production and export. In the period 2013-2022, the cumulated value of silk exported by China accounted for USD 10.93 Billion and the cumulated value of silk import was USD 8.46 Billion, leading to a positive trade balance of USD 2.47 Billion.

In the sub-period 2013-2017, the export value was USD 6.75 Billion, while in the sub-period 2018-2022, it declined to USD 4.18 Billion.

The import value was smaller in the period 2013-2017, accounting for USD 4.02 Billion, compared to USD 4.44 Billion in the last sub-period 2018-2022 (Table 4).

Table 4. China's raw silk trade, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	6.75	4.02	+2.73
	Average	1.35	0.90	+0.54
2018-2022	Total	4.18	4.44	-0.26
	Average	0.84	0.89	-0.05
2013-2022	Total	10.93	8.46	+2.47
	Average	1.09	0.85	+0.25
2018-2022 vs.	Absolute difference	-2.57	0.42	+2.47
2013-2017	Relative difference (%)	-38.08	+10.44	-27.64

Source: Own calculation based on the data from ITC, 2024 [7].

Raw Silk trade value in India

India comes in force after China as a country with a high potential in producing raw silk. Its export doubled its figure in the last five years compared to the previous five years.

In 2022, its export value was USD 0.86 Billion compared to USD 0.15 Billion in 2013. In the period 2018-2022, its silk export valued USD 4.1 Billion compared to USD 2.06 Billion in the period 2013-2017.

The import value was USD 1.39 Billion in the first sub-period, but smaller, USD 0.5 Billion in the last sub-period.

In the whole decade, India's silk export accounted for USD 6.16 Billion compared to the import value which was USD 2.44 Billion, resulting a positive balance of USD 3,72 Billion (Table 5).

Table 5. India's raw silk trade, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	2.06	1.38	+0.68
	Average	0.41	0.27	+0.14
2018-2022	Total	4.10	1.06	+3.04
	Average	0.41	0.11	+0.60
2013-2022	Total	6.16	2.44	+3.72
	Average	0.62	0.24	+0.38
2018-2022 vs. 2013-2017	Absolute difference	+2.04	-0.32	+1.72
	Relative difference (%)	+99.02	-25.19	+347.5

Source: Own calculation based on the data from ITC, 2024 [7].

In the coming years, China will become teh main supplier of garments enlarging the world market, while India will become the main source for apparel market.

Raw silk trade in the European Union

The EU is an important producer of silk textiles, fabrics and apparel, but especially elegant and luxury clothes produced by fashion industry. For realizing these products, it needs raw silk which is usually imported from the Asian countries.

In the whole analyzed period, the silk export value of the EU accounted for USD 5.59 Billion, while the import value was USD 7.03 Billion, leading to -USD 1.44 Billion trade balance.

By sub-period, it was noticed a reduction in the 2nd period 2018-2022, both in case of export and import (Table 6).

Table 6. The EU silk trade, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	3.34	4.10	-0.76
	Average	0.67	0.83	-0.15
2018-2022	Total	2.25	2.93	-0.68
	Average	0.45	0.59	-0.14
2013-2022	Total	5.59	7.03	-1.44
	Average	0.56	0.70	-0.14
2018-2022 vs. 2013-2017	Absolute difference	-1.09	-1.17	-0.08
	Relative difference (%)	-36.64	-38.54	-10.53

Source: Own calculation based on the data from ITC, 2024 [7].

Italy's silk trade

Italy is the major importer of raw silk which is process in high value silk products which are successfully exported.

Its imports of Chinese blouses accounts for about 80% of China's exports and also silk garments are required by Italy from the same Asian supplier.

Italy is recognized as the most important player in buying silk to transform it in special luxury clothes (dresses, coats, suits, ties, scarves, collars, gloves etc) using a high developed processing industry finishing, dyeing and printing silk fabrics.

In the whole period 2013-2022, Italy imported raw silk in value of USD 3.36 Billion and its export value was USD 2.81 Billion, leading to a negative trade balance of USD 0.55 Billion.

In the sub period 2018-2022, both the export and import had smaller values than in the sub-period 2013-2017 (Table 7).

In 2022, Italy came on the 2nd position after China based on the silk export value.

The share of the top silk exporting countries in the total silk export value is: China 49%, Italy 12%, Vietnam 7.5%, India 5%, Uzbekistan 4.9%.

Italy imports raw silk especially from China, Romania, France, Germany, Brazil and Slovenia.

The main beneficiaries of Italian silk products are: France, Romania, Tunisia, USA and Germany.

Table 7. Italy's silk trade, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	1.60	1.89	-0.29
	Average	0.32	0.38	-0.06
2018-2022	Total	1.21	1.47	-0.26
	Average	0.24	0.29	-0.05
2013-2022	Total	2.81	3.36	-0.55
	Average	0.28	0.34	-0.06
2018-2022 vs. 2013-2017	Absolute difference	-0.39	-0.42	-0.03
	Relative difference (%)	-24.38	-22.2	-10.35

Source: Own calculation based on the data from ITC, 2024 [7].

Romania's silk trade

Romania comes on the 2nd position in the EU for its import of raw silk after Italy, being followed by France, Germany and Spain. But, it is also an exporting country at the world level, but its export value is lower than the import value [14].

With a long tradition in silkworm rearing, Romania process mulberry cocoons into silk fibers for producing handicrafts, silk blouses, house decorations, brooches. Its exported products made of silk are especially raw silk, silk yarn and woven fabrics. However, analyzing by sub-period, it may notice that in the first sub-period 2013-2017, Romania's export value as well as the import value had higher levels than in the sub-period 2018-2022 (Table 8).

Table 8. Romania's silk export, import and trade balance, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	0.46	0.51	-0.05
	Average	0.09	0.10	-0.01
2018-2022	Total	0.39	0.46	-0.07
	Average	0.08	0.09	-0.01
2013-2022	Total	0.85	0.97	-0.12
	Average	0.08	0.10	-0.02
2018-2022 vs. 2013-2017	Absolute difference	-0.07	-0.05	-0.02
	Relative difference (%)	-15.22	-9.81	+40.0

Source: Own calculation based on the data from ITC, 2024 [7].

France 's silk trade

France has a long tradition in processing silk in fabrics and nowadays especially in garments. curtains, bed spreads, wall coverings and upholstery are very much required for internal house or hotels decorations. France is both an important importer of raw silk and also an exporting country of ready-made goods, but import value is higher than export, which results in a negative trade balance.

In the sub-period 2013-2017, France recorded a higher export and import value and the trade balance was smaller than in the second sub-period 2018-2022 (Table 9).

Table 9. Romania's silk export, import and trade balance, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	0.41	0.59	-0.18
	Average	0.08	0.12	-0.04
2018-2022	Total	0.24	0.5	-0.26
	Average	0.05	0.1	-0.05
2013-2022	Total	0.65	1.09	-0.44
	Average	0.06	0.11	-0.04
2018-2022 vs. 2013-2017	Absolute difference	-0.17	-0.09	-0.08
	Relative difference (%)	-41.47	-0.16	+44.4

Source: Own calculation based on the data from ITC, 2024 [7].

Germany's silk trade

One of the largest European market of textiles and garments is in Germany. Also, a large range of silk clothes, accessories and materials for interior decorations are imported by Germany from its main supplier, China.

This country could be cited as among the top producer of silk products in the EU like Italy, Romania and France, even though its silk export and import values have smaller levels than in the other countries.

If in the sub-period 2013-2017, the export value was about 2.5 times higher than in the sub-period 2018-2022, in case of import, its value was doubled in the period 2028-2022 versus 2013-2017 (Table 10).

Table 10. Germany's silk export, import and trade balance, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	0.33	0.40	-0.07
	Average	0.06	0.08	-0.02
2018-2022	Total	0.16	0.82	-0.66
	Average	0.03	0.16	-0.13
2013-2022	Total	0.49	1.22	-0.73
	Average	0.05	0.12	-0.07
2018-2022 vs. 2013-2017	Absolute difference	-0.17	0.42	+0.59
	Relative difference (%)	-51.52	+105.0	+842.6

Source: Own calculation based on the data from ITC, 2024 [7].

Spain's silk trade

Spain was many years known as a producer of silk and also as an exporter, silk stock exchange being in Valencia.

At present, it has a balanced export and import, the differences being not significant. However, by sub-period, the export value was by USD 0.08 Billion higher in the period 2013-2017 than in the period 2018-2022.

Regarding the import value, it was also a little higher, the difference between the two sub-periods being only USD 0.04 Billion.

For this reason, for the whole period the trade balance is zero, the export value being similar with the import value (Table 11).

Table 11. Spain's silk export, import and trade balance, 2013-2022 and by sub-period (USD Billion)

Period	Specification	Export value	Import value	Trade balance
2013-2017	Total	0.12	0.09	+0.03
	Average	0.02	0.02	0
2018-2022	Total	0.03	0.05	-0.02
	Average	0.006	0.01	-0.004
2013-2022	Total	0.15	0.14	+0.01
	Average	0.01	0.01	0
2018-2022 vs. 2013-2017	Absolute difference	-0.09	-0.04	-0.05
	Relative difference (%)	-75.00	-44.45	-43.35

Source: Own calculation based on the data from ITC, 2024 [7].

But, along the analyzed period, a positive trade balance was achieved in 2015, 2016 and on the whole sub-period 2013-2017, while in the other years of the first sub-period and in the whole 2nd sub-period, the trade balance was negative (Table 11).

CONCLUSIONS

Natural fibers are more and more requested as the future will belong to healthy products especially in clothes and fashion industry, but also in textile and cosmetics industry and medical sector.

However the development of silk market will impose a higher production cost for assuring new technologies to produce long life cycle and recycling goods which have also to be environmentally friendly for sustaining the development of the silk sector.

Also, a high silk demand will be justified not only by the new orientation in silk production and processing, but also by rising consumers' purchasing power.

China and India will remain the major growth drivers of the world silk market. China will continue to be specialized in silk blouses and clothes and India in garments.

In the EU, Italy will preserve its status of global leader in silk imports being followed by other important players in the EU silk market like Romania, France, Germany and Spain.

Silk worm rearing has to be stimulated to increase production and also new technologies have to be used for processing and transforming silk in high value products destine to better satisfy consumers.

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LAND USE FOR ANIMAL FEED IN ROMANIA IN THE PERIOD 2013-2022

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Abstract

The goal of the paper is to analyze the land use as cultivated area and grasslands for producing animal feed in Romania in the interval 2013-2022 utilizing the data from National Institute of Statistics (NIS) and Eurostat. The dynamics was highlighted as graphical trend lines, regression equations and R square, fixed basis and structural indices reflecting the changes across the time. The results showed that the surface with green forages in arable land was 847,978 ha in 2022 representing 10.59% of the total cultivated area and also reflected a reduction by 1.26% versus 2013. The perennial forages covered 675,207 ha in 2022 (+3.7% vs. 2013). Alfalfa accounted for a larger surface with a share of 62.52% in 2022(vs. 52.39% in 2013), while the clover area decreased its weight from 18.5% to 14.2%. In 2022, annual green forages covered 179,952 ha, by 13.35% less than in 2023. Fodder maize was cultivated on only 48,634 ha in 2022 (-13.36% vs. 2013) and root crops on only 3,033 ha, a surface smaller by 79.32% in 2022. The declined is justify by the negative influence of climate change which reduced forage production and also by the decreasing trend in livestock. Romania has also 5,172,800 ha grasslands, coming on the 3rd position in the EU after France and Germany. This area plays an important role in animal nutrition at a lower cost, in soil conservation, mitigating the effects of climate change, preserving biodiversity and the beauty of the landscapes.

Key words: *land use, cultivated forage crops, grasslands, trends Romania*

INTRODUCTION

The need of a balanced nutrition, food safety and health at the global level has led to a higher demand of food products both of vegetal and animal origin.
This reality resulted in a high pressure on land use, even though land surface is limited, but grace to the advanced agricultural technologies from a smaller utilized land area it is possible to obtain more food.
For obtaining more meat, milk and eggs, animal husbandry is called to raise and improve forage production on a smaller land surface favouring cropland for human consumption [34].
Animal feed is assured by farmers using agricultural land for cultivating specific fodder crops and also utilizing the permanent grasslands.
At the world level, about 23% of agricultural land is used for cultivating crops destined to cover human consumption and 77% is used for animal feed.
In 2021, Fuglie *et al*. affirmed that 159 million ha are cultivated with forage crops whose production value, estimated at 2014-2016 prices, accounted for USD 63 Billion per year [10].

Ritchie and Roser (2024) sustain that 48 Million km^2, meaning 44% of the global habitable land, are utilized for agriculture. Of this surface, only 15.9 Million km^2 (33%) is cropland for humans and the remaining of 32.1 Million km^2 (67%) is land for grazing [35].

If we sum the cropland for animal feed and the grazing land, we may easily draw the conclusion that about 80% of agricultural land is used for animal growing.

But, having in mind the technological progress to produce more forages and animal products on a surface unit, larger land areas could be saved applying a strategy destined to:

-diminish the cropland for animal feed;

-to reduce the grazing land;

-to grow yields both on the cropland and in the grazing field. At the same time, a higher food production could be produced mitigating the impact of climate change and environment pollution, and preserving biodiversity.

The large diversity of the fodder plants is explained by the geographically distribution in various regions of the globe characterized by specific soil features (structure, quality, fertility), climate conditions (tropical, temperate, equatorial, continental, alpine etc) which have a deep impact on forage production and trade.

The climate change has a deep impact on forage production which imposed new strategies in various countries to mitigate the negative effects and maintain a high level of forage production and nourish the livestock for attaining the yield performance [37].

Ates *et al*. (2015) presented new solutions to stimulate animal production in the agro-pastoral farming systems in small farms of the South Mediterranean countries where rainfalls are smaller than 500mm/year [1].

In Türkiye, Tan and Yolcu (2021) emphasized the need of a strategy to expand the cultivated area with forage crops and use more resistant crops to drought [36].

Muhammad, I.R. (2019) studied the problem of animal protein shortage and malnutrition in and tried to give solutions for grazing ruminants through the provision of adequate fodder that can be converted to high meat and milk in Nigeria [21].

Phelps and Kaplan (2017) gave a reply to the poor literature on land use in connection to livestock production and developed a framework for suitable for application in land use inventory and scenarios and studies on sustainable land use [25].

Franzluebbers and Martin (2022) sustained integrated crop-livestock agricultural systems which could be an efficient solution to increase animal production, protecting soil health, water quality and enhancing biodiversity [9].

King et al (2024) pointed out that the high request of land for farming, climate change negative effects, the discrepancies existing between various nations regarding land resources, increased competition between and uses and land users, have deepened "land crisis" and for creating a "sustainable land-wealthy world" it is needed "to diminish humanity’s land footprint, to develop a systemic and cooperative land resource management and strategy by governments, changing the methodology how land is valued and financed" [11].

Demand/offer ratio is of a high variability which influences forage market structure and price elasticity has a deep impact on export, import and forage trade balance.

Analyzing international forage trade in the period 1997-2020, Wang *et al.* (2023) revealed that the USA and Australia are the top forage exporting countries, while Japan, China and South Korea are the main importing countries [38].

In this context, the paper aimed to present in brief the general situation of land use at the global and EU level and then to analyze the situation of land area used for producing forages in Romania, regarding the evolution of surfaces cultivated with fodder crops in arable land and also the areas of grasslands (pastures and meadows) in the last decade 2013-2022 for which the data from the National Institute of Statistics are available at present. The trends in land use by category and structural aspects have been highlighted in order to point out if Romania is aligned to the EU policy according to the quota *"to produce more using less land"*.

MATERIALS AND METHODS

For setting up this study, it was started from the literature regarding land use based on official documents and research articled published in well known journals.

The data were picked up from various official information sources such as: National Institute of Statistics and Ministry of Agriculture and Rural Development of Romania, Eurostat, OEC World, World Bank, The European Feed Manufacturers Federation - FEFAC and other sources.

The period of analysis is 2013-2022 for which the data were available.

The fixed basis index and also the structural index were used for comparisons.

Also, graphical illustrations are destined to help the readers to easier understand the dynamics and the regression equations to highlight the main trend lines, while the R square value to reflect in what measure the variations of the studied indicators depends on the time changes.

Tables present the synthetic results reflecting the image of land use for animal feed at the world level, the EU and in Romani as well.

The paper contains in its structure the following aspects:

- the global land use for animal feed in brief in the recent years;

-a short overview on land use for animal feed in the EU at present;

-a detailed land use for animal feed in Romania in the last decade, 2013-2022.

The situation of land use was firstly analyzed in arable land, for the cultivated forage crops and then by category: perennial crops, of which alfalfa and clover, and annual crops, of which: fodder maize and fodder root crops.

Then, it is was approached the situation of the land use as grasslands in Romania, by category: pastures and meadows.

Finally, there were extracted the main ideas reflected by the obtained results in order to conclude in what manner in Romania land is used for sustaining forage production and implicitly livestock farming.

RESULTS AND DISCUSSIONS

Land use for animal feed at the global level

The surface used for animal feed at the world level accounts for 3.75 Billion ha, representing 78.5% of the global agricultural land of 4.78 Billion ha in the year 2021 [7].

Of the 3.75 Billion ha for animal feed, 3.2 Billion ha are grasslands, accounting for 85.3% of the land use for animal feed and 67% of the world agricultural land.

The remaining of 0.55 Billion ha from the land use for animal feed represent arable land for fodder crops. This small surface accounts for 14.7% in the global land use for animal feed and for 11.5% in the world agricultural land.

The permanent grasslands area is divided into two categories:

- permanent grasslands for grazing (pastures), which accounts for 2 Billion ha (62.5%); of this surface, 1.3 Billion ha are used for livestock farming (65%) and 0.7 Billion ha is land converted into arable cropland; the surface destined for livestock farming is used for cattle, buffaloes, sheep and goats growing;
- meadows, whose surface is 1.2 Billion ha (37.5%), are destined for producing hays and also for carbon sequestration.

The arable land for fodder crops of 0.55 Billion ha is cultivated mainly with cereals on 0.13 Billion ha (23.6%), with oilseeds crops also on 0.13 Billion ha (23.6%) and the remaining is destined for other crops (52.8%) (Table 1).

The secondary products remained after harvesting the cropland can be used by cattle, buffaloes, sheep and goats. But, the main products are used for humans.

Therefore, livestock consume 33% of the global cereals production as feed and 11% of the total feed.

The animals have the advantage that they are able to transform and convert cellulose from the forages they consume, which in fact could be considered wastes from vegetal cropping, into high value digestible nutrients included in food products like milk, meat and eggs [8].

Table 1. Global land use for animal feed in 2024

Global land use for animal feed 3.75 Billion ha					
Grasslands area 3.2 Billion ha			**Arable land for fodder crops 0.55 Billion ha**		
PASTURES 2 Billion ha		MEADOWS 1.2 Billion ha	Land for cultivating cereals 0.13 Billion ha	Land for cultivating oils seeds crops 0.13 Billion ha	Land for other crops 0.29 Billion ha
Land for livestock farming 1.3 Billion ha	Land converted into arable cropland 0.7 Billion ha	Land for hays and carbon sequestration 1.2 Billion ha			

Source: Own conception based on the data from [7, 8, 34].

Land use for animal feed in the EU

The EU has 157.4 Million ha utilized agricultural area (UAA), representing 3.2 % of the global agricultural land. The UAA is differently distributed among the member states and it is deeply linked to the farm structure and its physical size [26, 28, 29].

The largest surface in the EU is represented by arable land which accounts for 98.1 Million ha, meaning 62.3% of the EU total UAA and 6.3% of the global crop land.

A surface of 59.1 Million ha is used for animal feed. Of this area, 48 Million ha are permanent grasslands (30.5%) of the EU UAA and 1.5% of the global grasslands, and 11.1 Million ha are permanent crops for animal fodder. The remained 0.2 Million ha UAA (0.1 %) represent the kitchen gardens (Table 2). Compared to the year 2010, there were noticed important differences in the EU UAA structure [6].

In 2020, the surface covered by permanent grasslands was by 2 Million ha smaller and also the surface of arable land declined by 1.5 Million ha. Therefore, this reduction is in accordance of the EU Green deals which provide a Green Europe by 2050 [3].

This means a huge effort for improving agricultural technologies so that with less land to obtain higher agricultural production of high quality to sustain food safety and to mitigate negative impact of agriculture on environment and the negative impact of climate change.

Therefore, it is very important as land to be efficiently used in terms of agricultural production value, value added, labour productivity [30, 27, 31, 32].

Table 2. Land use for animal feed in the EU in 2020

Land use in the European Union 157.4 Million ha agricultural land (UAA)			
Arable land 98.1 Million ha	Permanent grasslands 48 Million ha	Permanent crops for animal feed 11.1 Million ha	Kitchen gardens 0.2 Million ha
62.3%	30.5%	7.1%	0.1 %

Source: Own conception based on the data from [4].

Land use for animal feed in Romania

Romania is an important agricultural country in the EU where it comes on the 5 position for UAA 12.9 Million ha representing 8.1% of the EU UAA. It is ranked after France, Spain, Germany and Poland.

Also, Romania is ranked the 4th in the EU for 3.7 Million ha permanent grasslands, accounting for 7.7% of the EU grasslands area, after France, Spain and Germany.

Taking into consideration the allocation of arable land, permanent grasslands and permanent crops, Romania is situated on the 15th position in the EU after Finland, Denmark, Sweden, Hungary, Malta, Lithuania, Cyprus, Poland, Bulgaria, Slovakia, Estonia, Czechia, Germany and Latvia [4].

Taking into account the data from the National Institute of Statistics, and Ministry of Agriculture and Rural Development, and

National Institute of Statistics in 2013 and 2014, Romania had a surface of 4,813.8 thousand ha grasslands, of which 3,273.9 thousand ha pastures and 1,541.9 thousand ha meadows, representing 22.38% and, respectively, 10.57% in the total agricultural area [20, 22].

Category of forages in Romania

Forages are of a large diversity taking into consideration the geographical localization of the country in the Eastern part of Europe, soil structure, quality and fertility, climate condition in the temperate area with Mediterranean influences in the Western part, the relief zones: mountain, hilly and plain areas, the species and categories of plants which could be grown in arable land and which are specific in grasslands floristic structure, the potential in forage yield and production [33].

Also, the forage production is correlated with the livestock size in terms of LU (livestock unit) for covering nutritional and energy requirements to assure vital functions and production in accordance with the species, breed, category, age, physiological status, and production potential.

In Romania there are raised the main farm species: cattle for milk and meat and mixed purposes, buffaloes, sheep and goats, pigs, poultry, horses etc.

Fodder production covers in general the quantitative and qualitative needs of these animals and also assures their health and expected production using technologies which are in general friendly with the environment.

The cultivated fodder crops are classified in two categories: *perennial crops*, having as main representatives: alfalfa and clover, and *annual crops* such as: maize, wheat, barley, oats, rye, triticale, Sudan grass, sorghum, sunflower, fodder cabbage and peas, root crops (carrots, pumpkin etc) [2].

Grasslands are used especially for grazing (70%) and the rest of 30% for mixed purposes and producing hay.

The permanent grasslands are continuously covered by a grass vegetation with a diversified floristic composition, production amount and quality along the altitude zones in accordance with the soil type, fertility and maintenance works.

The temporary grasslands represent a very small area, in general being degraded grasslands, where it is required to be sown with a mixture of grass and leguminous crops for recovering the soil natural structure and productivity.

The used area for producing forages and grazing in Romania

The cultivated area with forage crops in arable land

In Romania, the total cultivated area reached 8,006 thousand ha in the year 2022, being by 1.98% lower than in the year 2013 when it accounted for 8,167 thousand ha. The reduction is justified by the increased yields achieved in the last decade. The largest cultivated area accounting for 8,737 thousand ha was registered in the year 2020.

The cultivated area with fodder crops also decreased from 859 thousand ha in the year 2013 to 848 thousand ha in the year 2022, meaning a reduction by 1.28% (Figure 1).

These aspects reflect that a part of cropland destined to produce animal feed is saved and could be used for human consumption.

We mention that there are differences between the data displayed by NIS Tempo online data base and the data mentioned by NIS in 2022 after the General Agricultural Census, presented by Press Release no.74/24 March 2022 [23].

These differences are determined by the change in methodological procedures used for establishing the inventory in land use.

The share of fodder crops in the cultivated arable land accounted for 10.51% in 2013 and for 10.59% in the year 2022 in the total cultivated area in the country. The slight increase accounts for just +0.08 pp.

The fodder crops are perennial crops and also annual crops, which have been cultivated on different surfaces.

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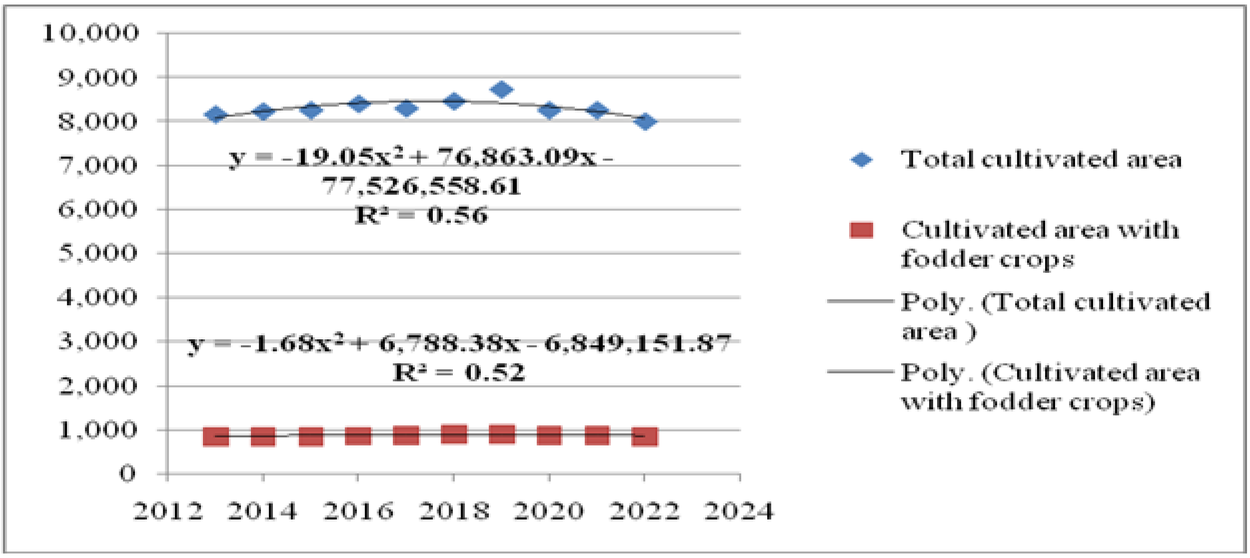

Fig. 1. Dynamics of the cultivated area in Romania and the cultivated area with fodder crops (Thousand ha)
Source: Own design based on the data from [24].

The cultivated area with perennial fodder crops registered an increasing trend from 651 thousand ha in the year 2013 to 675 thousand ha in the year 2022, reflecting a growth by 3.68%.

The main perennial crops cultivated for forages are alfalfa and clover.

Alfalfa was cultivated in the analyzed interval on a larger and larger surface, increasing from 341 thousand ha in the year 2013 to 422 thousand ha in the year 2022, meaning a surplus of 23.75%.

But the surface cultivated with clover decreased by 21.67% from 121 thousand ha in the year 2013 to only 96 thousand ha in the year 2022 (Figure 2).

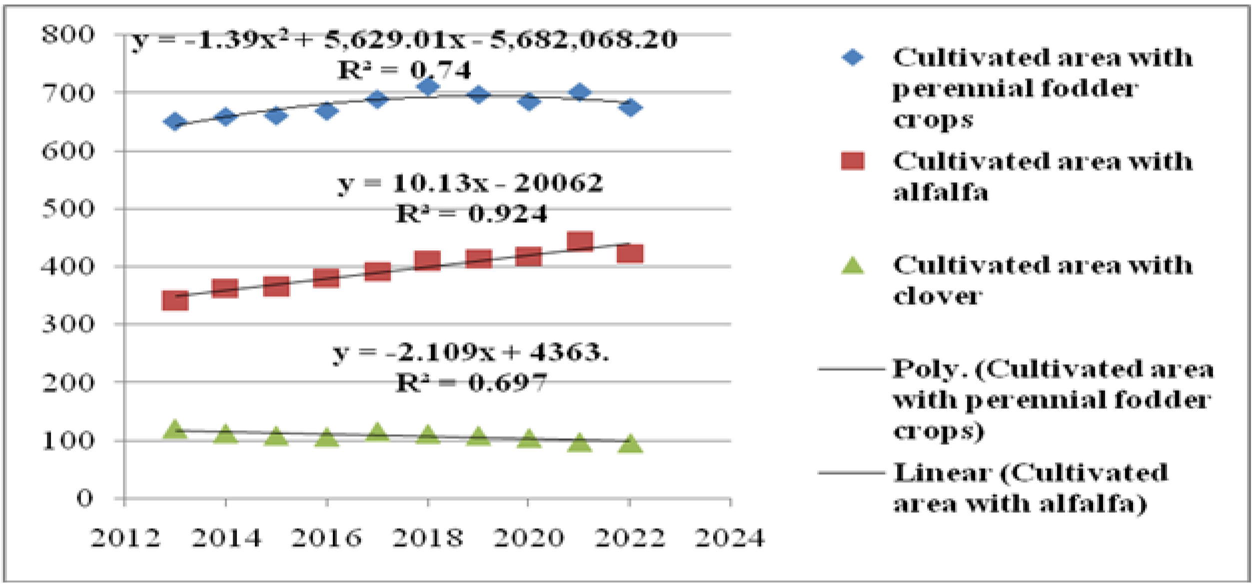

Fig. 2. Dynamics of the cultivated area with perennial fodder crops, alfalfa and clover (Thousand ha)
Source: Own design based on the data from [24].

In 2013, the share of alfalfa cultivated area in the total area cultivated with perennial fodder crops was 52.39%, and in 2022 increased to 62.52%.

In case of clover, its weight declined by -4.3 pp, from 18.51% in 2013 to 14.21% in 2022.

If we take into account the cultivated area with these two crops, in 2013 it accounted for

70.96 % and in 2022 for 79.70% in total cultivated surface with perennial fodder crops.

The cultivated are with annual fodder crops carried out a decline from 208 thousand ha in the first year of this study and 173 thousand ha in the last year, which means a loss of 16.83% (Fig. 3).

The major annual fodder crops cultivated in Romania are maize and roots.

The surface is higher for maize compared to roots.

Maize for fodder recorded a reduction in its cultivated area from 56 thousand ha in 2013 to 49 thousand ha in 2022, reflecting a loss of 12.5%.

The roots crops were cultivated only on 3,000 ha in 2022 compared to 14,000 ha in 2013 (-80%) (Figure 3).

The cultivated area with annual fodder crops represented 28.19% in the year 2013 and 20.39% in the year 2022 in the total cultivated fodder surface.

Maize share in the cultivated area with annual fodder crops accounted for 26.92% in 2013 and for 28.32% in 2022, while the share of root crops registered a deeper decline from 7.21% in 2013 to 1.73% in 2022.

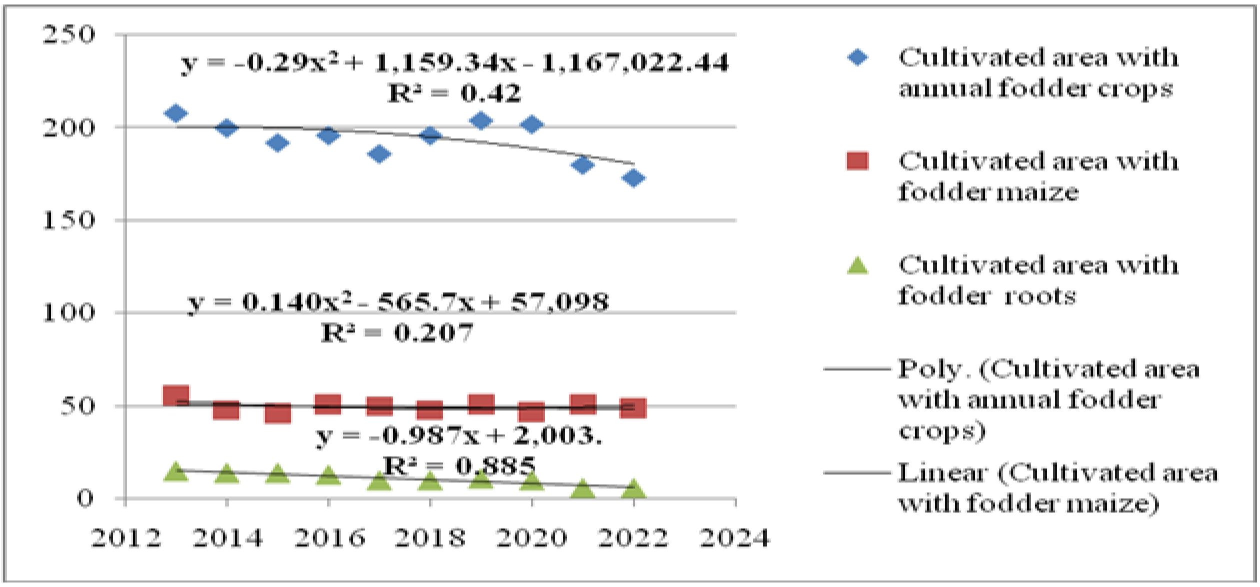

Fig. 3. Dynamics of the cultivated area with annual fodder crops, maize and roots (Thousand ha)
Source: Own design based on the data from [24].

Table 3. Land use for cultivated fodder crops in Romania in 2022

Land use for cultivated fodder crops in Romania 848,000 ha			
Perennial fodder crops 675,000		**Annual fodder crops 173,000 ha**	
Alfalfa 422,000 ha	Clover 96,000	Maize 49,000	Roots 3,000

Source: Own synthesis based on the data from [24].

A synthetic presentation of the cultivated area with fodder crops is shown in Table 3.

The area of grasslands in Romania

According to Knoema (2022), in 2021, Romania had 4,090 thousand ha permanent grasslands (pastures and meadows) [12].

According to Eurostat, Land use and Land cover survey, it was made a classification of all the EU countries based on LUCAS data (Land Use/Cover Are frame Survey) regarding the surface of permanent agricultural grasslands in km^2 and relative land cover area of permanent grasslands (%).

In this hierarchy, on the top position is situated France with 108,332 km^2 in the year 2015 and 107,781.1 km^2 in the year 2018 permanent grasslands, followed by a group of four member states: Germany, Romania, Poland and Spain with permanent grasslands over 40,000 km^2 [5, 6].

Romania is mentioned with 55,257.9 km^2 permanent grasslands in 2015 and with 51,728.8 km^2 in 2018.

The relative cover area of permanent agricultural grasslands is also specified in this survey which in case of France was 19.7% in 2015 and 16.3 % in 2018, while for Romania its value was 23.2 % in 2015 and 21.7% in 2018 (Table 4).

Of the 55,257.9 km^2 of grasslands, about two thirds are used for grazing and one third for producing hay (Table 4).

Table 4. Romania's position among the top member states regarding the area of permanent grasslands and relative land cover of permanent agricultural grasslands in the years 2015 and 2018

Country	2015		2018	
	Area of permanent grasslands (km^2)	Relative cover area of permanent agricultural grasslands (%)	Area of permanent grasslands (km^2)	Relative cover area of permanent agricultural grasslands (%)
1.France	108,332.9	19.7	107,761.4	19.6
2.Germany	59,442.7	16.6	58,331.4	16.3
3.ROMANIA	55,257.9	23.2	51,728.8	21.7
4.Poland	44,699.2	14.7	46,607.8	14.9
5.Spain	45,731.3	9.0	43,978.2	8.8
6.Ireland	37,0182.8	53.1	36,089	51.7
7.Italy	31,331.3	10.4	30,170	10.0

Source: Eurostat, Land use and Land cover survey [5].

Important achievements of the scientific research points out the production potential of Romania's grasslands and also offer a large variety of solutions to improve soil fertility, floristic composition, productivity, ecological reconstruction of the degraded grasslands, rational grazing, assessment of animal production obtained from grazing, efficient farming on the grasslands of Romania's mountains [13, 14, 15, 16, 17, 18, 19].

CONCLUSIONS

The main conclusions that could be drawn from this study are the following ones:

-At the global level, 3.75 Billion ha are used for animal feed, of which 85.3% for grasslands and the remaining for land for cultivating fodder crops. Grasslands accounts for 3.2 Billion ha, of which 62.5% are pastures and 37.5% are meadows. Arable land accounts for 0.55 Billion ha, of which 0.26 Billion ha are cultivated with cereals and oils seeds crops. Of the pastures area, 1.3 Billion ha are used for livestock farming and 0.7 Billion ha are converted into arable cropland.

-In the EU, the permanent grasslands cover 48 Million ha, and 11.1 Million ha are destined to cultivated fodder crops. This means 30.5% and, respectively, 7.1% of the EU UAA accounting for 157.4 Million ha.

-Romania comes on the 4th position in the EU for 3.7 Million ha permanent grasslands, representing 7.7% of the EU grasslands. It also is ranked the 15th for arable land, permanent grasslands and permanent crops in the EU.

- In Romania, fodder crops were cultivated on 848 thousand ha in 2022, a smaller area by 1.28% versus 2013. Fodder crops area represents 10.59% in the whole cultivated area in Romania in 2022.

-Perennial fodder crops were cultivated on 675 thousand ha in 2022, an area by 3.86% higher than in 2013. Of this surface, alfalfa is cultivated on 422 thousand ha and clover on 96 thousand ha, meaning 76.7% of the surface with perennial fodder crops.

-The annual fodder crops were cultivated on 173 thousand ha, a surface by 16.83% smaller than in 2013. Maize is cropped on 49 thousand ha and roots on only 3 thousand ha, which means -12.5% and, respectively, -80% compared to 2013.

- Romania had 51,728.8 km^2 grasslands in 2018, with a relative cover area of permanent agricultural grasslands of 21.7%, coming on the 3rd position in the EU after France and Germany.

In conclusion, Romania follows the general trend at the global and EU level to diminish the surface allotted to animal feed as the modern technologies assures more fodder production per surface unit. Also, this trend is in the advantage of the cropland for human consumption, and, at the same time, it contributes to the maintenance of environment quality and conservation of biodiversity.

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EVALUATION THROUGH NATURAL BONITATION WORK OF THE SOILS IN THE ZONE OF CONFLUENCE OF DOLJ AND MEHEDINTI COUNTIES, ROMANIA AND THE ESTIMATION OF CROP PLANT PRODUCTIONS SPECIFIC TO THE AREA

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Abstract

The technical bonitation work was carried out based on soil mapping in the reference area, identifying the typical preluvosoil, the typical luvosoil and the gleic alluviosoil as the main soil units. The soils identified and evaluated in these natural conditions are characterized by morphological, physical, hydro physical and chemical properties, specific to the hilly area. Based on the physical-chemical properties, the evaluation of the main identified soils was carried out, in terms of their favorability for different plants grown in the area, by establishing bonitation marks and favorability classes. It was found that the highest bonitation marks (over 50 points) and the lowest favorability classes (III, IV and V) were obtained by the gleic alluviosoil, followed by the typical preluvosoil, and the lowest bonitation marks and the highest favored classes are recorded for the typical luvosoil. The estimation of the productions that can be obtained by the specific crops in this area, are according to the value of the bonitation marks obtained in natural conditions, with the 3 researched soil types.

Key words: *soil mapping, soil bonitation, bonitation marks, favorability classes, yields*

INTRODUCTION

The soil, a naturally occurring body, ensures the entire process of growth and fruiting of plants and is of particular importance in the life of mankind, through the various functions it has - economic, ecological and social [13].
The soil, as a natural organism, through its functions, makes possible the existence of mankind on Earth, representing the guarantee of the provision of agricultural products and is the most important natural resource of the planet [17,10].
The soil, as a natural and complex system, is the natural resource that provides food and biomass, contributing to the transformation of substances such as water, carbon, nitrogen [12,15].
The main characteristic of the soil, which makes it the life support for plants and the main source of supply of agricultural made food products for mankind, is fertility. The soil, as a complex and natural system, through its fertility ensures the proper growth and development of plants in the phases of vegetation, through the favorable conditions it provides, depending on the physical, hydric - physical, chemical and biological properties, which it acquired in the soil genesis process [4].
In the last period of time, in many countries of the world, including in Romania, a series of soil degradation processes have been observed, which lead to the decrease of soil fertility, many of them due to soil genesis processes (acidity, salinity, erosion, etc.), which are amplified by the low level of precipitation, as a result of climate changes that are happening more and more obviously [1,11].
The low level of rainfall, combined with the high temperatures, has an immediate impact on the level of production, which it limits. In the southern part of Romania and especially in the Oltenia area, recently, drought has been present almost every year [3].
In addition to these negative aspects, determined by natural factors and formation conditions, the anthropic factor also intervenes in reducing the fertility of soils, through the agricultural activity they carry

out. Through the need to obtain large and immediate yields, farmers contributes to the destruction of the soil structure, to the decrease in humus content, to the reduction of the reserve of nutrients, to the reduction of permeability for water and air, etc. [26, 11].

In the current conditions, when climate changes are increasingly evident, it is necessary to obtain as much information as possible regarding the characteristics of the soils and related to the natural factors, which diminish or limit the fertility and quality of the soils and implicitly their productivity, the level of productions. All these data, once obtained, are very important in order to apply the most appropriate measures to improve, ameliorate or limit the negative aspects, in order to obtain high productions in terms of quantity and quality and for the sustainable use of soils in order to the practice of modern agriculture [16].

In the context of practicing sustainable agriculture, soil conservation and protection are supported and promoted by specialists and researchers in the field and this can only be achieved by knowing their physical, chemical and biological properties [5].

Through the relationships that are created between the characteristics of the soil and the plant, in their interdependence, farmers can thoughtfully intervene in the appropriate direction of the technologies that must be applied in order to obtain high and safe productions, to practice a sustainable, competitive agriculture [21].

The soil has its limits in producing yields, it cannot be multiplied, and if it is not used rationally, it wears out. Through their scientific and rational use, safe and quality productions, efficient from an economic point of view, are obtained; in this sense a profitable agriculture is practiced. The increase in production per surface unit satisfies the needs of food products and raw materials of mankind, thus supplementing the limited space, as a means of production by which the soil is generally characterized [6].

The intensive agriculture practiced in the last period, led to the decrease of soil fertility. This is a problem encountered in all areas of the country and is manifested in particular by the reduction of organic matter, which implicitly leads to the loss of soil biodiversity [14]. Maintaining the fertility of the soil and improving its quality is a primary concern of the specialists, of all those who have in their work this means of production, with the aim of ensuring, through the productions obtained, the food needs of the population, both for today's generations and for tomorrow [7, 8].

The studies carried out so far show that fertile soils are healthy soils, soils that determine the support for the development and development of biological activity, providing plants with everything they need to withstand thermal and water stress, climate changes [18,16].

Starting from all these aspects, it is topical and important to know the productive capacity of soils, in order to use them rationally, in a modern agriculture. This is the obligation of all those who work in this field. If it is used rationally, the soil maintains its productive capacity for a longer period of time, but it can be degraded quite quickly and difficult to recover [23].

The knowledge of the production capacity of the soils is achieved through the technical assessment work, with importance for agricultural practice, because it provides relevant indications regarding the agricultural crops and the uses that are best performed on certain soils and lands, by establishing the assessment grades in depending on the physical and chemical properties of the soil structural aggregates and the characteristic environmental factors [22]. It is also important for the application of appropriate technologies, but also for the investments that must be made and last but not least, for adequate earnings [20].

The topic under study, in this context, has a practical importance, but it also presents a theoretical importance, in light of the fact that the updating of research on the properties of Romanian soils enriches the specialized literature with new data about the soils and the productive potential of the area under study.

MATERIALS AND METHODS

The main purpose of the work is to establish the fertility of the soils in the confluence area of Dolj and Mehedinti counties, to assess their suitability for the agricultural crops practiced in the area and to estimate the productions that can be obtained. In order to achieve the objective pursued, the natural factors in which the soils were formed and evolved in this area were studied, the main soil units and their properties were identified, and based on them, credit rating indices were established, grades of credit rating, favorability classes and production estimation. The natural setting of the area was studied from the specialized literature, supplemented with data from the weather station Craiova and through field observations. The natural factors that are taken into account in the assessment of soils through natural assessment are represented by relief (slope of the land and landslides), climatic conditions (temperature and average annual rainfall), and hydrological conditions (depth of groundwater).

Soils were identified through field research and laboratory analysis. Soil profiles were dug on the relief forms specific to the area, plateau, micro depressions, valley, the morphological properties were studied in the field (number and sequence of horizons, thickness of horizons, color, humidity, state of gleization, stagnogleization, salinization, alkalization), according to the Romanian Soil Taxonomy System 2012, soil samples were collected from the soil horizons both in natural structure, in metal cylinders and with modified structure, to be analyzed in the laboratory, according to IRPA (Institute of Research for Pedology and Agrochemistry) methodology - 1987 and 2012 [24, 25].

The properties analyzed in the laboratory, which are taken into account directly or indirectly when establishing bonitation marks, are represented by: density, bulk density, total porosity, particle size composition and texture, reaction (pH value), exchange capacity for hydrogen, capacity to exchange for bases, total cation exchange capacity, degree of saturation in bases.

Each natural factor or property of the soil, specific to the natural assessment work, was analyzed and received a score, according to the bonitation, between 0 and 1 point, depending on the intensity of the influence on soil fertility, according to the assessment methodology established in Romania.

Using the score value for natural factors and soil properties, the value of the bonitation marks is obtained by calculation, by multiplying the bonitation indices, and the result is multiplied by 100 [2, 27]. The favorability classes in natural conditions for agricultural crops practiced in the area are established according to the value of the bonitation marks in descending order, from the first class when they are between 100 - 91 points to the X th class, with 10 - 1 points. The estimation of the productions that can be obtained on the identified soils is also carried out with the help of the bonitation mark, by multiplying it by the amount of products per point of the bonitation mark, for each plant, established by the Romanian bonitation methodology.

RESULTS AND DISCUSSIONS

The area under study, the confluence of Dolj and Mehedinti counties, is located in southwest Romania, the North Western part of Dolj county.

Due to the reconstitution of the property law, after the application of Law 18/1991, the land fund in the area became very non cropped and approximately 30-35% of the surface (as in the whole Dolj county), remained a large period of time not plowed by the new owners. This aspect led to lower yields per unit area.

The method of reconstituting the right of ownership, on the former locations, in the form of strips (Photo 1), in the N-S or E-W directions and with small widths of 8-10-12 m and on different lengths, depending on the configuration of the relief, also contributed to the amplification of the decrease in yielding capacity per hectare [19].

Recently, through the establishment in the area of agricultural forms and associations of different sizes in terms of surface area, there are no more uncultivated lands and the need to obtain large and qualitative yields is increased.

Photo 1. Crops drilled on stripes.
Source: Original photo.

Therefore, estimating the productions that can be obtained on the soils in this area is beneficial both for farmers in the area and for small private producers, in order to be able to take the most appropriate measures to increase the fertility and implicitly the productivity of the soils.

The soils identified in the studied area are represented by the typical preluvosoil, the typical luvosoil and the gleic alluviosoil [9]. The typical preluvosoil was formed and is found in the area of the plateaus with altitudes around 200 m, the typical luvosoil is present in the micro - depressions areas on the flat lands and the gleic alluviosoil specific to the low areas, the valley micro - relief. The identified soils were formed and evolved under natural conditions specific to the area of low hills, with relief characteristic of the Getic Piedmont, with a thermal and rainfall regime, which determines a period of drought from mid-May to mid-July, with bedrock material as clay, with groundwater at over 10 m in the area of the plateaus and at 1 – 1.5 m in the low areas, in the valleys, with vegetation typical of oak forests.

Photo 2. Wheat crop
Source: Original photo.

The crops cropped, both by farmers and private agricultural producers, are: wheat, barley, sunflower, corn, alfalfa (Photos 1, 2, 3, 4, 5), potato, and fruit trees especially plum and apple.

Photo 3. Barley crop
Source: Original photo.

Photo 4. Maize crop
Source: Original photo.

Photo 5 Sunflower crop
Source: Original photo.

The suitability of soils for agricultural crops practiced in the area and for fruit trees

Table 1 shows the suitability of the soils in the reference area for wheat and barley cultivation. It can be seen that on the typical preluvosoil, the bonitation for wheat is 66 points and the favorability class IV and for barley a bonitation score of 57 points is recorded, which places the soil in class V - favorability.

Low bonitation ratings, of 30 points for wheat and 27 points for barley, respectively high favorability classes, VIIIth, were obtained on the typical luvosoil. Gleizated alluvial soil recorded for the two agricultural crops the values of the bonitation ratings specific to the IInd classes for wheat (80 points) and the IIIrd for barley (71 points).

The values of the bonitation scores in the medium-high range, for the two analyzed crops, can be explained by the medium reserve in humus, the high compaction, the fine texture, and the low values of the bonitation scores for the typical luvosoil are caused by the low content in humus, acidity, high compaction and clayey texture.

Table 1. Suitability of soils for wheat and barley

Soil type	Wheat		Barley	
	Bonitation marks	Fertility class	Bonitation marks	Fertility class
typical preluvosoil	66	IV	57	V
typical luvosoil	30	VIII	27	VIII
gleic alluviosoil	82	II	71	III

Source: Own calculation.

The high ratings and low favorability classes, in the case of the gleic alluviosoil, are due to the coarser texture of the soil in the low area, and implicitly the higher porosity and the higher degree of loosening, the phreatic supply and the higher content in humus.

Analyzing the favorability of the typical preluvosoil, the typical luvosoil and the gleic alluvisoil for corn and sunflower crops (Table 2), it is found that the preluvosoil has bonitation rating values for the 6th class of favorability (49 bonitation points), for corn and for the 5th class for sunflowers (51 bonitation points). The typical luvosoil, records for these crops, particularly low values of the bonitation scores, 19 points for corn and 23 points for sunflower, and the gleic alluviosoil falls into the IVth class for the corn crop, which corresponds to 68 points for bonitation rating and fourth class in sunflower, for 67 bonitation rating points.

Table 2. Soil suitability for maize and sunflower

Soil type	Maize		Sunflower	
	Bonitation marks	Fertility class	Bonitation marks	Fertility class
typical preluvosoil	49	VI	51	V
typical luvosoil	19	IX	23	VII
gleic alluviosoil	68	IV	67	IV

Source: Own calculation.

The potato and alfalfa crops analyzed in Table 3, in terms of bonitation scores and favorability classes, keep the same configuration as the crops analyzed previously.

On the typical preluvosoil, the potato gets 39 points in the bonitation rating grade and falls into the VIIth favorability class, and alfalfa has the bonitation rating grade with 41 points and the VIth favorability class.

Table 3. Soil suitability for potato and alpha-alpha

Soil type	Potato		Alpha-alpha	
	Bonitation marks	Fertility class	Bonitation marks	Fertility class
typical preluvosoil	39	VII	41	VI
typical luvosoil	6	X	16	IX
gleic alluviosoil	54	V	72	III

Source: Own calculation.

The typical Luvosoil also records the lowest values of bonitation scores for these crops, 16 points for alfalfa and 6 points for potato, and the gleic alluviosoil falls into IIIrd favorability class for alfalfa and Vth for potato, corresponding to bonitation scores of 72 and 54 points, respectively.

For corn, sunflower, potato and alfalfa crops, the limitations presented for wheat and barley crops and which explain the values of bonitation scores and the classification of favorability classes are kept.

It can also be stated that the wide-planted crops, maize and sunflower, obtained low bonitation scores and high favorability classes compared to wheat and barley, and potato obtained the lowest bonitation scores and the highest favorability classes on plateau soils and the lowest bonitation rating grade 6 and the Xth favorability class on the typical luvosoil, characterized by severe limitations such as high compactness, clayey texture, high acidity and low humus content.

Fruit trees, which are suitable in the studied area, apple tree and plum tree (Table 4), on the typical preluvosoil obtained ratings of 55 and 58 points respectively and the 5th class of favorability, on the gleic alluviosoil, the favorability is still in the 5th class with a score of 51, respectively 53 bonitation score, and on the typical luvosoil, these plants occupy classes IXth (apple tree) and VIIIth (plum tree) with 19 and 25 points, respectively.

Table 4. Soil suitability for apple tree and plum tree

Soil type	Apple tree		Plum tree	
	Bonitation marks	Fertility class	Bonitation marks	Fertility class
typical preluvosoil	55	V	58	V
typical luvosoil	19	IX	25	VIII
gleic alluviosoil	51	V	53	V

Source: Own calculation.

Based on the score obtained by each plant taken into the study, the productions that can be obtained on the analyzed soils were estimated (Tables 5, 6, 7).
It is found that in the confluence area of Dolj and Mehedinti counties, the highest productions of agricultural crops (Tables 5 and 6) were obtained on the gleic alluviosoil, followed by the typical preluvosoil, and the lowest productions are obtained on the typical luvosoil.

Table 5. Estimation of yields in wheat, barley and corn crops

Soil type	Estimated yields (Kg/ha)		
	wheat	barley	corn
typical preluvosoil	3,960	3,420	3,920
typical luvosoil	1,860	1,620	1,520
gleic alluviosoil	4,920	4,260	5,440

Source: Own calculation.

Table 6. Estimation of yields in sunflower, potato and lucerne

Soil type	Estimated yields (Kg/ha)		
	Sunflower	Potato	Lucerne
typical preluvosoil	1,632	17,550	3,280
typical luvosoil	736	2,700	1,280
gleic alluviosoil	2,144	24,300	5,760

Source: Own calculation.

Wheat crop can get 3,960 kg on typical preluvosoil, 1,860 kg on typical luvosoil and maximum production of 4,290 kg on gleic alluvisoil, barley crop estimates yields are about equal to those of wheat crop and maize can yield 3,920 kg on typical preluvosoil, 5,440 kg on gleic alluviosoil and only 1,520 kg on the typical luvosoil. And as far as the sunflower, potato and alfalfa crops are concerned, the situation of estimating the productions that can be obtained on the three units of soil taken into account is similar, the value of the bonitation marks, they reflect the level of expected productions. The largest ones can be obtained on the gleic alluviosoil, the middle ones on the typical preluvosoil and the smallest ones on the typical luvosoil.
In the case of fruit trees, good productions are also obtained on the soil on the plateaus, with good drainage (the typical preluvosoil) and on those on the edge of the valley (the gleic alluviosoil), and the lowest productions are recorded on the soils formed and developed in the micro depressions areas of plateaus with low drainage, the typical luvosoil.
For apple tree and plum tree (Table 7), maximum production is obtained on the typical preluvosoil with 16,500 kg/ha for apple tree and 17,400 kg/ha for plum tree and the lowest productions of 5,700 kg/ha for apple tree and 7,500 kg/ha for plum tree are obtained on the typical luvosoil.

Table 7. Estimation of yields in apple tree and plum tree

Soil type	Estimated yields (Kg/ha)	
	Apple tree	Plum tree
typical preluvosoil	16,500	17,400
typical luvosoil	5,700	7,500
gleic alluviosoil	15,300	15,900

Source: Own calculation.

One in all, the estimated productions of the cultivated plants that are practiced in the studied area, it can be stated that they are in perfect agreement with the value of the obtained natural bonitation ratings.
If we include the studied crops and the three types of soil analyzed in the favorability maps, the following aspects would result, for the assessment in natural conditions: wheat falls for the typical preluvosoil in class B, for the typical luvosoil in class D, and for the

gleic alluviosoil in class A. Barley, class C in typical preluvosoil, D in typical luvosoil, B in gleic alluviosoil. Maize, class C for typical preluvosoil, E – typical luvosoil and B – gleic alluviosoil. Sunflower, class C on the typical preluvosoil, class D on the typical luvosoil and class B on the gleic preluvosoil. The potato occupies class D in the typical preluvosoil, class E in the typical luvosoil and class C in the gleic alluviosoil. Alfalfa, class C for typical preluvosoil, class E for typical luvosoil and class B for gleic alluviosoil. Fruit trees are listed together in class C, on the typical preluvosoil and gleic alluviosoil, and in class E (apple tree) and class D (maize) for gleic alluviosoil.

The increase in the fertility of the soils in the studied area and implicitly the agro-productive potential is achieved by applying a complex of improvement measures, and the establishment of fertility, suitability and the estimation of productions, which can be obtained, is achieved through enhanced bonitation which will be the subject of the next study in the area of confluence of Dolj and Mehedinti counties.

CONCLUSIONS

The territory under study is part of the Getic Piedmont and is located in the southwest of Romania in the North Western part of Dolj county. The natural conditions of climate, relief, vegetation, bedrock, hydrology, determined the formation and evolution in the area of some soils with different profile development, namely, well-developed soils in the area of the plateaus represented by the typical preluvosoil and the typical luvosoil and short soils on valleys represented by the gleic alluviosoil.

The agricultural crops used in the area by both farmers and small producers are represented by wheat, barley, corn, sunflower on a large scale, alfalfa and potato on a small scale. The most productive fruit trees in this area are apple trees and plum trees.

By calculating bonitation marks and establishing favorability classes, factors that determined the limitation of bonitation ratings were highlighted.

It was emphasized that the highest bonitation marks, over 60 points and the lowest favorability classes Ist, IInd, IIIrd, IVth and Vth, were obtained by the gleic alluviosoil for all 6 crop. Preluvosoil obtained bonitation marks above 50 points for wheat, barley, sunflower and IVth and Vth favorability classes, bonitation marks above 40 points for corn and alfalfa with favorability VIth class and below 40 points for potatoes, with XIIth class of favorability.

The typical luvosoil obtained small bonitation scores, in all agricultural crops 30 points for wheat, 27 points for barley, 19 points for corn, 23 points for sunflower, 16 points for alfalfa and 6 points for potato, and the favorability classes are VIIth , VIIIth, IXth and Xth.

The apple tree and the plum tree fall into favorability Vth class both on the typical preluvosoil and the gleic alluviosol, with ratings of over 50 points and VIIIth class (plum tree) and IXth (apple tree), with 25 and 19 points respectively bonitation marks, on the typical luvosoil.

Estimated productions for both agricultural crops and fruit trees faithfully follow the value of bonitation marks.

The analysis of the limiting factors of credit scores and implicitly the estimated productions, can be grouped into factors with moderate limitation (low content in humus, compaction, clayey texture, low total porosity) and factors with severe limitation (low content in humus, acidity, low value of saturation in bases degree).

In order to increase the fertility of the soils in the confluence area of Dolj and Mehedinti counties, complex amelioration works must be applied which will reduce or eliminate the restrictive, limiting or diminishing effects on fertility.

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THE SPECIFICS OF PUBLIC COMMUNICATION IN PROMOTING THE IMAGE OF AGRICULTURAL HOLDINGS

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Abstract

Considering the premises and theories of public communication, this paper aims, through a qualitative study, to capture, on the one hand, the main aspects of the image of agricultural companies with direct impact on their profitability and, on the other hand, to identify the mechanisms of public communication that have the greatest impact on image formation. The importance of agricultural companies is becoming more and more strongly perceived lately, the post-Covid 19 experience, the danger of uncontrolled increase in prices of basic foods, have made it easier for public opinion to understand the role of agricultural companies in ensuring food security. Certain governmental strategies to promote Romanian products, cooperation on the short producer-consumer chain, have led to putting on the public agenda, especially in recent years, the role and importance of agricultural companies within the Romanian society. In this context, the paper aimed to analyze the specific public communication strategies in promoting agricultural companies for increasing their credibility, enhance their competitiveness and conquest new markets. The qualitative research conducted through the method of the self-administered structured questionnaire analyses how agricultural companies, through their communication strategies, use recommendations and European funds in promotional campaigns to increase market image and build their own brand. The scientific premises, on which the research was based, were validated, the responses showing a significant correlation regarding information, access to funds, or the use of online promotional campaigns for building the image and brand.

Key words*: *public communication, image strategies, public opinion, target audience

INTRODUCTION

It is challenging to think of a more critical economic sector in today's world than agriculture. It is an industry that directly impacts the lives of all people, which is why governments worldwide take measures to protect and develop agriculture, ensuring the agricultural security of their people is safeguarded. This was highlighted, perhaps more than necessary, during the Covid-19 pandemic. Countries that could not predominantly secure their basic food security faced initial crisis moments.

A second impact, at the level of the EU and especially of the European countries neighbouring Ukraine which is facing hostilities. The shockwave, among other things, hit agriculture, in general, and agricultural companies, in particular. There is and was a need for additional funds distributed by the EU, as well as protectionist policies to assist farmers and those working in agricultural and agri-food companies. Today, from the Polish-Ukrainian border to Paris and Brussels, farmers have taken to the streets, frightened by the unfair competition of Ukrainian products or by the protection measures (subsidies) considered insufficient. It is a state of insecurity that the public opinion is increasingly aware of.

A third impact is directly or indirectly related to the impact of climate change on agriculture. This process has already begun and is already predominantly manifesting in southern Europe. Blaz Kurnik, an expert in the impact of climate change and adaptation to it, stated in 2019, following the Agency's Report on this aspect [12], that heatwaves and extreme weather phenomena are breaking climate records in Europe, once again emphasizing the importance of adapting to climate change. The expert mentioned that the phenomenon will not stop but will have an increasingly sustained dynamic. The European Environment Agency monitors evaluations made at the national, regional, and urban level by member states and manages the European Climate Adaptation Platform (Climate-ADAPT), whose mission is precisely focusing on advising and helping EU countries to build and develop adequate resilience against climate change [10]. On the other hand, the European Environment Agency has made available to the EU a database to adopt an Adaptation Strategy through the Common Agricultural Policy, adapting agricultural policies to climate change. The latest adaptation was in 2021 and aimed to answer how the EU can adapt to the inevitable impact of climate change and become resilient by 2050 [9]. The CAP for the period 2021-2027 has a clear objective of adaptation .

From another perspective, the future of the agricultural and food industry will be increasingly supported by the application of automated and scientifically precise agricultural techniques, which respect the soil and the environment and help rural communities in the long term. This complex situation in the agricultural sector has been attached to the relatively new concept of sustainable agriculture [2].

The general objectives of sustainable agriculture, capable of creating resilience, are [2, 5, 8]:

-*the production of food* in sufficient quantities and of high quality.

-*the conservation of natural resources*: products obtained from nature must be returned to nature in various forms, resources such as water, soil, and air need to be replenished and made available to future generations. It is necessary to minimize the use of pesticides to achieve this objective.

-*landscape management*: agricultural enterprises manage agricultural lands while conserving habitats of great value and maintaining biodiversity.

-*animal welfare*: animals are cared for and treated appropriately. Their natural behaviour is respected, being subject to a natural diet, adapted to each species.

-*economic viability*: agricultural enterprises generate sufficient income to be viable. Viable agricultural enterprises contribute to the strengthening of rural communities.

-*social equity*: agricultural enterprises are places of employment where interested individuals can earn a living.

These general objectives represent the future panacea for promoting the images of agricultural companies. Agriculture is the backbone of rural communities across the entire EU territory. These communities face several challenges, such as demographic aging and inadequate infrastructure, as well as a lack of services and employment opportunities. The Common Agricultural Policy (CAP) contributes to promoting resilience in rural communities in several ways. Furthermore, the CAP recognizes and strengthens the relationship between local communities and the rural environment. Measures that protect landscapes, wildlife, and natural resources, such as clean air and rivers, not only benefit agriculture and the environment but also contribute to the quality of life in rural areas, as well as to the opening of opportunities for recreational and tourism activities, to further support rural communities. The European Network for Rural Development (ENRD) is a tool developed for this purpose. Essentially, the network serves as a hub for exchanging information about how rural development policies are implemented and how they can be improved [11]. Everyone interested in this subject, from National Rural Networks, Local Action Groups to agricultural advisory services, agricultural researchers, and agricultural companies, can find support if their concerns are related to better involvement in rural development, improving the quality of rural development programs, or information regarding the benefits of rural development policy.

Measures that protect landscapes, wildlife, and natural resources, such as clean air and rivers, are not only beneficial for agriculture and the environment but also contribute to the quality of life in rural areas, as well as to the creation of opportunities for recreational and tourism activities, to further support rural communities.

The agricultural sector is very important for the economy and society, considered critical both at the level of the European Union and Romania. Its contribution to the GDP cannot be overlooked, just like the number of people employed in agriculture, which amounts to about 10 million people at the EU level, that is almost 5% of the total. In Romania, agriculture is even more important considering the rural population of about 9 million people, according to the National Institute of Statistics (INS) data.

Public communication promoting the image of agricultural companies

Public communication is a fundamental aspect of communication sciences and targets any exchange of information through which an organization becomes known in the market. Even if the organization's immediate purpose is to profit from its main activity, which represents, in fact, the organization's reason d'être [1], the reason why it was established, objectives related to building and promoting the image have become an integral part of the organization's efficiency and effectiveness [16].

Before highlighting some conceptual benchmarks necessary for the qualitative research underlying the scientific study, it is necessary to clarify how we conceptually constructed the term "agricultural company." In the context of this article, the phrase "agricultural company" transcends the framework of Law no. 36/1991 [12, 14] regarding agricultural societies. For us, any association in the agricultural field, including agri-food, aiming at the creation of agricultural products through cultivation or processing and covering any necessities included in the concept of food security, directly or through marketing, falls under the definition of an agricultural company. The food chain, a concept associated with sustainable agriculture, consists of an entire series of stages and operations involved in the creation and consumption of food products, from initial production to final consumption. This includes activities from the initial production to the final consumption, including the traceability of food products within the chain [13]. Clearly, we are talking about domestic agricultural companies. We made these clarifications because we wanted to explore more general aspects related to the management of agricultural companies' images and to connect, even complement them, with the EU actions in the field.

The social responsibility of the agricultural company is very important when discussing the impact it has on society or the community, about the image and prestige associated with an agricultural company.

To achieve these objectives, to reach these goals, agricultural companies develop, internally or through specialized partners, various planning, organizing, decision-making, or implementation-control tools. The intrinsic connection between these tools and their corresponding departments is made through a communication infrastructure, which can be internal or external [15]. The aim of this study is to examine the ways in which communication infrastructure is used for promoting the image of agricultural companies, how these companies manage to utilize communication facilities and the financial resources provided by the EU for their own image promotion, as well as how companies distinguish themselves in the market through their own resources or by accessing government funds.

It must be noted that the communication strategy of an agricultural company addresses both aspects, which go hand in hand and are, in terms of efficiency, complementary. In other words, the public communication of an agricultural company is both internal/external and can be operational or strategic. Internal operational communication refers to communication processes undertaken with the goal of ensuring the company's efficient activity. Communication within teams, task management, understanding management's expectations by employees, operational meetings, etc., are communication elements that occur in relation to the managerial work process – planning, organizing, decision-making, implementation, and control.

External operational communication encompasses the entire communication process through which stakeholders receive information about the organization's activities

– shareholders, media, stakeholders, consumers, etc.
The most important objective of public communication is to create and strengthen the company's image and identity, ultimately transforming the entire structure that builds the basic elements of the agricultural company's aim, into a brand.
In this context, the paper aimed to analyze the specific public communication strategies in promoting agricultural companies for increasing their credibility, enhance their competitiveness and conquest new markets.

MATERIALS AND METHODS

The qualitative research we conducted for the scientific grounding of the study focuses on how agricultural companies utilize EU expertise and financial resources made available to make themselves known in their market, to position themselves in the market, and to develop their image, thereby building a brand.
As a research technique, we used a self-administered structured questionnaire with open-ended questions, which included a total of 7 questions. Regarding sampling, since it was qualitative research, we did not analyse the representativeness of the sample but chose 20 companies from each category. We considered how EU legislation defines micro-enterprises, small enterprises, and medium-sized enterprises.
For the sampling construction technique, we chose the "step by step" technique, selecting a step of 50, using the list from the National Trade Register Office as the official sampling document. I used NACE codes 01 – Agriculture, hunting and related service activities, code 03 – Fishing and aquaculture, and code 10 – Manufacture of sugar.
Regarding the actual construction of the sample, we started with micro-enterprise number 50, 100, 150, etc. For each sub-sample, I repeated the operation.
Methodologically, we note that we did not give importance to the company's name (the questionnaire was anonymous anyway, as a fundamental condition of any qualitative sociological research). The small number of questionnaires, as well as the small number of questions (which were otherwise focused on what we were aiming for), allowed for the empirical processing of the research results. For some correlations considered significant, we used SPSS – Statistical Package for the Social Sciences.
The working scientific hypotheses were as follows:
1. Agricultural companies, regardless of their size, have access to information and research opportunities offered by the EU or EC for enhancing their market image.
2. Agricultural companies, regardless of their size, access European funds allocated for campaigns promoting products or activities specific to agricultural companies.
3. Agricultural companies predominantly use promotional campaigns specific to the online environment.

RESULTS AND DISCUSSIONS

The qualitative research was conducted among Romanian agricultural companies from the perspective of image building and identifying elements that can lead to brand creation targeted 60 agricultural companies included in the three categories (micro-enterprises, small enterprises, or medium-sized enterprises as defined by the Recommendation of the European Commission) [3]. Although the actual number of companies differs, favouring agricultural micro-enterprises, it was chosen an equal number of companies for the sample—20 from each type: 20 micro-enterprises, 20 small enterprises, and 20 medium-sized enterprises.
SMEs are the backbone of the European economy, representing 99% of all businesses, with around 21 million SMEs fostering the spirit of entrepreneurship and innovation, encouraging the growth of competitiveness.
The European Commission supports the businesses of these companies through European and national programs, offering assistance or intervening financially in special situations. Specifically related to the theme of our scientific study, for the year 2024, the Commission has allocated 185.9 million EUR

for financing activities promoting sustainable and high-quality agri-food products from the EU, not just within the Union, but worldwide [4, 6, 7]. The Commission adopted the work program on promotion policy for 2024, contributing to the achievement of the European Commission's political priorities for the 2019-2024 period, especially the "Farm to Fork" strategy.

The promotion projects selected in 2024 are expected to highlight and favour products that meet objectives such as:

- Encouraging sustainable practices in EU agriculture
- Improving conditions for animals
- Promoting the consumption of fresh fruits and vegetables and a healthy and sustainable diet.

The Commission has at its disposal two types of promotion actions: those carried out by professional or interprofessional associations and co-financed by the EU, as well as actions carried out directly by the EU, including the activities of the European Commissioner in charge in third countries for developing trade with agri-food products, participating in fairs, and communication campaigns.

Regarding the responses processed from the qualitative research, we make the following methodological clarification: although initially we wanted to divide the agricultural companies that were interviewed into companies owned by foreign entities and domestic ones in order to analyse a possible correlation between the tendency to follow the Commission's activities for each entity individually, we considered that this approach is complex and could be analysed through a separate qualitative research.

To question 1, regarding whether the interviewed companies are aware of these opportunities from the EU and the Commission and whether they constantly follow the activities of the European Commissioner for Agriculture, the responses indicated the following: the activity of the European Commissioner is followed by approximately 50% (29 companies), predominantly by medium-sized companies, over 75%, 16 out of 20, followed by small companies 11 out of 20, over 50%. These figures show a medium level of interest in what happens at the level of the agri-food sector in the Commission.

To question 2, regarding the funding by the EC for the promotion of agri-food products in 2024, 50 out of 60 companies, over 80%, stated they are aware of this program. The largest share is from medium-sized agricultural companies, which likely have people specifically focused on these activities.

To question 3, about how many of the interviewees participated in "Promotion of Agricultural Products: Info days 2024," a hybrid event held between January 31 and February 1, 2024, in Brussels, only 15 companies stated that they participated, approximately 25% of those questioned, the majority being small and medium-sized companies, and 2 medium-sized companies stated they were physically present.

To question 4, regarding their intention to submit proposals and what type of proposals they wish to submit, simple or multi-program, the responses were as follows. 32 companies, (over 50% of those interviewed), 2 micro agricultural companies, the rest small and medium-sized companies declared they are prepared to submit proposals, with the call being open until May 14, 2024. Most proposals will be simple programs targeting one or more companies from the same country. Only 4 companies stated they are preparing multi-program proposals through the association of at least 2 members from one country with at least 2 members from other European countries.

To question 5, regarding the aim/effect they pursue through the project applications submitted, the responses highlighted that the objectives are diverse, from maintaining or increasing market position, 6 responses, awareness of products in some markets as well as conveying the quality of these products, 15 responses, obtaining preferential positions, 5 responses, to building or promoting a brand, 2 responses, customer loyalty and launching new products, 4 responses.

From the responses given, it is clear that the effects of promotion aim at both sales effects and effects on public communication. Indeed, the 68 new campaigns proposed by the Commission, 50 generically named "Simple" and 18 "Multi," generally target these two objectives.

To question 6, regarding the type of promotional campaign for which agricultural companies can receive funding through the EU program, we asked what type of public communication they would like to use, from those eligible, for development. A primary observation is that online campaigns – websites or social media, dominate with a share of 75%. The production of communication materials in the form of leaflets, brochures, and guides holds a 60% share, but those online sent via e-mail, or other forms of online communication prevail.

Participation in exhibitions and fairs, organizing masterclasses, and exchange of experiences are favoured by 40% of the interviewed companies. Advertising campaigns in the press, television, or radio are seen as important by approximately 35%.

PR activity – public relations is considered important by 35%, yet it is more directed towards social media and less towards classical public communication. There is a desire to focus PR more on concrete activities and less on generalist activities that target the overall organizational culture of the company (principles, values, etc.).

To question 7, regarding what other sources of information they access for promoting their image, the majority of companies are attentive to information coming from the Government, 90% of companies, and the Ministry of Agriculture, 85% of companies.

CONCLUSIONS

Based on the premises formulated in the research, as well as other results obtained from the analysis and processing of the data, it appears that the three hypotheses are validated by the research outcomes. Summarizing the study results, we can say that the main conclusions drawn from the qualitative research are:

A first conclusion of the study is related to the fact that the level of information among agricultural companies is linked to credible sources: the EC, Government, and Ministry of Agriculture. The EC's initiative on promoting agricultural products is considered a great opportunity by all Romanian agricultural companies, each trying to diversify their promotion campaigns for company development.

A second conclusion is that social media remains the most important way to enhance the company's image, to become known, and to explore other markets. The opportunities generated by social media will be exploited in the future by agricultural companies.

A third important conclusion is that agricultural companies are attentive to the philosophy and structural requirements of the EU and converge in focusing on these objectives in the future. Likely, the financing, subsidies offered, and the geopolitical situation have created a greater sense of belonging to the EU structures.

A final conclusion is that companies emphasize PR activities, despite all the changes and developments it entails. Recognizing the importance of public communication and promotion campaigns brings Romanian agricultural companies closer to the connections of the European and global agri-food market. Companies become bolder, despite the immense pressures of the last 3-4 years, understanding the importance of collaboration, information, and risk-taking.

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VARIANCES BETWEEN CONTRACT AND NON-CONTRACT FARMS IN THE USE OF SUSTAINABLE FARMING PRACTICES: CASE STUDY

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Abstract

The present paper aimed to investigate the main characteristics of contract farming versus non-contract farming from Dornelor Basin, Suceava county. The research was based on a large-scale survey conducted in the study area, the data being collected from 52 farms who raise dairy cows. The results reveal that contract farmers are, generally, younger, have a slightly higher education level, with more years of agricultural experience and have larger farms, both in terms of size and number of animals, but they express a lower degree of willingness to uptake sustainable practices in comparison with non-contract farmers. Still, it looks like contract farming could represent a viable support instrument to farmers for converting to more sustainable practices. One possible way of achieving this is by creating a connection between contracting and the adoption of ecological farming methods and by supporting farmers with inputs and training in sustainable agricultural practices.

Key words*: *contract farming, sustainable agricultural practices, livestock farming

INTRODUCTION

Over time, agriculture has been an income source and a way to improve the socio-economic status of the population.

Environmental protection has become an important issue for mankind in recent decades. New directions of thinking, innovation and methods to protect the environment have appeared. One such direction is sustainable agriculture, considered as the production of agri-food products, crops and animal products, obtained through agricultural practices that provide benefits for the environment and population and support economic profitability [6]. Briefly, sustainable agriculture is a more ecological farming practice though the promotion of economically, ecologically and socially viable methods and practices [15]. A sustainable food system does not require the use of chemicals, conserves energy and water, while focusing on local production, reduces inputs and uses local resources more efficiently, values biodiversity and ecology and operates within global natural resource limitation. As opposed to conventional agriculture, sustainable agriculture holds an important potential to benefit the environment and to preserve natural resources [4]. As the sustainable farming methods and practices have a positive impact upon the environment, they contribute to the increase of the population's quality of life.

The modern farming practices, like contract farming, must achieve all the objectives of ensuring enough agricultural products to support food security and to boost small farmers' prosperity, but also to protect natural resources and prevent environment degradation [8]. Contract farming is considered a modality to organise commercial agricultural production of both large and small farmers. In a wide acceptance, contract farming is considered an agreement between two parties – producers on one hand and different types of buyers, on the other hand- agreeing beforehand all the conditions for the fulfilment of the contract (production, marketing etc) [6].

Contract farming has significant benefits both for farmers and buyers. However, the benefits are accompanied by a series of risks (Table 1).

Table 1. Contract farming – benefits and risks

Benefits	***Risks***
Farmers (producers)	
• *easier access to inputs, services and credit, which are also provided by the buyer;* • *acquiring new production and management skills;* • *ensuring market participation and access to new markets;* • *reducing price-related risks;* • *ensuring more stable incomes;* • *introducing new technologies;*	• *loss of flexibility to sell to other buyers;* • *possible delays in payments and supply of inputs;* • *debt risk due to loans provided by buyer;* • *environmental problems – due to the cultivation of only one type of crop;* • *unequal bargaining power between farmer and buyer;* • *increasing farmer dependency and vulnerability if buyers are not trustworthy;*
Buyers	
• *good supply of raw material;* • *providing conform products that comply with quality and food safety standards;* • *reducing labour and input costs compared to integrated production on the land owned by the company;* • *better opportunity to ensure products of consistent quality;* • *overcoming land constraints;* • *reliability of purchased production compared to purchases on the free market.*	• *high transaction costs of contracts with small farmers;* • *risk of farmers selling to other buyers violating contractual provisions;* • *misuse of supplied inputs;* • *farmers use seeds and fertilisers supplied by the buyer for other purposes;* • *loss of flexibility to seek other sources of supply;* • *reputational risk if things go wrong.*

Source: https://www.fao.org/in-action/contract-farming/background/what-is-contract-farming/en/ [7].

In a period of market liberalisation, globalisation and expansion of agribusiness, small farmers may find it difficult to participate actively in the market economy. Several studies indicated that contract farming represents an important step on the way to modern agriculture and significantly improves the living conditions of many small farmers around the world [5]. Some specialists consider that contract farming represents a way of responding to a series of issues that are capping farmers' productivity and incomes in emerging economies, including financing difficulties, limited knowledge regarding production methods, and market related aspects. In that respect, farming activities based on contract can help agricultural producers to shift from subsistence production, with low-value crops, to commercial production with high value crops, facilitating their access to national economy and increasing their incomes [11], [5]. Contract farming enables small farmers to surpass different barriers and to extend their sales area to national and international levels; also, it can support a higher production, incomes level and improves food security for the population [12].

Although a rich literature exists on the economic impact of farming based on contract, when it comes to the impact on the environment by adopting sustainable practices, there is a considerably lower number of studies: the environmental effects of farming based on contract has received little attention so far [9], [16]. There are studies addressing concerns over environmental degradation and overuse of natural resources attributed to this type of farming, pointing out that it could have adverse effects on durable land management [1]. Nevertheless, other studies highlight the fact that contract farming could also positively influence the adoption of sustainable practices by farmers: for instance, some find soil fertility-enhancing effects for vegetable farmers due to the application of natural fertilisers and compost [13], organic fertilisers that they have not used before concluding the contracts; the higher incomes of contract farmers can also lead to learning to optimise the production processes [3].

Contract farming has existed for many years and there is a growing interest for this type of farming, especially in emerging economies and/or early stage liberalised ones [5].

In this context, the paper aims to study the degree of adoption of sustainable farming practices by farmers who conclude contracts as compared to farmers who operate on no contract basis.

MATERIALS AND METHODS

This paper is based on a field survey that was conducted in the Dornelor Basin in Suceava county. Data was collected from 52 farmers who raise dairy cows, using a questionnaire with dedicated questions. Data obtained from respondents were registered and processed using the SPSS software.

Out of total 52 farmers investigated, 90.4% (47 farmers) concluded a contract to sell their production. Most farmers (84.6%) opted to conclude an individual contract on independent basis (44 farms) and only 5.8% (3 farms) opted for a collective framework contract.

Contract production is a significant element of the agricultural business, depending on the type of buyer: small or large companies, agricultural cooperatives, public agencies or individuals/entrepreneurs.

RESULTS AND DISCUSSIONS

The obtained results reveal that contract farmers adopt sustainable agricultural practices to a lesser extent compared to non-contract farmers. The paper provides new insights into the characteristics of contract farming and starting points for future research work on the functions of agriculture related to food production and environmental protection.

General characteristics of farms and farmers: the figures in Table 2 highlight evident differences as regards age, gender, education, experience in farming and farm size between contract farmers and non-contract farmers. Briefly, the analysed values reveal that there are differences between farmers who operate on contract basis and those who sell freely on the market or produce for self-consumption.

Compared to non-contract farmers, contract farmers tend to hold a larger productive base (including livestock and agricultural area), to rely on modern technology and inputs and to engage in trading with wholesalers and/or with processors.

Table 2. Descriptive statistics – general variables

Variables	Contract farming	Non-contract farming
Average age of farmers (years)	50	53
Gender (%)	M-70.2% F-29.8%	M-80% F-20%
Education (%)	Gymnasium - 21.7% High school - 32.6% Tertiary - 41.3%	Gymnasium- 20% High school- 40% Tertiary - 40%
Average number of agricultural experience (years)	27	24
Average farm size (ha)	13.2	10.3
Number of animals (LSU/farm)	10.9	7.4

Source: own processing based on [10].

As shown in Table 2, both the farm size and the number of animals, expressed in conventional units, are larger in the case of contract farmers. However, there are studies that show that the presence of contrasting results can be, in part, justified by the type of product: in Indonesia, for instance, contract seed producers were, in general, over average as size, whereas contract poultry producers were below average [14].

As regards the characteristics of farmers, it can be noticed that contract farmers are younger, have a better professional training and more experience in agriculture.

Attributes of contracts: For the valorisation of cow milk production, 97.9% of farmers from the Dornelor Basin who have concluded a contract prefer a processing company as partner, while only 2.1% prefer an agricultural cooperative as partner (Table 3).

Table 3. Types of contractors/buyers

Contractor	Number of farms	Share (%)
Farmer association	0	0
Agricultural cooperatives	1	2.1
Processing company	46	97.9
Retailer	0	0
Other situations	0	0
Total	47	100

Source: own processing based on [10].

The prevalence of contract farming differs significantly by product: milk production is, generally, convened based on contract by a processor that organizes the provision of this product, that is highly subject to spoiling. Worldwide, the dairy sector relies on private processors that have replaced the cooperatives that used to collect milk [2]. This situation is also found in Dornelor Basin: to sell cow milk production, most contract farms prefer a (private) processing company as partner.
Out of total 47 farmers who have concluded a contract for the sale of their production, 38 (80.9%) declared that they had a fixed duration of contract. Most of these (86.8%) concluded contracts with a maximum duration of 1 year (Table 4).

Table 4. Duration of the contract

Length of contract	Number of farms	Share
One year or less than one year	33	86.8
Several years	5	13.2
Total	38	100.0

Source: own processing based on [10].

From the analysis of collected data, it can be seen that the intensity of contractual agreement can fall into one of these categories (Table 5):
i) market terms: the parties (producer and buyer) consent regarding the contract's terms;
ii) resource terms: the buyer assists the producer with technological support, different inputs and marketing arrangements;
iii) management standards: the producer (farmer) follows the buyer's requirements regarding the production process, types of inputs and agricultural practices' specifications [5].

Table 5. Specifications provided in concluded contracts*

	Number of farms	Share(%)
Market provisions		
Sale in advance of next year's production on contract basis, at a guaranteed price	14	26.9
Unplanned sale of production, at the price at the time of sale	9	17.3
Regardless of the two options	29	55.8
Fixed price	25	53.2
Minimum price	3	6.4
Market price	12	25.5
Average market price	6	12.8
Fixed amount	21	44.6
Minimum amount	13	27.7
No specified amount	13	27.7
Provisions related to the use of resources		
Origin of inputs used	20	47.6
Quality of inputs used	23	54.8
Adoption of specific technologies	20	47.6
Compliance with certain working conditions	11	26.2
Compliance with certain environmental conditions	32	76.2
Management specifications		
Restrictions on the use of pesticides	27	84.4
Restrictions on the use of antibiotics	30	93.8
Conservation of soil quality	15	46.9
Conservation of biodiversity	8	25.0

*Questions with multiple answers
Source: own processing based on [10].

The majority of contracts signed with farmers from the case study area included specific management requirements restraining the use of some inputs like antibiotics and pesticides. Also, the requirements on the use of certain resources had important values: the requirements focused on the origin and quality of inputs used, adoption of specific technology, observance of restrictions targeting environmental protection. The restrictions on environmental protection have the most important share – 76.2%. The explanation may come from the fact that the study area is benefiting from certain agro-environmental schemes of CAP. Some requirements related to quantity were present in the case of market provisions: 44.6% (21 farmers) declared that they concluded contracts for the delivery of a fixed quantity; 27.7% of contracts stipulated a minimum quantity and 27.7% did not have any stipulated quantity. More than half of concluded contracts (53.2%) provided for the sale of production at a fixed price. A significant share of farmers (25.5%) concluded contracts at the market price.

The farming system based on contract ought to be regarded as a cooperation between two parties -buyers and farmers. In order to be successful, a long-term commitment is required from both parties. In many cases, these engagements are short lived, and thus they may jeopardise investments in agri-business. The most frequent problems that contract farming is facing are the secondary sale of production by farmers and the manipulation of quality testing by buyers. Conflicts between buyers and farmers frequently arise over prices and quality standards. In certain market conditions, for example an increase of prices, some contract farmers could be enticed not to respect the contract's terms and try to sell the products for a higher value on the market. On the other side, some contractors could, also, be enticed to temper with quality results with the purpose of reducing the price they have to pay to farmers, mainly when market prices have fallen [11].

Adopting sustainable agricultural practices: In order to evaluate the attitude of contract versus non-contract farmers, when it comes to sustainable practices' adoption, the main agricultural practices used by dairy farmers from the study area were determined: we aimed to investigate if the selected practice enhances or decreases farm sustainability. Table 6 highlights the main agricultural practices that can be considered sustainable.

In the first place, no farmer, either contract farmer or non-contract farmer, uses chemical fertilisers, although balancing plant nutrition is important in improving productivity. This situation could be also attributed to the fact that the component administrative-territorial units of Dornelor Basin are under the implementation of (CAP) agro-environmental measures. All farms, either contract or non-contract farms, use manure for the fertilisation of meadows. In the areas with developed manure markets, like the Dornelor Basin, usually farmers can sell and buy manure on the market. In lack of specialized markets, the main source of manure derives from farmer's own livestock. Consequently, the smaller the livestock is, the less organic fertilisers will the farm have at its disposal.

Table 6. Sustainable farming practices

	Farming practices	**Contract farming**	**Non-contract farming**
Grassland management	chemical fertiliser application	0%	0%
	manure application	100%	100%
	compost application	8.5%	0%
Dairy cow farming	LSU per ha permanent grassland	0.51	0.54
Livestock feeding	average number of months: -grazing in open air	5.6	6
	-silage feeding	5.1	7
	-hay feeding	6.4	6
	-combined feed	6.5	5.3
Disease control	use of antibiotics for treatment and prevention	17%	40% (2)
	use of antibiotics only for treatment	70.2%	80% (4)
	use of alternative remedies	0%	0%
	use of physical measures – separation of animals	34%	40% (2)
Movement of animals	local movements /around the farm	83%	100%
	seasonal movements (shepherd summer camps / grazing on mountain pastures)	44.7%	40% (2)
	specific storage facilities to reduce greenhouse gas emissions	31.9%	20%
	storage facilities to reduce leakage	55.3%	80%
	digester use	8.5%	0%
	composter use	4.3%	0%

Source: own processing based on [10].

In the Dornelor Basin, both in contract or non-contract dairy farming, dairy cows are generally raised in a traditional system, with a low animal load per surface unit. Many farmers raise a small number of animals, kept in naturally-ventilated shelters, with wooden floors and straw bedding.

Contract farmers, as compared with non-contract ones, are inclined to a higher usage of antibiotics, when it comes to treatment and prevention. This supports the assumption that contract farmers can easier resort to medication and thus are less inclined to take up sustainable practices. Concurrently, contract farmers also resort to the method of separating ill animals to a lesser extent (34%) compared to non-contract farmers (40%).

Taking into consideration the physiology of dairy cows, feeding is based on grazing and on foodstuffs produced on the farm – hay and silage, both on contract and no-contract farms. As regards contract farms, the combined feed registered a slightly higher usage level.

CONCLUSIONS

The present-day production and commercial channels, including contract farming, that boosts farm's productivity and income level, play a key role in poverty abatement and food security, especially in emerging economies. The sustainable methods of cultivation and conservation of natural resources have become major issues in research and practice. Contract farming, simply described as an arrangement between producers and buyers (processors, marketing companies, contractors, etc.) for the supply of agricultural products based on previously concluded agreements, often at predetermined prices, is a practice that becomes increasingly important in both developed and developing countries, supported by growing consumer interest in food security and safety.

This paper used the data collected at farm level in the Dornelor Basin (Suceava county) and had as main objective to evaluate the way the contract farming influences the adoption of sustainable agricultural practices. Firstly, it seems that these farmers, in general, are younger and more experienced as regards agricultural activities, hold larger farms in terms of size, but also have more livestock – in comparison with non-contract farmers. Secondly, the obtained results indicate a significant link between contract farming and the intensity of sustainable agricultural practices: there is a lower level of adoption of sustainable practices in the case of contract farmers

The analysis also pointed out that contract farming could represent a support instrument for farmers willing to uptake more sustainable practices. Also, it supported the idea that contracting ought to be coupled to the acceptance of sustainable practices to ensure that farmers adopt ecological farming methods. Contractors could also commit to provide sustainable inputs and training in sustainable farming methods to farmers. The existing contracts could also be linked to certification schemes that actively promote sustainable agricultural practices.

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PROBLEM-SOLVING GROUNDS IN SMALL-SCALE FARMING IN WESTERN ROMANIAN AGRICULTURE

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Abstract

The paper introduces the analysis results over a selected number of small-scale farms in the Western Romanian agriculture, more precisely in the counties of Arad and Timis. The purpose of the investigation is linked to the assessment of need for advisory services input in solving the problems of the farmers, particularly for the ones operating in small farms. Analysing the returned answers in connection with the fields of interest or needed expertise, accounting for the forms of mutual or directional help, compiling any forms of advice inputs, including the specialised structures other than public in absence of a function Farm Advisory Service allow the development of a structured image in terms of current problems, the way of solving and the interactions among the farmers inside or outside their communities. The quantified findings can serve as base for a public policy recommendation in the field of farm advisory as part of the Agriculture Knowledge and Innovation System.

Key words: *problem-solving, extension, advisory services*

INTRODUCTION

The Common Agricultural Policy of the European Union represents the reference system for supporting the needs of the farmers in terms of knowledge and innovation [6]. With the aid of the specifically developed instrument, the Farm Advisory Service [7] it provides for the enlarged farming community the type of subsidized interventions expected individually at the farm level. Romania as a member state had and has access to this type of publicly supported intervention sets and aims for the first time to approach their use as an instrument for the newly shaped Agriculture Knowledge and Innovation System in the current programming period. The use of digital technologies is recognized by the World Bank as one of five key issues in agriculture [23].

The agricultural advisory services were long time apprised in need for a future reevaluation and reform with the aim of better using the available resources for an enhanced impact on the farmers and their communities [1]. Redefining the roles in agricultural extension by using a conceptual framework, [5] identified among other findings that the work is very personal subject linked to the identity for the farmers. After a long and successful set of consultations the FAO launched a Family Farming Knowledge Platform meant to support, inspire and guide the small-scale initiative in their business orientation [8]. Agricultural extension was for many years the work-horse of the agricultural extension and regardless the nature of contributor to the extension work the usual suspect when success is less than expected is represented by the provider of advisory [16].

The most recent developments in information technology brings extensive contributions of the machine learning and artificial intelligence to agricultural extension work and research identifies new specific needs in curricula adaptation for the advisory workers [19]. The

Information and Communication Technologies for agricultural extension had a continuous evolution and adaptation in the effort to meet the agricultural advisory needs [22]. During the COVID-19 health crisis digital agriculture accelerated the digital delivery of extension for smallholder farmers as part of the Rural Poverty Stimulus Facility [11] of International Fund for Agricultural Development. The use of digital advisory services was apprised and assessed as positive by the agricultural extension agents [12]. However, the impact of digital transformation in agriculture cannot be seen as a magic wand [13] as packed with all the benefits there are series of shortcomings. Current extension services use different sets of instruments developed experimentally, tested, validated and incorporated as part of available advisory tools, all based on the benefits they produced [2]. The effects are both positive and efficient with a highlight on localization of the provided technological adaptation or solutions and therefore a higher scale of the impact.

Smart farming using tested and validated models may lead to a large range of results when used in small-scale farming given a large number of reasons [18]. Researchers weight the smart agriculture as an urgent need for the developing countries [9] particularly having in view the population growth perspective and the need to improve the developing countries' GDPs. The enhancements and the progress credited to the information technology are definitely beneficial for the agriculture and advisory work yet answering the triple challenge of the agriculture: feeding a growing population, providing a livelihood for farmers, and protecting the environment proves to be a hard nut for the multi-challenge [17]. Although the digital environment can model and solve virtually most problems moral constraints with localized knowledge are required to balance the interventions and their long-term impact in each and every of the three directions.

The sustainability of agriculture as practice is consistently influenced by the university extension activities [3]. Solving problems in sustainable agriculture can be supported by university involvement in training their graduates using digital technologies and based on cases openly available [20]. Small farms are, particularly important for the fresh products in developed countries yet the use of advanced technologies require large investments unavailable for the small-scale operations [4]. Precision farming although a solution for large scale farms is also approachable from the small scale farms perspective if supplementary funding become available to support the adoption [15]. Therefore technological advancement might not always be the solution despite the obvious and proved benefits even in the case of the small-scale farms.

Adopting climate-smart agriculture in small-farms requires extra resources usually provided by extra-income activities developed parallelly to farming in developed countries [14]. The inquiries of the present research identify over 10% of respondents indicating that their household budget would be questionable without the non-agricultural income supplementing the income from farming.

Although there are no conflicts of interest when connecting agricultural advisory services with agri-input business as extra costs are balanced by extra income, the consumers and the environment might suffer and within the public policy framework the situation might lead to issues [21].

The current paper aims to answer the research question related to the current grounds of problem-solving for the small farms in Western Romania. The circumstances of an absent advisory system and the results of surveying small or family farms indicating a large number of structural issues make the inquiry actual and of interest not only for the research yet for policy makers and other private actors. The study will identify and collect answers and opinions on critical elements necessary for proper problem-solving in small farms. Solving problems is considered central to the current operation of the farms as well as for the development options.

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MATERIALS AND METHODS

The approach is supported by questionnaire implementation structured in three parts, a profiling part identifying the production, scale, and the farmer's profile (age, education, farming experience). The second part is dedicated to the problem-solving incorporating the satisfaction self-appraisal for the current situation, the problem-solving effect or satisfaction about the resolution results level, communication and involvement with other farmers, offering help, sources of support and sources of knowledge, and development prospects and priorities. The third part, not used in the present study, collects more precise data about the use of digital technologies, equipment used and applications, general use of digital technologies and applications used in connection with the farming activities.

The sample of small farms used to harvest the answers by questionnaires consists of 119 subjects after cleaning and consolidating the answer database.

Little over 70% of the respondents are male (71%) while the rest is represented by female head of farms, with an age distribution for the entire sample of 64% under the age of 45, while 27% of respondents have 46 to 60 years of age and the rest of 9% have over 60. Also, among the first age share 49% of the total sample are aged of 31-45 years of age and the youngest share, 18-30 years of age represents 15%.

In terms of education, 24% of the respondents have a bachelor or equivalent level, 26% have a master's degree or doctoral studies, 40% have secondary or tertiary short cycles and only 10% have primary education or less.

The land ownership places two thirds of farmers in owned land only, 8% on leased land only and the rest of 27% farming on both own and leased land.

The selection of respondents aimed to place the participating farmers in a classified distribution regarding the farming experience; in this respect, one third of respondents have more than ten years of experience, respectively, 11-20 years; 22% have 6-10 years of experience; 29% have less than 5 years of farming, and the remaining 18% have been farming for more than 20 years.

This sequencing attempts to maintain the specific ratios valid for small farms revealed by earlier research in the field.

The questionnaire structure follows an earlier proved methodology used during the implementation of the WiseFarmer project [10] targeting the critical points regarding the opening for collaboration, typical actions and interventions, main obstacles encountered in ordinary farming activities, the level of satisfaction of the farmers, communication with peers or third parties, their current level of involvement and participation in organised or ad-hoc support organisations.

RESULTS AND DISCUSSIONS

The most important findings are presented by sequences related to the elements considered critical to the problem-solving process in farming.

Figure 1 below displays the level of satisfaction in relation to the overall economic results from farming to the general working conditions and to the personal life as level of comfort.

The largest number of answers, as illustrated bellow, point towards the "somewhat satisfied" option that indicate that respondents are rather satisfied with their current standing.

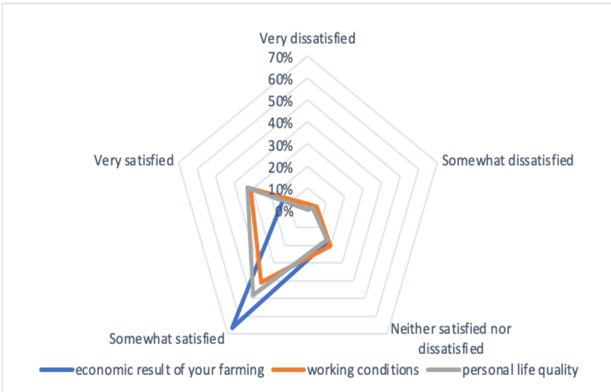

Fig. 1. Satisfaction levels regarding economic results, working conditions and personal life
Source: Survey data.

That type of answer was selected by 2/3 of the respondents (66%) for the farming economic results, while for the other two investigated directions respondents only amounted less than half of the total, respectively 48% for the personal life and 41% for the working conditions. Important observation indicates that positive answering to this question gather systematically more than 90% of answers from 92 to 97% of total describing relative positive grounds for these general three directions.

The next question inquired the sources of professional support for farming, graphically introduced in the Figure 2 bellow.

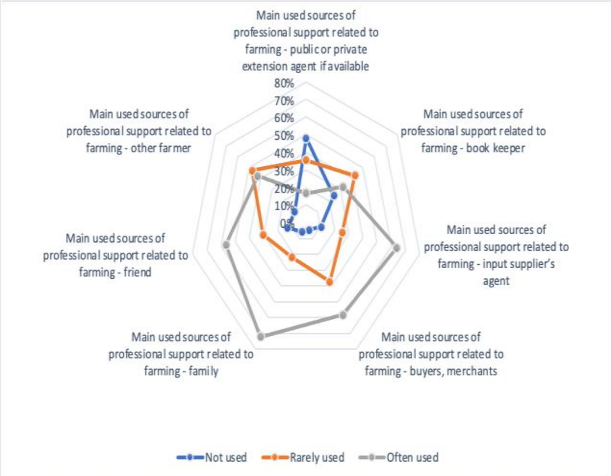

Fig. 2. Sources of professional support for farming
Source: Survey data.

The most often used sources indicate: family for 72%, supplier agents for 64%, buyers and friends for 58%, respectively 57%. If cumulated, both often and rarely, to collect the usage at any level, the buyers come first with 95% of answers, followed by the family with 94%, suppliers with 89% and friends with 87%. Placing the friends on the fourth place could indicate a high level of business maturity, while placing family, respectively the trust level in the previous experience, could indicate a need for stability and risk aversion.

The responses regarding the sharing and discussing the farming issues with other farmers point hardly towards a reduced number of farmers participating, meaning a reduced professional network, most likely including neighbours or friends. The graphic from Figure 3 show a small difference between the categories 1-3 farmers and 4-10 farmers.

In relative figures the highest number of answers (1-3) represents almost half of the options with 47% while the next option (4-10) represents one third of the options with 34% of answers. Sharing concerns and issues with a large number of farmers, such as part of a professional organisation, is however the answers for 14% of the respondents.

Considering the relative aversity for collaboration, this figure is relatively positive and should be considered purely indicative. Supplementary information about structures of professional representation is dealt by another question, as introduced subsequently.

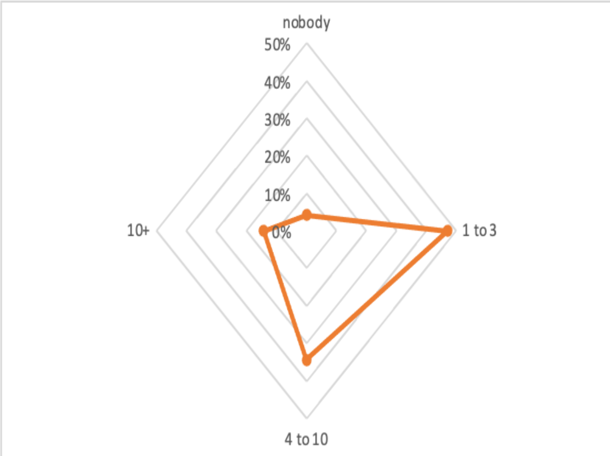

Fig. 3. Discussing farming issues
Source: Survey data.

Membership to a farmer organisation of any type, including the informal organisations, is illustrated in Figure 4 bellow.

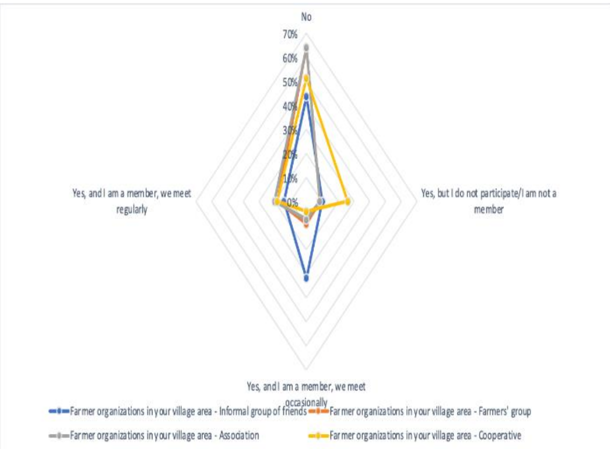

Fig. 4. Acting in farmer's organisations
Source: Survey data.

Most answers related to the involvement to any organisation type are negative regardless their formal or informal nature.

Systematically, more than half of the respondents, indicate that they do not belong or attend any of the categories, where 54% do not belong to an informal structure or group, 72% are not members of a farmers' group or association and 77% are not part of a cooperative.

These answers and quantified figures might appear large, particularly in the context of the Romanian agriculture, however, the other part of the respondents are members of such formal or informal groups or associations and cooperatives, attending on regular basis or less frequent their meetings. For this second part the relative distribution accounts 46% members in informal farmer groups, 28% members of formal farmer groups and with the same share members of associations and 22% members of cooperatives.

The immediate and direct relation with other farmers, namely providing help to other farmers is graphically introduce in Figure 5.

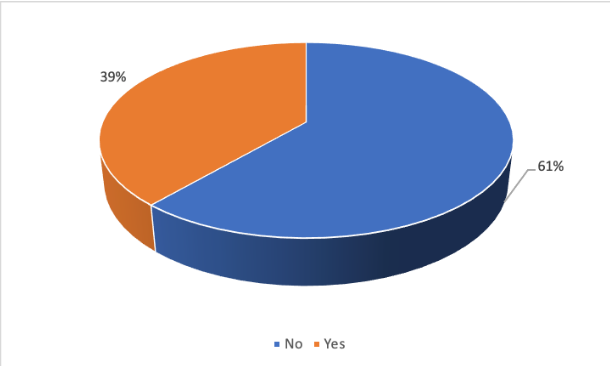

Fig. 5. Providing help to other farmers
Source: Survey data.

The number of farmers usually providing help to fellow farmers is relatively large where 61% are usually not doing it. Still the 39% of those helping the other farmers in their community is a consistently high share. We might expect other reasons such as distance, production type, scale or intensity to be responsible for this segregation as well.

Since no advisory system or other kind of expertise sharing is in place currently, the enquiry about the knowledge sharing sources where the farmers participate returned split answers as pictured in Figure 6 bellow.

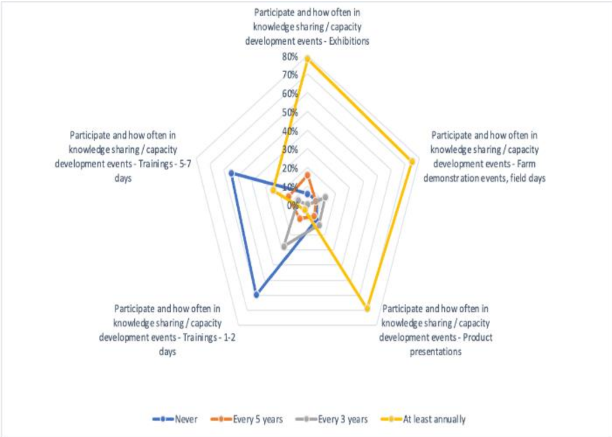

Fig. 6. Participation to knowledge sharing events
Source: Survey data.

Half of the respondents acknowledged that they never attend trainings (57%) of any duration, not even short ones (60%). However, 25% of farmers do attend 5-7 days trainings annually, age and education leading to this split. A more intricate contact to knowledge is preferred, where 78% of respondents attend agricultural exhibitions, 75% participate to demonstrations and filed days and 69% participate to product presentations.

The current situation of problem-solving was investigated in three main directions: production, market access and agricultural administration (Figure 7).

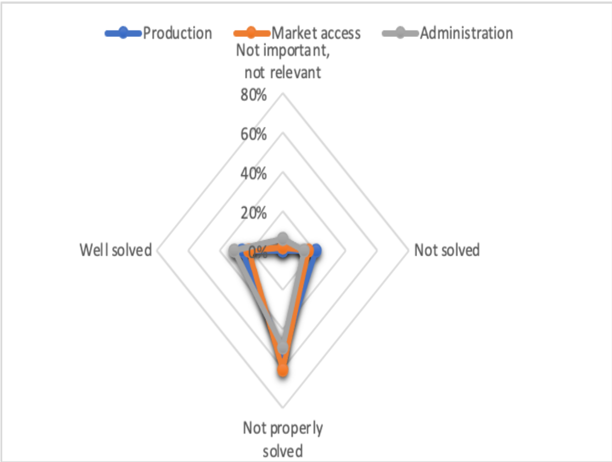

Fig. 7. Problems solved at farm level
Source: Survey data.

The large majority of answers to all three inquired directions point to the "not properly solved" answer. In detailed shares that translates into 61% of answers for market access, 53% for production and 50% for agricultural administration. If compiled with the “not solved” answers the above shares become more important, respectively, 76% for market access, 74% for production problems and 63% for agricultural administration.

There is also a sufficient share of more successful farmers answering for 31% of well solved problems with administration, 26% for production issues at farm level and 22% regarding the market access for their products.

Collecting the answers for the farming perspective and the priorities on medium term of five years led to a relatively dispersed set of answers as illustrated in Figure 8.

Quitting farming is almost not an option as 77% of farmers consider that not important while an extra 13% give it a low importance. The age distribution of the sample is to a certain extent responsible for these answers and at the same time highlights the commitment of those younger farmers to continue.

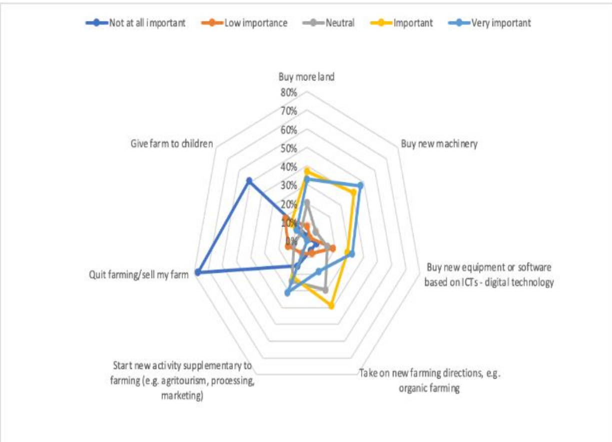

Fig. 8. Farming priorities for the near future
Source: Survey data.

Starting a new activity or diversifying the farm economic activities seems a valid option for slightly more than half of the farmers (53%). Switching to new farming directions, such as organic farming is appealing for even more farmers as 57% indicate that as a potential priority for the next half decade. Modernising and extending the mechanical capacity of the farms is the most popular priority option with 88% of farmers choosing the respective direction. The digital technologies as new addition to the farm becomes a priority for 61% of farmers indicating a high interest for both hardware and software solutions capable of increasing their competitiveness. Extending the land ownership by purchasing more land remains an important option and a priority for the large majority of farmers (70%) even if the market remains saturated and at high price levels in the region while the offers are scarce and expensive.

The most important options considered for increasing the competitiveness of the farms indicate that collaboration with other farmers in sharing machinery and equipment is shared by most of the respondents, 69%. Two very important findings were revealed by this inquiry: the first is that 61% of the interviewed farmers are ready to improve their knowledge and skills, and the second relates to the fact that 52% feel the need to improve the farming activities by using digital technologies.

Although not very popular as options collaborating with other farmers for better prices collected 43% of answers while collaboration for more integrated use of land was a condition seen by 36% of the farmers.

CONCLUSIONS

The development processes in farms, including the small-scale or family farms, are basically supported either by supplying for the needs, either by solving the problems encountered. Targeting the second aspect and investigating the current status for the small farms in Western Romania as research question led to a series of interesting findings.

The problem-solving for small farms remains at a moderate and rather safe level of satisfaction. The low use of advisory services given their unavailability and the exposure to a potential biased advice for buyers or suppliers forces the farmers to use the local knowledge accumulated in the family and to a lesser extent the advice from friends. This situation depicts aversion to risk and need for safe operation with potential less positive implications over the competitiveness increase. The relatively important shares of farmers targeting as priorities for their farms’ development the acquisition of new knowledge and skills, and equally the adoption of new digital technologies aims precisely to a safe development in absence of impartial advice on the regional and local markets. The needs for a consolidated and functional Agricultural Knowledge and Innovation System become obvious after the long period when Farm Advisory Service as part of the Common Agricultural Policy was missing in Romania.

Linked to this absence and the reserved position of farmers is the expression of satisfaction related to the problem-solving level regarding the main directions of the farms' operation. The lack of satisfaction and the estimation of rather unsolved issues at the farm level reflects the poor knowledge and innovation levels used under risk aversity conditions. This cross-reference link indicates a close causativeness and calls for a shared responsibility from the public agricultural administration and farming communities.

The priorities drawn by the respondents are well connected to the modern agriculture requirements, to the market trends and orientations, to the need of adaptation to respond to different crisis challenges. It can be assumed, reading the general orientations and prioritisation that these farms well were advised and benefited from long-term counselling activities. In reality, the forms that are the most consumed for knowledge transfer are the mass advisory work originating from private input providers. The access to new knowledge and the observed technological transfer results are potentially supplemented by the use of digital technologies for information. These paths could further be enforced by advice-accompanying activities related to the relevant and safe sources securing a safer and faster way to the relevant information.

The explored grounds in terms of problem-solving appear solid and favourable for future development; no immediate risks are identified as the answers to development priorities indicate. The policy makers can find useful quantified and their significance in the present dataset and their interpretation knowing the efforts to enable the new Agriculture Knowledge and Innovation System.

The limitations of the present paper relate to the relatively small size of the sample. An expanded sample with national coverage incorporating more regional features, segmented by production types and intensity level could operate investigating links between multiple questions to reveal extra-findings and validate them by statistical significance. Supplementary, a higher level of detail related to the problems and the problem-solving processes can be incorporated allowing for a finer observation of specific difficulties. Of high interest for the extension activities of all connected actors can be the source of the encountered problems, including the structural issues. Also, the digital technologies component, not used in the present paper can contribute to both, problem-solving and deeper understanding of causality relations.

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ECONOMIC EFFICIENCY OF MAIZE CROP IN SMALL FARMS IN THE SOUTH WEST OF OLT COUNTY, ROMANIA

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Abstract

A simple experiment was carried out at three neighboring micro-farms where the owners agreed to implement some proposed technologies in which the influence of differentially applied agricultural works and the influence of some inputs on corn production will be tested. The micro-farms are located in the South-West part of Olt county in the vicinity of Dolj county. Conventional works and minimum tillage were executed. For the conventional works, the farmers continued to use their knowledge of corn cultivation. For the proposed technologies, they received nitrogen 70 kg ha-1, phosphorus 90 kg ha-1 and NPK 8.15.15 + 3%CaO+ 9%S 200 kg ha-1. In the short run, it has been observed that employing minimum tillage alongside soil fertility management technologies proves more beneficial in boosting maize yield under conditions of limited rainfall compared to conventional tillage methods.

Key words: *maize, minimum tillage, fertility management, efficiency*

INTRODUCTION

The application of the technique of integrated management of soil fertility, depending on the physical and chemical properties, leads to obtaining increased productions even in the conditions of periods with low precipitation. This technique is primarily favorable for owners of small areas and who do not have enough inputs for the food source for plants. [12].
Components of ISFM such as manure, leguminous crops, mulch, etc. they increase plant nutrient availability, microbial quality and soil physical properties [11, 5] leading to increased agricultural production. Small farmers apply little chemical fertilizers in order to increase soil fertility [8].
Monoculture leads to a decrease in fertility [15, 16] and excessive tillage has a negative effect on fertility [13]. This is not justified by inconsistencies related to how the soil is worked with effect on quality parameters [13]. It was thus hypothesized that the technologies implemented through conventional and minimal soil work significantly improve its properties [3, 4]. Nitrogen, phosphorus, potassium fertilizers applied in corn culture increase production and the evaluation of ISMF by farmers increases the probability of their adoption.
In this context, the purpose of the paper is to test some technologies for maize crop in micro-farms situated in the South West part of Olt County. In this experiment, conventional system of agriculture was compared to minimum tillage technology with soil fertility management in order to evaluate the impact on production.

MATERIALS AND METHODS

Site description

This study was carried out on a plot of land in the southern part of Olt county on an area of 4.5 hectares collected from three farmers. According to the classification of soil taxonomy, the soils arezonal chernozems, whose properties are presented in Table 1. The soils are slightly inclined, 0 + 1%, deeply profiled, located on very old subsoil alluvium. Soil samples were taken at 0 - 15 cm depth at the beginning of the experiment. The resulting values are presented in Table 1. For pH, a pH meter model FLO 89000 was used, which displays the soil moisture, the pH reagent and the temperature.

Farmer selection and interviews

Three farmers were selected, each with an area of 1.5 hectares on a random location in the same locality, trained and guided in choosing the technologies to be implemented. The selection of farmers was based on the availability to implement the proposed technologies in terms of tillage, treatments, in the annual agricultural season. At the end of the experiment, selected farmers were interviewed to evaluate the new technology.

They answered questions regarding the implementation of the technology and whether they would recommend the technology to other farmers.

Of the technologies implemented by each farmer, one was a control (conventional work without inputs), abbreviated **CvCon**.

The other applied technologies were MinTill = minimum tillage; + Mineral fertilizer+ SOLFERT 10-5-40+ME abbreviated Min Till Îc Îls and MinTill=minimum tillage; + Mineral fertilizer abbreviated **MinTill Îc**.

For the control area, the small farmers applied the technologies used in the respective area: plowed at 22 cm, the soil was loosened twice, sown, administered chemical fertilizers (ammonium nitrate), cultivated, harvested.

At the beginning of the season, the farmers received fertilizers and corn. We used NPK 15:15:15, ammonium nitrate.

The amount of biomass on the studied land area was not taken into account.

SFI- soil fertility input

CvCon- conventional tillage without inputs

MinTill Îc - minimum tillage; + Mineral fertilizer

Min Till Êc Íls - minimum tillage; + Mineral fertilizer+ SOLFERT 10-5-40+ME

Note: application doses of inputs:

Mineral fertilizer = 60 kg N ha^{-1}, 90 kg P ha^{-1};

Plowing (CvCon) was executed at 22 cm. Pentru (Min-Till) the executed depth was 15 cm.

This was achieved through reduced tillage methods that involve less soil disturbance compared to conventional plowing, aiming to preserve soil structure and reduce erosion while still adequately preparing the land for planting.

Corn was sown at a distance of 0.70 m between rows and 0.28 m between seeds per row.

Calculated number of seeds per hectare was 50,000 grains.

The predominant corn variety utilized in the local area is commonly planted and well-suited for the region under investigation. Agricultural equipment such as the Kuhn Maxima Monosem Amazone seeder equipped with microgranular corn discs, fertilization discs, and a seed control monitor is employed for precise and efficient corn seeding. Additionally, a herbicide installation with a 400-liter capacity, covering a 12-meter working width and featuring a sprayer equipped with three nozzles, notably the Demarol Cyklon, is utilized for effective weed control. The farming machinery roster includes a CLAAS 685 tractor for various agricultural tasks and a corn combine harvester for efficient corn harvesting operations.

The small farmers independently applied the necessary agronomic practices according to the training

Data collection

Soil samples were taken at the end of the experiments at the specified depth to be analyzed in order to determine the chemical properties. Phenological data were recorded together with the researchers. Corn cobs were harvested and weighed from the measurement plots with an area of 21 m^2.

Samples taken were dried to a constant weight. The spikelets were dried and the grains separated by hand. Grain moisture was determined with portable grain moisture analyzers. The weight of the grains was determined at a moisture content of 12.5%.

RESULTS AND DISCUSSIONS

Table 1 presents the soil chemical properties at a depth of 0-15 cm, indicating important factors for crop growth and nutrient availability. These properties include total nitrogen (N), available phosphorus (P), total organic carbon (C), exchangeable potassium

(K), exchangeable magnesium (Mg+), exchangeable calcium (Ca), C/N ratio, and pH. The values provided offer insights into the soil's fertility status and its potential to support crop growth.

Table 1. Soil chemical properties (0 – 15 cm)

Chemical properties	Unit	Value
N total	%	0.10
Available P	mg kg^{1}	43.00
Total organic C	%	0.81
Exchangeable K	cmol kg K^{-1}	1.25
Exchangeable magnesium Mg^{+}	cmol+kg^{-1}	1.396
Exchangeable calcium Ca^{+}	cmol+ kg^{-1}	11.49
Report C/N		8.10
pH water (1:1, soil:water)	Ph units	5.84

Source: Own determination.

Tables 2, 3, and 4 outline the inputs and associated costs for different agricultural practices: Minimum Tillage (+ Mineral Fertilizer), Minimum Tillage (+ Mineral Fertilizer SOLFERT 10-5-40+ME), and a Control setup, respectively. Each table itemizes the quantity and cost of various inputs such as workforce, fuel, fertilizers, seed, and herbicide for the specified agricultural practices (Fig.1).

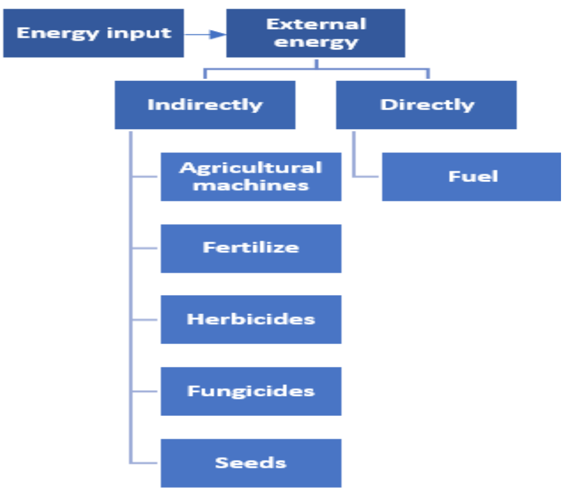

Fig. 1. Cost categories associated to the technology
Source: Authors' conception.

Most farmers showed a preference for technologies incorporating higher levels of soil fertility inputs, regardless of the tillage method employed. The most favored technologies were MinTill Îc (involving minimum tillage with added mineral fertilizer) and Min Till Îc Îls (involving minimum tillage of soil with additional mineral fertilizer, SOLFERT 10-5-40, and microelements). These technologies were preferred due to the accessibility of inputs, ease of implementation, and their ability to enhance production. We observed that the CvCon paper was preferred by a few farmers for ease of implementation, but not by the majority of small farmers.

Table 2. MinTill Îls (minimum tillage; + Mineral fertilizer)

Inputs		Quantity	Costs, lei
Workforce		16 h	16 x 33 = 528
Machinery			
Fuel	Diesel	77 L	77x 8.20 = 631.4
Fertilizers	N P K	200 Kg	4x 245 =980
Seed	Local variety	3x25,000 grains	3x152 =304
Herbicide	Corn Herbicide NICORN 040 SC	5 L	238
Total			**2,681**

Source: Own calculation.

Table 3. Min Till I Îls (minimum tillage; + mineral fertilizer SOLFERT 10-5-40+ME)

Inputs		Quantity	Costs, lei
Workforce		16 h	16 x 33 = 528
Machinery			
Fuel	Diesel	107 L	107 x 8.20= 877.4
	N P K	200 Kg	4x 245 =980
	Solfert 20-20-20 +ME	3 Kg	3x 17.8 =53.4
	Local variety	3x25,000 grains	3x152lei = 304
	Corn Herbicide NICORN 040 SC	5 L	238
Total			**2,980.8**

Source: Own calculation.

Table 4. Control

Inputs		Quantity	Costs, lei
Workforce		40 h	40 x 33 = 1,320
Machinery			
Fuel	Diesel	67 L	67x8.20= 549.4
Fertilizers	Ammonium nitrate	300 Kg	1,541
Seed	Local variety	3x25,000 grains	3x152lei = 304
Herbicide	Corn Herbicide NICORN 040 SC	5 L	238
Total			**3,952.4**

Source: Own calculation.

MinTill maintained soil moisture and favored the mineralization and accumulation of nitrogen in the soil. Other authors have extensively discussed the capacity of MinTill to preserve soil moisture and its impact on biochemical processes, as evidenced by works by [1, 2].

Tillage practices have been shown to stimulate acid-phosphomonoesterase activities, thereby promoting phosphorus mineralization, as alterations to the soil surface prompt responses in the soil's biochemistry and biology, as indicated by [9].

Yields of corn kernels and plant residues

The tillage method did not significantly affect the amount of corn grains and the yield of plant residues in the three locations (Table 5).

Table 5.Comparison of the average production of grains and vegetable residues in corn

Work	Average grain production, t/ha	Average production of vegetable residues, t/ha	The proportion of grains-vegetable remains
Conventional control + Ammonium nitrate 33.5% N	4.2	4.3	1:1.04
MinTill=minimum tillage;+ Mineral fertilizer	5.6	6.16	1:1.1
MinTill=minimum tillage; + Mineral fertilizer + SOLFERT 10-5-40+ME	7.1	9.23	1:1.3

Source: Own calculation.

The notable rise in maize yield observed during the 2022 harvest season, attributed to the interaction between tillage practices and Soil Fertility Inputs (SFIs), may be linked to elevated soil moisture levels and enhanced availability of plant nutrients resulting from SFIs in the soil, similar to findings reported in studies conducted by [6 and 17].

Higher corn yields could be related to readily available nitrogen from inorganic fertilizers while organic inputs could have released organic acids that increased soil pH [14]. Their capacity to release phosphorus and facilitate the availability of other nutrients for crop absorption can result in heightened maize production, consistent with findings reported by [10].

Likelihood of adoption of experienced ISFM technologies

All participating farmers who implemented ISFM under both conventional and minimum tillage conditions considered that they would continue to use ISFM technologies, and would recommend them to other farmers.

[7] found that farmers prefer technologies for increasing corn production.

The involvement of small farmers in the implementation of the project influenced the decision of other farmers to use the applied technologies.

Farmers commonly practice conventional tillage. The willingness to use minimum tillage is supported by the possibility of using the tillage method on a wide range of crops, under different climate and soil conditions.

Short-term threats to the adoption of the technologies used in this study included the unwillingness of smallholder farmers for their transmission from farmer to farmer. The same was found by [11].

Adoption of ISFM can be improved by disseminating information in the area The duration of the experiment coincided with the agricultural season for the maize crop in the year 2022 of 133 days.

CONCLUSIONS

Minimum tillage with integrated soil fertility management technologies was more effective in increasing maize production under conditions of a reduced amount of precipitation than in the case of conventional tillage.

We used the results as a proxy to assess the likelihood of farmers adopting the implemented ISFM technologies.

It could be observed that a higher production is obtained if a larger amount of fertilizers is used, but it is not a direct proportional relationship between the level of fertilization and the productive level. Thus, other work options can be observed that are more efficient. A long-term performance evaluation study under both tillage methods is needed for site-specific recommendations

The increase in corn production under different changes in soil fertility and the participation of farmers in their implementation ensures the probability of their being taken over by farmers in the area

To advance the adoption of these technologies, it is imperative to encourage the farmer-to-farmer learning approach.

The primary obstacle in utilizing corn as a soil fertility enhancer stems from its predominant use as animal feed.

There is a crucial necessity to educate farmers on achieving a balance between utilizing maize as animal feed and as a soil fertility input.

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THE ECONOMIC CENTERS IN BULGARIA - AN OPPORTUNITY TO DISCOVER ADDITIONAL POTENTIAL IN THE REGIONAL DEVELOPMENT OF RURAL TERRITORIES

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Abstract

In Bulgaria, according to the Institute for Market Economics, 16 economic centers have been defined, which form a large part of the national economy. The paper focuses on the economic centers located in the territory of the North Central Planning Region and the North Western Planning Region, emphasizing their role in revealing the potential for development of the rural areas within their scope.In this context, the specific features of their development have been analyzed and the possibilities for future development have been assessed in order to achieve the goals of sustainable development of the territory, to increase the living standards of the population, and to reduce the risk of poverty in rural areas. The study utilized statistical methods for analyzing dynamic trends, hypothesis testing, regression, and correlation analysis. It was found that the indicators for the municipalities within the economic centers are more favorable compared to those outside of them.The results of the analysis demonstrate that the presence of economic centers in the region has a statistically significant impact on indicators such as population, age dependency ratio, population density, average annual salary of employees under labor and service contracts, and unemployment rate.

Key words: *economic centers, rural territories, potential, regional development, sustainability*

INTRODUCTION

The development of rural areas, not only in Bulgaria but also in Europe and around the world, faces a variety of problems and challenges, the clarification of which provides a solid foundation for implementing measures to make them more appealing for business and living. Within the EU, rural areas represent 80% of its territory, and 30% of the population lives in them, while the agricultural sector and food production provide around 40 million jobs. Several programming periods have been directed towards improving development opportunities and living conditions in rural territories. However, despite this, the migration of the population continues due to limited employment opportunities, inadequate training, insufficient investments, and weak entrepreneurial activity.

According to [6], agriculture remains pivotal for the development of rural areas in Europe, yet with its increasing industrialization, there is a rise in the average size of farms and utilized agricultural land, accompanied by a decline in the number of farms and employed workers. In their study, Dammers and Keiner emphasize that in rural areas in recent years, various processes are observed. On one hand, there are processes of depopulation, while on the other hand, there are also processes of resettlement. According to them, for successful sustainable and balanced development of rural areas, it is necessary to implement various programs to stimulate their development, including the development of ecological production, organic farming, rural tourism, etc.

Ahlmeyer and Volgmann conduct an analysis of trends in the development of rural areas in Europe, highlighting that structural changes are observed therein, leading to significant differentiation and the delineation of prosperous and underdeveloped regions [2]. Based on an analysis of reports on EU-funded projects, they examine the impact of economic, technological, social, environmental, and other trends on the development of rural areas. They conclude that the major challenge for rural areas is their development in the context of transitioning to a green economy, utilizing technologies with minimal environmental impact and employing renewable energy sources, among other strategies. The strategic directions for rural development highlighted by [24] are associated with enhancing the competitiveness of the agricultural and forestry sectors, improving the environment, enhancing quality of life, as well as creating opportunities for local economic development and increasing employment. Achieving them requires not only securing funding but also the real implementation of the priorities set out in various programs.

Limited employment opportunities in rural areas and poor infrastructure and connectivity with urban centers are key issues, and to address them, a series of measures are being taken, reflected in the Common Agricultural Policy of the EU [5] as well as in other documents. With the development of information and communication technologies and the increasing digitization of processes, some of these problems can be overcome, as they provide opportunities to increase employment in rural areas through remote work, thereby reducing or eliminating the need for daily or frequent commuting to workplaces in larger cities, reducing daily labor migrations, and providing new opportunities for the development of rural areas. Infrastructure projects have a significant impact on the socio-economic conditions for rural development, as confirmed by the study conducted by [10], who empirically demonstrates the necessity of a comprehensive approach in developing strategic plans and emphasizes that improving transportation infrastructure contributes to reducing social and economic disparities.

The effects of improving public infrastructure are reflected in increased economic activity, higher investment in the region, enhanced employment, reduced unemployment, improved quality of life, and better access to education and healthcare.

According to [27], the development of rural areas contributes to varying degrees to the formation of the Gross Domestic Product (GDP) of individual countries, thus requiring incentives to enhance its efficiency and transform it into a significant factor for economic growth. In her research, she also focuses on the potential for rural areas to become centers for non-agricultural activities such as tourism, local traditions and crafts, ecological productions, etc. According to [3], the formation of regional centers encompassing rural and urban areas will contribute to stronger connections between them, potentially creating a favorable environment for expanding trade links, stimulating the local economy, reducing poverty, etc.

[28] analyzes the development of small municipalities in rural areas and the challenges faced by communities in small towns, emphasizing the importance of implementing strategies for their development in the context of intensified urbanization. In the study, based on research conducted in four small urban communities in the USA, White found that they have successful strategies for economic development, including regional cooperation, cross-sectoral connections and interactions, stimulation of local economies and entrepreneurial initiatives, and the development of a long-term vision for development. The results of the analysis indicate an increasing number of people moving to urban centers, primarily consisting of young and more educated residents. The main reasons for this trend are the greater employment opportunities and improved living conditions available in urban areas. At the same time, there is a tendency for an aging population to predominate in rural areas. Based on the research, it was found that there is poor infrastructure and connectivity between small settlements. To address these issues, [28] emphasizes the need for long-term planning, adoption of strategies for sustainable development and smart growth, programs and partnerships with educational institutions, promotion of local initiatives, regional cooperation, improvement of transportation and social infrastructure, and

creating favorable conditions for remote living and working.

[1] proposed an approach using the Delphi methodology and find that besides the economy, social well-being also significantly contributes to the development of rural areas.

The aforementioned studies by foreign authors on rural development issues indicate that most of the problems in individual countries are similar, but naturally, there may be some specificities and particularities in each country.

On the issues of rural development in Bulgaria, numerous Bulgarian scholars have conducted studies. Doitchinova, Nikolova, Stoyanova, Stanimirova analyze employment, human resources, demographic processes, sources, and the size of agricultural income in rural areas [7, 8, 17, 25].

Important aspects of the opportunities for sustainable development of rural areas and the implementation of suitable business models and diversification of activities are presented by Kopeva, Doichinova, Nikolova, Petrova, Pavlov, Linkova, and others, with a focus on the problems and perspectives [13, 14, 15].

The condition of rural areas, as well as the issues of integrated and balanced regional development, territorial balance, and the use of agricultural land, are also the subject of research, with numerous publications dedicated to them [14, 16, 21].

Some authors see new opportunities for the development of rural areas with the introduction of various technological innovations, improvement of internet coverage, digitization of processes and services, as conditions are created to increase interest in them both as places for relaxation from the hectic everyday life and as places to live with the possibility of remote work [26, 22, 29].

From the conducted review of publications on the topic, it was found that the problems and challenges facing the development of rural areas are numerous and of different nature, and in assessing their state, a comprehensive analysis of a system of indicators characterizing economic, demographic, social, and ecological phenomena and processes is necessary. A number of studies demonstrate that rural territories are significantly integrated with nearby urban centers in terms of education, healthcare services, administrative services, and employment. This indicates that the development of rural areas is closely linked to the development of surrounding urban areas, as well as to the formation of economic centers around some of them. An in-depth study of the economic centers in the territory of Bulgaria was conducted by the Institute for Market Economics, in which 16 economic centers were defined [12].

Based on a rich information base of statistical data, the authors of the study "Economic Centers in Bulgaria - 2023" form "broad economic centers that are not limited to the administrative-territorial division of regions, planning areas".

The approach adopted by the authors consists of defining core municipalities, which are strongly developed economically, and peripheral municipalities, which are less developed but closely linked economically to the cores [12].

It was precisely the analysis conducted by the Institute for Market Economics on economic centers in Bulgaria that sparked the authors' interest in studying their significance for the development of rural areas. The purpose of this publication is to study the role of economic centers in revealing the potential of rural territories in a regional scope in two of the planning regions in Bulgaria - the North Central Planning Region and the Northwestern Planning Region.

The research focuses on several directions:

-A brief description of the economic centers in the North Central Region and North Western Region.

-Comparative analysis of indicators for the municipalities included in the composition of the economic centers and for the municipalities that are not part of them.

-Hypothesis testing regarding the difference between the mean values of indicators for the municipalities that are part of the economic centers and for the municipalities that do not fall within the scope of the economic centers.

MATERIALS AND METHODS

The assessment of the condition and the comparative analysis between the municipalities forming the economic centers and the rest of the municipalities that meet the requirements to be defined as rural areas were carried out through an analysis of the following indicators:

-Population as of December 31

-Natural population growth

-Migration growth

-The age dependency ratio as of December 31

-Population density as of December 31

-Relative share of employed persons in the industry out of total employed persons

-Average annual salary of employed persons under labor and service relationships

-Unemployment rate as of December 31.

-Number of healthcare facilities for hospital care

-Number of schools.

The information provision of the study is based on official statistical data from the National Statistical Institute, extracted from publications such as "Districts, Regions, and Municipalities in the Republic of Bulgaria" [19] as well as from the Information System [20] and from publications of the Institute for Market Economics [11], "Economic Centers in Bulgaria - 2023" and "Regional Profiles. Development Indicators - 2023". In order to ensure compliance with requirements for comparability and consistency of data at the municipal level, time series have been formed for the period 2007-2019. For some indicators, data for the years 2020 and 2021 have also been analyzed.

Statistical methods for time series analysis, hypothesis testing, regression and correlation analysis were used.

RESULTS AND DISCUSSIONS

In the study by the Institute for Market Economics, it is noted that 132 municipalities form 16 economic centers, but 29 municipalities can be identified as engines of regional economic development [12]. In the designated economic centers, 74% of the country's population, 78% of the economically active population, over 80% of the produced output, and over 85% of the foreign direct investments are located. The agricultural sector in Bulgaria accounts for about 4% of the gross value added and employs over 6% of the workforce in the country, with the sector being highly export-oriented and the country maintaining a positive trade balance in agricultural goods. Agricultural land occupies 41% of Bulgaria's territory, and in 2021, rural areas represent 22% of the country's territory, with 13% of the population located in them, and the number of registered farmers is 76,372 [4].

The two poorest regions in the EU are located in Bulgaria – the North Western and North Central Regions. This is the main reason why the municipalities falling within the scope of economic centers are analyzed in the article, to determine whether they influence the development of the region.

Conducting such an analysis would be beneficial from the perspective of monitoring processes, as the results of it can become a reliable basis for determining priorities and the need for changes in regional and sectoral policies and programs at national and regional levels.

Within the North Western and North Central Regions, there are four economic centers entirely encompassed – "Kozloduy", "Pleven", "Gabrovo-Sevlievo", and "VelikoTarnovo", while the economic center "Ruse-Targovishte-Razgrad" predominantly covers the North Central Region (12 out of 15 municipalities). Three municipalities from the Northwestern Region (Teteven, Roman, and Mezdra) are included in the economic center "Sofia-Pernik-Botevgrad". As previously indicated, the principle of forming economic centers by the Institute for Market Economics is not geographical and is not aligned with the delineated statistical regions. For the purposes of this study, data on all municipalities from the North Western and North Central Regions that fall within the scope of the delineated economic centers, as well as municipalities not included in them but meeting the requirement to be considered rural areas, have been systematized. During the research period, according to the National Plan on Agriculture and Rural Development under the Rural Development Program, rural municipalities are defined as those where there is no populated place with a population exceeding 30,000 inhabitants.

For the period 2007-2019, the average annual population decline in Bulgaria is 0.78%. However, the average annual decline for municipalities within the economic centers in the Northwestern and North Central Regions is 1.53%, while for municipalities not part of these economic centers, it is 2.27% (Figure 1).

During the analyzed period, Bulgaria experiences negative natural population growth. All municipalities in the North Western and North Central Regions have a negative population growth. The migration growth is also negative – the number of people moving into the municipalities is smaller than the number of people moving out.

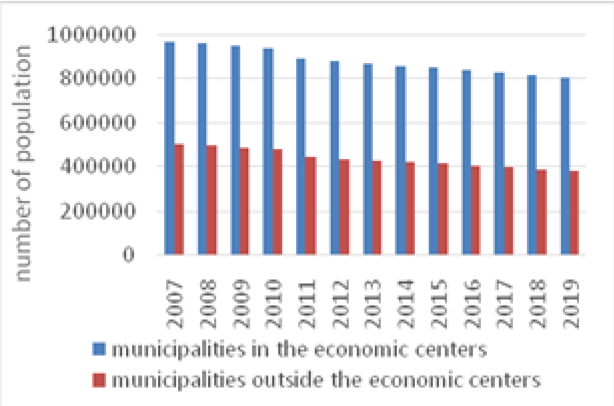

Fig. 1. Population of municipalities according to their participation in the economic centers in the North Western Region (NWR) and North Central Region (NCR).
Source: NSI [18].

The age dependency ratio shows the number of persons of the population in the "dependent" ages (population under 15 and population aged 65 and over) per 100 persons of the population in the "independent" ages (aged 15 to 64) and is calculated as a percentage [18]. The total age dependency ratio in Bulgaria increases from 44.3% in 2000 to 56.4% in 2019, with the increase being 1.3 times compared to 2007 [23].

For the municipalities within the economic centers in the North Western Region (NWR) and the North Central Region (NCR), the increase is from 59.4% to 69.5% (Figure 2), with an average annual growth rate of 1.3%.

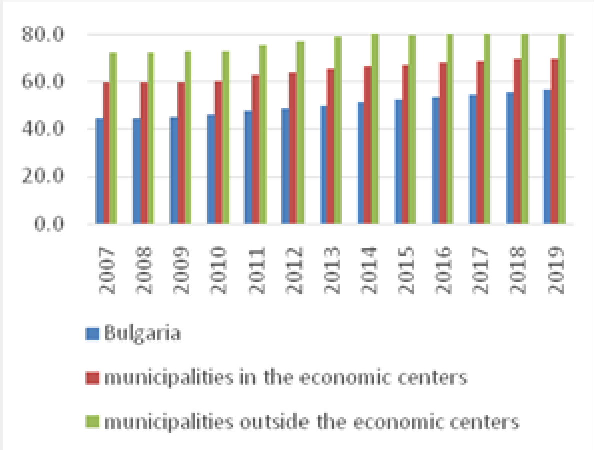

Fig. 2. The age dependency ratio for Bulgaria and for the municipalities based on their participation in the economic centers in the NWR and the NCR.
Source: NSI [18] and author's own calculations.

The age dependency ratio for the municipalities outside the economic centers of the NWR and the NCR ranges between 72% and 81%, indicating exceptionally high values and clearly demonstrating a sustainable trend towards population aging in these areas.

Negative demographic trends are characteristic of the entire country, but they are most pronounced in the North Western and North Central Regions, affecting both the municipalities within the economic centers and those in rural areas. Tracking the dynamics of population density provides the opportunity to identify changes in population density. Population density analysis is important as it serves as a basis for analyzing accessibility to healthcare, education, social, and administrative services, etc.(Fig. 3).

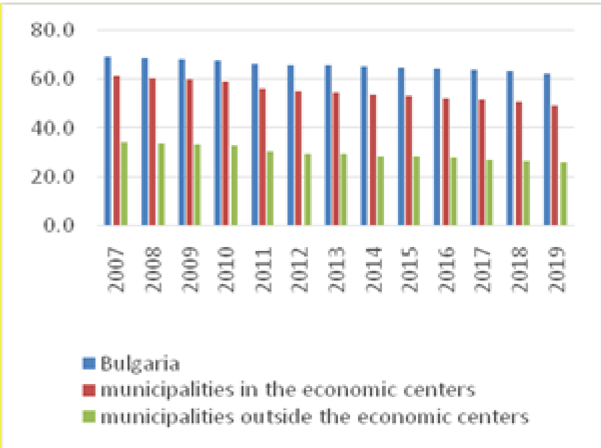

Fig. 3. Population density for Bulgaria and for the municipalities based on their participation in the economic centers in the NWR and the NCR.
Source: NSI [18] and author's own calculations.

Analyzing the relative share of employed individuals out of the total employed population allows for an assessment of the sectoral structure of the local economy. During the analyzed period, the indicator for Bulgaria decreased from 38.8% in 2007 to 31.9% in 2018. Values for municipalities within the economic centers are close to these, but significantly lower for municipalities not part of the economic centers – decreasing from 31.6% in 2007 to 27.4% in 2018. The average annual decrease in the indicator for municipalities within the economic centers is 1.83%, while for municipalities outside them, it is 2.38%.

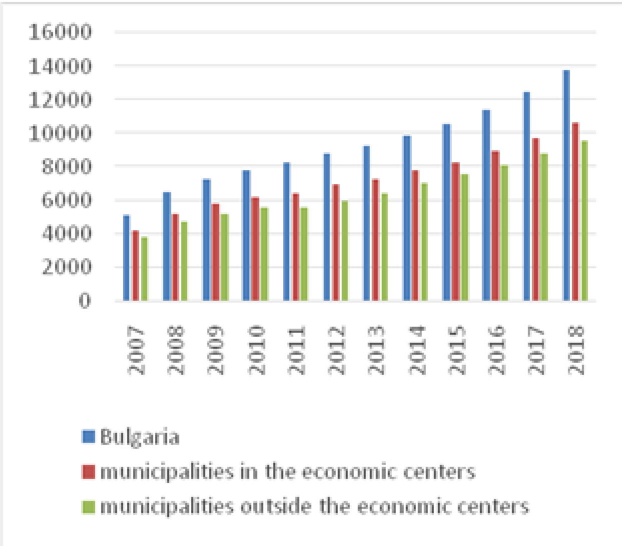

Fig. 4. Average annual salary for Bulgaria and for the municipalities based on their participation in the economic centers in the NWR and the NCR.
Source: NSI [19] and author's own calculations.

An assessment of the purchasing power and living standards of the population can be conducted based on an analysis of the average annual salary of employees under labor and civil service contracts. The results of the analysis show that during the analyzed period, the average annual salary for the country for 2018 was 2.7 times higher compared to 2007, increasing from 5,167 BGN (in 2007) to 13,755 BGN (in 2018). For the municipalities within the economic centers in the North Western Region (NWR) and the North Central Region (NCR), the increase in the average annual salary shows a growth of 2.54 times, with an average annual growth rate of 8.8%. For the municipalities outside the economic centers, the increase is 2.48 times, with an average annual growth rate of 8.62%. The average annual salary in the municipalities in the NWR and the NCR lags behind the national average, with this difference being more pronounced for the municipalities outside the economic centers, which correspond to the requirement of being designated as rural municipalities (Figure 4).

The unemployment rate in Bulgaria for the period 2007-2018 ranged from 6.1% in 2018 to 11.8% in 2013. The results of the analysis show that for the municipalities in the NWR and the NCR, the unemployment rate is much higher compared to the national average. The average annual increase in the unemployment rate for the municipalities within the economic centers is 0.87%, while for the municipalities outside the economic centers, it is 1.97%. It was found that the unemployment rate is higher for rural municipalities compared to the municipalities that are part of the economic centers, indicating a poorly developed local economy, low entrepreneurial activity, significant labor market disparities, etc. (Fig. 5).

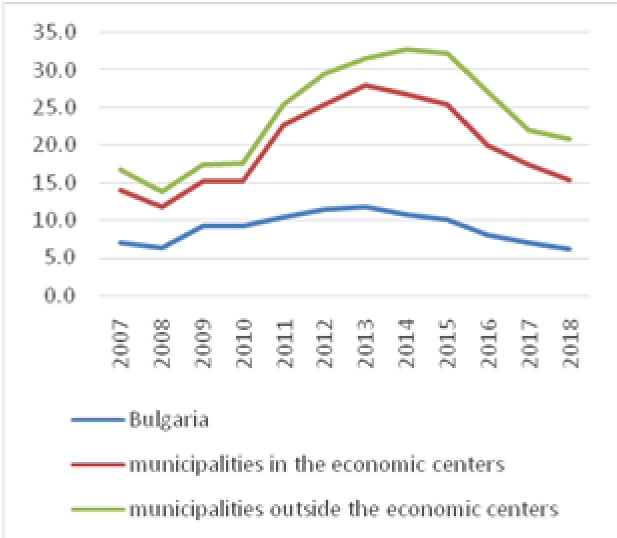

Fig. 5. Unemployment rate for Bulgaria and for the municipalities based on their participation in the economic centers in the NWR and the NCR.
Source: NSI [19] and author's own calculations.

The number of healthcare facilities providing hospital care decreases in both the municipalities of the NWR and the NCR – for the municipalities within the economic centers from 41 in 2008 to 37 in 2019, and for the municipalities outside the economic centers from 32 in 2008 to 29 in 2019. The number of beds in healthcare facilities providing hospital care in the municipalities within the economic centers is almost twice as high compared to the other municipalities.

A sustainable trend towards a decrease in the number of schools was observed (Figure 6), with the reduction occurring at higher rates in rural municipalities compared to those municipalities that are part of economic centers. The results of the analysis indicate that for the period 2007-2020, the average annual decrease in the number of schools in municipalities belonging to economic centers was 2.28%, while it was 3.31% for municipalities outside of economic centers or in rural municipalities. The analysis conducted so far on key aspects of the demographic situation in rural areas provides grounds to assert that the main reasons for the decrease in the number of schools in these areas are low birth rates, migration, deteriorating age structure of the population, reflected in the decrease in the population in age groups 0 to 19 years old, and an increase in the population in older age groups. At the same time, disparities in access to education and the quality of education in rural areas are intensifying.

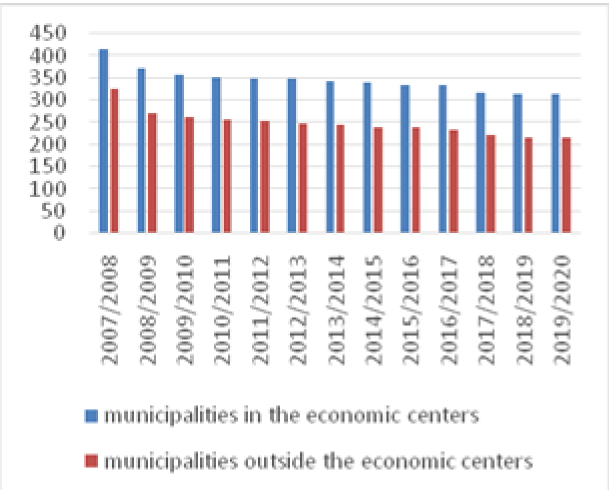

Fig. 6. Number of schools (primary, lower secondary, and upper secondary levels) for the respective school year for the municipalities based on their participation in the economic centers in the NWR and the NCR.
Source: NSI [20].

In order to determine whether the difference in the mean values of the analyzed indicators for the municipalities that are part of the economic centers and the municipalities that are outside the economic centers is systematic as a result of the formation of the economic centers or is random and not dependent on this factor, a hypothesis test for the difference between means has been conducted using the Student's t - test [9]. The null hypothesis states that the difference between the mean values is random and is denoted as $H_0 : \bar{x}_1 = \bar{x}_2$, while the alternative hypothesis states that the difference between the two mean values is not random and is denoted as $H_1 : \bar{x}_1 \neq \bar{x}_2$, meaning it is statistically significant and is generated by the inclusion of municipalities in the economic centers in the territory of the NWR and the NCR. If $t_{EM} \leq t_T$, the null hypothesis is accepted, thus indicating that the difference in the mean values of the indicator for the two populations (samples) is random and cannot be claimed to be generated by the inclusion of municipalities in the economic centers. However, if $t_{EM} > t_T$ the null hypothesis is rejected, and the alternative hypothesis is accepted, suggesting that there is a difference between the mean values, which is statistically significant and is generated by the action of the investigated factor on which the two populations are distinguished.

Table 1.Results from the hypothesis test regarding the difference in the mean population in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	23005,3429	9342,512
Variance	1142486142	69500795
Observations	35	41
Pooled Variance	562494063	
Hypothesized Mean Difference	0	
Df	74	
t Stat	**2,50323066**	
P(T<=t) one-tail	0,0072562	
t Critical one-tail	1,66570689	
P(T<=t) two-tail	0,0145124	
t Critical two-tail	1,9925435	

Source: NSI [18] and author's own calculations.

The results of the hypothesis test for the difference between the average population in municipalities that are part of economic centers and municipalities that are not part of economic centers (Table 1) provide grounds to assert that there is a statistically significant difference in the mean population between them, as $t_{stat} > t_{critical}$. The conclusion that can be drawn is that the null hypothesis is rejected and the alternative hypothesis is accepted, indicating that economic centers have a significant impact.

The hypothesis test for the difference between the mean values of the age dependency ratio for the two groups of municipalities (Table 2) revealed a statistically significant difference, as $t_{stat} > t_{critical}$. Based on these results, the null hypothesis is rejected and the alternative hypothesis is accepted, indicating that economic centers have a statistically significant influence on the age dependency ratio.

Table 2. Results from the hypothesis test regarding the difference in the mean values of the age dependency ratio in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	67,48026	78,82218
Variance	134,8768	254,699
Observations	35	41
Pooled Variance	199,6456	
Hypothesized Mean Difference	0	
df	74	
t Stat	**-3,48799**	
P(T<=t) one-tail	0,000411	
t Critical one-tail	1,665707	
P(T<=t) two-tail	0,000823	
t Critical two-tail	1,992543	

Source: NSI [18] and author's own calculations.

The difference in the mean population density between the municipalities within the economic centers and the municipalities outside their scope is not random but statistically significant (Table 3). The null hypothesis is rejected, as $t_{stat} > t_{critical}$, and the alternative hypothesis is accepted, indicating that the presence of economic centers exerts a statistically significant influence on the population density in municipalities.

The hypothesis test for the difference between the mean values of the proportion of employees in the industry to all employed persons for the two groups of municipalities (Table 4) revealed that the difference is random and not statistically significant, as $t_{stat} < t_{critical}$. Therefore, the null hypothesis is accepted, and the alternative hypothesis is rejected.

Table 3. Results from the hypothesis test regarding the difference in the mean population density in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	47,75844	25,10279
Variance	2600,141	228,1814
Observations	35	41
Pooled Variance	1318,001	
Hypothesized Mean Difference	0	
Df	74	
t Stat	**2,711676**	
P(T<=t) one-tail	0,004159	
t Critical one-tail	1,665707	
P(T<=t) two-tail	0,008319	
t Critical two-tail	1,992543	

Source: NSI [18] and author's own calculations.

Table 4. Results from the hypothesis test regarding the difference in the proportion of employees in the industry to all employed persons in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	30,71228	26,77039
Variance	306,2824	348,3658
Observations	35	41
Pooled Variance	329,0302	
Hypothesized Mean Difference	0	
Df	74	
t Stat	0,94429	
P(T<=t) one-tail	0,174047	
t Critical one-tail	1,665707	
P(T<=t) two-tail	0,348094	
t Critical two-tail	1,992543	

Source: NSI [19] and author's own calculations.

The difference in the average annual salary of employed individuals under labor and service relationships in the municipalities within the economic centers and the municipalities outside their scope is not random but statistically significant (Table 5).

The null hypothesis is rejected, as $t_{stat} > t_{critical}$, and the alternative hypothesis is accepted, indicating that the presence of economic centers exerts a statistically significant influence on the average salary size in the municipalities.

The results from the hypothesis test for the difference in the unemployment rate between the two groups of municipalities (Table 6) indicate a statistically significant difference in the unemployment rate, as $t_{stat} > t_{critical}$. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, suggesting that economic centers exert a substantial influence on the unemployment rate.

Table 5. Results from the hypothesis test regarding the difference in the average annual salary of employees under labor and service relationships in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	10359,23	9368,902
Variance	6621101	2484299
Observations	35	41
Pooled Variance	4384992	
Hypothesized Mean Difference	0	
df	74	
t Stat	**2,055006**	
P(T<=t) one-tail	0,021704	
t Critical one-tail	1,665707	
P(T<=t) two-tail	0,043409	
t Critical two-tail	1,992543	

Source: NSI [19] and author's own calculations.

Table 6. Results from the hypothesis test regarding the difference in the unemployment rate in the two groups of municipalities for the year 2019

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	14,85429	20,3841
Variance	100,694	157,817
Observations	35	41
Pooled Variance	131,5717	
Hypothesized Mean Difference	0	
df	74	
t Stat	**-2,09483**	
P(T<=t) one-tail	0,019805	
t Critical one-tail	1,665707	
P(T<=t) two-tail	0,039609	
t Critical two-tail	1,992543	

Source: NSI [19] and author's own calculations.

CONCLUSIONS

In recent years, the dependency of rural areas on urban centers has been steadily increasing. More and more frequently, the population from rural areas has to travel to larger cities for employment or to access various administrative, educational, social, healthcare, or other services. The reasons mentioned so far are at the core of the increasing migration to cities, especially to those that have become regional economic centers. The development of rural areas faces a number of challenges that require the implementation of an adequate policy based on a thorough analysis, a complex approach and the implementation of strategies to preserve the population and jobs in rural areas.

The results of the empirical analysis have demonstrated statistically significant differences between the indicators for the municipalities that are part of the economic centers in the Northwestern and North Central Regions and the municipalities outside of them classified as rural areas. Statistically significant influence of the economic centers is observed for the indicators: population, age dependency ratio, population density, average annual salary of employees under labor and service relationships, and unemployment rate. It was found that the indicators for the municipalities within the economic centers are more favorable compared to those outside of them. Therefore, opportunities should be sought to expand the scope of the economic centers by integrating the neighboring municipalities with the aim of sustainable development of the region and increasing the living standards of the local population in rural areas.

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MARKET TRENDS IN THE EUROPEAN UNION BEVERAGE INDUSTRY

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Abstract

The aim of this paper is to analyze the significant changes within the European beverage industry between 2011 and 2020. This period was characterized by a complex interplay of economic, technological, and socio-cultural factors that influenced the sector. During this decade, there were notable shifts in employment structures, market trends, production innovations, and responses to both global and regional economic challenges. Different national strategies led to workforce expansion in Malta and reductions in Poland and Denmark. Technological advancements, changing consumer preferences, and increased awareness of sustainability prompted strategic adaptations, production restructuring, and the creation of new market segments. Significant changes in the top 10 countries by the number of active companies include growth in Spain, France, Italy, and the Czech Republic. The financial performance across countries such as Germany, Italy, and Romania highlight a dynamic and evolving market landscape. This analysis underscores the resilience and adaptability of the European beverage industry in the face of varying national responses and market conditions.

Key words: *beverages, market trends, economic challenges, consumer preferences*

INTRODUCTION

The early 21st century was known as the age of information, but we now observe changes in technology, beliefs, and activities. Some renowned economists now refer to the current era as the age of entrepreneurship [1].

The beverage sector represents a significant and extensive segment of the food industry, encompassing a diverse array of sub-categories and drink types, each varying in complexity in terms of production and quality evaluation [3]. Enhancing product quality positively impacts profitability, labor productivity, and competitiveness [5,11].

Across countries in Europe, packaged food and non-alcoholic beverage product markets have shown to be moderately to highly concentrated with a low number of unique companies [15].

The global COVID-19 outbreak has altered the trajectory but not the core content of consumer trends in the food industry [14]. At the same time, as consumers enjoy increasing prosperity and technological advancements, the food sector stands out by focusing on creating connections beyond the product itself and emphasizing the story behind it [6].

Another approach is presented by Witther and Anderson (2020), who highlight the global interaction of the beverage market, emphasizing changes in consumer preferences [17]. Kokole et al. (2021) noted an increase in interest in low-alcohol or alcohol-free beverages because of health awareness [4]. Toma, Năstase and Cojocaru (2022) presented how the labor market in the EU continues to be influenced by the evolution of the beverage industry, emphasizing changes in labor demand as well as the skills needed in this sector [15].

According to Soava, Mehedintu and Sterpu (2022) it has been observed a notable increase in online trade at EU level, including in the drinks sector, fact that clearly suggests the industry's adaptation to digital technology but also consumer preferences in terms of making purchases online [11].

In this context, the beverage industry in the European Union experienced a period of significant transformations between 2011 and 2020, marking a defining era for the sector. [13] This decade was characterized by a complex dynamic, influenced by economic, technological, and socio-cultural factors [9]. The analysis of the evolution of the average number of employees per enterprise in the beverage industry reveals major changes in the workforce structure and adaptations to market trends, production, and consumption innovations, as well as responses to global and regional economic challenges.

Each member state of the European Union made unique contributions to this diverse landscape, from the impressive workforce expansion in Malta to the significant reduction in the number of employees per enterprise in Poland and Denmark. These variations reflect different national strategies and responses to global market demands, as well as internal developments.

Additionally, the EU beverage industry has been shaped by technological innovations, changes in consumer preferences, and an increase in sustainability awareness. The impact of these factors has led to strategic adaptations, production and marketing restructurings, and the emergence of new market segments [16].

The aim of this paper is to analyze the significant changes within the European beverage industry between 2011 and 2020, when a complex interplay of economic, technological, and socio-cultural factors influenced the sector.

MATERIALS AND METHODS

The study utilizes a comprehensive approach to analyze the evolution of the beverage industry in the European Union (EU) from 2011 to 2020, drawing on data from multiple sources, including Eurostat databases, market research reports, and peer-reviewed journal articles. Data on the number of employees per enterprise, financial performance metrics, and company numbers were extracted from Eurostat to assess changes in workforce structure, market trends, and economic performance across different EU member states. Additionally, market research reports and journal articles provided insights into shifts in consumer preferences, particularly the rising interest in low-alcohol and non-alcoholic beverages, and the impact of technological advancements on production processes and product offerings. Descriptive and time-series analyses were employed to identify trends, while content analysis of reports and articles highlighted regulatory impacts and sustainability practices. Comparative analyses across EU countries underscored differences in industry evolution, with data visualizations such as graphs and charts illustrating key trends and performance variations. This methodical approach ensures a robust understanding of the dynamic and evolving beverage industry in the EU during the specified period.

RESULTS AND DISCUSSIONS

Food supply chains and the assurance of food quality and safety have become major public concerns worldwide, driven by the unprecedented rapid economic growth [7]. Data on the beverage industry in EU member countries in the period 2011-2020 show various trends both in terms of growth and development.

Germany saw a healthy growth of 30.61%, with the number of companies increasing from 2,019 to 2,637.

At the opposite pole was Hungary, which faced challenges, thus registering a slight decrease of 8.10%, with the number of companies falling from 2,334 to 2,145.

As for Portugal's situation, it has demonstrated a truly impressive growth, with an increase of 61.89% starting from 1,215 and reaching 1,967 companies, thus placing itself among the first competitors.

The Netherlands stood out from the others, registering an amazing increase of 550.79%, the number of companies thus increasing from 189 to 1,041.

The number of companies in Slovakia almost tripled, increasing by 133.56% from 441 to 1,030. if we talk about the situation in Romania, the beverage sector registered an

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increase of only 5.38%, the number of companies increasing from 651 to 686.

Table 1. Evolution of the top 10 EU member countries in terms of the number of companies in the beverage industry and Romania's position

Rank	Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020/2011 %
1	**Spain**	4,557	4,617	4,500	4,889	4,761	4,908	5,061	5,061	5,206	4,863	106.71
2	**France**	2,959	3,117	3,125	3,051	4,113	3,946	3,853	3,755	4,137	4,466	150.93
3	**Italy**	2,871	2,891	2,949	3,191	3,219	3,390	3,348	3,281	3,234	3,202	111.53
4	**Czech Republic**	1,263	1,222	1,266	1,613	1,815	2,077	2,237	2,412	2,544	2,691	213.06
5	**Germany**	2,019	2,002	1,932	1,977	2,142	2,166	2,033	2,257	2,435	2,637	130.61
6	**Hungary**	2,334	2,295	2,251	2,238	2,287	2,245	2,229	2,161	2,178	2,145	91.90
7	**Portugal**	1,215	1,223	1,441	1,659	1,754	1,793	1,885	1,981	2,023	1,967	161.89
8	**Greece**	893	795	755	1,137	1,013	1,097	1,123	1,101	1,150	1,147	128.44
9	**Netherlands**	189	208	290	338	450	563	687	836	956	1,041	550.79
10	**Slovakia**	441	421	419	497	492	619	755	884	894	1,030	233.56
13	**Romania**	651	664	678	678	677	677	676	684	646	686	105.38

Source: Eurostat, 2024 [2].

In what concerns the turnover indicator, France shows the leader position in the beverage industry, doubling its value, from 25,125.7 million euros in 2011 to a peak of 46,841.7 million euros in 2017, then stabilizing the value at 29,258.2 million euros in 2020, marking a growth of 116.45%. Regarding the situation of Germany, a constant and at the same time balanced growth is clearly showed, the growth rate being 127.59%, starting from 20,118.4 million euros in 2011, ending with 25,669.1 million euros in 2020. The beverage industry in Italy managed a smooth growth, from 18.908.3 million euros in 2011 to 20,234.6million euros, the growth rate being only 107.01%.

For two of the analyzed countries, namely Spain and Portugal, the growth rate is very similar. Spain recorded 107.07% while Portugal recorded 107.19%. Poland, being an emerging economy in the EU, showed an increase of approximately one million euros, from 7,282.1 million euros to 8,231.8 million euros, the growth rate being 113.04%.

By far, in percentage terms, the biggest increase was evident in Austria and Belgium, with rates of 143.08% and 143.48%, respectively. The Netherlands maintained a relatively constant turnover in the beverage industry, being the only country among those analyzed that showed a slight decrease from 4,742.6 million euros to 4,736.0 million euros, the rate being 99.86%.

Romania amazes this time, managing to present an impressive increase from 2,087.9 million euros to 2,818.1 million euros, with a growth rate of 134.97%.

Table 2. Evolution of the top 10 EU member countries in terms of turnover in the beverage industry (million euros)

Rank	Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020/ 2011 %
1	**France**	25,125.7	26,637.3	28,117.6	27,709.7	29,934.1	29,447.1	46,841.7	32,842.0	31,502.7	29,258.2	116.45
2	**Germany**	20,118.4	20,386.9	20,300.3	20,811.4	20,227.3	21,146.7	20,634.9	25,926.6	25,980.8	25,669.1	127.59
3	**Italy**	18,908.3	17,103.0	17,038.8	17,697.8	18,424.4	19,721.2	20,870.9	21,797.0	22,103.8	20,234.6	107.01
4	**Spain**	15,795.6	15,981.9	15,991.8	15,616.3	16,149.4	16,530.4	17,256.1	20,327.5	19,580.7	16,911.9	107.07
5	**Poland**	7,282.1	7,415.8	7,671.4	7,316.0	7,636.1	7,130.6	7,298.3	8,294.4	8,176.2	8,231.8	113.04
6	**Austria**	4,873.1	5,370.1	5,215.4	5,392.1	6,111.2	6,225.7	6,127.8	6,487.3	6,885.7	6,972.3	143.08
7	**Belgium**	4,810.8	4,776.3	4,801.9	4,598.9	4,540.3	5,219.9	5,578.4	6,259.8	7,589.8	6,902.7	143.48
8	**Netherlands**	4,742.6	4,846.1	4,872.9	4,900.9	5,140.4	5,085.5	5,392.2	5,268.5	5,241.2	4,736.0	99.86
9	**Portugal**	2,991.9	2,973.9	3,014.6	3,099.4	3,135.5	3,242.6	3,362.3	3,404.3	3,565.7	3,206.9	107.19
10	**Romania**	2,087.9	2,197.6	2,165.6	2,100.4	2,410.3	2,545.9	2,627.4	2,854.6	2,967.7	2,818.1	134.97

Source: Eurostat, 2024 [2].

The agri-food sector is a key component of the European Union's economy, essential for supporting its population and contributing significantly to the EU's economic stability and health [10, 12].

At the same time, labor productivity is determined by a large range of factors [8]. Germany stands out as a leader in the industry, with a substantial increase in the number of employees from 70,492 in 2011 to 85,705 in 2020, representing a growth of 121.58%. This increase demonstrates the strength and expansion of the beverage sector in Germany. Spain recorded impressive growth, with the number of employees rising from 47,800 in 2011 to 58,678 in 2020, an increase of 122.76%. This reflects an active labor market and an expanding beverage industry. France experienced notable fluctuations in the number of employees, from 44,128 in 2011 to 55,157 in 2020, with a growth rate of 124.99%. This indicates the industry's adaptability and dynamism. Italy's beverage industry showed moderate but steady growth, with the number of employees increasing from 35,878 in 2011 to 41,997 in 2020, a growth rate of 117.06%. The number of employees in Poland's beverage industry slightly declined from 27,048 in 2011 to 24,950 in 2020, indicating a small decrease of 92.24%.

Romania maintained relative stability, with a slight decrease in the number of employees from 22,309 in 2011 to 21,772 in 2020, a rate of 97.59%. Both the Czech Republic and Portugal saw consistent growth, with rates of 114.26% and 114.52% respectively, indicating healthy and expanding markets. Hungary had a relatively stable evolution, with a slight increase from 13,716 employees in 2011 to 13,947 in 2020, a growth rate of 101.68%. Belgium showed an impressive increase in the number of employees, from 10,454 in 2011 to 13,052 in 2020, with a growth rate of 124.85%.

The evolution of the number of employees in the beverage industry across the EU reflects a dynamic and diverse sector. Significant growth in countries like Germany and Spain demonstrates industry expansion, while the stability observed in countries like Romania and Hungary highlights different approaches and challenges in local markets.

Table 3. Evolution of the Top 10 EU member countries in terms of number of employees in the beverage industry

Rank	Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020/2011 %
1	**Germany**	70,492	70,398	70,354	68,696	68,951	70,107	70,654	82,444	89,115	85,705	121.58
2	**Spain**	47,800	47,051	45,469	44,932	46,697	50,917	51,496	56,862	59,799	58,678	122.76
3	**France**	44,128	51,694	70,440	50,526	58,383	47,338	84,739	51,771	54,378	55,157	124.99
4	**Italy**	35,878	35,768	35,343	37,869	37,345	40,108	41,790	42,882	43,529	41,997	117.06
5	**Poland**	27,048	25,651	24,662	24,568	24,867	23,488	23,522	24,578	26,185	24,950	92.24
6	**Romania**	22,309	20,937	20,565	18,286	18,848	19,950	20,190	21,131	21,941	21,772	97.59
7	**Czech Republic**	15,106	14,898	14,709	14,957	15,301	15,779	16,426	16,986	17,463	17,260	114.26
8	**Portugal**	14,980	14,560	14,481	14,844	15,197	15,235	15,789	16,609	17,535	17,155	114.52
9	**Hungary**	13,716	13,193	13,087	13,189	13,305	12,963	13,130	13,463	14,100	13,947	101.68
10	**Belgium**	10,454	10,125	10,214	9,795	9,827	10,113	10,606	12,384	12,890	13,052	124.85

Source: Eurostat, 2024 [2].

Austria ranks first, with a relatively stable turnover per employee, increasing slightly from 542.8 thousand euros in 2011 to 648.6 thousand euros in 2020. France experienced significant fluctuations, starting at 569.4 thousand euros in 2011 and reaching 530.5 thousand euros in 2020, showing adaptation to market conditions. Belgium maintained a stable turnover per employee, beginning at 460.2 thousand euros in 2011 and reaching 528.9 thousand euros in 2020. The Netherlands recorded an impressive figure, although it decreased from 675.5 thousand euros in 2011 to 519.9 thousand euros in 2020, remaining efficient. Italy maintained a relatively constant level, with a slight decrease from 527.0 thousand euros to 481.8 thousand euros over the period. Sweden and Poland showed stable development, with

Sweden experiencing a slight increase, while Poland recorded a modest rise from 269.2. thousand euros in 2011 to 329.9 thousand euros in 2020. Luxembourg and Germany had relatively stable evolutions, with Luxembourg starting at 350.2 thousand euros and ending at 320.2 thousand euros, and Germany remaining around 300 thousand euros.

Denmark showed variations, starting at 289.6 thousand euros, and reaching 294.6 thousand euros in 2020.

Romania, although still below the EU average, showed a consistent increase from 93.6 thousand euros to 129.4 thousand euros, indicating growth potential.

This analysis highlights the efficiency and adaptability of the EU beverage industry. Austria, France, and Belgium stand out for their high productivity, while Romania shows signs of growth, although it remains below the European average.

Table 4. Evolution of the top 10 EU member countries in terms of turnover per employee in the beverage industry and Romania's position (thousand euros)

Rank	Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020/2011 %
1	**Austria**	542.8	594.1	586.6	607.6	671.4	673.2	674.3	605.8	648.2	648.6	119.49
2	**France**	569.4	515.3	399.2	548.4	512.7	622.1	552.8	634.4	579.3	530.5	93.17
3	**Belgium**	460.2	471.7	470.1	469.5	462.0	516.2	526.0	505.5	588.8	528.9	114.93
4	**Netherlands**	675.5	724.9	737.5	745.0	764.2	731.8	726.4	629.2	578.1	519.9	76.97
5	**Italy**	527.0	478.2	482.1	467.3	493.4	491.7	499.4	508.3	507.8	481.8	91.42
6	**Sweden**	330.9	358.6	351.3	326.3	329.5	331.7	316.3	355.8	349.6	354.8	107.22
7	**Poland**	269.2	289.1	311.1	297.8	307.1	303.6	310.3	337.5	312.2	329.9	122.55
8	**Luxembourg**	350.2	359.0	347.8	348.4	347.8	350.4	351.7	360.8	359.1	320.2	91.43
9	**Germany**	285.4	289.6	288.5	302.9	293.4	301.6	292.1	314.5	291.5	299.5	104.94
10	**Denmark**	289.6	301.3	323.7	318.7	272.0	390.3	307.5	298.9	305.9	294.6	101.73
19	**Romania**	93.6	105.0	105.3	114.9	127.9	127.6	130.1	135.1	135.3	129.4	138.25

Source: Eurostat, 2024 [2].

Austria stands out with a notable growth of 119.49%, indicating increased efficiency. France, with a ratio of 93.17%, shows a slight decline, possibly due to economic challenges or changes in efficiency. Belgium, with a growth of 114.93%, reflects positive dynamics in the beverage sector, suggesting improvements in performance or strategy. The Netherlands, with a ratio of 76.97%, indicates a significant decline, suggesting difficulties or recalibrations in the industry. Italy, with a ratio of 91.42%, shows a moderate decline, possibly due to changes in demand or operational efficiency. Sweden, with 107.22%, highlights moderate growth, suggesting adaptability and sector growth. Poland stands out with an impressive growth of 122.55%, indicating significant expansion or improvement in operational efficiency. Luxembourg registers a slight decline at 91.43%, indicating adjustments or changes in market conditions. Germany, with 104.94%, demonstrates modest growth, suggesting stability or positive development in the sector.

Denmark, with 101.73%, indicates slight growth, suggesting a stable industry.

Romania, with an extraordinary growth of 138.25%, illustrates significant expansion or major improvement in efficiency.

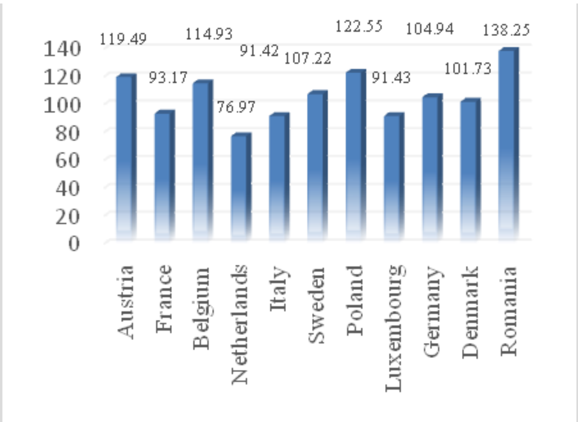

Fig. 1. The evolution from 2011 to 2020 of the top 10 EU member states from the perspective of turnover per employee in the beverage industry and Romania's position (thousand euros)

Source: Own projection based on data provided by Eurostat, 2024 [2].

Malta stands out with exponential growth, increasing from 43.8 to 66.9 employees per enterprise, highlighting an impressive progress of 152.74%. This trend may indicate substantial sector expansion, possibly driven by factors such as favorable economic policies or technological advancements. Poland reflects an opposite dynamic, with a decrease from 55.3 to 34.3 employees per enterprise, a decline of 62.03%. This suggests industry restructuring, possibly in the context of efficiency improvements or adaptation to a changing market. Germany presents relatively moderate fluctuation, decreasing from 34.9 to 32.5 employees per enterprise, a rate of 93.12%. This may indicate a trend of stabilization or optimization in a consolidated sector. Lithuania and Romania, with decreases to 84.99% and 92.42%, respectively, demonstrate gradual adjustments in workforce size, suggesting possible strategic recalibrations or responses to economic conditions. Austria, Belgium, Denmark, Latvia, and Luxembourg illustrate varying degrees of restructuring, ranging from minor modifications to significant changes in workforce structure.

In conclusion, these trends reflect a complex landscape of the beverage industry in Europe, highlighting diverse strategies for adapting to economic, technological, and market changes. It is essential to understand these trends within a broader framework of economic and social developments at the European level.

CONCLUSIONS

The European beverage industry has shown adaptability and continuity from 2011 to 2020. This period presented substantial changes not only in workforce structures but also in market trends and production innovations. Austria and Romania presented an enhanced growth. In contrast, Netherlands encountered notable declines indicating in this way industry recalibrations while Germany and France exhibited moderate fluctuations but even that, has shown a balance between stability and adaptability.

Broadly, the industry's progression emphasizes its dynamic nature and the different strategies employed by EU member states to adapt to changing economic conditions and consumer preferences.

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COMPETITIVENESS OF MOLDOVAN AGRI-FOOD EXPORTS AT THE REGIONAL LEVEL IN THE CONTEXT OF CURRENT CRISES

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Abstract

In the context of current crises, the competitiveness of Moldova's agri-food exports emerges as a primary topic of interest, given that they account for over 50% of the nation's total exports. This study investigates the competitiveness of Moldova's agri-food exports compared to three EU candidate countries - Georgia, Moldova, and Ukraine - and two EU member states - Poland and Romania. Using the Balassa Index, it analyzes the comparative advantages of these nations in the agri-food sector, with particular attention to the sub-categories of food products and vegetables. The results indicate a high competitiveness of Moldova in the exports of food products and vegetables, while the category of animal products shows comparative disadvantages. The study contributes to the literature by highlighting the dynamics of comparative advantages and recommends focusing on the development of the agri-food processing industry to improve the external trade structure. The research emphasizes the need for a strategic approach in adapting and integrating national agricultural and food systems into global value chains to maximize economic benefits in a changing regional and global landscape.

Key words: *export competitiveness, Balassa Index, comparative advantages, economic impacts of regional crises*

INTRODUCTION

International trade serves as a pivotal element in the growth of national economies and in ensuring the equilibrium of domestic markets. It enables countries to export excess agricultural and food products and import those that are scarce or not produced in adequate volumes. Over the past two decades, the volume of agri-food products trade has quadrupled, reaching a staggering 1.66 trillion USD in 2021 [8]. This rapid expansion is primarily attributed to advancements in production and trading operations which have facilitated the creation of global value chains in the agriculture and food sectors. Additionally, the integration of digital technology and increasingly sophisticated uses of artificial intelligence have propelled this growth [19]. According to FAO, a significant part of international trade in agri-food products (about 1/3) is carried out through the global value chain [7]. This is due to factors including the desire for product variety, comparative production costs, seasonality, logistics, and the division of labour in global supply chains. Integrating national agricultural and food systems into global supply chains does not hinder.

Moreover, it supports the growth of the local agro-industrial sector and the export of agricultural and food products. Within this framework, the competitiveness of agri-food exports plays a distinctive and critical role.

In the Republic of Moldova, where agri-food products account for over half of the total exports, assessing their market competitiveness is a key concern.

This assessment gains further importance as Moldova, alongside Ukraine and Georgia, steps into the role of EU candidate countries. Additionally, regional vulnerabilities, exacerbated by the military actions of Russia in Ukraine, heighten the need for a thorough evaluation of foreign trade competitiveness.

The competitiveness of exports, having a complex nature, could be improved in the dimensioning process. Competitiveness can be analysed from two different perspectives. On the one hand, competitiveness can be evaluated at the macroeconomic level and on the other at the microeconomic level, from the exporting companies' perspective. In the first case, the current account surplus of the Balance of Payments indicates the competitiveness of exports, and in the second, the profitability of exporting companies [18]. The competitiveness of exports at the macro level, as in the case of other multidimensional concepts, can be evaluated by employing composite indices [9]. The most widespread is the World Competitiveness Index, developed by the IMD World Competitiveness Centre, which is based on 336 criteria selected from international, regional, and national sources for a relatively small number of 64 countries [15] the Global Sustainable Competitiveness Index (GSCI), calculated by [20] and includes 188 indicators, which are divided into six groups, for 180 economies [20].

Although composite indices cover many indicators, they cannot indicate the competitiveness of agri-food exports, as they are calculated for the entire economy. Another approach is based on the determination of comparative advantages in specific sectors of the economy, which focuses on highlighting the differences between countries in the endowment of production factors, which give them privileges [17].

This methodology determines a country's areas of comparative advantage based on the structure of production, consumption, and foreign trade. Therefore, it is assumed that the comparative advantage for a specific product is manifested in the country's export specialization for this product [5]. Thus, relative advantage will be reflected in a country's foreign trade structure. This method is known in the specialized literature as Balassa's indices [25].

Another approach, Hausman-Klinger, allows the assessment of the "exploitation potential" of a country's unexploited export opportunities [11]. It aims to assess the potential for export growth for those goods for which the analyzed country is not specialized and has no comparative advantage [2].

Constant market shares (CMS) analysis is a technique through which the factors that have a decisive impact on the comparative export performance of an economy are identified [1].

In the specialized literature, a combination of the GTAP quantitative method with the qualitative method, based on Delphi experts, is proposed for evaluating the competitiveness of products. Therefore, combining these methods can enhance the order and comprehensiveness of foreign trade competitiveness [14].

A review of specialized literature reveals that, while the topic of foreign trade competitiveness receives considerable attention, the specific area of agri-food product export competitiveness is not as thoroughly explored. This gap underscores the need for focused research on this subject. Therefore, this study aims to evaluate the competitive standing of agri-food exports among EU candidate countries – Georgia, the Republic of Moldova, and Ukraine, as well as two neighbouring EU member states, Poland, and Romania. This research employs a methodological framework that assesses comparative advantages and seeks to understand their dynamics within these nations.

The objectives of this study are twofold: (1) to assess the comparative advantages of agri-food exports using quantitative methods of analysis; and (2) to perform a benchmarking analysis of these exports among EU candidate countries – Georgia, Moldova, and Ukraine, and EU member countries, Poland, and Romania.

To fulfil these objectives, the methodology involves employing quantitative techniques to evaluate the competitiveness of agri-food product exports. Relevant data for this analysis have been sourced from several international databases, including FAOSTAT [9], ITC [16], WITS [24], World Bank Data [23], and the National Bank of Moldova [6].

MATERIALS AND METHODS

In the conditions of fierce competition, which characterize the contemporary world economy, only trade based on advantages can generate maximum benefits for the world's countries. The development of foreign trade based on comparative advantages is possible only if the parties engaged in the conduct of foreign trade retain the free choice of conditions for mutually beneficial exchange, excluding significant regulations by the state.

The effects of foreign trade can be distorted by state intervention using various trade policy instruments that should be limited and based on considering the country's existing and potential comparative advantages.

Foreign trade, like any economic process, is a stochastic one. Accordingly, the indicators of comparative advantages cannot be static. It is relevant for each country to analyse the dynamics of comparative advantages and elaborate on specific strategies for developing foreign trade.

The research carried out based on the methods of quantitative analysis of the comparative advantages of exports, developed by [3] (the Balassa index), allows the identification of their transformation tendencies and the elucidation of the priorities of foreign commercial policy [3].

The approach based on the determination of B. Balassa's comparative advantages assumes that implicit comparative advantages are directly reflected in trade flows and are manifested in a relatively large share of the product in the structure of exports [4].

The index calculates the ratio of a specific product’s (or group of products’) export share in a country’s total exports to its share in the total global exports of that product.

$$RCA_i = \frac{X_{ij} / \sum_{i=1}^{N} X_{ij}}{X_{iw} / \sum_{i=1}^{N} X_{iw}}, i = 1, ..., N \qquad (1)$$

where:

X_{ij} - the export of the goods ***i*** to country ***j,***

N- the quantity of all goods,

X_{iw} -global export of the commodity ***i.***

If the value of the index is between 0 and 1, it indicates the lack of comparative advantages.

When the index exceeds the value of 1, the persistence of specialization in trade with this product (group of products) is attested, and thus comparative advantages are identified.

The approach based on the determination of B. Balassa's comparative advantages assumes that implicit comparative advantages are directly reflected in trade flows and are manifested in a relatively large share of the product in the structure of exports [4].

As an object of study, Balassa chose the structure of exports of industrial goods, as he considered that they correspond most fully to the comparative advantages existing in countries: its volumes are influenced by both price and non-price factors.

One of this method's most significant advantages is the possibility of assessing the comparative advantages as a coefficient. Another advantage in choosing the Balassa index is its simplicity, which is sufficient to assess the specialization of a country in the export of a specific product or group of products or its absence.

Subsequently, the formula for calculating the Balassa index has been revised and improved several times. In this way, both a product's exports and imports were considered, making it possible to determine the comparative advantage by considering intra-industry trade [10].

J. Hinlupen and C. Marrevik, based on a more extensive statistical database. At the same time, a link was identified between export fluctuations and commodity price changes due to oil crises (70s–80s of the XX century), confirming the feasibility of using his methodology, Balassa [13]. Thus, numerous research studies have elucidated that, despite the different theoretical approaches that justify the need to improve the classic Balassa formula, this index is a valuable tool for analysing the competitiveness of countries' economic sectors.

The Balassa index is mainly recognized as a classic formula for evaluating countries' comparative advantages for a product or product category. Thus, A. Hillman, studying the presence of the correlation of the Balassa index, theoretically substantiated the possibility of using this indicator as an index of comparative advantage of countries [12].

RESULTS AND DISCUSSIONS

Evaluating the competitiveness of agricultural and food products is crucial for Moldova, which saw the agriculture sector contribute 10.6% to its GDP in 2022, with agri-food exports accounting for over 60% of total exports [22][23].

The regional context for Moldova remains challenging. To analyze the competitive

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standing of Moldova's agri-food sector, a comparative study was conducted with three EU candidate countries - Moldova, Ukraine, and Georgia - all aspiring to align their economic frameworks with EU standards, and two neighboring EU nations, Poland and Romania. These countries were selected to benchmark the competitive advantages in agri-food exports over the period from 2011 to 2021, a time characterized by macroeconomic stability that provides clearer insights into evolving economic indicators. The analysis excludes 2022 due to significant disruptions in Moldova's economy and regional instability stemming from the conflict involving Russia and Ukraine.

Figure 1 illustrates the agricultural sector's impact on GDP and its proportion in total exports among the chosen countries. Notably, Moldova and Ukraine contribute 10.63% and 10.39% respectively to their GDPs through agriculture.

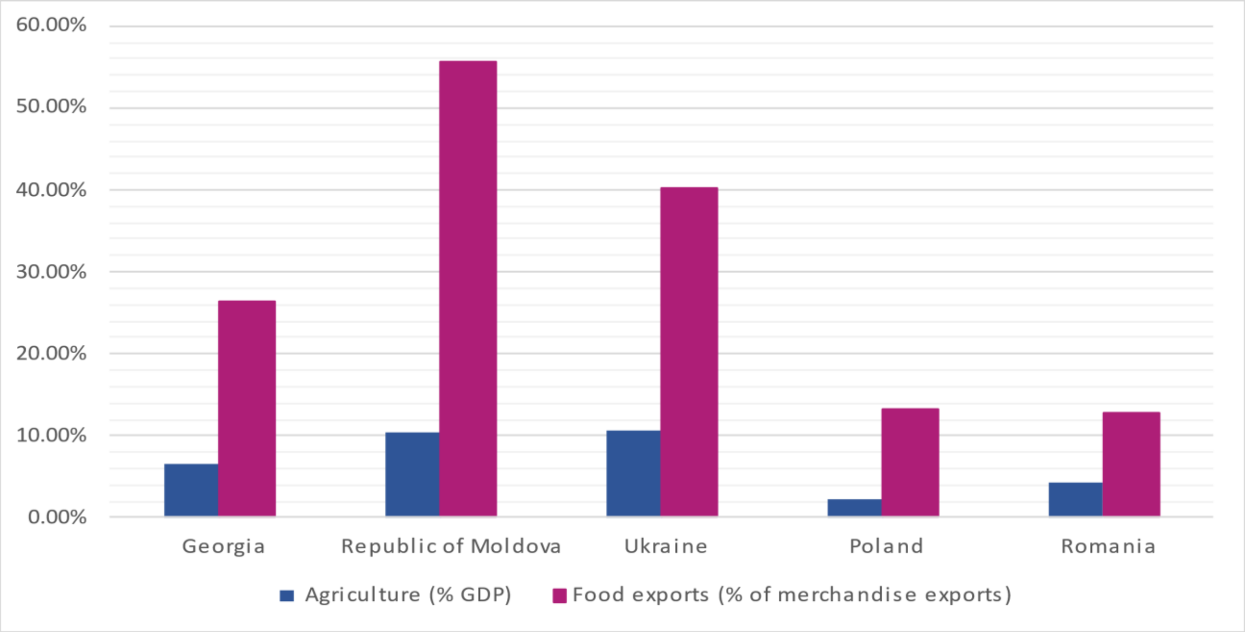

Fig. 1. Agriculture contribution to GDP and food export, 2021
Source: (The World Bank Data, 2021 a,b) [22], [23].

Additionally, the proportion of agri-food exports to total exports is substantial, with Moldova at 55.59%, Ukraine at 40.32%, Georgia at 26.32%, and EU member states Poland and Romania at 13.25% and 12.71%, respectively.

It is noteworthy that in the countries vying for EU membership, the proportion of agri-food products within total exports significantly surpasses this metric in the selected EU member states.

Among these, three countries stand out as key trading partners for the Republic of Moldova.

Specifically, Romania and Ukraine occupy the first and second spots, respectively, with Poland not far behind in fifth place.

In the year 2021, Moldova's agri-food exports included 18 different products to Georgia, 33 to Poland, and 56 to Ukraine, with the number rising to 99 for Romania [6]. As for the most significant value of exports of agri-food products, we can see from Table 1 that in Georgia; these are the group's wine and undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% vol; spirits, liqueurs, and other spirituous beverages (9,348 KUSD and 646 KUSD), in Poland apple juice, concentrated and wine (13,281 KUSD and 10,725 KUSD), in Romania sunflower seed and rape or colza seed (49,787 KUSD and 27,311 KUSD), in Ukraine rape or colza seed and wine (5,710 KUSD and 5,339 KUSD) [9].

Table 1. Agri-food products export of the Republic of Moldova to Georgia, Poland, Romania, and Ukraine to Georgia, Poland, Romania, and Ukraine, K USD

Goods	**Georgia**	**Poland**	**Romania**	**Ukraine**
Apples	0	0	344	0
Apple juice, concentrated	0	13,281	233	1837
Apricots	0	77	392	581
Barley	0	0	9,421	0
Bran of wheat	0	0	2,604	0
Chocolate products nes		1,214	2,941	298
Communion wafers, empty cachets of a kind suitable for pharmaceutical use, sealing wafers, rice paper and similar products.	0	0	619	4
Crude organic material n.e.c.		70	501	318
Food preparations n.e.c.	48	294	2,963	464
Fruit prepared n.e.c.	4	0	1,922	1167
Grapes	0	2,506	8,659	2259
Maize (corn)	0	0	15,967	51
Molasses	0	0	1,553	0
Mustard seed	0	19	2,436	0
Natural honey	0	995	2,356	0
Other fruit n.e.c., dried	425	953	328	629
Other non-alcoholic caloric beverages	162	79	3,204	35
Pastry	255	501	10,260	827
Plums and sloes	0	502	3,404	0
Plums, dried	0	2,494	1,949	849
Prepared nuts	0	0	9,144	0
Rape or colza seed	0	2,330	27,311	5710
Raspberries	0	1,509	0	0
Refined sugar	0	0	7,481	0
Soya bean oil	0	248	904	0
Soya beans	0	0	2,901	0
Sugar confectionery	38	212	907	0
Sunflower seed	37	3,755	49,787	488
Sunflower-seed oil, crude	0	0	12,416	
Sweet corn, prepared or preserved	0	0	1,586	465
Undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% vol; spirits, liqueurs and other spirituous beverages	646	80	808	4,415
Vegetables preserved nes (o/t vinegar)	42	442	1,030	174
Walnuts, shelled	0	0	1,835	0
Wheat	0	0	8,672	171
Wine	9,348	10,725	25,296	5,339

Source: [10].

Before analyzing the competitiveness of agri-food product export, we will determine their share in Moldova compared with Georgia, Romania, Ukraine, and Poland. For a more detailed analysis, we divided the agri-food products category into three subcategories: food product, animal, and vegetable.

From Figure 2, the largest share of food products in total exports is recorded in Georgia and Moldova, weighing 17.51% and 12.98%, respectively; at the opposite pole are Romania and Ukraine (3.72 % and 5.72%).

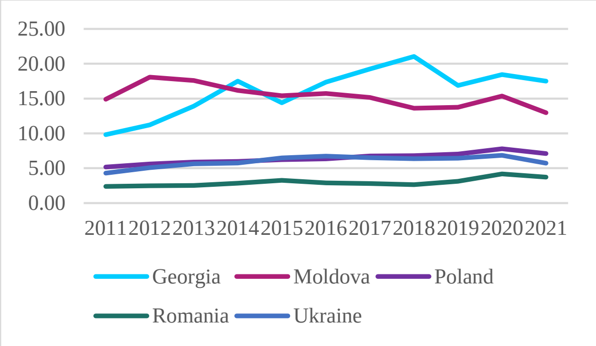

Fig. 2. Moldova Food Products Export Product Share compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

As for animal exports in total exports, this category has a higher share in Poland and Georgia (3.85% and 2.44%) and the lowest in Moldova and Romania (1.17% and 1.37%).
The last more significant vegetable export category is in Ukraine and Moldova, 32.79% and 31.52%, respectively. The lowest shares were recorded in Poland and Romania (2.70% and 7.72%).

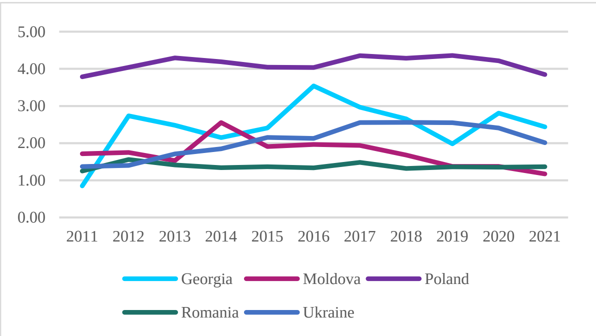

Fig. 3. Moldova Animal Export Product Share compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

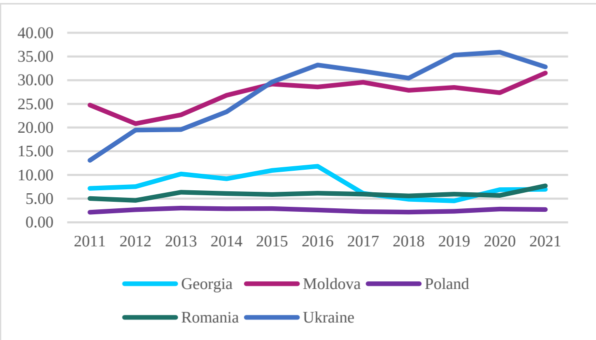

Fig. 4. Moldova Vegetable Export Product Share compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

The last more significant vegetable export category is in Ukraine and Moldova, 32.79% and 31.52%, respectively.
The lowest shares were recorded in Poland and Romania (2.70% and 7.72%)
Another indicator that is important to determine is the growth of subcategories during the analyzed period. Figures 5-7 show the evolution of the three subcategories of agri-food products.

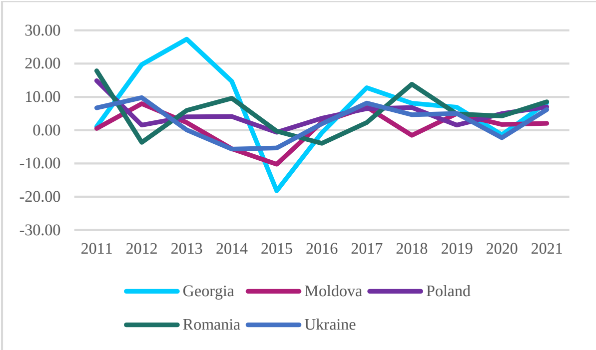

Fig. 5. Moldova Food Products Country Growth compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

CAGR indicates the compound annual growth rate to identify growth dynamics. Its value allows us to estimate the growth rate of the three subcategories, and we will use the CAGR compound yearly growth rate indicator. The CAGR value will permit us to estimate the exponential growth rate of agri-food production.
If we refer to food products, in the period 2011-2021, the CAGR recorded the highest growth in Georgia 13.22%, followed by Poland and Romania (8.81% and 8.18%); in Ukraine and Moldova, the growth was – 2.51% and 2.13%.

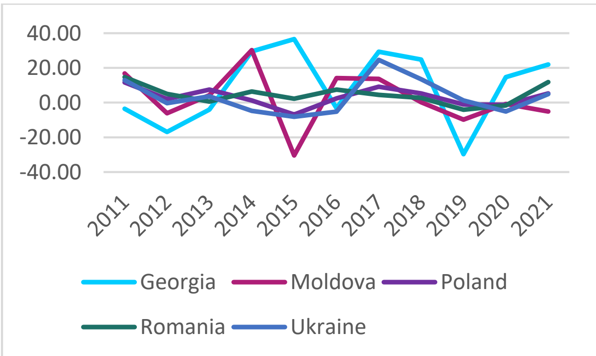

Fig. 6. Moldova Animal Country Growth compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

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In the case of the animal export subcategory, the leader is the same Georgia, CAGR, during the analyzed period, was recorded at the value of 18.74%, by Poland and Romania (5.55% and 4.42%), in Ukraine- 3.53%, and in Moldova the CAGR had a negative value of -0.32%.

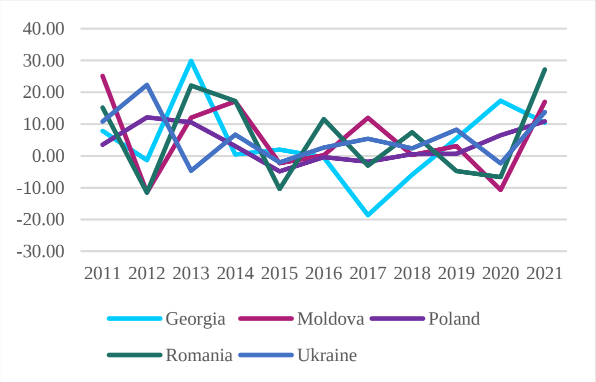

Fig. 7. Moldova Vegetable Country Growth compare with countries Georgia, Romania, Ukraine, Poland
Source: [24].

As for the vegetable category, the compound annual growth rate indicator recorded close values. The most significant increase in vegetable exports was in Ukraine at 9.21%, followed by Romania and Poland (CAGR 7.99% and 7.84% respectively), then Georgia at 6.53% and Moldova at 6.09%.

Moreover, the Export Potential Map specific to the Republic of Moldova identifies that two of the top three products with the highest potential are agri-food items: sunflower seeds, which rank first, and maize, in third position. In Ukraine, the top three products with the most substantial export potential all belong to the agri-food sector: crude oil from sunflower seeds or safflower, maize, and wheat (excluding durum and meslin). In Georgia, wine from fresh grapes holds the fourth position in terms of export potential, while in Romania, sunflower seeds are ranked sixth. As for Poland, an agri-food product appears at 21st place, specifically in the category of food preparations [16].

Furthermore, Table 2 illustrates the development of the Balassa index from 2011 to 2021 across three subcategories of agri-food products, indicating that Georgia shows the highest revealed comparative advantage in the food subcategory, closely followed by the Republic of Moldova.

Table 2. Moldova Agri Food Products Revealed comparative advantage compare with countries Georgia, Romania, Ukraine, Poland

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Moldova Food Products Revealed comparative advantage compare with countries Georgia, Romania, Ukraine, Poland											
Georgia	1.93	3.36	5.23	6.04	4.78	5.37	5.61	6.25	6.83	5.62	5.49
Moldova	4.64	5.45	5.18	4.11	3.72	3.69	3.51	3.04	3.31	3.44	3.11
Poland	2.09	2.22	2.11	2.11	2.15	2.1	2.22	2.32	2.3	2.32	2.41
Romania	0.83	0.84	0.81	0.86	0.94	0.78	0.77	0.89	0.99	1.1	1.15
Ukraine	1.33	1.65	1.76	1.74	1.97	2.09	2.12	2.13	2.24	2.07	1.9
Moldova Animal Revealed comparative advantage compare with countries Georgia, Romania, Ukraine, Poland											
Georgia	0.3	0.26	0.22	0.32	0.75	0.8	1.1	1.65	0.76	0.86	1.07
Moldova	0.81	0.73	0.71	1.03	0.6	0.74	0.79	0.72	0.56	0.57	0.45
Poland	2.3	2.49	2.5	2.27	2.17	2.08	2.3	2.35	2.17	1.98	2
Romania	0.58	0.7	0.6	0.58	0.71	0.73	0.75	0.71	0.65	0.66	0.73
Ukraine	0.66	0.68	0.77	0.75	0.85	0.79	1.05	1.26	1.19	1.07	0.96
Moldova Vegetable Revealed comparative advantage compare with countries Georgia, Romania, Ukraine, Poland											
Georgia	1.61	1.91	3.14	2.76	3.37	3.91	1.98	1.86	2.04	2.25	2.11
Moldova	8.06	6.4	7.41	8.98	9.55	9.32	9.06	9.04	9.76	7.44	8.11
Poland	0.72	0.93	1.02	0.99	0.92	0.85	0.71	0.73	0.74	0.72	0.74
Romania	1.33	1.13	1.48	1.78	1.56	1.78	1.47	1.69	1.6	1.35	1.78
Ukraine	3.67	5.69	5.6	7.03	8.46	9.36	8.4	8.97	10.26	9.03	8.73

Source: [24].

Moldova, Ukraine, and Romania have no competitive advantages in the animal export subcategory. Moreover, Ukraine and Moldova have the most advantage in the last category of vegetables, while Poland has no competitive advantage.

CONCLUSIONS

The Republic of Moldova is a country where agriculture not only contributes to the formation of GDP [21] but also the branch whose products have the largest share in total product exports and with the highest export potential.

In this context, any vulnerability in the region could impact agriculture and the entire national economy in a situation where, in 2021, more than 50% of total exports were agri-food products.

Summarizing the data obtained, we can conclude that the results of the analysis indicate that in the category "Agri-food products," the subcategories vegetables and "food products" have the most significant weight (32.79% and 17.51%). At the same time, the two vegetable products have the most significant export potential. It is also important to recognize that exporting food products entails a greater complexity compared to other agri-food subcategories. Thus, it would be more profitable for Moldova to improve the structure of foreign trade goods in this subcategory, stimulating the development of the agricultural processing industry.

The results obtained highlight the fact that two countries from the group selected for analysis have a significant share of exports of agri-food products (Ukraine - 40.32% and Moldova - 55.59%), at the opposite pole are EU member states (Poland - 13.25%), and Romania 12.71%).

Regarding the revealed comparative advantage, it is clear that the animal product segment does not demonstrate comparative advantages. Conversely, in the vegetable and food product segments, Moldova is positioned second according to the Balassa index values. Considering the unique aspects of Moldova's economy, it is advisable to sustain specific advantages through innovative agricultural practices, along with the judicious utilization of natural resources, constrained labor resources, and effective management strategies.

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ONLINE LEARNING TECHNOLOGIES AND SUSTAINABLE RURAL DEVELOPMENT: AN EUROPEAN PERSPECTIVE

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Abstract

An important factor for local communities is education. Education has a long-term influence on the community development. Education has significant differences between urban and rural regions. The purpose of this study is to analyse how the extent education can reduce these differences and particularly, the online education contribution to the development of rural communities. Also, the economic and social factors relevant for rural development were studied. This study utilized a qualitative analysis of statistical publications, academic literature, and official data from the European Commission and Eurostat. The results showed that online learning technologies provide several benefits for rural development, such as: easy access to knowledge, build new skills, exchange information with peers with similar interests, raising individual awareness of the modern topics like smart agriculture. Additional to the key factors there are challenges posed to the development of the rural communities, from which the digital divide, limited broadband coverage and the ageing of rural population that makes the online education less effective in rural communities. Through this study, it is given a contribution on how to improve the understanding of the role of online learning technologies in a sustainable rural development and to provide insights to various stakeholders, including national and regional authorities, entrepreneurs, educators and researchers.

Key words: *e-learning, online learning technologies, rural development, smart agriculture, sustainability*

INTRODUCTION

The COVID-19 period saw an unprecedented acceleration in the adoption of online learning technologies, both in terms of formal and informal education. Online learning technologies are defined as information and communication technologies (ICT) that use the internet via different devices to support learning activities in formal or informal educational settings. These include a wide range of platforms such as Open and Massive Online Courses (MOOCs), knowledge marketplaces, Learning Management Systems, gamification, online assessment systems, and collaborative platforms such as Zoom, WebEx, Microsoft Teams or Google Meets. These technologies, often synonymous with e-learning, digital learning, and virtual education, have improved access to knowledge by removing geographical and socio-economic barriers. With internet connectivity, online educational resources have become available to wider categories of users and, in many cases, have saved users' time and money. However, the accelerated adoption of these technologies in response to the COVID-19 pandemic has revealed both benefits and disadvantages. As benefits, it can be mentioned:
they provided flexibility, extended access to learning resources or improved communication and motivation. As challenges, it can be mentioned: issues related to digital division, content quality variability and the need for self-discipline among students. It is generally accepted that education is one of the essential elements of sustainable rural development [21]. E-learning technologies have an impact that is visible in both formal and informal education. These technologies can play an important role in upskilling, reskilling, and career change. Remote training and knowledge sharing through online learning technologies can be beneficial for rural regions. The online learning platforms can also promote other innovative approaches ortechnologies such as the Internet of Things (IoT) and help improve practices related to smart agriculture. The integration of IoT and smart agriculture

revolutionizes farming practices, making them more efficient, data-driven, and sustainable.

Courses offered through e-learning platforms can specifically focus on sustainable practices. The topics of these courses can include sustainable agriculture, water conservation techniques, and renewable energy use, directly contributing to sustainable rural development goals.

E-learning platforms can provide rural communities with access to various educational learning resources and courses. This includes specialized training in sustainable farming practices, environmental conservation, and renewable energy technologies. With e-learning, individuals can learn at their own pace and according to their own schedule. This is particularly beneficial in rural areas where residents may have to balance education with agricultural or other work responsibilities. By providing online courses tailored for EU learners current and future needs, the online learning platforms can help individuals to improve their digital skills and competitiveness [25].

The most common definition of sustainable development is given by World Commission on Environment and Development (WCED) and is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[29].

The United Nations (UN) established seventeen Sustainable Development Goals (SDGs**)** [28]**.** Among them, the SDG number 4 ensures access to quality education and promotes lifelong learning. Sustainable rural development, in the context of SDG 4, is essential. Sustainable rural development encompasses a holistic approach, aiming to improve living conditions in rural areas while preserving the environment [28]**.**

In European Union (EU), the SDGs are monitored, and periodically, the European Commission issues an evaluation of them. The SDG 4 monitoring concerns the progress in increasing and improving basic and tertiary education, adult education, and digital skills [13]**.**

Literature Review

In an older study, [20] stated that the "rapid evolution of Information and Communication Technologies (ICT) creates numerous opportunities for agricultural education and training." The authors argued that metadata interoperability is an essential element in achieving information exchange between online databases called learning repositories that store educational resources relevant for agricultural stakeholders. Similarly, in a more recent study, [23] stated that farmers need to acquire new digital skills to keep up with the progresses brought by Agriculture 4.0. Moreover, digital education provides easier ways to acquire new knowledge and skills.

[2] have demonstrated the utility of a plant identification quiz using a learning technology based on Excel spreadsheet quizzes. These sets of quizzes allow students to test their knowledge on the plants that were taught in a live course and to get quick feedback.

[27] conducted a systematic literature review (SLR) to identify dimensions and sub-dimensions relevant to sustainable development in rural territories. They found key sub-dimensions in the sustainability's social, ecological and economic dimensions and these authors suggested relating these to the SDGs for improving rural well-being. Within the social dimension, the author identified education as an important sub-dimension.

[18] examined how frugal innovation contributed to sustainable development in rural areas. The authors investigated how frugal enterprises contributed to specific SDGs and discussed implications for future research. [22] discussed the role of building rehabilitation in sustainable development and territorial cohesion in rural Europe. They emphasized the importance of heritage preservation and vernacular construction in rural settlements. [19] investigated the disappearing components of cultural heritage in rural areas of Poland. They proposed ways to utilize these components for regional development and to promote rural cultural heritage. [24] developed spatial farm models to assess agricultural development potential and defined farm types for multifunctional rural development in Poland.

[31] assessed the sustainable development of rural areas in Poland since its entry into the European Union. They used 38 indicators covering environmental, social, and economic aspects, identifying progress and challenges in rural sustainability.

[30] examined sustainable rural tourism in Poland, focusing on environmental sustainability and pro-environmental behavior. They identified sustainable development postulates being implemented in rural tourism and emphasized the protection of natural and cultural resources.

[6] investigated the role of social, economic and cultural aspects in the sustainable development of rural tourism in Romania (the Gurghiului Valley). They emphasized the importance of local entrepreneurs and the capitalization of natural and anthropic tourism heritage. [1] explored the potential of cultural tourism for sustainable rural development in Hărman Commune, Romania. They highlighted the importance of capitalizing on local cultural heritage to enhance local development and sustainability.

[3] explored the role of intangible cultural heritage (ICH) in sustainable tourism development in rural areas. They analyzed the "Marche Food and Wine Memories" project in Italy, emphasizing the need for local community involvement and networking with local businesses. [26] examined the impact of mining on local governance and sustainable development in a Swedish municipality. The study revealed a conflict between ideas of sustainable development and sacrifice, shaping local political stances on mining.

[21] examined the sustainable development in rural areas for five European Union (EU) countries (Germany, the Netherlands, Poland, Bulgaria and Romania). The authors argued that education is an essential condition for rural development while ensuring the required infrastructure. Moreover, they shown that the share of educated people in the analyzed countries has decreased. [7] analyzed the impact of food procurement on the economy of the rural areas. The authors asserted that high volume of food supply contracts associated with the requirements of sustainable procurement seem to be opportunities of development for enterprises from the rural areas. In a subsequent study, the same authors argued that public organizations have a substantial contribution to the development of sustainable agriculture and to achieving the sustainable development objectives in the food sector [8].

The list of studies reviewed above suggest that rural development is a multidimensional concept and besides agriculture, other activities such as rural tourism, development of rural businesses, preserving local heritage represents relevant topics in academic research.

In this context, the objective of this research is to explore the impact of online learning technologies in ensuring a sustainable rural development in Europe. Particularly, the study is looking into how the online learning technologies influence economic sustainability and activity diversification in European rural areas. In the current research, the authors have performed a literature review and document analysis.

In this paper, the following research questions are explored:

RQ1: To what extent do online learning technologies help promote sustainable rural development in a European context?

RQ2: How do online learning technologies influence economic sustainability and activity diversification in European rural areas?

The novelty of this paper lies in the analysis of the relevant socio-demographic indicators with an aim to identify the ways to increase the online learning adoption in Rural Europe.

This paper is organized as follows. The next section includes a description of the materials and methods used in this study and a literature review of the existing research regarding e-learning technologies and sustainable rural development. The paper continues with a general discussion of the results and their implications. Next, the paper presents the conclusions of the research and it concludes with the limitations and possible further researches.

MATERIALS AND METHODS

Document analysis

A significant number of EU official publications and websites have been reviewed in order to extract and compare relevant statistical data and themes for the current study.

Literature Review

The authors have performed an analysis of academic studies, journal articles, reviews and research reports that were published in academic journals indexed in major databases such as Web of Science, Scopus, Science Direct or Google Scholar, published in the past 15 years.

Data sources

In the current research, the public data sources from European Commission and Eurostat have been used. Specifically, the following official publications have been reviewed:

-Eurostat - Statistics Explained (including details regarding internet connection, devices used to connect to internet and the typologies of activities done via internet) and

-European Commissions' Rural Vision.

Scientific methods used to process the information have been as follows:

The authors have adopted mainly a qualitative approach, using various artefacts for comparative and content analysis. The objective was to extract relevant themes and context information for the researched topic.

RESULTS AND DISCUSSIONS

Eurostat territorial typologies

European statistics recognizes three typologies: grid, regional, and local.

Grid typologies are detailed statistics that differentiate three types: urban centers, urban clusters, and rural grid cells.

Regional typologies: under this category, there are metropolitan typologies that differentiate between metropolitan and non-metropolitan areas, and urban–rural typologies, which include a) predominantly rural regions, b)intermediate regions, and c)primarily urban regions.

Local typologies include the degree of urbanization criterion. Based on this, it can be differentiated into the following: a) cities, b)towns and suburbs, and c)rural areas. These entities will be used in the current analysis. The next level of granularity on this criterion (the second classification level) differentiates among cities, towns, suburbs, villages, dispersed rural areas, and mostly uninhabited areas [17].

Socio-demographic and economic and perspectives of rural development in EU

According with official statistics (European Commission, n.d.-a), the population from EU's rural areas represent 30.6% of the EU's total population. Furthermore, the lowest percentage of individuals with ages below 50 are in rural and remote areas. What is more, the percentage of population at risk of poverty and social exclusion is larger in rural regions comparing with urban areas. In rural areas, based on the data from 2019, there is an employment gap between men and women of 13% [11].

In 2018, in rural regions, the GDP per capita was only 75% of the EU's average, as illustrated in the Figure 1 below.

Furthermore, the GDP per capita in intermediate regions was 88% of the EU-27 average while in urban regions; this indicator reached 125% of EU-27 average.

This may suggest a common economic divide between urban and rural, with rural regions falling behind the EU average. The rural regions may rely more heavily on agriculture activities or may have lower levels of industrial or service sector activities.

These disparities may have implications on economic policies that may be needed to address the disparities between urban and rural and to ensure a more balanced economic and social development between these regions.

Besides GDP per capita, other indicators may be relevant to describe the economic development such as employment rates, income distribution, and access to various services such as healthcare, education or banking.

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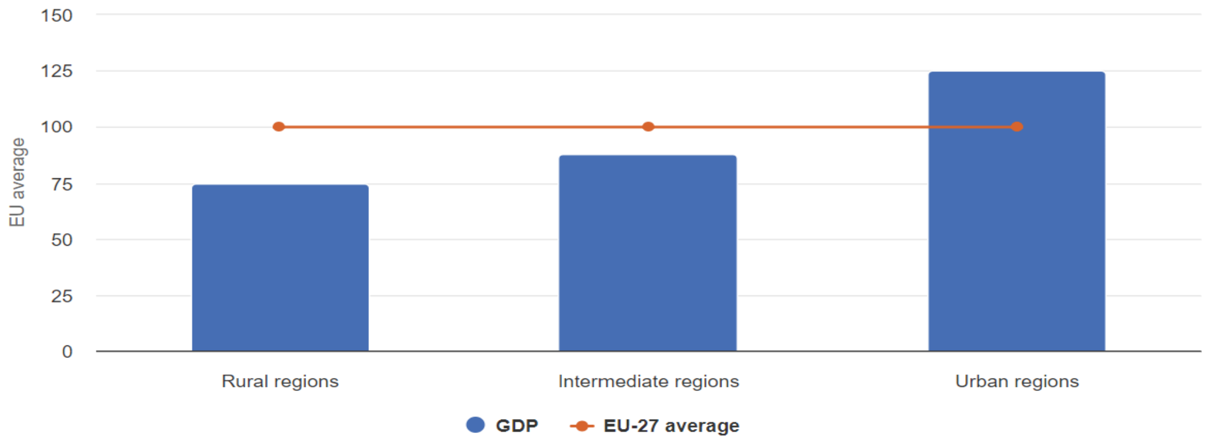

Fig. 1. GDP per capita, 2018, (percentage from the EU average).
Source: [12].

Internet connectivity is a major factor in the adoption of online learning technologies. The percentage of households in Rural Europe that are connected to broadband internet has evolved in the last decade. Table 1 illustrates this evoluti

Table 1. Percentage of households with an internet connection by connection type and degree of urbanisation in EU, between 2012–2021

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fixed broadband	54	60	60	62	64	66	67	67	69	70
Mobile broadband	16	22	28	33	39	41	47	51	56	56

Source: [14].

Both fixed and mobile connections among rural households have consistently increased since 2012 with the fixed broadband having a more gradual and steady growth. The percentages of households that adopted the mobile broadband more than tripled, increasing from 16% in 2012 to 56% in 2021.
After 2020, it can be seen that the mobile broadband coverage remained the same, indicating a possible stagnation.
The broadband internet connection allows accessing a wide range of resources including video and audio files, typically used in asynchronous online learning.
New technologies have emerged that allow internet connectivity on remote regions such as internet via satellites (such as Starlink that provides internet access services also in EU countries).
Furthermore, the share of people (16 – 74 years) accessing internet on a daily basis reached 80% at EU level in 2021, with a higher percentage in cities (84.4%) and towns and suburbs(80.6%) and a lower percentage in rural areas (73.82%). It is important to mention that the gap between urban and rural areas has narrowed gradually, reaching only 10% in 2021 [15].
Among the devices that are used most frequently by Europeans from rural areas to access the internet, the mobile phone or smartphone is the preferred device, regardless of the localization (rural areas, towns and suburbs or cities).
This suggests that this device is the primary mean to internet access to most individuals. Next preferred devices are the laptops and desktop computers and, on the last place was the tablet as illustrated in the Table 2.
For online learning utilizations, the best suited devices seems to be laptops and desktop computers due to larger display surfaces that facilitates the reading of e-textbooks and the consumption of videos as learning materials.
Smartphone and tablets might be used by learners for quizzes, various surveys, audiobooks and audio-recorded materials.

Table 2. Percentage of population (16–74 years old) accessing the internet, based on the types of devices and degree of urbanisation in EU, 2021

Device Type	Cities	Towns and Suburbs	Rural areas
Mobile phone or smartphone	85	81	76
Laptop	58	49	47
Desktop computer	36	34	31
Tablet	33	29	25
Other mobile device (1)	29	26	20

(1) Smart TV, smart speakers, games console, e-book reader or smart watch.
Source: [15].

According with the recent statistics [16], the activities for which the internet is used most often in EU are: sending and receiving emails (69%), instant messaging (63%), finding information on goods/services (61%), telephone or video calls (58%), reading online news (58%), internet banking (52%). There is another category of activities with a lower representation: doing an online course (13%), civic or political participation (14%), selling goods or services (16%), job search (10%). These were illustrated in the Figure 2 below. As it can be seen in Figure 2, the activities related to online learning attract a relatively smaller percentage of individuals from both urban and rural areas. In cities, on average 23% of individuals (17- 74 years) have used internet for online course, in towns and suburbs there was 17% and in rural areas only 13% of individuals did an online course. The lower usage across all categories in rural regions comparing with cities and towns suggests a digital divide that may have various causes. The low adoption of online courses in rural areas may suggests potential barriers such as low awareness, limited content in local language, or a lower level of digital skills.

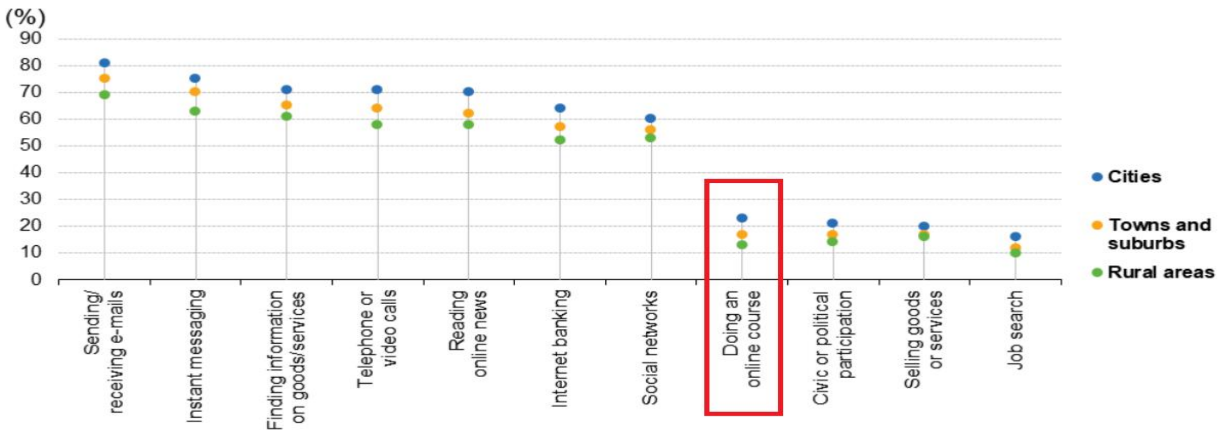

Fig. 2. Percentage of individuals (16–74 years) using the internet for various activities by degree of urbanisation, EU, 2021.
Source: [16].

Multilingualism and language literacy in EU

Currently, in EU there are 24 official languages [10]. Official statistics from EU from 2016 has shown that 35.4% of the adults on working age (25–64- year-olds) declared that they did not know any foreign languages. Table 3 below shows the percentage of working-age individuals that knew one or more foreign languages [10]. As it can be seen from the official data, covering nine years (2007 – 2016), there was a general trend toward learning languages between 2007-2011. Between 2011 and 2016, there was an increase in the percentage of individuals in the category "No foreign language" and a decrease in the categories "Two foreign languages" and "Three or more foreign languages".

Table 3. The percentage of individuals aged 25–64 based on the foreign languages knowledge in 2007, 2011 and 2016 in EU

Years	No foreign language	One foreign language	Two foreign languages	Three or more foreign languages
2007	37.0	38.4	17.7	7
2011	34.3	35.4	21.3	9.1
2016	35.4	35.2	21.0	8.4

Source: [10].

Speaking a foreign language helps individuals to be more competitive on the labour market and may improve workforce mobility.

The potential of online learning platforms and their offerings

ClassCentral.com – an online aggregator of offerings on online courses- has listed 204 courses on the topics related to agriculture delivered by various online learning platforms. Furthermore, on the topics related to tourism, 197 courses are returned and, for searches on topics related to sustainability, the aggregator displayed 662 online courses [4]. The following examples have been presented below in order to give an indication regarding the possibilities offered by a few of the online learning platforms.

Online courses from Coursera.org

Coursera–one of the largest learning platforms- has a wide range of relevant offerings [5]. Our search with the string “Agriculture” has returned 92 results. Furthermore, the platform returns 247 results on the search related to “sustainable development” string. See the Table 4 for a few examples of courses and their enrollment levels.

Table 4. Examples of courses from online learning platform Coursera

Course Name	Educational Institution	Language	Number of enrolled learners
Sustainable Agricultural Land Management	University of Florida	English / 19	40,483
Agriculture, Economics and Nature	University of Western Australia	English / 19	44,971
Discover Best Practice Farming for a Sustainable 2050	University of Western Australia	English / 19	38,623
Transformation of the Global Food System	University of Copenhagen	English / 19	23,454

Source: [5].

Most of the courses above are offered in English however, the platform has translated the content of these courses in more than 19 languages.

Online courses from EdX.org

EdX [9], another global online learning platform offers a significant number of online classes on agriculture related topics. Our search with the string “Agriculture” has returned 73 courses. In addition, the platform returns 202 results on our related to “sustainable development”.

Table 5 presents for a few examples of such courses on online learning platform and their enrollment levels.

Table 5. Examples of courses from online learning platform EdX

Course Name	Educational Institution	Language	Number of enrolled learners
e-Learning on Digital Agriculture	The World Bank Group	English	13,438
Understanding Agribusiness, Value Chains, and Consumers in Global Food Systems	University of Adelaide	English	22,276
Drainage in Agriculture: controlling water and salt levels in the soil	University of Wageningen	English	7,808
WageningenX: Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	University of Wageningen	English	17,307

Source: [9].

The availability of the courses and their enrollment levels presented in Table 5 may vary depending on the time of the search on the platform.

The majority of the courses from the global learning platforms such as EdX, Coursera, FutureLearn are delivered in English language.

However, a substantial number of such courses benefit from translation in multiple languages. The above examples demonstrate the global reach and impact of these online learning platforms. The number of the courses delivered online will continue to grow year by year as shown in the official reports of these platforms. The learners from rural regions may find a substantial benefit and opportunities in attending relevant courses from these platforms in order to upskill, reskill or even change the job.

Rural Europe can benefit from a wider adoption of online education, both formal and informal as long as the basic conditions (internet adoption, availability of the devices and existence of basic digital skills and language literacy) are met. Online learning platforms have recorded substantial growth in terms of adoption of new learners and the development of their offerings. Top educational institutions around the globe have developed high quality online courses with a global audience that are delivered via internet in both synchronous and asynchronous format.

Challenges and opportunities

The availability of the computers or mobile devices, digital literacy and internet connectivity are pre-requisites for adopting online learning.

Lack of basic education and digital skills among rural inhabitants are also other barriers in adopting online learning technologies.

Another blocker is the availability of internet connectivity in the region at an acceptable price. Another barrier in adopting online learning in rural region is represented by the accessibility of these courses. The associated costs and the required language skills (English) may decrease the accessibility. The translations whenever available will increase the impact among learners and will help on the course comprehension. As EU is composed of a multitude of languages, besides a good internet connectivity, the delivering of the course in the local language may represent a substantial factor in adopting online learning.

Another point to consider is tailoring the course content for mobile learning. The mobile phones and tablets seems to be pervasive and many online learning platforms offer mobile applications as an alternative to accessing their web site. Accessing the courses via mobile devices will help the learners from rural areas to access their course content much easier.

CONCLUSIONS

The socio-demographic and economic indicators of rural developments presented in this study have shown significant differences between urban and rural areas. More than 30% of the EU population lives in rural regions. These regions face significant challenges, including:

-a higher percentage of the population at risk of poverty and social exclusion;

- an employment gap between men and women;

- a lower GDP per capita compared to the EU average.

Despite this, there is a positive trend in internet connectivity adoption among the EU's rural households.

Smartphones and mobile broadband internet connectivity are the preferred ways for rural inhabitants to connect to the internet. The pervasiveness of mobile devices and broadband internet connectivity are factors that can positively influence the adoption of online learning technologies.

Despite the good adoption of other internet activities such as sending emails, instant messages, internet searches, using social networks, or making telephone/video calls, the use of online courses remains relatively low in rural areas (13% of individuals). This may suggest a digital divide and potential barriers such as limited content in local languages or lower digital skills.

Another challenge is revealed by the fact that a significant share of the EU individuals at working age do not know any foreign languages. This has implications for labour market competitiveness and workforce mobility.

The examples provided, indicating the availability of online courses related to relevant topics such as agriculture, tourism, and sustainability, suggest the potential of online learning platforms to contribute to rural development.

Study Limitations and Further Research

The current research has considered only a limited number of online learning technologies, namely MOOC platforms. There is a wide range of online learning technologies that have the potential to help individuals from rural areas to gain access to quality learning content from anywhere in the world via an internet connection that deserves a closer attention. The EU Member states have recorded different levels of progress in adopting online learning technologies. The current study did not looked closely at these differences among European countries and these differences may influence the strategies to increase the share of online learning in Rural Europe. In addition to this, due to the extensive scope of the online learning technologies and sustainable rural development as well as the limitation on the number of pages, this paper could only provide an overview of the topic as opposed to a deep investigation.

Further researches may focus on the specific types of education such as formal education or lifelong learning as these may have different underlying motivations to access an online learning course.

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THE APPLICABILITY OF FARMS IN ROMANIA REGARDING THE ECO-SCHEME "PD-04 ENVIRONMENTALLY BENEFICIAL PRACTICES APPLICABLE IN ARABLE LAND"

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Abstract

"European Green Architecture" refers to the implementation of sustainable agriculture that provides sufficient food and ecosystem services for both present and future generations. The conditions contained in eco-scheme PD-04 "Environmentally friendly practices for arable land" refer to the introduction of agricultural practices that have a positive impact on the environment and are aimed at farms with an area of more than 10.01 ha. The data was provided by the Agency for Payments and Interventions in Agriculture in Romania. The method of analysis was the comparative method, as well as the analysis of the structure of the cultivated and non-cultivated areas, the average for each county of Romania, the situation of the structure of the crops and the presence of nitrogen-fixing crops and protein crops, relevant indicators for the farms that applied for the PD-0 eco-scheme. The results of the analysis show that in 2023, the number of farms in Romania that have applied for the PD-04 eco-scheme is 46,608, with a total area of 5,789,746.35 ha, of which 2,934 were declared as uncultivated land, corresponding to 26,829.82 ha. According to the general agronomic rules, the crop rotation for field crops aims at an optimal crop structure as follows: 25% cereal straw, 25% maize, 25% legumes (soybeans, peas, beans, etc.) and sunflowers, 25% forage crops (alfalfa, clover, peas, etc.) necessary to increase soil fertilization. The paper presents the culture preferences of Romanian farmers in the year 2023, regarding the implementation of the eco-scheme PD-04 "Environmentally beneficial practices applicable to arable land".

Key words: *eco-scheme, Romanian farms, crops, beneficial agricultural practices*

INTRODUCTION

The environmental objectives proposed by the current "European green architecture" [4] under the CAP are based on different instruments, such as payments for disadvantaged areas which had a compensatory function and were intended to limit the abandonment of agricultural land [5]; agri-environment and climate measures (AECS). In the last programming period [11], there were cross-compliance measures as well as direct payments from the first pillar and rural development projects from the second pillar "in line with the EU's wider environmental and climate objectives" [3] because climate change has a negative impact on our planet [6].

As far as eco-schemes are concerned, their number varies from 3 to 21, depending on how each country chooses and the implementation systems differ considerably: there may be several eco-schemes or mutually exclusive eco-schemes, or there may be a single measure with multiple requirements [13]. Eco-schemes can refer to permanent crops (which can be seen in Spain), afforestation (which can be seen in Ireland), pasture (which can be seen in Spain), livestock (which can be seen in Bulgaria or the Netherlands [8]) and more. The specifics of eco-schemes vary widely according to their primary objectives, such as conserving unproductive arable land, maintaining vegetation cover, or implementing water-saving irrigation systems [18]. However, the level of farmer enrolment in voluntary schemes and full adoption of organic practices "when compensation for such schemes does not fully compensate for lost income and costs incurred" is low [2]. However, the studies carried out in Romania highlighted that the farmers, regardless of the size of their farms, cannot survive without subsidies, especially in years with difficult conditions [12,16,17], and the increase in profitability at the farm level is supported by optimal employment [14], especially in conditions of imbalances on the market of agricultural products [12].

The conditions outlined in the PD-04 eco-scheme “Environmentally Beneficial Practices Applicable to Arable Land” pertain to introducing agricultural practices that positively impact the environment on farms receiving this subsidy. These conditions encompass both general and mandatory requirements, as well as specific and optional ones [15].

The first mandatory condition involves setting aside uncultivated areas within farms, expressed as a percentage of the total arable land. Starting in 2024, non-productive elements (uncultivated land) must constitute 5% of the operational area. Non-productive elements (uncultivated land) will have to be allocated 5% of the existing area in operation, a measure that will be applied starting in 2024. Another measure within the eco-scheme concerns the introduction of protein crops at a rate of 10% of the area in 2023 and 5% in 2024. The protein crops that can be cultivated include soybeans, pea for consumption or forage pea, vetch, sainfoin, clover, phacelia, beans, cowpea, birdsfoot trefoil, chickpea, lupine, lentil, field beans, alfalfa, peanuts, the mixture of grain legumes and perennial grasses. Another mandatory condition is to maintain soil cover throughout the agricultural year, including the period from June 15 to October 15. This requires covering 85% of the surface with either crops, stubble left after harvesting, secondary crops, green cover crops, or newly established autumn crops after harvesting the main crop.

The eco-scheme “Environmentally Beneficial Practices Applicable to Arable Land” is intended for farms larger than 10.01 hectares, which can receive an annual payment for their arable land, provided they meet certain specific conditions in addition to the general ones mentioned above. One specific condition is crop diversification. Farms with areas between 10.01 and 30 hectares must cultivate at least 2 different crops, with the main crop not exceeding 75% of the total area (the diversification period is from May to September). Farms larger than 30 hectares must diversify with at least 3 crops, with the main crop not exceeding 70% of the area and the other two combined not exceeding 85% of the area [8]. Among the specific conditions outlined, crops from various genera as defined in botanical classifications, along with crops from the *Brassicaceae*, *Solanaceae*, and *Cucurbitaceae* families, as well as fallow land or land cultivated with grasses or other herbaceous fodder, are considered main crops.

Additionally, conservation agriculture practices must be applied to 50% of the arable surface. These practices include no-tillage, strip-tillage, or minimum tillage (no-minimum-strip tillage). No-tillage involves sowing without prior soil preparation, strip tillage entails sowing in prepared strips without intervening in the space between rows, and minimum tillage refers to sowing after superficial soil preparation without turning the furrow.

Furthermore, farms eligible for this subsidy have the option to plant 2 trees per hectare from a selection of species, including apple, peach, plum, cherry plum, apricot, cherry, sour cherry, quince, walnut, oak, elm, linden, hazel, acacia, honey locust, sycamore maple, maple, field maple, pine, little willow, chestnut, and others.

In this context, the purpose of the paper is to analyze the crop preferences of Romanian farmers in 2023, regarding the implementation of the PD-04 eco-scheme “Environmentally beneficial practices applicable to arable land”.

MATERIALS AND METHODS

The paper presents, based on the APIA payment requests for 2023, the situation of the farms that applied for this measure and the conditions selected by these to fulfill its legislative requirements.

The research includes a vast bibliographic and legislative base that completes the analysis carried out.

RESULTS AND DISCUSSIONS

The PD-04 eco-scheme “Environmentally beneficial practices applicable to arable land” has been implemented in Romania since 2023, as set out in the Regulation (EU) 2115/2021 [9].

This scheme covers an eligible area of 5,750,000 hectares of arable land in Romania, owned by farms of specified sizes engaged in semi-intensive or intensive conventional agriculture [1]. The main aim of the annual payment proposed under this eco-scheme is to partially compensate for the loss of income due to the additional costs associated with meeting the general, mandatory, and specific conditions. Additionally, farmers seeking eligibility for the eco-scheme must fully adhere to the standards concerning good agricultural and environmental practices outlined in the Basic Income Support for Sustainability (BISS), respectively in the conditionality rules [10].

In 2023, according to the Payment Requests received by APIA, there were 46,608 farms [1] throughout the country that opted for the PD-04 eco-scheme “Environmentally beneficial practices applicable to arable land”.

The number of farms that applied for the eco-scheme PD-4 is shown in Figure 1.

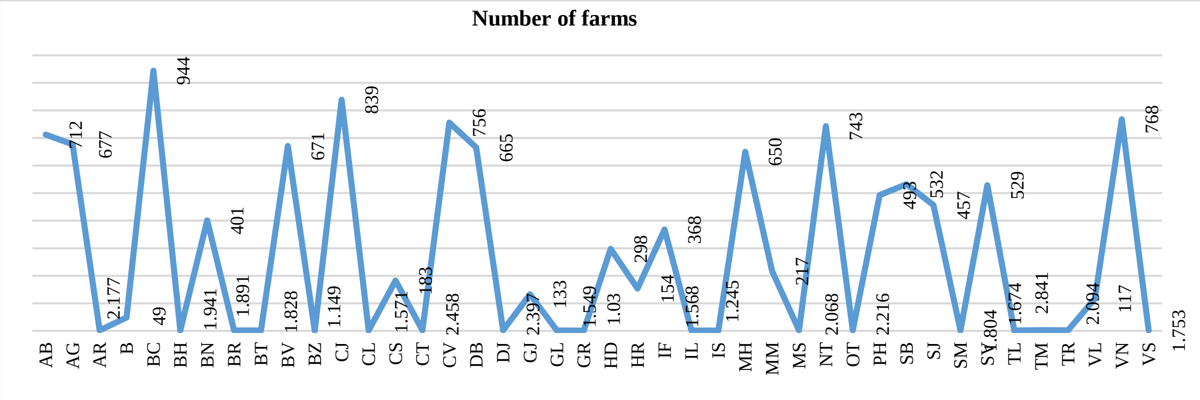

Fig. 1. Number of farms that applied for the eco-scheme PD-04 in the counties of Romania,
Source: [1].

The country that requested suport for the implementation of the aforementioned eco-scheme amounted had an area of 5,789,746.35 hectares. The specific arable land area for which the granting of the subsidy was taken into account, for each county, is presented in Figure 2.

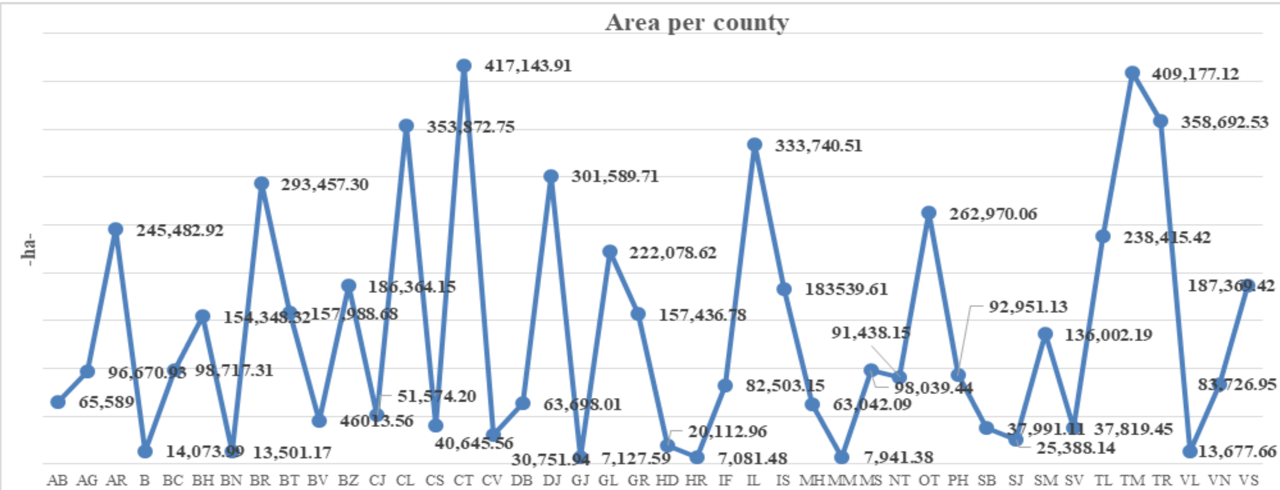

Fig. 2. Area per county under the eco-scheme, PD-04,
Source: [1].

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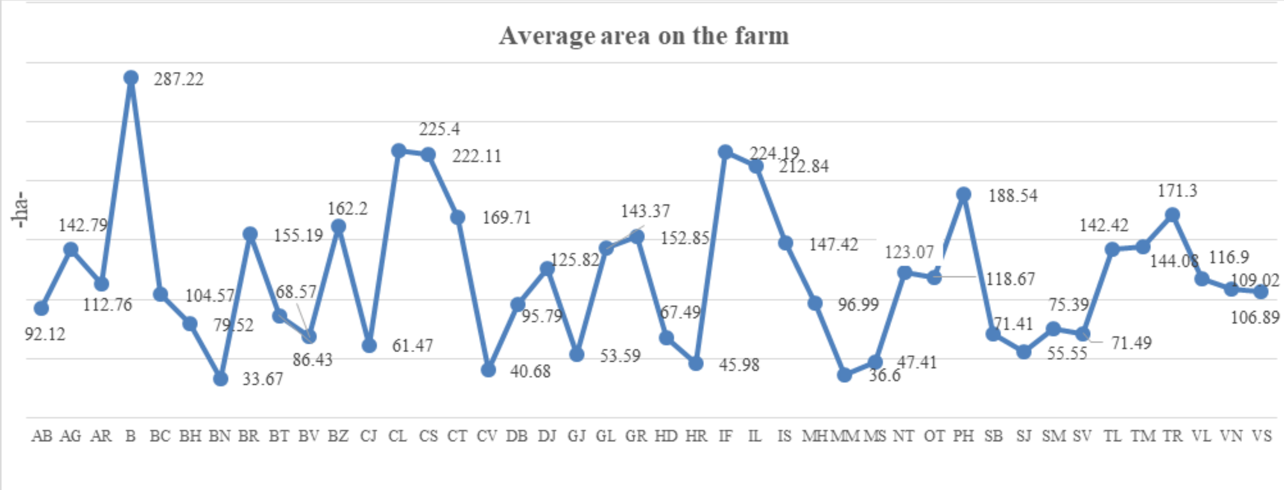

Fig. 3. Average area on the farm by county,
Source: [1].

The analysis of the average area per farm in each county showed that it ranged between 33.67 ha and 287.22 ha.
The average area per farm under the eco-scheme PD-04 is presented in Fig. 3.
Under the derogation provided for in the Commission Implementing Regulation (EU) 2023/1317, farmers are required, in the application year 2023, to declare the areas of arable land allocated to non-productive elements, including areas of land left uncultivated. Areas of land left uncultivated can be used for crops intended for food production, such as cereals, legumes, oilseeds, and protein crops, except for maize and soybean crops for grains [1]. In Romania, 2,934 farms were declared uncultivated areas, representing 26,829.82 ha throughout Romania.
Farmers who access this eco-scheme are required to keep the arable land covered between 15 June and 15 October on at least 85% of the farm's arable area, with crops or stubble left after harvesting, secondary crops, green cover crops or newly established autumn crops, the time required for the preparation of the land and the establishment of the new crop is no more than two weeks, a period that will be entered in the records of agricultural works at the farm level [1].
In Figure 4, it is presented the number of farms with uncultivated area.

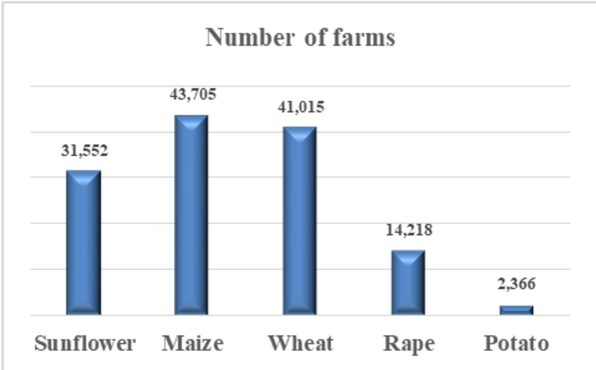

Fig. 4. Number of farms with uncultivated area declared by county,
Source: [1].

Cereals are essential for human nutrition [7]. **Regarding the wheat crop**, the farmers chose: winter common wheat, spring common wheat, spelt, winter durum wheat, and spring durum wheat. There were 41,015 farms that had wheat in the crop plan, with a cultivated area of 1,558,146.06 ha (Fig. 5).
Maize was found in APIA payment requests from 43,707 farms, in the form of maize, silage maize, sweet maize, hybrid maize, semi-late variety, feed maize, hybrid maize, early variety, hybrid maize, semi-early variety. The total area with maize, which was mentioned by farmers countrywide was 1,266,096.33 ha (Fig. 5).
Rapeseed crops were included in the APIA payment requests submitted by 14,218 farms participating in the PD-04 eco-scheme. These requests encompassed autumn rapeseed, spring rapeseed, as well as rapeseed with

mustard, with farmers specifying a total area of 742,454.50 hectares for this crop (Fig. 5).

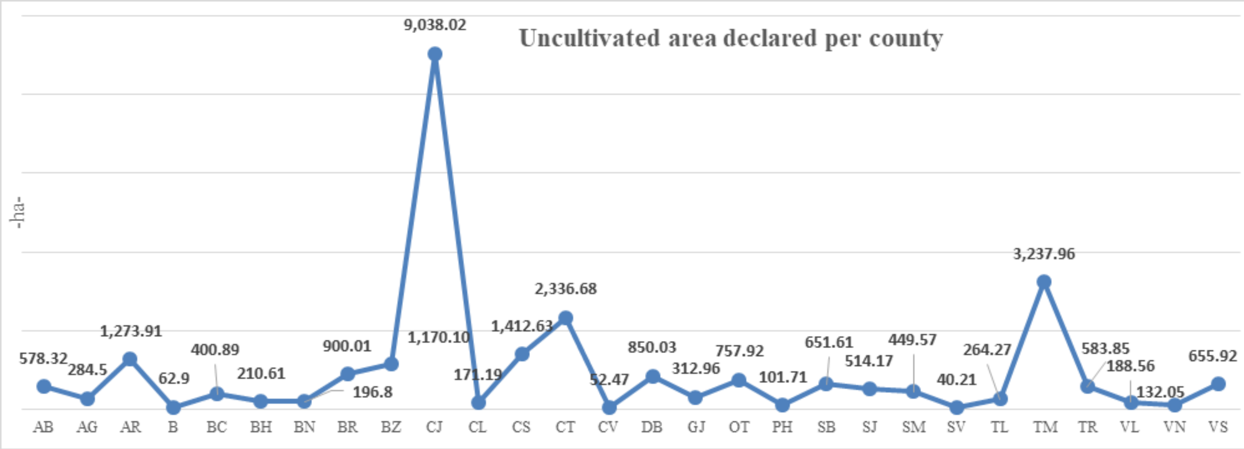

Fig. 5. The number of farms cultivating wheat, maize, rapeseed crop, sunflower, potato
Source: [1].

Sunflower cultivation was reported in APIA payment requests submitted by 31,552 farmers participating in the PD-04 eco-scheme encompassing the following crops: sunflower, sunflower hybrid-semi-early variety, sunflower hybrid-early variety, hybrid sunflower-late variety, hybrid sunflower-semi-late variety.

The mentioned area for this crop in Romania was 833,119.45 ha (Fig. 5).

As far as potato is concerned, 2,366 farmers that requested support based on the PD-04 eco-scheme opted for this crop, in the form of early potato crops (including semi-early and summer potatoes), late season potatoes, seed potatoes as well as other potato crops. The mentioned area for this crop, countrywide, was 19,870.39 ha (Fig. 5).

Under the derogation provided for in the Commission Implementing Regulation (EU) 2023/1.317, in the year of application 2023, farmers were required to grow on at least 10% of the total arable land declared as the main and/or secondary crop, leguminous crops, nitrogen fixers, mixtures of legumes and perennial grasses, provided for in the annex no. 12 to the MADR Order no. 80/2023, with subsequent amendments and additions, without restrictions on the use of plant protection products, except for substances declared to meet option b) of GAEC 8 [7].

Protein crops mentioned to be grown within the PD-04 eco-scheme “Environmentally beneficial practices applicable to arable land” were: soybean, pea for consumption or forage pea, vetch, sainfoin, clover, phacelia, beans, cowpea, birdsfoot trefoil, chickpea, lupine, lentil, field beans, alfalfa, peanuts, the mixture of grain legumes and perennial grasses.

Regarding soybean, this crop was specified by 6,126 farmers who mentioned the following soybean varieties: soybean, semi-late variety, soybean, late variety, soybean, semi-early variety, soybean, early variety, soybean for seed (soybean seed lot), soybean (certified seed) or soybean (mixed with perennial grasses). The mentioned area for this crop, countrywide, was 131,638.75 ha.

Peas can be grown, according to the mentioned eco-scheme, in the form of monocultures or a mixture with perennial grasses or peas and oats or peas and triticale, or grain peas or garden peas but also autumn fodder peas. This crop was specified by 10,585 farmers in the payment requests, for an area of 107,142.45 ha countrywide.

Vetch can be grown according to the eco-scheme in monoculture or mixed peas with perennial grasses, peas and oats, peas and rye, peas and triticale, and autumn peas.

This crop was specified by 111 farmers in the payment requests, for an area of 747.72 ha countrywide.

A number of 527 farmers proposed including sainfoin on a total area of 2,138.29 hectares and 1,749 farmers proposed including clover on total area of 8,688.87 hectares for the 2023 cropping plan.

Beans were an option within the PD-04 eco-scheme for 372 farms that cumulatively cultivated an area of 3,392.42 ha countrywide.
Phacelia can be found in the crop options of 72 farmers in Romania on an area of 526.63 ha.
Cowpeas were an option within the PD-04 eco-scheme for 7 farms and a cumulative area of 136.78 ha countrywide.
Birdsfoot trefoil was an option within the PD-04 eco-scheme for 932 farms and an area of 3,103.44 ha countrywide.
Chickpea stood out within the PD-04 eco-scheme in the crop plan of 148 farms on an area of 3,263.9 ha countrywide.
Lupine was highlighted in the PD-04 eco-scheme within the crop plans across 27 farms covering an area of 159.59 hectares.
Field beans were referenced in the PD-04 eco-scheme within the crop plans, either in monocultures or alongside oats, across 10 farms covering an area of 144.18 hectares.
Lentils were included in the PD-04 eco-scheme within the crop plans across 2 farms covering an area of 32.53 ha.
Alfalfa was mentioned to be introduced in the crop plan in monocultures or mixtures with perennial grasses or in the form of certified seeds or energetic alfalfa. 38,466 farms and an area of 312,085.24 ha countrywide opted for this crop.
Average area per farm with protein crops is presented in Figure 7.

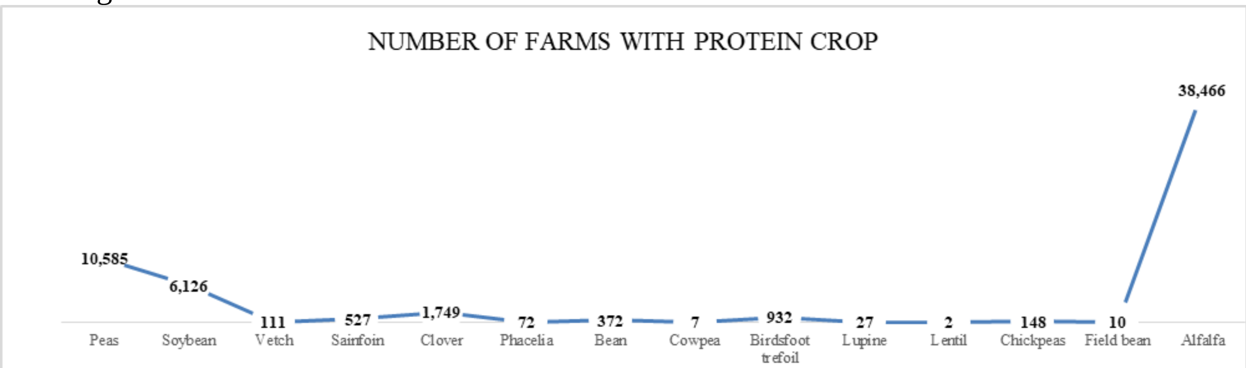

Fig. 6. Number of farms with protein crops
Source: [1].

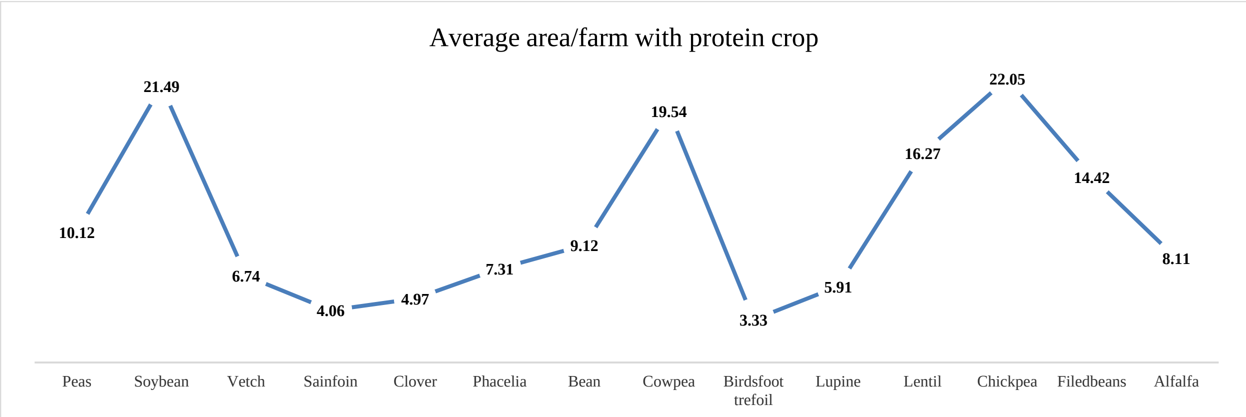

Fig. 7. Average area per farm with protein crops
Source: [1].

In the given context, farmers who sought support under the eco-scheme in 2023 were required, starting from 2024, to adhere to the mandatory stipulations outlined by the scheme. These conditions included reserving a minimum of 5% of arable land for non-productive elements, such as uncultivated land. For farms utilizing over 75% of arable land for grass production, leguminous crops, crops submerged in water for a significant part of the cycle, or a combination thereof, the proportion of non-productive elements, including fallow land, must be greater than 3%. Additionally, farmers must allocate at least 5% of the total declared arable land for leguminous crops, nitrogen fixers, and mixtures of leguminous and perennial grasses, provided for in the annex no. 17 to MADR Order no. 80/2023, as their main crop.

These mandatory conditions will be combined with one of the specific requirements, at the farmer's choice: practice crop diversification, depending on the area, practice a conservative type of agriculture (no/minimum/strip tillage) on at least 50% of the cultivated area or plant at least 2 fruit trees and/or trees per hectare each year throughout the farm.

CONCLUSIONS

Farmers in Romania complied with the requirements of the PD 04 eco-scheme, given the number of farms that applied and the arable land areas involved, although the requirement for uncultivated areas at the farm level was considered irrelevant and could lead to weed infestation of agricultural lands and production losses. This subsidy (73 euros/ha for the year 2023) introduced in the Romanian National Strategic Plan for the period 2023-2027 aimed to support the farm incomes, which should be reliable and contribute to mitigating climate change through better adaptation of agricultural activity, promotion of sustainable development of natural resources and their efficient management. However, the need for subsidies in agriculture is essential, primarily to ensure thecontinuous economic activity of farms, which are directly involved in ensuring food security, without medium and long-term damage to the environment. This involves using sustainable, yet expensive technologies, and without funding, it would be impossible to implement.

The subsidy introduced through the PD-04 eco-scheme and paid to all areas of arable land on which an agricultural activity is carried out in the vegetable sector and which meet the above-mentioned conditions triggered the awareness of farmers on these urgent needs in terms of the environmental impact of agricultural activities environment and on the fact that the EU and Romanian legislative bodies support, from an economic and financial point of view, the environmentally beneficial practices through training and investment.

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FINANCIAL DIAGNOSTICS OF BANKRUPTCY RISK IN AGRICULTURE: THE CASE OF BULGARIAN ENTERPRISES

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Abstract

The present study makes financial diagnostics of enterprises from the agricultural sector in Bulgaria in order to carry out a thorough analysis of the trends related to the development of economic processes and the possibility of early detection of financial difficulties. The studied enterprises from the agrarian sector are classified according to levels of financial sustainability, which reveal their ability to generate a positive financial result, to pay debts in a timely manner, to be financially independent, etc. To predict the risk of bankruptcy, well-established models in the world practice are used, including the Altman Z-score model, the Springate model and the Fulmer model. The comparison of the results of more than two models will give us a reliable picture of the state of financial stability of the enterprises. The presence of a high percentage of coincidence between the model forecasts is a reason to claim that the forecasts approximate the real state of financial stability. The results show that at least 1/3 of the surveyed enterprises in the period 2019-2021 are in a state of financial instability.

Key words: *agricultural sector, risk of bankruptcy, Z-score models*

INTRODUCTION

The agricultural sector is one of the most vulnerable sectors of the Bulgarian economy in terms of increasing the risk of insolvency and bankruptcy of the companies operating in it.

The problems associated with the unstable political and economic environment, both nationally and internationally, leading to turbulence in the demand and supply of agricultural production. Here could be added the adverse effects of the accumulation of large volumes of inventories in recent years due to the war situation in Ukraine. Another risk factors are not less significant - the impact of climatic and biological shocks, the fluctuations in the prices of input resources – fuels, fertilizers, etc. All this result in an increase in bankruptcies among companies in recent years. According to the COFACE report on corporate insolvencies for Central and Eastern Europe for 2022, Bulgaria once again occupies one of the top eight positions together with Croatia, Hungary, Latvia, Lithuania, Poland, Romania and Serbia (COFACE, 2023) [3]. The same report states that the number of bankruptcy proceedings in CEE countries increased by 10,173 in 2022 compared to 2021, which is equal to 39.3%. Among the sectors that reported the highest growth in bankruptcy proceedings is the agricultural sector, especially livestock farmers.

The prediction of company bankruptcy is recognized as a significant factor for the normal course web-based of economic activity and for the functioning of enterprises. In this regard, in 2019 The European Union adopted Directive 2019/1023, entitled Directive on Restructuring and Insolvency (European Parliament, EU Directive 2019/1023) [5]. It aims to unify the terms and conditions in the legislations of EU Member States related to preventative restructuring and bankruptcy proceedings. Behind this goal is the idea of developing mechanisms for early warning of financial difficulties and recovery of enterprises, so that they are given a second chance to survive and maintain their viability. The Directive does not give specific instructions, but rather guidelines and the right of each Member State to determine how to approach, according to the characteristics of its economic subjects and the environment in which they do their business. Two approaches are allowed:

a/ active – in it, the individual entrepreneur or persons designated by him, including shareholders or partners, are encouraged to make a self-assessment of their financial situation. It is considered that when financial difficulties are encountered, these have to be signalled to authorities nominated by the state, which in turn will give publicity to the identified problem and propose measures for the recovery of the company;

b/ passive–in it, the assessment of financial well-being is assigned to a consulting agency or certified accountants, who objectively analyzes the accounting documents of the relevant enterprise, and also notify its debtors of possible difficulties.

Initially, in 2021 a project called "Bulgaria - Early Warning Tools" gained popularity (World Bank, 2021) [14]. It was developed with the assistance of the World Bank Group at the request of the Ministry of Justice of Bulgaria. At the end of 2023, the Council of Ministers of the Republic of Bulgaria adopts an Ordinance on early warning tools and access to information about enterprises in case of probable bankruptcy (Council of Ministers, 2023) [2].

The document mentioned envisages the Bulgarian SMEs promotion agency creating an information system that promptly signals the danger of bankruptcy.

The work towards the development of tools for early warning of financial difficulties will be increasingly developed and enriched. It is expected to be effective as from December 2024. However, it is still not clear what methods and analysis methodology will be used. It is assumed that an algorithm will be developed to calculate indicators of the financial condition of enterprises, information about liabilities, receivables, etc.

Whether a uniform approach will be applied to all sectors or whether there will be a distinction is not yet clear.

The high capital intensity of production enterprises in the agrarian sector implies a significant volume of costs for depreciation of fixed assets, as well as a significant volume of related material stocks.

The latter sometimes manifests itself in large values of total liquidity at significantly lower levels of quick liquidity indicators.

Regarding the financial performance of agricultural enterprises, we can point to the traditionally lower values of profitability in the sector, while at the same time we observe a large cash flow from operations given the high depreciation costs.

Some authors draw attention to the need to adapt bankruptcy risk assessment models for the agrarian sector as well as for developing economies.

Karas (2015) [8] and Režňáková and Karas (2015) [11] analysed the meaning of selected financial indicators, called “predictors”, of enterprises from different economic sectors and found that the same indicators were not equally applicable in different industries. Financial indicators appear to be significant predictors of bankruptcy, for example, for some of the companies studied, but not for companies in the construction or agribusiness sectors.

The authors present some significant specific financial indicators from the agrarian sector, different from industrial enterprises - such are: net working capital to assets, current liabilities to total assets, long-term liabilities to assets and the interest coverage.

M. Karas, M. Režňáková, P. Pokorny (2017) [7] developed this thesis and proved that in the agrarian sector reinvestment of the profit back into the enterprise is of great importance and that depreciation costs are a significant source of operating cash flow. They concluded that due to agribusiness specificity a special attention should be paid to financial performance indicators including EBITDA, such as interest coverage or assets profitability.

Srebro, B. Et al. (2021) [12] also proved that, together with the Altman model, it is necessary to use adapted models to assess the bankruptcy risk in studying firms from the agrarian sector in developing markets. The authors found that some agricultural companies were wrongly classified in the red zone, but when the model was adapted for companies operating in developing markets, they improved their rank.

In order to investigate bankruptcy in the agrarian sector, the purpose of the present study was to apply several analytical models widely used both in theory and in practice to predict bankruptcy risk and to track the degree of conformity of their predictions.

MATERIALS AND METHODS

A total of 94 small and medium-sized agrarian enterprises, both from the Livestock and the Plant growing sectors, participated in the research.

Data were used from the annual financial reports of the companies for three consecutive years - 2021, 2020 and 2019. We realize that this is a period that coincides with the Covid crisis and affects the financial results in one way or another.

Initially, the analysis applied a methodology for grading the financial sustainability of enterprises by calculating and comparing key financial indicators from the accounting balance sheets (Todorov, 2014; Kulchev, 2023) [13, 10].

Table 1 presents the levels of financial stability adapted according to (Todorov, 2014; Kulchev, 2023) [13, 10].

Table 1. Levels of financial stability

Measures of financial stability	1. TA-TL>0 2. TA-TL>TL 3. (E+NCL)>NCA 4. (CA-CL)>0 5. (W+STL)>Inv 6. (CA-CL)>Inv
Levels of Financial Sustainability	**Criteria**
Highest level	Measures 1 to 6 are fulfilled
High level	Measures 1 to 5 are fulfilled
Medium level	Option I - Measures 1 to 4 are fulfilled
	Option II - Measures 1, 3, 4, 5, 6 are fulfilled
Low level	Option I- Measures 1 and 2 are fulfilled
	Option II - Measures 3 and 4 are fulfilled
Financial crisis	Measure 1 is fulfilled.
Bankruptcy	None of the measures are fulfilled

Source: The table has been adapted (Todorov, 2014; Kulchev, 2023) [13, 10].

where:
TA – Total Assets;
TL – Total Liabilities;
E – Equity;
NCL – Non-current Liabilities;
NCA – Non-current Assets;
CA – Current Assets;
CL – Current Liabilities;
Inv – Inventories;
WK – Working Capital;
STL – Short-term Loans.

Three models for predicting the risk of bankruptcy well-established in the global practice have been used in the analysis (Altman, 2000; Freitfalts, 2018; Delev, A., 2016; Kasarova, V., 2010) [1, 6, 4, 9] :

- *The Altman model:*

$$Z = 0.717 * X1 + 0.847 * X2 + 3.107 * X3 + 0.42 * X4 + 0.998 * X5$$

- *The Springate model:*

$$Z = 1.03 * X1 + 3.07 * X2 + 0.66 * X3 + +0.4 * X4$$

- *The Fulmer model:*

$$H = 5.528 * V1 + 0.212 * V2 + 0.073 * V3 + 1.27 * V4 - 0.12 * V5 + 2.33 * V6 + 0.575 * V7 + 1.083 * V8 + 0.894 * V9 - 6.075$$

Altman defined three variants of bankruptcy risk prediction according to Z values, while Springate and Fulmer – two each (Table 2).

Table 2. Interpretation of the integral coefficient values

<table>
<tr><td colspan="6">Z_{Altman}</td></tr>
<tr><td colspan="2">Z<1.23</td><td colspan="2">1.23<Z<2.9</td><td colspan="2">Z>2.9</td></tr>
<tr><td colspan="2">High probability of bankruptcy</td><td colspan="2">Pottentialy bankrupted</td><td colspan="2">Financially healthy</td></tr>
<tr><td colspan="6">$Z_{Springate}$</td></tr>
<tr><td colspan="3">Z<0.862</td><td colspan="3">Z>0.862</td></tr>
<tr><td colspan="3">Financial distress</td><td colspan="3">No financial distress</td></tr>
<tr><td colspan="6">H_{Fulmer}</td></tr>
<tr><td colspan="3">H<0</td><td colspan="3">H>0</td></tr>
<tr><td colspan="3">Financial distress</td><td colspan="3">No financial distress</td></tr>
</table>

Source: The table has been adapted (Todorov, 2014).

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Table 3 presents the main parameters and ratios involved in the above models.

Next, in order to investigate the probability for enterprises from the agrarian sector to be at risk of bankruptcy, we look for comparability between the results of the financial ratios determining the levels of financial sustainability (Todorov, L., 2014) [13] and the scored of the Altman, Springate and Fulmer models.

Table 3. Insolvency risk forecasting indicators

X Altman		X Springate		V Fulmer Model	
X_1	WK/TA	X_1	WK/TA	V_1	RE/TA
X_2	RE/TA	X_2	EBIT/TA	V_2	SR/TA
X_3	EBIT/TA	X_3	EBT/CL	V_3	EBIT/E
X_4	MVE/TL	X_4	SR/TA	V_4	CF/TL
X_5	SR/TA			V_5	TL/TA
				V_6	CL/TA
				V_7	Log (Tang A)
				V_8	WK/TL
				V_9	Log (EBIT/i)

Source: own contribution.

where:
WK – Working Capital;
TA – Total Assets;
RE – Retained Earnings;
EBIT – Earnings Before Interest and Taxes;
MVE – Market Value Equity;
TL – Total Liabilities;
SR – Sales Revenue;
EBT – Earnings Before Taxes;
E – Equity;
CF – Cash Flow;
CL – Current Liabilities ;
Tang. A – Tangible Assets
i – interest expense.

For this purpose: (1) we determine the levels of financial sustainability of the enterprises by applying the criteria specified in Table 1; (2) we apply the Altman, Springate, and Fulmer bankruptcy prediction models, and (3) we track the percentage of compliance of the obtained Altman, Springate, and Fulmer model estimates with the levels of financial sustainability. Thus, for each of the defined financial sustainability levels in Table 1, first, we will obtain the total number of enterprises falling into them and second - the corresponding number of enterprises assessed by Altman, Springate, and Fulmer models matches. We estimate the percentage of enterprise matches by dividing the number of enterprises estimated by the prediction models falling into one level by the total number of enterprises in the same level.

RESULTS AND DISCUSSIONS

The distribution of the agrarian enterprises included in the study, classified according to their financial stability according to the indicated degrees of financial sustainability, has been graphically presented on Figure 1, Figure 2 and Figure 3.

The Altman model assessment, presenting three categories of financial sustainability, offers the opportunity for a more in-depth analysis. We observe greater dynamics in the change in the number of financially stable enterprises for 2020/2019 compared to 2021/2020 (Figure 1).

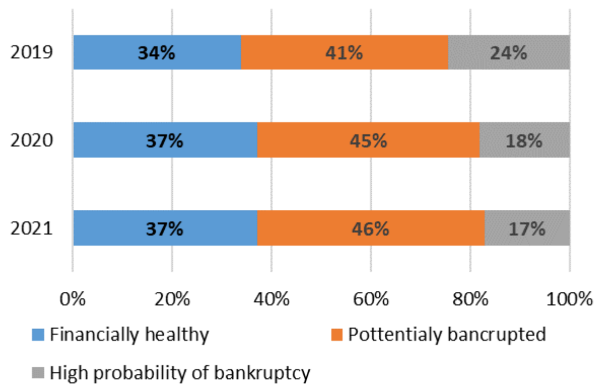

Fig. 1. Distribution of Altman Z score for agricultural enterprises
Source: own contribution.

Only three enterprises managed to improve their financial sustainability in 2020, with the overall relative share of financially healthy enterprises rose to 37% and maintained the same value in 2021. For the period 2019-2021, seven enterprises increased their financial sustainability by improving their assessment from “high risk” to “high risk without risk of bankruptcy”. The amendment involves a reduction of enterprises with deteriorating financial health by 7 percentage points.

The calculations made according to the Springate model determine an even higher relative share of enterprises in a state of potential bankruptcy (Figure 2). We observed the highest share in 2019, with financially unhealthy enterprises being 59% of all surveyed.

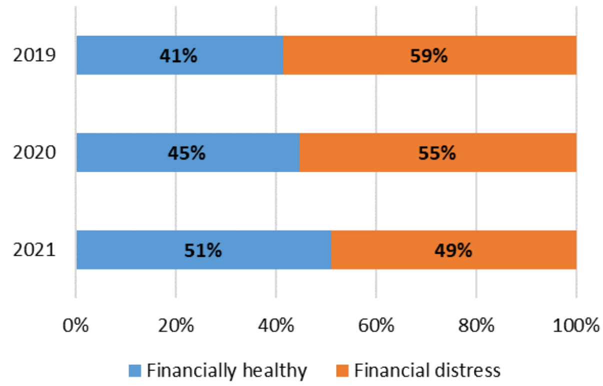

Fig. 2. Distribution of Springate Z score for agricultural enterprises
Source: own contribution.

As at 2021, the data showed a significant improvement in the financial health of the enterprises, with 51% of enterprises being financially stable. Although for the three-year period we could see a significant increase in the number of financially sound enterprises by 10 percentage points, it should be noted that the share of enterprises with a high bankruptcy risk stays significant.

Fulmer's model calculations single out 2019 as the year with the highest relative share of 39% of businesses in poor financial health and at risk of bankruptcy (Figure 3). This share decreases to 34% in 2021, and financially stable enterprises increased their share to 65%. During the period, we observed a steady increase of the enterprises with good financial stability.

The forecasts for the financial status of enterprises according to the three prognostic models (Altman, Springate and Fulmer) revealed that the estimates are mutually asserted in a significant percentage of the cases.

We observe a positive trend of the share of agrarian enterprises with good financial stability. All coefficient estimations show an increase on an annual basis, including in 2020.

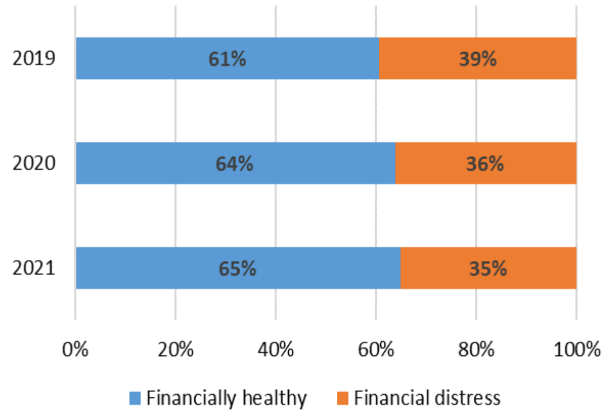

Fig. 3. Distribution of Fulmer H-factor for agricultural enterprises
Source: own contribution.

The results of comparing the levels of financial stability and the estimates of the Altman, Springate and Fulmer models are presented in Table 4, Table 5 and Table 6.

For a better presentation of the data, we have combined the number of enterprises appearing in Option I and Option II of Medium level; as well as the ones in Option I and Option II of Low level of stability.

In each table, we proxy the total number of enterprises falling into a given sustainability level to be 100%.

The percentages following the financial distress statuses of the Altman, Springate, and Fulmer models indicate the share of companies whose financial stability matches the corresponding stability level.

When comparing the percentage of enterprises with same financial stability according to both methods - financial sustainability levels and Altman’s financial stability statuses, we observed high matches in the upper two categories.

Most precisely, we see that the data show 77% coincidence in 2019 and 2021. (Table 4).

The smaller percentage rate of 69% in 2020 could be due mainly to the pandemic situation and the need for enterprises to absorb the shock in the short term.

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Table 4. Comparing the financial sustainability levels and Altman model scores

Levels of Financial Sustainability, firms = 100%	Altman's Z	2021	2020	2019
Highest level	Financially healthy	77%	69%	77%
High level	Financially healthy	22%	33%	33%
Medium level Options I and II	Potentially bankrupted	78%	47%	68%
Low level Options I and II	Potentially bankrupted and high probability of bankruptcy	65%	92%	9%
Financial crisis and bankrupt	High probability of bankruptcy	78%	58%	79%

Source: own contribution.

The outstanding number of enterprises (Altman's scores) that do not belong to the highest-level group refers to the second level - "high financial stability": 22%, 33%, and 33%, respectively.

Following the above data, we had the highest percentage of matches in 2020.

Enterprises headed to bankruptcy or with a high probability of becoming bankrupt match 92% of all cases of low financial stability (Option I and Option II).

Considering the Springate model results related to the financial stability categories reveal to us a high matching rate of 85% of the financially stable in 2021 (Table 5).

In the other two models, those values gravitate around 77%.

At the same time, the Springate model predicts very high values of correctly classified enterprises in the Financial Crisis and Bankruptcy group - 100% for 2021, 92% for 2020, and 93% for 2019, respectively.

The Fulmer model closely approximates that of Altman in its predictions.

Table 5.Comparing the financial sustainability levels and the Springate H model scores.

Levels of Financial Sustainability, firms = 100%	Springate's Z	2021	2020	2019
Highest level	Financially healthy	85%	69%	80%
High level	Financially healthy	67%	33%	0%
Medium level Options I and II	Financial distress	89%	53%	55%
Low level Options I and II	Financial distress	42%	71%	82%
Financial crisis and bankrupt	Financial distress	100%	92%	93%

Source: own contribution.

The two integral indicators present a complete coincidence at the two polar levels of financial sustainability, i.e. at "highest level" and "financial crisis and bankrupt". The discrepancies in the other degrees are due to the presence of only two interpretations according to Fulmer and Springate - "financial distress" and "financially healthy" (Table 6).

It should be pointed out that the estimates of the applied models testify that the relative share of enterprises with financial instability remains high during the three-year period.

Table 6. Comparing the financial sustainability levels and the Fulmer model scores

Levels of Financial Sustainability, firms = 100%	Fulmer's H	2021	2020	2019
Highest level	Financially healthy	77%	83%	87%
High level	Financially healthy	89%	33%	33%
Medium level Options I and II	Financial distress	56%	24%	32%
Low level Options I and II	Financial distress	31%	50%	45%
Financial crisis and bankrupt	Financial distress	78%	75%	79%

Source: own contribution.

The minimum value of the relative share of enterprises with an estimated high probability of a financial crisis and impending bankruptcy has been obtained according to the Fulmer model for 2021 at the amount of 35% - therefore, at least 1/3 of enterprises studied in the period 2019-2021 are in a state of financial instability. We can determine the share of 17% of enterprises with a high degree of risk of bankruptcy according to Altman as being not very small.

A comparative analysis of the Fulmer and Springate scores shows the Springate model as being more restrictive. With both methods, financially stable enterprises increase their share compared to 2019 by more than 10%, but the Springate score defines ½ of enterprises as financially healthy, while according to the Fulmer model this relative share reaches 60%. The difference between the defined relative shares of financially stable (respectively unstable) enterprises for the three-year period between the two models is between 15 and 20 percentage points.

In addition, all models demonstrate the same variation, i.e. higher values for 2019 and 2021 compared to 2020, which was the worst year of the Covid crisis. The fluctuations in the lower degrees of financial sustainability and the discrepancies in the percentage shares among the models are due to the differences in the financial indicators that participate in them, as well as the adopted weights. Examined in detail, we find that the first two models from Table 3 involve almost the same financial indicators, but in different positions and with different constants in front of them.

CONCLUSIONS

In conclusion, the present study made use of widely applied and proven accuracy models for assessing financial sustainability. We reckon that comparing the results of more than two models can present a reliable picture of the financial sustainability of the enterprises.

We also assume that the higher share of consilience of the models' scores is a reason to claim that the forecast of a bankruptcy risk in the agrarian sector approaches its real state.

Based on the fives levels of financial sustainability, Springate model compared to Fulmer model, showed less matching scores of financially healthy enterprises. However, Altman’s model turned to be the most restrictive one, as for both categories of financial sustainability – “highest level” and “high level” indicates least match.

The results show very high share of enterprises at risk of bankruptcy. Following the overall consilience of models forecasts, at least 33% of the surveyed enterprises in the period 2019-2021 are at risk of financial instability, although we observe an increase in the share of financial healthy enterprises.

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FINANCIAL PERFORMANCE IN THE CROP PRODUCTION SECTOR IN THE ERA OF DIGITAL TRANSFORMATION

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Abstract

This paper analyses the financial performance of crop production enterprises related to the costs associated with their innovation activity. We aim to determine influencing factors related to the digital transformation process, on the one hand, and on the other, explore the change in the economic performance of enterprises. For this purpose, we trace out enterprises' intangible assets and financial performance indicators. The study is based on a sample of enterprises, classified according to whether they disclose intangible assets in balance sheets. We use panel data collected on financial results, income, expenses, liabilities, and assets for five years. Both the Probit model and Fixed effects model are applied in an attempt to deepen the analysis. The results show that enterprises spend a negligibly small share of their revenue on innovation activities.Larger and more innovative crop farms with higher labour productivity have better financial performance. However, we found out that the higher value of return on assets does not affect enterprises' innovation decisions.

Key words**:** *innovation activity, profitability, digitalization, Probit, agriculture*

INTRODUCTION

The era of digitization and changes in the Common Agricultural Policy (CAP) have led to dynamic changes in agriculture in Europe, particularly in Bulgaria, as a member of the European Union. The new CAP 2023-2027 continues its policy of funding farmers to deliver public goods, mainly linked to the conservation of natural resources and the protection of the environment, while at the same time increasing productivity. In addition, it is planned to focus efforts on providing safe food at affordable prices for EU citizens and ensuring a fair standard of living for farmers.

The restructuring processes are related to the application of new digital technologies and digital innovations in agricultural enterprises' production processes and management. Accelerating the digitalization process in agriculture at the national level would help to optimize the production process, increase yields and farmers' income, achieve sustainability and food safety, and increase the competitiveness of Bulgarian agriculture and Bulgarian production on the single European market (MAF, 2019) [10]. Digitization of operations and new digital technologies changes the results in agriculture, turning it into a more efficient and sustainable economic activity (Lorenzo et al., 2020) [9]and creating new opportunities for business and developing new business models (Nikolov et al., 2022) [13].

In the economic literature, innovation has been considered an essential element of strategic business planning and a key factor in creating competitive advantages, improving the ability to fight competitors, adapting to the changing environment, and achieving intelligent, sustainable growth and a better standard of living.

European countries recognize innovation as an important element of the economic policy for the formation of successful national economies, and the stimulation of innovation activity has become an important tool. OECD (2015) [15] states in its research that countries with a high standard of living are characterized by high innovation of production and labor productivity.

According to the data published in the European Innovation Scoreboard (EIS, 2023) [4] for 2023, Bulgaria belongs to the group of emerging innovators with an innovation performance rating of 46.7% of the EU average. Productivity is below average for emerging innovators (up to 54%), with performance improving (4.4% growth) but at a slower pace than the European Union (8.5%). Hence, the difference in the results of Bulgaria compared to the EU is continue increasing. Our country is also lagging behind the stated target of reaching 70% of the EU average level of innovation and moving from the group of "emerging" to "moderate" innovators. The Innovation Strategy for Smart Specialization (ISIS) [18] 2021-2027 adopts a new grouping of member states according to their innovation performance compared to the EU average. The countries are divided into four groups: innovation leaders – over 125%; strong innovators – between 100% and 125%; moderate innovators – between 70% and 100%; emerging innovators – below 70%.

The data show that in 2023 Bulgaria's performance exceeds the 70% rate of average European levels in six dimensions: digitalization (in the part of broadband access), use of information technologies (in the part of employed ICT specialists), innovators (in the part of product innovators (SMEs), intellectual assets (in the trademark and industrial design applications part), sales impact (in the knowledge-intensive services export part) and environmental sustainability (in the environment-related technologies part). The country's performance in terms of public financing of innovations is particularly weak. The indicator “expenditure on R&D as a relative share of GDP” for 2022 maintains a low value of 0.75%, which is extremely insufficient and even represents a decrease compared to the share of funds provided for 2021. The performance is also relatively weak in terms of lifelong learning, resource productivity, innovation costs per employee, and the number of enterprises providing ICT training.

Compared to 2022, there has been a significant increase in the number of innovative collaborating SMEs, business process innovators, and product innovators, but at the same time, there has been a sharp decline in the number of doctoral candidates, a reduction in R&D spending in public and private sectors, as well as technologies related to the environment and the export of medium and high technology products.

The data show that enterprises are reducing their investment activity in terms of the creation and implementation of new products. At the same time, studies show that enterprises are willing to implement innovations as well as to make small improvements (Galev et al., 2015) [5].

One of the main strategic goals of the CAP, set in the new program period 2023-2027, is the stimulation and sharing of knowledge, innovation, and digitalization, as well as promoting their use.

Agriculture should use and apply new and innovative technologies to meet the growing challenges of the digital age and create and capture value. Hence, a number of questions arise regarding the impact of digitization and related business models on the financial performance of enterprises. Including how the digitization of operations and management processes will affect the financial and economic results of agricultural enterprises, their viability, and competitiveness.

In the literature, there is a lot of evidence for the positive impact of digitization on the profitability and competitiveness of enterprises. Balzer & Vojtková (2023) [2] recognize investments in new digital technologies and software expertise as key factors to make the sector more flexible and adaptable to changing market conditions. In their research, the authors also find that digitally mature firms in the market spend up to three times more on intangible assets than the industry average, which translates into higher levels of overall profitability, competitiveness, and improved firm performance compared to non-digital participants. A number of authors such as Gupta et al. (2017), Nguyen-Anha et al. (2022), Rizaev & Kadirov (2022), Zhaiet al. (2022), Klerkx & Rose, (2020) [6, 14, 17, 19, 8], found the positive relationship between investment in intangible assets and firm performance.

Although we are at the beginning of the digitalization era, there are studies in the literature that suggest an ambiguous relationship between the digitalization of processes and financial results. Masuda &Whang (2021) [11] investigate whether digitization will lead to higher profitability of enterprises. The authors prove that such dependence is found for enterprises with high variable costs and accelerated depreciation. Only in this case does digitization favor profitability. In their study of the cost effects of digitization, Ebhote&Nwanna (2020) [3] find that digitization does not have a statistically significant effect on return on equity. Anderton et al. (2023) [1] analyzed the data of 2,390,805 enterprises operating in the EU and concluded that the costs of digitization do not in every case increase productivity and should not be considered as a one-size-fits-all approach.

The current study attempts to explore the dynamics of costs related to the innovation activity of plant-growing enterprises and their impact on financial performance. In order to achieve the goal, on the one hand, we research the factors related to the digital transformation process, and on the other, search for a related change in the economic results of the enterprises. An attempt has been made to trace the relationship between the cost of intangible assets of enterprises in the crop sector as an indicator of innovation and selected financial performance indicators.

MATERIALS AND METHODS

To investigate and analyze the costs of innovation activity, the study is based on a sample of agrarian enterprises operating in the section "Crop production, animal husbandry, and hunting; auxiliary activities', part of sector A “Agriculture, forestry and fisheries”, according to the NACE Rev.2 Statistical Classification of Economic Activities [12]. The sample covers panel data containing financial information from the balance sheets of an average of 71 medium and large plant-growing enterprises in the Republic of Bulgaria. The time span of the study covers the period from 2017 to 2021.

We apply a Probit regression model to further investigate the relationship between the probability of crop farms investing in digital innovation and the achieved profitability and innovation activity. We track the factors that determine the propensity of plant-growing enterprises to seek and implement innovative solutions in their activities. To distinguish between innovative and non-innovative enterprises and to assess the relationship between the propensity to digitize and the selected financial performance indicators, we introduce a dichotomous dependent variable, Yi, defined as follows:

$$Y_i = \begin{cases} 1, if\ Y^* digitalization \\ 0, if\ Y^* no\ digitalization \end{cases}$$

where: Yi takes two values –the presence or absence of intangible assets (digitalization) and Y* is the latent variable that indicates the propensity of crop farms to invest and introduce new digital innovations in their activity.

The applied Probit model has the following form:

$$\begin{aligned} & P(Y \\ & = 1|ROA_{it}, Labour\_Prod_{it}, Solvency_{it}, logTA_{it}) \\ & = P(\beta_0 + \beta_1 ROA_{it} + \beta_2 Labour\_Prod_{it} \\ & + \beta_3 Solvency_{it} + \ \beta_4 logTA_{it} + \ \epsilon_{it} > 0) \\ & = \Phi(\beta_0 + \beta_1 ROA_{it} + \beta_2 Labour\_Prod_{it} \\ & + \beta_3 Solvency_{it} + \ \beta_4 logTA_{it}) \end{aligned}$$

where: Y is the propensity of crop farm i to invest in digital innovation i year t;

The betas, βs are the coefficients to be estimated, and the X is a vector of independent variables – return on assets (ROA), labour productivity (Labour_Prod), solvency and farm size (LnTA) of the *i*-thcrop farm.

To assess the significance of the relationships between innovation costs and financial results, a regression model with fixed effects is applied with a dependent variable – the economic profitability (ROA), we assess a sample of plant-growing enterprises showing intangible assets in their balance sheets. We use a fixed-effects model, widely used in the literature for analyzing and estimating dependencies in panel data. The model also allows the consideration of the individual characteristics of enterprises (factors not included as variables in the model, i.e.,the presence of unobserved heterogeneity). For the purpose of the analysis, we present ROA as a function of the following factors: investment costs in the long-term of intangible assets, the intensity of intangible assets, labour productivity, capital structure, and size of enterprises. The above-selected factors are among the most commonly used ones in the economic literature, a precise summary of which can be found in the publications of Kamruzzaman (2019), Pandey & Diaz (2019), Zhaiet al. (2022) [7, 16, 19].

The applied fixed effects model has the following form:

$$ROA_{it} = \alpha_0 + \beta_1 digit_{it} + \beta_2 RD\_int_{it} + \beta_3 Laboour\_Prod_{it} + \beta_4 Solvency_{it} + \beta_5 logTA_{it} + \epsilon_{it}$$

Description of the variables in the models applied in the study:

Investment costs in long-term intangible assets (*digit*) – we use this indicator to define the innovative activity of enterprises. We classify enterprises into two groups – innovation-active and innovation-inactive enterprises, depending on the disclosure of R&D costs and costs of concessions, patents, trademarks, and software products. We conditionally accept the costs of investment in intangible assets as a measure of innovation costs or costs related to innovation activity. On this basis, we analyze the size, structure, and dynamics of innovation costs.

Return on assets (ROA) – a proven indicator in economic literature, measuring economic results and efficiency of enterprises' assets. It is also suitable for use in comparative analyses.

One-year lag of the return on assets (lagROA) – we introduce a lagged value of return on assets in order to trace the existence of a relationship between the return in the previous year and the propensity of crop farms to invest in digital innovation. The lag variable will show us whether enterprises that generated higher returns in previous periods have higher innovation activity.

Intensity of intangible assets (RD_int) – the indicator is calculated as a ratio of incurred costs for intangible assets and the net sales. The obtained value shows us the relative share of innovation costs from the revenues generated in the current year.

Labour productivity (Labour_Prod) – a ratio of net sales revenue per employee; in order to track both the differences in the productivity of innovative enterprises and the presence of an impact on their profitability.

Solvency–we set an indicator of the ability of enterprises to meet their long-term obligations in view of the relatively high rate of financial bankruptcy in the agricultural sector. We use the ratio of total liabilities to total assets of the enterprises.

Size of the enterprises (logTA) – to define the enterprises' size we calculate the natural logarithm of the book value of total assets.

Table 1 shows the descriptive characteristics of the variables used in the models.

Table 1. Descriptive statistics of the variables used in the models, N=356, n = 115

Variable	Mean	Std. Dev.	Min	Max
digit				
overall	.427	.495	0	1
between		.462	0	1
within		.201	-.373	1.23
ROA				
overall	.070	.087	0	.776
between		.099	0	.776
within		.045	-.135	.275
lagROA				
overall	.070	.087	0	.776
between		.082	0	.472
within		.059	-.313	.453
RD_int				
overall	.006	.029	0	.300
between		.021	0	.149
within		.015	-.139	.158
Labour_Prod				
overall	125.7	191.3	.819	2099
between		234.3	.819	1906.5
within		82.9	-818.7	1070.1
Solvency				
overall	.373	.293	.004	1.54
between		.291	.006	1.35
within		.074	.021	.725
logTA				
overall	9.482	1.10	5.12	12.44
between		1.17	5.12	12.06
within		.128	8.98	9.97

Source: Own calculations.

For all variables, we observe a greater deviation from their average values between enterprises (between variation), compared to the deviation of one enterprise by years (within variation). The average return on assets (ROA) in our sample is 7%, with a variation of 10% between firms. We observe a very low value of the ratio of innovation expenses to sales revenue – enterprises spend an average of 0.6% of their costs on investments in innovation activity. Significantly higher between-group deviation is evident in labour productivity. The average income of one employee is BGN 126,000 with a standard deviation of BGN 191 thousand. The data show good financial stability with an average solvency ratio of 37%. As a positive result, we can consider the low within-group deviation of 7%.

RESULTS AND DISCUSSIONS

The panel data from the sample covers all the necessary financial information of balance sheet data for the financial result, income, expenses, liabilities, and assets of plant-growing enterprises in the Republic of Bulgaria. We consider 5-year period. Only medium-sized and large enterprises are included in the analysis.
For 2021, the total number of enterprises analyzed is 69, which is 10% less than in 2017 (77). The enterprises operating in the branches "Growing of cereals (except rice), leguminous crops and oil seeds" (code 0111), "Growing of vegetables and melons, roots and tubers" (code 0113), "Growing of other non-perennial crops" (code 0119), "Growing of grapes" (code 0121), "Growing of pome fruits and stone fruits" (code 0124), "Growing of other tree and bush fruits and nuts" (code 0125), "Growing of other perennial crops' (code 0129) and 'Plant propagation' (code 0130) (Table 2).
The predominant part of them works in the branches "Growing of cereals (except rice), leguminous crops and oil seeds" - 70% and "Growing of vegetables and melons, roots and tubers" - 15%.

Table 2. Number of enterprises, distributed according to their economic activity, 2017-2021

Year	NACE Ref. 2 code			Total
	0111	0113	Others 0119-0130	
2017	56	13	8	77
2018	50	9	10	69
2019	51	11	11	73
2020	46	10	12	68
2021	47	9	13	69
Total	250	52	54	356

Source: Own calculations.

The data analysis shows an average relative share of 43% of the innovation-active farms in the sample, making expenditures for concessions, patents, trademarks, and software products related to digitalization.
Figure 1 clearly shows that R&D expenses occupy an extremely low share in the structure of intangible assets, from 1.49% in 2017 to 2.13% in 2021. R&D expenditures reached a share of 4.95% in 2018, due to an increase of BGN 45 thousand (an increase of 563%) compared to the previous year. In the following years, a negative dynamic in their size was observed. In 2017 - 2020, the intangible assets were predominately occupied by the costs of concessions, patents, licenses, trademarks, and software, which formed 90.69% in 2017. At the same time, in 2021 we see a significant decrease of 83%.

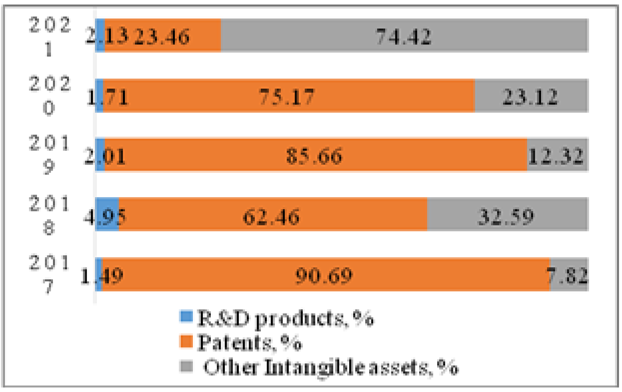

Fig. 1. Structure of costs for intangible assets for 2017-2021
Source: Own design.

Considering the costs for concessions, patents, licenses, trademarks, and software, their extremely low amount is striking. The average value of the expenses for the period is 0.525

thousand BGN and 15.728 thousand BGN, respectively (Table 3). We can highlight 2019 and 2020 with average costs significantly exceeding those for the relative year. The erratic dynamics in their size are not surprising given the significant between and within deviation.

Table 3. Descriptive statistics of costs for R&Dand expenditure for concessions, patents, licenses, trademarks, and software, 2017-2021

Year	R&D products, BGN 000'		Concessions, patents, licenses, trademarks, software, BGN 000'		Freq.
	Mean	Std. Dev.	Mean	Std. Dev.	
2017	.1039	.661	6.325	16.393	**77**
2018	.768	5.791	9.696	22.834	**69**
2019	.685	5.390	29.137	142.652	**73**
2020	.662	5.216	29.029	142.472	**68**
2021	.449	3.496	4.957	13.367	**69**
Total	**.525**	**4.466**	**15.728**	**90.940**	**356**

Source: Own calculations.

Only 3.5% of the analyzed enterprises (Table 4) disclose R&D expenditure for the period. Total2.25% of the enterprises spent up to BGN 10 thousand; by 2020, almost 1% spent up to BGN 50 thousand, and in 2021, only one enterprise spent up to BGN 30 thousand.

Table 4. Number of enterprises as per the presence of R&D expenditure

R&D products, BGN	Year					Total
	2017	2018	2019	2020	2021	
0	75	66	70	66	67	**344**
up to 10,000	2	2	2	1	1	**8**
up to 30,000	0	0	0	0	1	**1**
up to 50,000	0	1	1	1	0	**3**
Total	**77**	**69**	**73**	**68**	**69**	**356**

Source: Own calculations.

Analyzing the disclosed innovation costs of the enterprises, it is noticeable that a high share of farms does not carry out innovation costs – an average of 61% for the considered period (Table 5). On average, 23% of the enterprises (17 of them) carry out innovation costs up to BGN 10,000, nearly 11% (8 enterprises) – up to BGN 50,000, 3.65% - up to BGN 100,000, and only 1,4% - over BGN 100 thousand (2 companies for 2019-2020).

Table 5. Number of enterprises as per the presence of concessions, patents, licenses, trademarks and software

Concessions, patents, licenses, trademarks, software, BGN	Year					Total
	2017	2018	2019	2020	2021	
0	46	43	44	41	43	**217**
up to 10,000	19	14	17	15	17	**82**
up to 50,000	9	7	7	8	8	**39**
up to 100,000	3	4	3	2	1	**13**
more than 100,000	0	1	2	2	0	**5**
Total	**77**	**69**	**73**	**68**	**69**	**356**

Source: Own calculations.

Results of applied regression models

Table 6. Results of the Probit analysis

digit	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
ROA	-.740	2.795	-0.26	0.791	-6.22	4.74
labour_prod	-.013**	.005	-2.70	0.007	-.02	-.004
solvency	2.64*	1.27	2.07	0.038	.14	5.13
logTA	1.76**	.577	3.06	0.002	.63	2.90
_cons	-17.08***	5.07	-3.37	0.001	-27.01	-7.14
/lnsig2u	2.857	.432			2.01	3.70
sigma_u	4.17	.902			2.73	6.37
rho	.946	.022			.882	.98

legend: * p<.05; ** p<.01; *** p<.001
Source: Own calculations.

The results from the Probit model (Table 6)show a negative but statistically insignificant relationship between ROA and the probability of enterprises carrying out innovation costs. A higher value of ROA does not affect enterprises' innovation decisions. Additional tests were performed on the influence of lagged ROA values over three years, again showing no lagged ROA effect.

We prove statistically significant relationship between labour productivity, solvency, and farm size. One potential explanation for the negative relationship between earnings per employee and the propensity for innovation activity is the perception of innovation as a development driver. Enterprises with higher productivity are less likely to carry out innovation activities, while those with lower labour productivity are more likely to increase the revenue per employee by implementing digital solutions. The results also reveal that long-term solvent and larger enterprises are more likely to become innovatively active.

When applying the regression model, we want to account for the firm-specific characteristics. For this reason, we perform a Hausman test in order to choose between fixed and random effects models. The results show that the p-value is less than 0.05, and we can reject the null hypothesis and should use the fixed effects model.

Results of Fixed effects model (Table 7)show that there is no significant relationship between the ROA and innovation costs.

Table 7. Results of the Fixed effects model

ROA	Coef.	Std.Err.	t	P>t	[95% Conf. Interval]	
digit	-.012	.014	-0.86	0.391	-.039	.015
RD_int	.339*	.190	1.79	0.075	-.035	.711
labour_ prod	.00006*	.00003	1.74	0.083	-7.75	.0001
solvency	-.169***	.040	-4.21	0.000	-.249	-.090
logTA	.049**	.023	2.11	0.036	.0039	.095
_cons	-.337	.225	-1.50	0.135	-.78	.105
sigma_u	.119					
sigma_e	.052					
rho	.841	(fraction of variance due to u_i)				

legend: * p<.1; ** p<.05; *** p<.01
Source: Own calculations.

Results cannot explicitly explain better ROA of the innovative crop farms with their innovation activity. All other variables are statistically significant (although at different levels of significance). ROA is positively related to the labour productivity, R&D intensity and size of the crop farms. That means the larger and innovative crop farm with increasing sales per employee, have better financial performance. The negative relationship between solvency and ROA could be explain with greater liabilities of the bigger crop farm.

CONCLUSIONS

Concessions, patents, licenses, trademarks, and software dominate the crop farm's intangible assets. R&D expenses occupy an extremely low share of them – the highest share for the 5-year period is 4.95% (2018). The total amount of the expense is also negligibly small – up to 50,000 BGN. The predominantly share of crop farms does not invest in innovation activities (61%).The results clearly show that crop farms prefer to implement existing innovative solutions and do not invest in developing new and innovative products.

Furthermore, related to crop farms that are innovatively active, investments in intangible assets do not appear to be determinants of better financial performance, although larger, financially sound, and insolvent enterprises have better returns. Finally, the results also reveal that long-term solvent and larger enterprises are more likely to become innovatively active.

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ANALYSIS OF COOPERATIVES IN THE AGRICULTURAL SECTOR AND MANUFACTURING INDUSTRY-PRODUCTIVITY AND GROWTH IN BULGARIA

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Abstract

The article examines cooperatives from the Agricultural sector and the Manufacturing industry. The research focuses on the growth of cooperatives of different sizes and ages. The period of the research is 5 years. After an in-depth study of the empirical data of the studied sectors, an analysis of the rate of change in net sales revenue and their productivity is made. The productivity, growth and age of the cooperatives are expected to be positively related for the period under study. Cooperatives with longer working experience are predicted to realize a higher rate of change in net sales revenue compared to cooperatives that have been operating for a shorter period of time.

Key words*: *cooperatives, growth, productivity, agricultural sector, manufacturing industry, Bulgaria

INTRODUCTION

In recent years, cooperatives have improved and become one of the widespread models for managing production factors and providing services to their members in almost all economic sectors and countries around the world [1]. With their specific principles and values in their activities, they contribute to socio-economic development. Cooperatives adapt easily and respond more effectively to economic, market and financial challenges thanks to their unique business model [15]. The impact of cooperatives on rural welfare and overall economic performance has been widely discussed in the scientific literature [16], [4], [10], [9], [17], [3], [8].

According to [7], cooperatives in the Agricultural sector have a positive effect on the modernization of agricultural machinery and technologies. This affects changes in the agricultural structure and leads to an overall improvement of the economic condition of rural areas. In recent years, the GDP of the Agricultural sector has been decreasing, but there has been an increase in the productivity of various crops such as cereals and others [14]. [11] explains these events with the fact that the development of other sectors in the economy is more pronounced. [13] believes that this is entirely due to a country's economic policies regarding agriculture and industry (manufacturing). The fact that in poor countries the Agricultural sector is a leading force, and in richer countries it is smaller and insignificant. The social significance of this phenomenon must be considered. Strong industrial development often has a negative impact on agricultural production [12], [5]. Such a sector, for example, is the Manufacturing industry. Both the Agricultural sector and the Manufacturing industry have been the subject of discussions by numerous authors over the years because they are the main driving force in the economy of most countries. In the scientific literature, there are studies of various dependencies between them such as age, growth and innovation; size and growth; productivity and growth; size and performance and others. The present study examines the relationship between productivity, growth and age.

In this context, the purpose of the paper is to study the cooperatives in Agricultural sector and Manufacturing industry in the period 2017-2021 in Bulgaria using the rate of change of net sales, growth and productivity by classes of cooperatives, according to the

European Commission NACE Rev.2 (2008), size and age.

MATERIALS AND METHODS

The productivity and growth of cooperatives is considered as an expression of net sales revenue and fixed tangible assets in the current period. For the purposes of the analysis, we define productivity as net sales revenue per 1 employee. We measure the growth of cooperatives by taking into account the dynamics of fixed tangible assets per 1 employee. The productivity and growth of cooperatives are determined as a function of their size and age (years of operation of cooperatives).

The size of the cooperatives is determined depending on the number of employees in them, according to their definition in the Law on SMEs [6] - micro: up to 10 employees, small: 10-49 employees, medium: 50-249 employees and large cooperatives over 250 employees.

The distribution of enterprises in this study is in accordance with this Law.

For the purposes of the analysis, the large cooperatives are excluded from the processing of the empirical data, due to their limited number in the current sample, which is not representative enough and would have an incorrect influence on the general analysis of the state of the problem.

Regarding the age of cooperatives, four categories are defined as follows: 0-10 years, 11-20 years, 21-30 years and over 31 years.

The cooperatives that are studied in the current article are conventionally divided as representatives of the Agricultural sector and the Manufacturing industry according to NACE Rev. 2 (2008), The EU commission established that the Agricultural sector represents Section A Agriculture, forestry and fisheries and Manufacturing industry is Section C [2].

The database used has 1,296 cooperatives, of which 1,103 are from the Agricultural sector and 193 from the Manufacturing industry. The study uses empirical data for a period of five years 2017 – 2021.

RESULTS AND DISCUSSIONS

Productivity

Based on the results obtained from the researched data, it is observed that higher cash receipts are realized for all representatives of cooperatives in the Agricultural sector. Exceptions were reported in 2019 and 2020, where industrial cooperatives realized more net sales revenue per 1 employee. Figure 1 clearly shows that during the studied period cooperatives in the Agricultural sector are characterized by higher productivity compared to cooperatives in the processing industry.

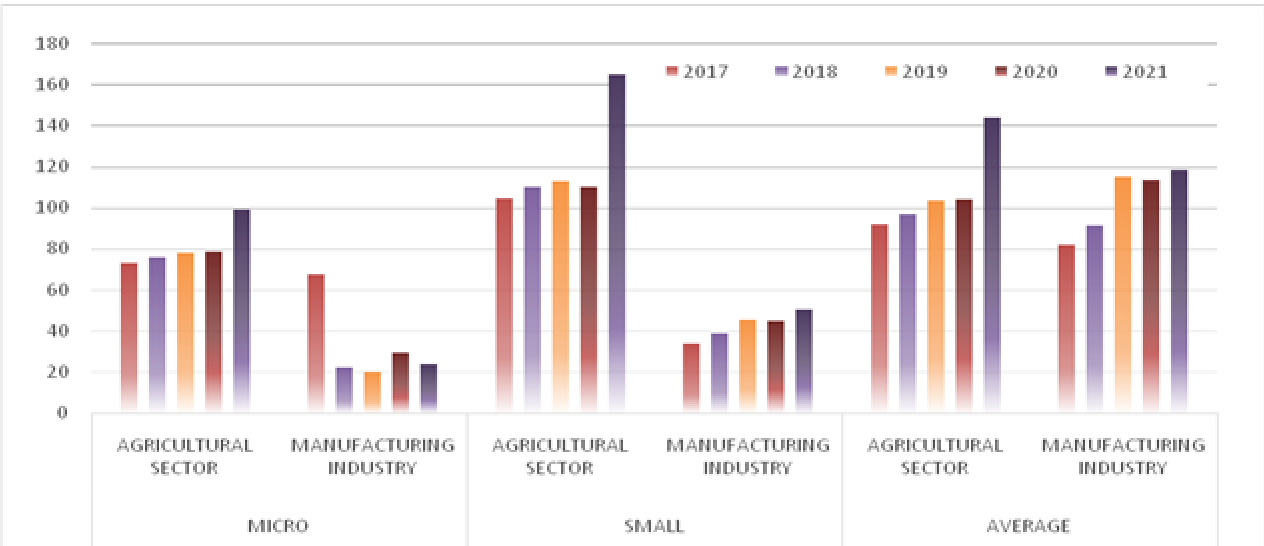

Fig. 1. Productivity of the Agricultural sector and the Manufacturing industry, 2017-2021.
Source: the author's creation.

Examining the empirical data, a trend of growth in the income of the net sales revenue per 1 employee is clearly outlined in both studied sectors, with the exception of one year each (Figure 2).

The total productivity of all cooperatives for the studied five-year period in the Agricultural sector is 1,547.50, while in the Manufacturing industry it is 898.21, which shows that it is 1.72 times higher values.

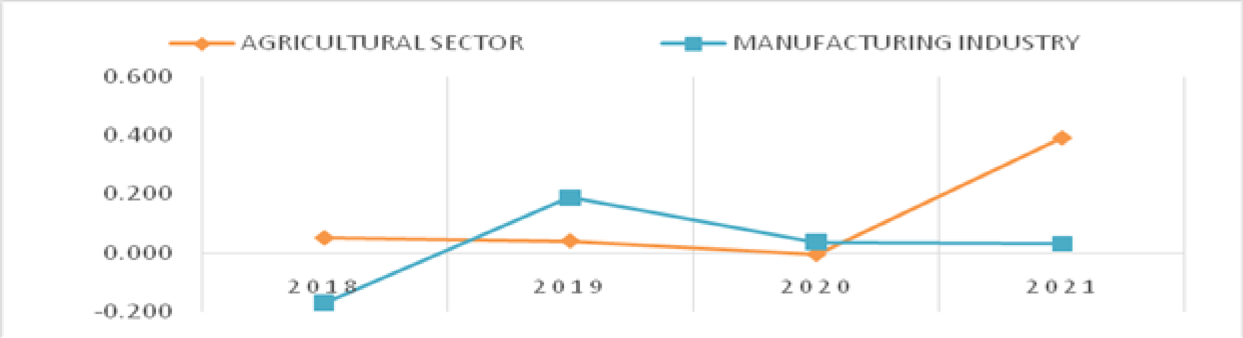

Fig. 2. Dynamics of productivity in the Agricultural sector and Manufacturing industry, 2017 - 2021
Source: the author's creation.

Based on the age factor, the agricultural cooperatives are distributed as shown in Fig. 3.

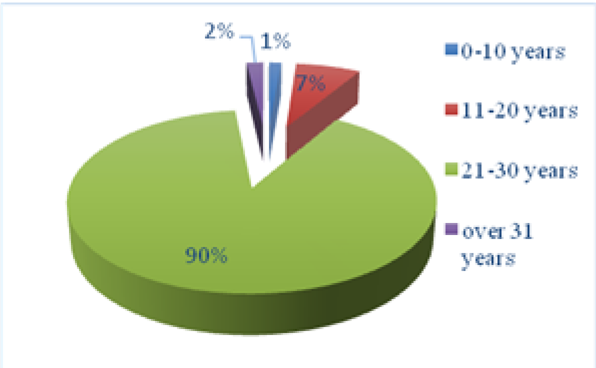

Fig. 3. Distribution of cooperatives by age, Agricultural sector
Source: the author’s creation.

In the Agricultural sector, the fewest representatives are observed in the newly established cooperatives, followed by those with the most work experience (Figure 3). The most numerous are cooperatives that have existed for 21-30 years. In Manufacturing industry, the age distribution looks different (Figure 4).

Cooperatives with the longest experience are 41% of all, the fewest are from the group of beginners. The predominant number of cooperatives are again the representatives who have been active for 21-30 years.

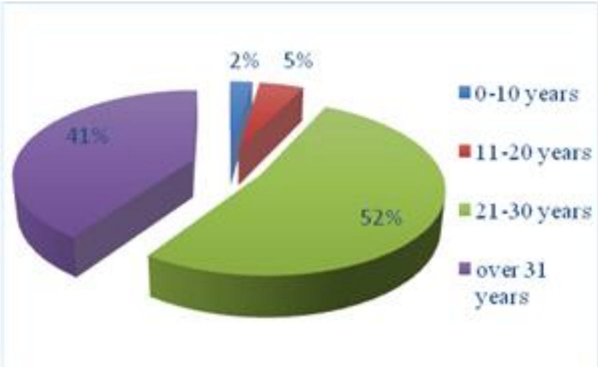

Fig. 4. Distribution of cooperatives by age, Manufacturing industry
Source: the author’s creation.

Based on an in-depth study and analysis of empirical data, it is observed that cooperatives with more work experience realize higher productivity values in both studied sectors (Figures 5 and 6).

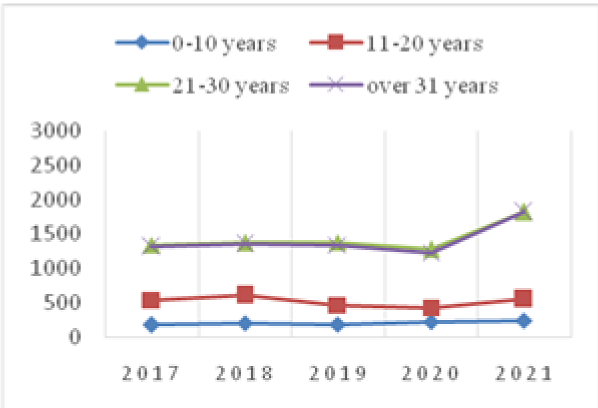

Fig. 5. Dynamics of the productivity of cooperatives in the Agricultural sector, 2017-2021
Source: the author's creation.

The statement made is proven by a detailed survey of the database of cooperatives in the studied sectors, as well as by an ANOVA analysis conducted to track the presence of significant differences at a significance level α=0.05.

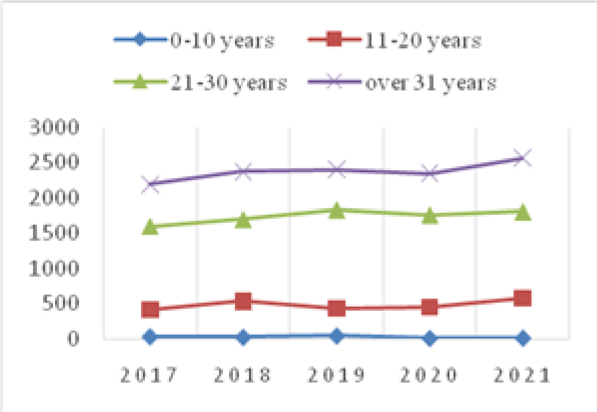

Fig. 6. Dynamics of productivity of cooperatives in the Manufacturing industry, 2017-2021
Source: the author's creation.

Growth

In this article, the growth of cooperatives is tracked based on the available fixed tangible assets per 1 employee that they own. In the database being studied, the majority of cooperatives are representatives of the Agricultural sector (85.11%).

They also show the presence of a more active development in the activities of cooperatives compared to those from the Manufacturing industry, something not so typical of practice in reality. Based on the available empirical data, it appears that the cooperatives from the Agricultural sector, which have been managing their activity for a short time or for a period of up to 10 years, are developing the fastest (Table 1).

They are followed by the cooperatives that have the longest period of service. Cooperatives that have existed for 11-20 years are observed with the least investment in fixed tangible assets per 1 employee.

In the Manufacturing industry, the cooperatives already established in the market are developing at the slowest pace, i.e. those with more than 31 years of experience.

The cooperatives that are the most prosperous and developing manage their activity for 21-30 years, followed by those that are at the beginning of their economic and labour activity.

Table 1. Average values of fixed tangible assets per 1 employee of the Agricultural sector and Manufacturing industry, distributed by age for the period 2017 - 2021

	2017		2018		2019		2020		2021	
	A.S	M.I.	A.S	M.I.	A.S	M.I.	A.S	M.I.	A.S	M.I.
0-10 years	116.94	39.59	138.33	54.42	139.78	57.13	178.51	113	181.03	113
11-20 years	126.06	42.94	83.98	42.53	87.03	46.98	97.53	90.79	147.10	84.27
21-30 years	109.75	88.57	118.95	91.59	125.85	87.72	132.44	88.39	159.08	99.79
over 31 years	114.01	42.75	124.96	45.55	140.15	61.56	138.36	63.31	177.62	77.66

Source: the author's creation.
Note: A.S.= Agricultural sector; M.I. = Manufacturing industry.

Based on the distribution of the cooperatives by age and size, it gives the impression that the cooperatives representing the Agricultural sector are developing more actively (Figure 7). Small cooperatives with 11-20 years of work experience have the highest growth, followed by micro cooperatives with the richest work experience. The manufacturing cooperatives with the highest growth are those that have already established themselves in the market and have been operating for more than 20 years. This is explained by the fact that they already have enough realized financial means and can afford to invest part of them for the future development and prosperity of the cooperatives.

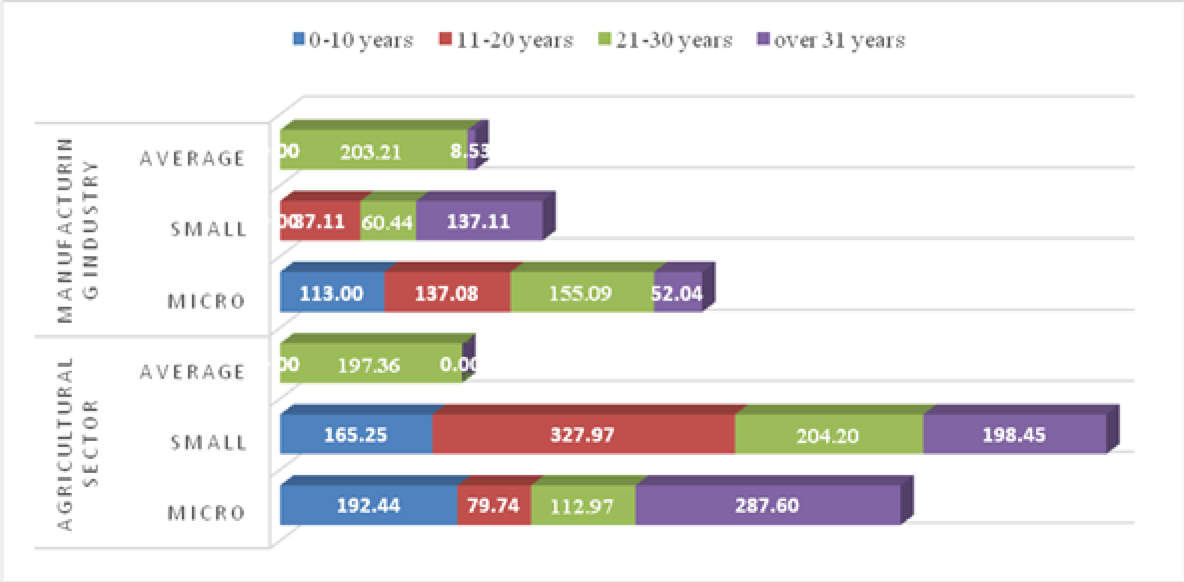

Fig. 7. Distribution of fixed tangible assets per 1 employee by size and age of cooperatives from the Agricultural sector and Manufacturing industry, 2021
Source: the author’s creation.

CONCLUSIONS

Based on the empirical analysis, the following conclusions can be drawn:
-Cooperatives in the Agricultural sector have greater cash receipts and are characterized by higher productivity compared to Manufacturing cooperatives. As for both sectors, there is a tendency to increase the income of net sales revenue and increase their productivity.
-The conducted empirical research proved the statement that cooperatives with more work experience realize higher productivity values. The statement is valid for both studied sectors – Agricultural sector and Manufacturing industry.
-Cooperatives from the Agricultural sector are developing more actively.
Among them, the most dynamic growth is observed in small cooperatives with 11-20 years of work experience, while in the Manufacturing industry, those with the highest growth are those that have already established themselves on the market and have been managing their activities for more than 20 years.

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REPUBLIC OF MOLDOVA'S CROP SECTOR- DEVELOPMENT TRENDS AND ASSESSMENT OF COMPETITIVENESS AT THE INTERNATIONAL LEVEL

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Abstract

The agricultural sector of the Republic of Moldova is strongly relying on the crop production sector, which has been holding an average share of about 70% of the total agricultural output, being followed by livestock sector and services. Crop sector's importance is determined through its contribution to ensuring food security, provision of raw material for the food processing sector and also support to the livestock's sector development. Therefore, the paper aims to evaluate the current development trends of the sector, by emphasizing its achievements on the foreign markets through assessment of its competitiveness. The used methodology is based on the scientific research methods like comparative analysis, synthesis, sectoral SWOT analysis and calculation of several competitiveness indices like Revealed Comparative Advantage, Revealed Symmetric Comparative Advantage, Trade Specialization Index and Grubel-Lloyd Index. The results present a continuous development of the sector with the need for production diversification and a competitive advantage on external markets for mostly raw material products like oil seeds, edible fruits and nuts, cereals, etc.

Key words: *agriculture, crop sector, competitiveness, Republic of Moldova*

INTRODUCTION

The crop sector of the Republic of Moldova represents an important asset of the entire agrifood sector, as it accounts for about of 70% of the total value of agricultural output. Its significance is confirmed by the great contribution to ensuring food security, provision of raw material for the food processing sector and also support to the livestock's sector development. At the same time, the economic impact of the crop sector is also noteworthy, especially with respect to the added-value crops such as fruits, vegetables and grapes [13].
The crop sector of the Republic of Moldova can be divided in several categories, based on the added-value of production. Therefore, the first group to be analysed is represented by cereals and technical crops in which the country has a direct specialization, with high amounts of production volumes, consumption, export and self-sufficiency level, but which are low added-value. The second group is represented by the horticultural subsector, meaning fruits, grapes and vegetables, which is considerably developing, but is lacking, at the same time, in market access, competitive labour force and injection of investments and innovation.
Assessing competitiveness of the crops sector is based on the assumption that the crop sector of the Republic of Moldova is capable of continuous development and maintenance of a good competitive ranking or position at the international level.
The competitiveness of Moldovan agri-food products has been analysed through the following aspects: competitiveness with respect to EU countries for all product groups [15], with respect to all countries by [4, 3, 5, 10].
[8] have assessed the competitiveness of the livestock sector, while Golban selected the horticultural production for assessment of competitiveness [6, 7]. Therefore, the crop sector with emphasize on certain important products has been poorly assessed within

existing studies has a room for additional evaluations.

In the framework of the recent evolutions at the regional level, climate changes, numerous crises like pandemic and humanitarian ones, increased prices for inputs and low prices for production, it is of particular importance to pay attention to the further development of the crop sector, by its modernization and increase of competitiveness at the international level.

In the framework of DCFTA and the recent status of a candidate country to EU, as well as due to the Russian Federation frequent embargoes on Moldovan horticulture products, Moldovan exports with cereals, technical crops, fruits, nuts, vegetables and grapes have a trend to be directed towards EU market, other countries and declining volumes to CIS countries.

Therefore, the paper aims to evaluate the current development trends of the crop sector, by emphasizing its achievements on the foreign markets through assessment of its competitiveness.

MATERIALS AND METHODS

The paper results and conclusions are based on the application of a series of scientific research methods aimed at achieving the main aim of the article. The analytical framework of the Moldovan crop sector is based on the following methods: analysis and synthesis, comparison, induction and deduction, etc. The main data sources with respect to output, production, self-sufficiency levels are represented by the Annual reports (2015-2024) and the database of the National Bureau of Statistics of the Republic of Moldova (2015 – 2024) [12].

In regard to the assessment of the competitiveness of the sector at the international level, a set of methods have been used, among which can be mentioned calculation of the Revealed Comparative Advantage (RCA), Revealed Symmetric Comparative Advantage (RSCA), Trade Specialization Index (TSI) and Grubel-Lloyd Index (GLI).

The following RCA formula has been used to evaluate the competitiveness degree of certain products or a group of products:

$$RCA = \frac{\frac{x_{ij}}{x_{it}}}{\frac{x_{nj}}{x_{nt}}} = \frac{\frac{x_{ij}}{x_{nj}}}{\frac{x_{it}}{x_{nt}}} \qquad (1)$$

where: X represents exports, i – a country, j – a commodity or an industry, t – a set of commodities or industries, and n – a set of countries [1]. If RCA> 1, it means that the analysed country holds a comparative advantage in a specific sector in which the country is specialized in terms of exports [11].

Taking into account that RCA indicator is a bit incomparable, the symmetric index is used for allowing certain comparisons (RSCA), which has been calculated based on the formula:

$$RSCA = \frac{RCA_{ij}-1}{RCA_{ij}+1} \qquad (2)$$

Moreover, the interpretation of RSCA is similar with that of RCA. RSCA greater than 0 implies that country i has comparative advantage in good j. In contrast, RSCA less than 0 implies that country i has comparative disadvantage in product j [14].

One more indicator used in the paper is the trade specialization index. It aims to analyse the relation between the net flow of goods and the total flow of goods.

$$TSI = \frac{X-M}{X+M} \qquad (3)$$

In this case, X is being defined as exports, while M – as imports.

This indicator is considered to be more appropriate in the identification of the real producers of certain goods, or a category of goods, as it extracts the large exports values that result from activities related to re-export [10].

And the last index - Grubel–Lloyd is entitled to measure the intra-industry trade of a particular product, being introduced by Herb Grubel and Peter Lloyd in 1971. It is calculated as

$$GLi = 1 - \frac{|X_i-M_i|}{X_i+M_i} \qquad (4)$$

where: Xi denotes the export, and Mi - the import of the good i. In case when GLi = 1, it points on the existence of only intra-industry

trade, with no inter-industry trade identified. Overall, the explanation is that the given country is exporting the same amount of a certain good as it is importing. Nevertheless, when GLi = 0, it signifies the lack of intra-industry trade, with the presence of only inter-industry trade, meaning that a certain good is either imported, or exported [10].
The data used for assessing the crop sector's competitiveness at the international level is based on the statistical data provided by UN Comtrade database (2024) [16]. WITS database (2024) [17] and National Bureau of Statistics of the Republic of Moldova (2015 – 2024) [12].

RESULTS AND DISCUSSIONS

During the period of 2000 – 2022, the share of crop production in the total agricultural production has varied between 58% in 2012 to 81.1% in 2021.
The average share accounts for about 70%, which indicates on the great role of the crop sector within the total agricultural output (Figure 1).

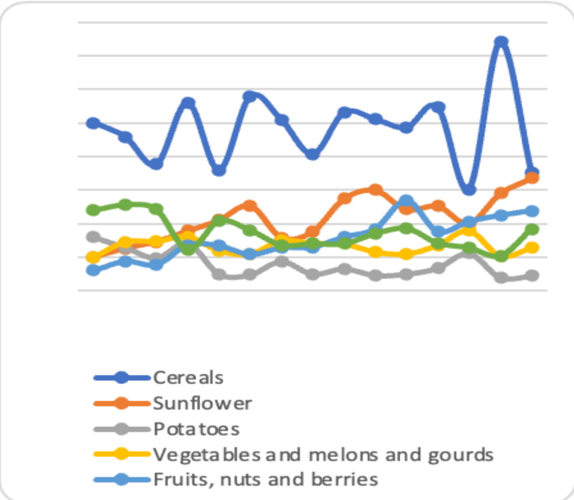

Fig. 1. Share of the main crop products in the agricultural output, %
Source: National Bureau of Statistics of the Republic of Moldova, 2023 [12].

In order to achieve the aim of the paper, the crop sector of the Republic of Moldova has been separated in several sub-sectors, mainly: cereals and technical crops, vegetables, fruits, nuts and grapes.
*Cereals and technical crop s*have a significant share in the total agricultural output. During 2000 – 2022, their share fluctuated between 25.1% in 2020 to 51.5% in 2021. The average share during the analysed period accounts for 35%. Therefore, the largest share of the agricultural output is occupied by low added-value crops like wheat, maize and sunflower (Figure 2).
At the same time, most of the sown areas of arable land is occupied by cereals and technical crops, which indicates on a certain level of specialization of the country for this type of production.

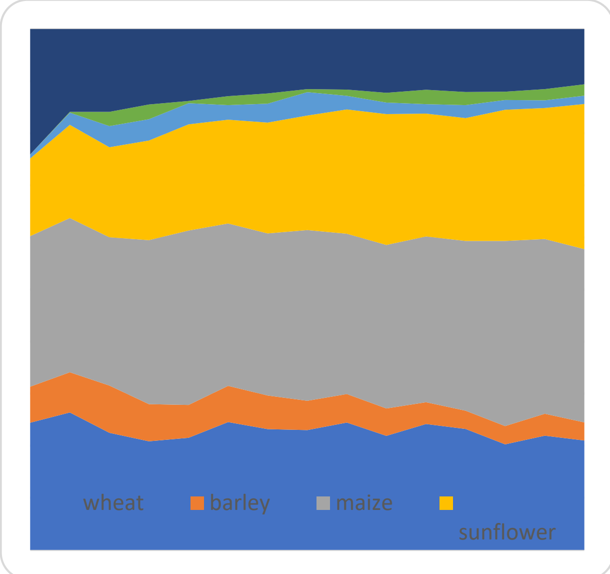

Fig. 2. Share of cereals and technical crops in the total sown area, %
Source: National Bureau of Statistics of the Republic of Moldova, 2023 [12].

Production of cereals and technical crops is marked by important fluctuations due to severe droughts have been affected the country recently. Therefore, there are noted significant decreases in production in 2012, 2015, 2020 and 2022 – years with difficult climate conditions (Figure 3). The strong dependence on weather conditions makes this agricultural sub-sector to be of an increased-risk activity. Taking into account the lack of an attractive insurance system for Moldovan farmers, as well as appropriate banking conditions for insuring the yield, the gaps registered in production during years with severe drought have a significant impact on the public support program, mainly through the need to distribute additional funds (or the

existing ones) for countering the effects of adverse climate conditions. At the same time, the lack of irrigation systems also represents a cause for the low production.
Therefore, the need of climate-change adaptation and mitigation measures is strongly correlated with the current state of the sector and more emphasize should be placed on the development of cereals and technical crop production in a sustainable practice, taking into account the climate factors.

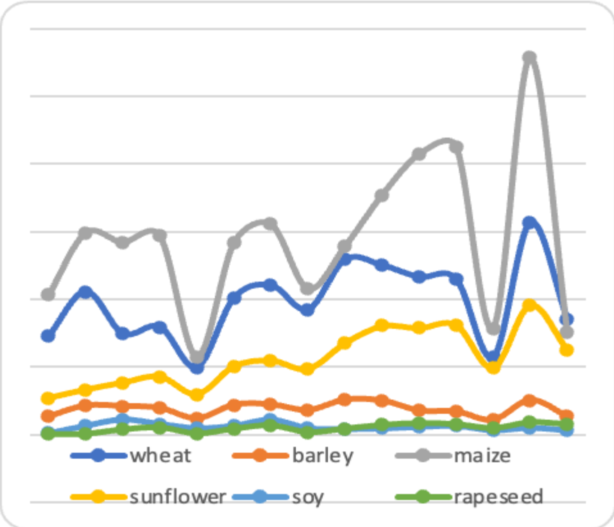

Fig. 3. Cereals and technical crops production, thous. tons
Source: National Bureau of Statistics of the Republic of Moldova, 2023 [12].

The self-sufficiency level of wheat is mostly over 100%, as being an important product for ensuring food-security, there is also a state reserve of wheat intended for emergency purposes. The market regulation for heat is a liberalized one, with very few and random cases of export prohibition. Maize is more affected by climate changes than other crops, and significant issues arise for agricultural producers engaged in cultivation of maize, especially from the South region of the country, where the volume of annual precipitations is decreasing. Thus, the shortage of maize, being one of the most important forage crops for the livestock, creates preconditions for hindering the development of the animal sector in the subsequent period, due to its insufficiency in production. With respect to sunflower, being one of the most attractive crops for Moldovan farmers, the self-sufficiency level during 2012 – 2022 is always exceeding 100%. (Figure 4).

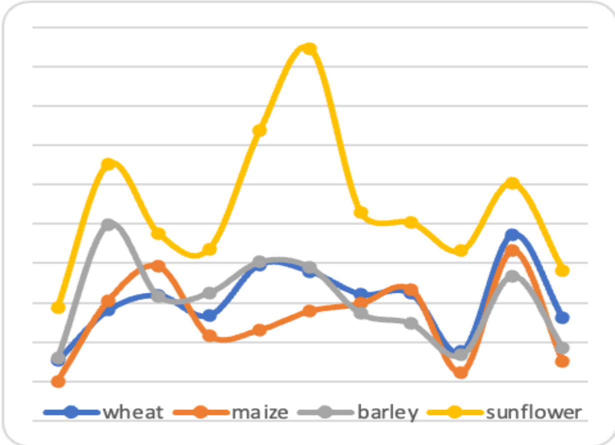

Fig. 4. Cereals and technical crops self-sufficiency level, %
Source: National Bureau of Statistics of the Republic of Moldova, 2023[12].

With respect to cereals and technical crops, based on the analysis of the Trade Specialization Index (TSI), Republic of Moldova during 2015 – 2022 has been a net exporter of wheat, barley, maize, rape seed and sunflower. Fluctuating values have been noticed for rye and oats (Figure 5).

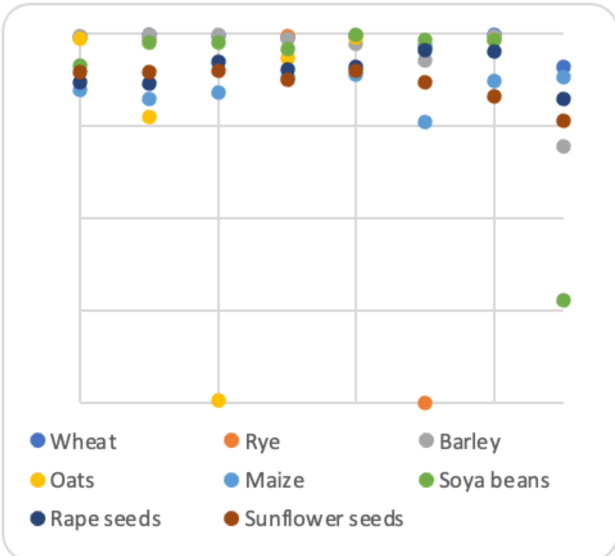

Fig. 5. Trade Specialisation Index, TSI, for cereals and technical crops
Source: authors' calculations.

The Grubel–Lloyd index which is entitled to measure the intra-industry trade provides for the figures below (Table 1). Based on it and taking into account that for most of the values are quite closed to zero for all the analysed products, it can be concluded that there is little intra-industry trade. This would mean that the country either only exports or only imports the above-mentioned goods.

Table 1. Grubel–Lloyd index for cereals and technical crops

	2015	2016	2017	2018	2019	2020	2021	2022
Wheat	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2
Rye		0.0		0.0		0.0		
Barley	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.6
Oats	0.0	0.4	0.0	0.1	0.0		0.0	
Maize	0.3	0.4	0.3	0.2	0.2	0.5	0.3	0.2
Soya beans	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.6
Rape seeds	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.4
Sunflower seeds	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.5

Source: authors' calculations.

Having a net export status for the most important cereals and technical crops like wheat, maize and sunflower, the RCA indicator confirms the competitiveness with respect to the world market for these products. Thus, RCA values are extremely high for sunflower seed reaching 265 in 2022, followed by maize – 29, rape seeds – 14, etc. All the cereals and technical crops analysed except oats, rye and soya beans in some years have RCA values higher that 1, meaning a comparative advantage on the world market of these products (Table 2).

Table 2. RCA index for cereals and technical crops with respect to world market

	2015	2016	2017	2018	2019	2020	2021	2022
Wheat	11	20	19	16	16	4	26	5
Rye		0		1		0		6
Barley	18	19	24	15	8	3	21	4
Oats	0	0	0	2	0		0	0
Maize	12	12	13	23	23	15	17	29
Soya beans	4	1	1	1	1	1	0	0
Rape seeds	7	10	21	22	25	14	25	14
Sunflower seeds	378	397	381	335	319	281	289	265

Source: authors' calculations.

The RSCA indicator gives a more comparable approach with respect to competitiveness of products. The data can be visualized in the figure below and indicates on strong competitive advantage of sunflower, wheat, maize and rape seeds and negative values for oats, rye and soya bean (Figure 6).

The vegetable sector has also a significant role in the agriculture of the Republic of Moldova, especially due to its impact on the food security and the population's diet. Vegetable production is characterized by a strong seasonality and it largely depends on natural conditions and market availability (Ignat., A., Tirigan, S., Lucasenco, E., 2018) [9].

The Moldovan farmers also face a great competition on the internal market as a result of massive imports of vegetables from other countries. Greenhouses are still under development, as most of the vegetable products are grown in open fields. There is also more room for the development of organic vegetable production, which is also supported by state through the exiting subsidy program.

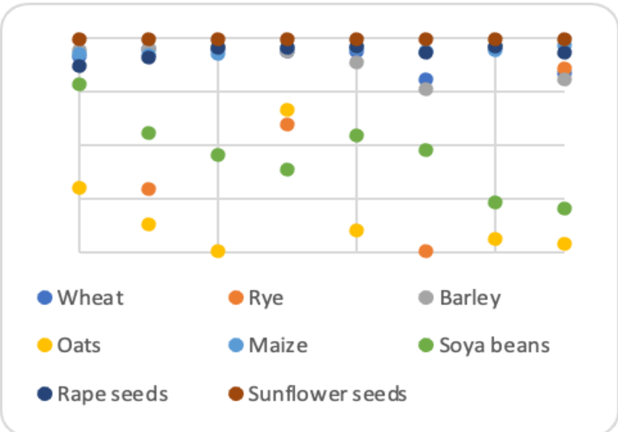

Fig. 6. RSCA for cereals and technical crops
Source: authors' calculations.

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Vol. 24, Issue 2, 2024
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In 2022, vegetables accounted for about 6.4% in the total agricultural output value. Between 2015 and 2022, decreases in agricultural production are observed in: potato (from 214.0 thousand tons to 171.8 thousand tons), cabbage (from 23.7 million tons to 15.7 thousand tons), tomato (from 54. 6 thousand tons to 47.1 thousand tons), cucumbers (from 17.3 thousand tons to 16.1 thousand tons) and garlic (from 10.2 thousand tons to 8.3 thousand tons). However, increases in agricultural production were recorded for a number of vegetables like: carrots (from 16.1 thousand tons to 23.5 thousand tons), peppers (from 9.8 thousand tons to 13.8 thousand tons) and eggplant (from 4.2 thousand tons to 6.2 thousand tons).

The level of self-supply with all types of vegetables is insufficient. Decreases are noted for tomatoes, cabbage and cucumbers (Table 3).

Table 3. Self-sufficiency level with vegetables, %

	2016	2017	2018	2019	2020	2021	2022
Vegetables, total	99.8	96.9	86.3	85.5	78.2	79.0	81
Tomatoes	74.6	83.1	72.7	57.1	41.3	47.8	67.5
Cabbage	-	-	-	80	79.9	70.6	48.7
Cucumbers	-	-	-	96.8	84.0	99.5	59.6
Others	108.1	101.6	90.7	93.1	91.6	88.3	97.7

Source: National Bureau of Statistics of the Republic of Moldova, 2023 [12].

With respect to the weak points of the given sector, they are based on the lack of production diversification, insufficient irrigation systems, absence of high-quality inputs, and lack of producers' associations.

With respect to vegetables, based on the analysis of the Trade Specialization Index, Republic of Moldova during 2015 – 2022 has been a net importer of potatoes, tomatoes, onion and garlic, cabbages, carrots and cucumbers (Figure 7).

Based on the net importer status, it is expected for the Moldovan vegetables to be lacking in competitiveness on the foreign market.

Therefore, RCA values higher than 1 have been registered in random years for potatoes, tomatoes, onions, and carrots, but they are more an exception to the general rule of low competitiveness (Table 4).

The prospects of the development of the vegetable sector can be seen through the development of processing industry, mainly of frozen vegetables and organic agriculture. Moreover, new opportunities emerge for agricultural producers who may get specialized in cultivation of different salads like lettuce or rucola, parsley, broccoli or cauliflower. For all of this to take place, there is a need to develop specialized micro-zones and centres.

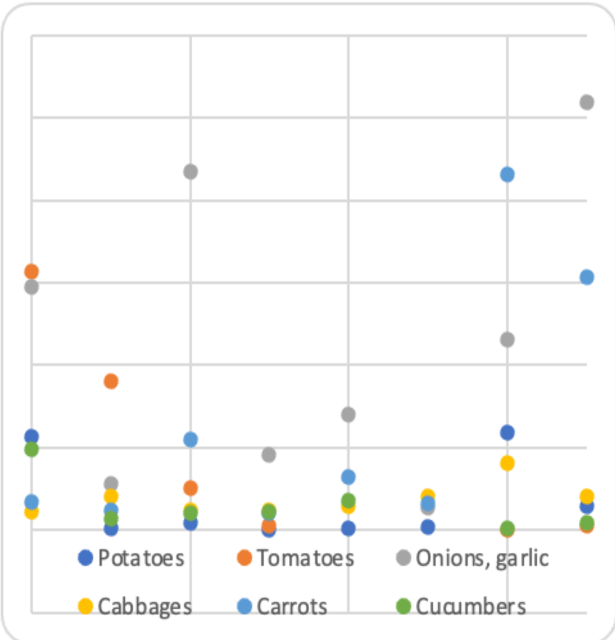

Fig. 7. TSI for vegetables
Source: authors' calculations.

Republic of Moldova is specialized in growing *fruits, nuts and grapes.* Moldovan fruits have remarkable organoleptic qualities that distinguish the products among others of different origin. The tradition of growing fruits and grapes is an old one, being based on the appreciation of taste and quality of fresh and processed products [2].

Table 4. RCA values for vegetables, %

	2015	2016	2017	2018	2019	2020	2021	2022
Potatoes	1.7	0.0	0.1	0.0	0.1	0.1	1.3	0.3
Tomatoes	3.0	1.4	0.3	0.1			0.0	0.0
Onions, garlic	0.8	0.1	0.8	0.6	1.0	0.1	0.8	2.4
Cabbages	0.1	0.3	0.1	0.2	0.2	0.2	0.6	0.3
Carrots	0.2	0.2	0.7	0.2	0.6	0.3	2.5	2.9
Cucumbers	0.6	0.1	0.1	0.2	0.3		0.0	0.1

Source: authors' calculations.

In the last 10 years, the sector has received a massive attention from the state through the subsidy program, where measures for deforestation, plantation, installation of anti-hail and anti-rain systems have been supported.

These all led to the beginning of deforestation of old, unproductive plantations and planting of new varieties required mainly on the international markets in super-intensive of intensive orchards.

Overall, the planted surface has undergone some changes for apples, with a decrease from 57.8 thous. ha in 2016 to 51.2 thous. ha in 2022, for peaches (from 7.9 thous. ha to 5.4 thous. ha) and vineyards (from 135.3 thous. ha to 116.5 thous. ha). Increases have been noticed for cherries, sour cherries, apricots and nuts plantations (Table 5).

In 2022, fruits accounted for 11.9% in the total value of the agricultural output, while grapes – 9.2%. As for production, during 2016 – 2022, apples have increased from 411.8 thous. tons to 447.7 thous. tons, with a peak of 665.2 thous. tons in 2018, sour cherries from 4.1 thous. tons to 9.7 thous. tons and cherries from 7.6 thous. tons to 13.6 thous. tons.

Relatively stable values have been registered for apricots, peaches, plums and nuts and significant decreases for grapes (from 615.7 thous tons to 531.2 thous. tons) (Figure 8). Climatic conditions are one of the main factors in the decrease of the grape harvest in recent years, accompanied by plantations with varieties with low productivity.

Table 5. Area planted with fruit trees and vine, thous. ha

	2016	2017	2018	2019	2020	2021	2022
Apples	57.8	58.1	57.4	56.6	56.0	53.3	51.2
Sour cherries	3.8	4.0	4.1	4.2	4.4	4.5	4.8
Cherries	4.2	4.3	4.7	5.1	5.2	5.3	5.3
Apricots	4.0	4.2	4.3	4.5	4.4	4.4	4.5
Peaches	7.9	7.8	7.2	6.6	6.1	5.6	5.4
Plums	22.3	22.6	22.9	22.8	22.2	21.3	21.0
Nuts				26.7	33.2	35.0	35.5
Vineyards	135.3	129.7	133.0	126.0	121.2	117.5	116.5

Source: National Bureau of Statistics of the Republic of Moldova, 2023 [12].

The self-sufficiency rate for fruits is on the rise, increasing from 195.8% to 205.3% between 2006 and 2022.

The fruit sector represents an important component of the exported agri-food goods of Moldovan origin. Therefore, the export of "Edible fruits and nuts" has a share of around 18-20% in the total value of exports of agri-food products. The export value of this group of products exceeds the import values by about 2.7 times, the main exported subgroups being: "Other nuts, fresh or dried, whether or not peeled", "Apricots, cherries, sour cherries, peaches (including nectarines), plums and plums, fresh", "Apples, pears and quinces, fresh" and "Grapes, fresh or dried" (Ceban, A., 2022) [2].

With respect to fruits, nuts and grapes, based on the analysis of the Trade Specialization Index, Republic of Moldova during 2015 – 2022 has been a net importer of quinces, pears and walnuts and a net exporter of plums, cherries, sour cherries, apricots, apples and grapes (Figure 9).

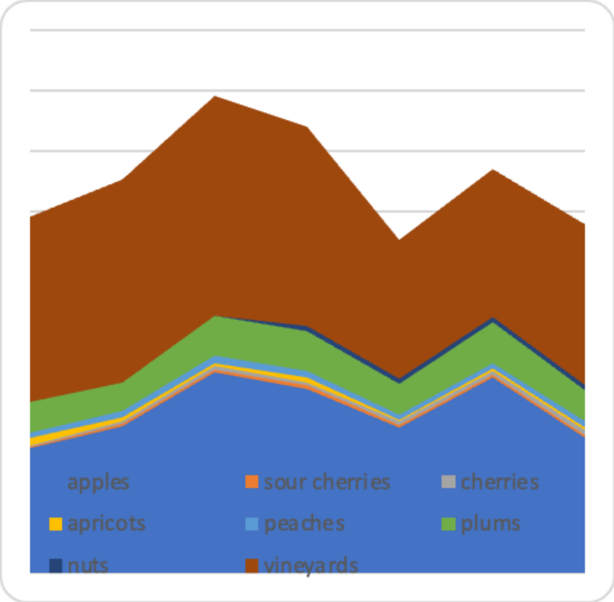

Fig. 8. Fruit and grapes production, thous. tons
Source: National Bureau of Statistics of the Republic of Moldova, 2023[12].

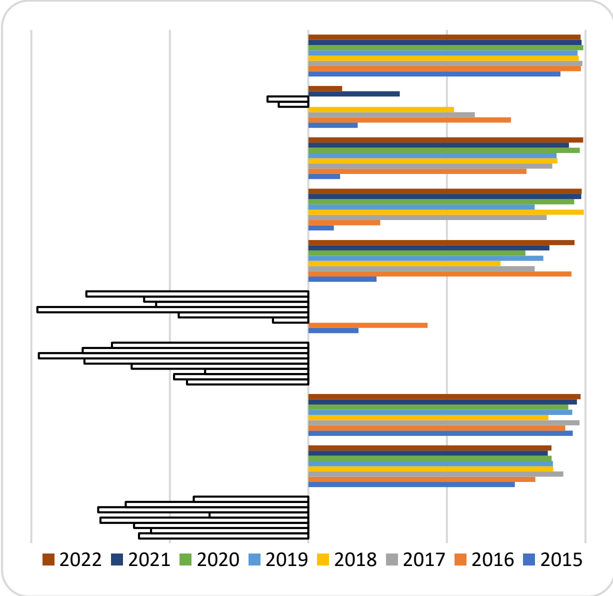

Fig. 9. TSI for fruits and grapes
Source: authors' calculations.

Table 6. GLI values for fruits, nuts and grapes, %

	2015	2016	2017	2018	2019	2020	2021	2022
Walnuts	0.4	0.4	0.4	0.2	0.6	0.2	0.3	0.6
Grapes	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Apples	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0
Pears	0.6	0.5	0.6	0.4	0.2	0.0	0.2	0.3
Quinces	0.8	0.6	0.9	0.5	0.0	0.5	0.4	0.2
Apricots	0.8	0.1	0.2	0.3	0.2	0.2	0.1	0.0
Sourcherries	0.9	0.7	0.1	0.0	0.2	0.0	0.0	0.0
Cherries	0.9	0.2	0.1	0.1	0.1	0.0	0.1	0.0
Peaches	0.8	0.3	0.4	0.5	0.9	0.9	0.7	0.9
Plums	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: authors' calculations.

When analysing this sub-sector from the point of view of the Grubel–Lloyd index, we find out that with respect to apples, sour cherries, cherries, grapes, apricots and plums, GLI is quite close to zero, which means only a small amount of intra-industry trade. For walnuts, quinces, and peaches, the calculated values are near the figure of 1, pointing on the intra-industry trade (Table 6).

The RCA values for fruits, nuts and grapes are greater than 1 for all the analysed products except pears. High values are recorded especially for plums, sour cherries and apples, being followed by grapes, walnuts and cherries (Figure 10). Therefore, Moldova is highly competitive on external market with fruits, just like for cereals and technical crops.

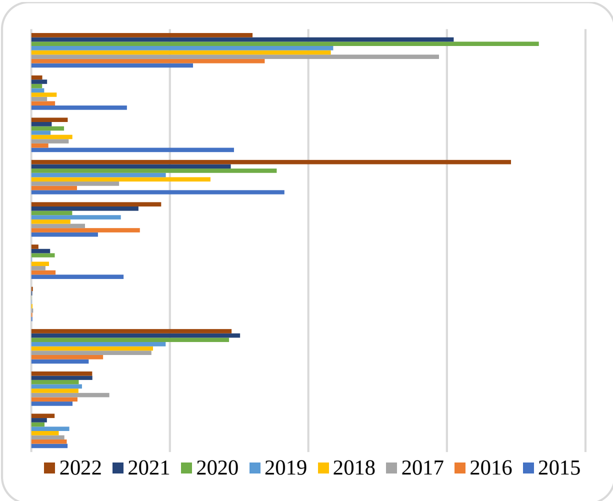

Fig. 10. RCA for fruits, nuts and grapes
Source: authors' calculations.

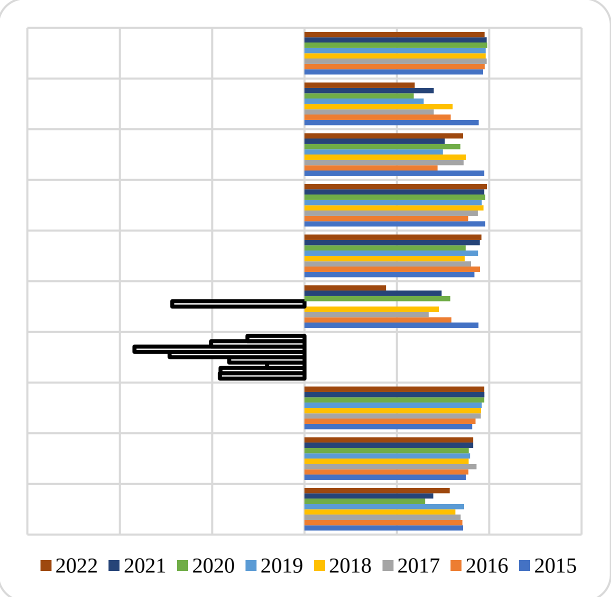

Fig. 11. RSCA for fruits, nuts and grapes
Source: authors' calculations.

The RSCA indicator gives a more comparable approach with respect to competitiveness of fruits, nuts and grapes (Figure 11). The data can be visualized in the figure below and indicates on strong competitive advantage of all fruits, except pears and to a lesser extent – quinces.

CONCLUSIONS

The crop sector of the Republic of Moldova has an important impact on ensuring population's food security and dietary needs. It also represents a sector in a continuous development that needs additional incentives for its modernization and continuous growth. State support is significant and the first results are already noticeable, but additional recommendations are provided for its development.
For cereal and technical crops, which have an important share in the agricultural output, as well in the foreign trade, being some of the most competitive products externally according to the RCA indicator, the following recommendations are proposed:
- Improvement of crop cultivation technologies and precision agriculture. Large yields and increased productivity can be achieved through proper fertilizer management, optimizing crop rotation, controlling moisture levels through modern irrigation practices, soil conditions and pest stress. By providing the sector with more precise planting and cultivation practices, farmers can benefit from increased efficiency and better cost management.
- Elaboration of antitrust rules for agricultural products that will help protect farmers from concerted commercial practices.
- Special incentives to diversify cultivated grains by increasing organic production and smaller-scale grains such as sorghum, oats or rye will help meet changing consumption patterns and international demands for high-value grains.
- Strengthening value chain infrastructure such as efficient storage facilities, transportation, export procedures and other means of facilitating exports and reducing costs. Farmers can be given more flexibility in adjusting production to a certain market category, as well as making the decision to store or sell production at a certain time of the year, thus increasing the chances of getting a higher price.
For fruits and vegetables, there is a need to support the development of processing sector, as it is one with the most perspectives and possesses high-quality raw material. RCA values are high for fruits and low for vegetables, which points on the need for additional developments in the vegetable sector. Development of agri-food clusters is another recommendation aimed at the establishment of modern infrastructure and common facilities for processing units. For the vegetable sector, it is becoming imperative to create profile associations able to represent the farmers and provide them with the necessary support. Moreover, it is necessary to support market research and business partnerships for the production of value-added processed fruits and vegetables. And one of the most important is the undertake of actions with respect to future farming, based on modern greenhouses and indoor vertical farming.

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CONCURRENCY AND DISTRIBUTION IN ECONOMIC MARKETS: MODEL DESCRIPTION

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Abstract

Economic markets can be modeled using a system-based approach. In an economic system, agents have complex behavioural patterns, two of the most important being concurrency and cooperation. In this paper, we present a model of an economic system that integrates the dual characteristic of economic system. On one hand, the concurrent characteristic is modeled using Petri nets and focuses on determining the agent behavioural patterns in the system related to the resources distribution and market share. On the other hand, the cooperation characteristic is related to the determination of an agent that can influence the market behaviour, using a model based on Leader Election. In this matter, the concurrency between agents is integrated with market coordination, useful in contexts as quality standard establishment or collective issues. The context of the model related to distribution can be further developed, especially related to agrifood chains in economic markets, by establishing a classification of the agents of the economic market, useful for a vertical integration of the market.

Key words: *economic market, concurrency, cooperation, model*

INTRODUCTION

Mathematical modeling and information systems are important scientific tools which could offer solutions for economic development in many fields of activity [1, 6, 12].

Economic markets are dynamic and complex systems that involve the interaction of various agents, each with its own unique behavioral patterns [11, 15].

Concurrency [16] and cooperation [18] are two fundamental aspects of these systems, influencing the dynamics of resource distribution [3, 7], market share [8] and overall market behavior [13].

In this paper, we propose a novel approach to modeling economic markets using a system-based methodology.

Our model integrates the dual characteristics of economic systems by leveraging two key modeling techniques: Petri nets [2, 14, 5] and Leader Election [9, 10].

The approach is not novel, but it is based on the particular nature of local and European agrifood chain structure.

Petri nets are utilized to capture the concurrent nature of economic activities, focusing on understanding the behavioral patterns of agents in relation to resource distribution and market share dynamics.

On the other hand, Leader Election is employed to model cooperation among agents and determine influential actors that shape market behavior.

By combining these approaches, we aim to provide a comprehensive understanding of how concurrency and cooperation interact

within economic systems.
Furthermore, our approach is not limited to the economic domain, but can be adapted and applied to a variety of other contexts, including team management and education, to better understand the dynamics of interactions and decision making in these domains.

MATERIALS AND METHODS

The first important step of the study run in this paper was considered to be the development of a bibliographic study related to agrifood chain modelling. In this matter, the bibliographic study was created using the Dimensions.ai scientific database [4] as the search domain and the VOS Viewer software [17] as the mapping instrument.

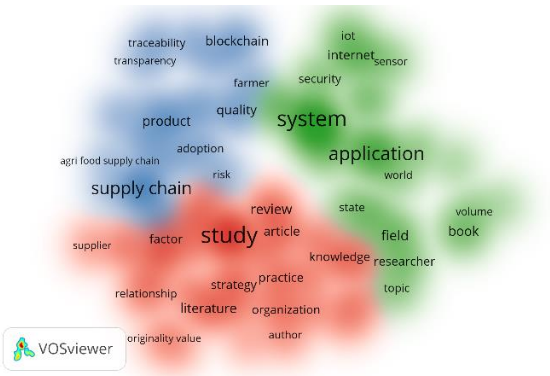

Fig. 24. Graphical representation of the most relevant research terms
Source: Own results.

We can observe that the main directions of research in the literature were delimited related to the scientific method (red cluster), the economic aspects (blue cluster) and technology-based approaches (green cluster). In this matter, the most relevant terms related to technological-based approaches were selected and are shown in Table 1.
The main technology-based approaches were determined to be close to the instruments used for modelling, such as machine learning, blockchain technology and artificial intelligence, but also related to the agrifood chain characteristics, such as traceability, transparency and relationship. Finally, the practical aspects of technology implementation in the agrifood chain were determined, delimited by terms such as IoT, sensor or Internet.

Table 1. Term list related to the research subject with the occurrences and relevance scores

No.	Term	Occurrences	Relevance score
38	machine learning	118	2.4417
33	Iot	254	2.4195
32	Internet	321	2.1962
62	Supplier	145	2.0693
55	Sensor	167	1.9687
72	transparency	147	1.9468
71	traceability	204	1.804
70	Topic	232	1.3377
10	blockchain technology	224	1.2626
49	relationship	237	1.2559
7	artificial intelligence	213	1.2151

Source: Own results.

Now, in order to establish the main conceptual aspects of the model, we will take into consideration the main two ideas related to the economic model: concurrency and cooperation. This paper extends an approach of establishing an economic map [1] which uses a graph-based approach and graph algorithms to model the structure and functionality of an geographical economic map. This paper focuses on the development of a model which deals with two of the most important aspects of an economic market within an agrifood chain, as mentioned above. The market will be modelled based on two components
-the enterprise (E), defined as a node within a network;
-the relationship between the enterprises (R), defined as a link between two nodes. A relation is defined as a transaction between a provider E (EP) and a client E (EC) and can be approached based on two characteristics: existence and intensity.
The model of enterprises and relations can be seen in Fig. 25.

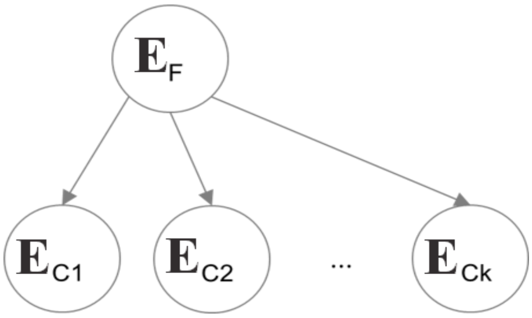

Fig. 25. An example of modelling relationships between enterprises
Source: Own conception.

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The enterprises are grouped alongside the agrifood chain, forming in this matter clusters based on its components.

Agrifood chains are complex systems with various stages, from production and processing to distribution and consumption.

Within the agrifood chain, several key stages can be identified:

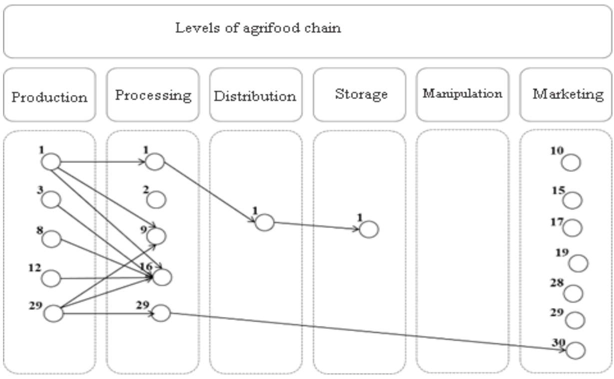
(1)*Food Production*: This stage encompasses factors related to agricultural activities, such as growing crops or raising livestock.

(2)*Processing:* Here, raw materials from production are transformed into refined food products through various processes.

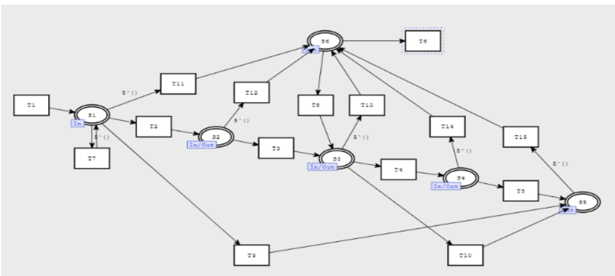
(3)*Logistics*: This stage involves the efficient movement and handling of food products throughout the chain, from producers to processors and then to distributors.

(4)*Distribution:* This step brings the food closer to its final destination - the consumer - by making it readily available through various channels.

(5)*Marketing to consumption*: Finally, the food reaches its ultimate purpose - being consumed by the end user.



(a)



(b)

Fig. 26. Examples of models related to agrifood chains: (a) graph-based approach; (b) Petri net approach
Source: Own conception.

A pictorial view of the organisation of the enterprises on the agrifood components organisation can be seen in Fig. 26.

The first approach (a) is based on graph theory, being a result of an implementation on a geographical economic map of a village. The second model (b) presents the clusters on the agrifood chain and the waste management alongside it.

Thus, we can observe that relations are established based on the place of the enterprise within the agrifood chain and several other characteristics.

In this paper, the main characteristics taken into consideration are:

-the enterprise turnover, which defines the economic power of an enterprise, used in the cooperation model;

-the situation of the enterprise in the agrifood level as a classifier operator. Usually, the enterprises are situated automatically alongside the agrifood chain by their NACE code, but, for simplification reasons, the enterprises are classified manually with the correspondent agrifood level identificatory (1 to 5). It is used in the concurrency model.

The considered agrifood system may be represented as a Petri net PN, which is considered to be a quintuple $PN = \{ S, T, A, F, M_0 \}$, where:

$S = \{S_i | i = 1,n\}$ is the set of places, which will model the enterprises;

$T = \{T_i | i = 1,m\}$ is the set of transitions, which will model the transactions;

$A = \{(T_i, S_j) | i = 1,m; j = 1,n\}$ is the set of arcs (edges), which will represent relationships between enterprises;

$F = c \times S_i \xrightarrow{T_k} p \times S_j, i,j = 1,n; k = 1,m$ is the arc function, which will delimit the requirements for a transaction to be made;

$M_0 = \{S_l | S_l \textit{ is in the final agrifood component}\}$ is the initial state of the Petri net, delimited by the leader of the market.

This model uses an arc function to account for waste within the agrifood chain. This function acts like a multiplier, determining the power of an enterprise at each stage.

A variable, denoted by c, represents the minimum number of tokens required in state S_i for transition T_k to activate. When the transition fires (representing a stage in the chain), state S_j produces p tokens. In this matter, an inverse path related to agrifood chain flow could be used, in order to use the arc function properly.

Concurrency model

The concurrency model aims to study the network based on the competition between the enterprises situated at the same level in the agrifood chain. The methodology of concurrency model design comprises the following steps:

S1.The identification of the net components: in this matter, the states will be modelled as the enterprises, the transitions will be transactions between them, arcs will be relationships between them and the function would be related to the turnover ratios between the enterprises.

S2.The definition of the conditions used for the transition firing: in this matter, a transition will be made whether the client enterprise (EC) will reach a threshold of tokens related to the provider enterprise (EP), where a token can be represented as a turnover unit (e.g., thousand lei).

S3.The Petri model build: the net is implemented using specific instruments. For this purpose, a Python implementation for the generation of the network, the Orange software for visualisation and the CPN software for modeling were used.

S4.The simulation of the model: the results, as configurations of the market, are obtained after the simulation of Petri nets.

Cooperation model

The main purpose of the cooperation model is related to the determination of the leader enterprise of the market in order to establish several aspects such as quality standard establishment or common approaches for collective issues.

The cooperation model is obtained using a Leader Election algorithm. The phases of the development of the cooperation model are:

S1.The identification of the net components: in this matter, the states will be modelled as the enterprises, the transitions will be transactions between them, arcs will be relationships between them and the function would be related to the turnover ratios between the enterprises.

S2.The selection criteria establishment: for the current implementation, the selection criteria for the leader is selected to be the turnover.

S3.The implementation of the Leader Election algorithm: the implementation is made using a Python script.

S4. The integration with the concurrency model: this step will be accomplished by marking the leader as the main node in the Petri net, with consequences related to the market dynamic.

S5. Simulation and analysis of leader behavior and its impact on the economic system: this may involve evaluating the leader's performance and effectiveness under various input scenarios and conditions.

The two models are then integrated in order to facilitate market coordination, enabling effective decision-making processes in contexts such as establishing quality standards or addressing collective issues.

RESULTS AND DISCUSSIONS

The results were determined for a randomly-generated network of 10 enterprises for which the turnover and the place in the agrifood chain were considered.

The agrifood chain components were encoded with 1 to 5, according to the list presented in the previous sections. The characteristics of the enterprises are presented in

Table 2 and Fig. 27.

Table 2. The characteristics of the generated enterprises

No.	Enterprise	Turnover [lei]	Agrifood chain place
1.	Enterprise 1	3,579,258	1
2.	Enterprise 2	4,854,139	2
3.	Enterprise 3	8,587,311	2
4.	Enterprise 4	8,075,937	1
5.	Enterprise 5	7,735,355	5
6.	Enterprise 6	6,156,748	3
7.	Enterprise 7	1,315,977	4
8.	Enterprise 8	3,141,598	4
9.	Enterprise 9	8,487,998	3
10.	Enterprise 10	8,351,205	5

Source: Own results.

We can observe that the randomly-generated

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data has a close resemblance with a real unsimulated environment. The next figure shows the graphical view of the characteristics.

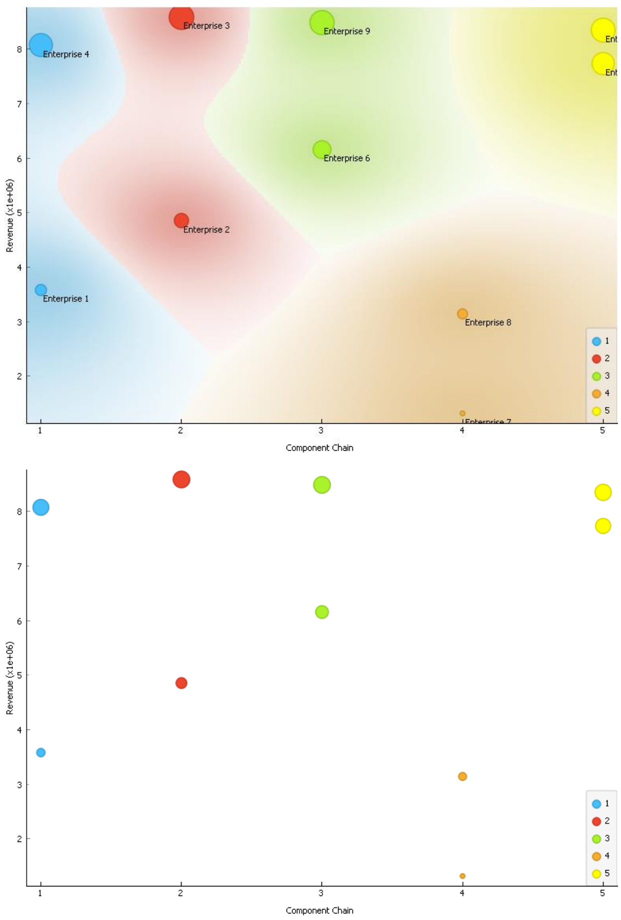

Fig. 27. The characteristics of the generated enterprises
Source: Own results.

In Fig. 27, the enterprises were plotted on a scatterplot graph, where x-axis represented the component of the agrifood chain and the y-axis the turnover of the enterprises. This graph shows more clearly the distribution of the enterprises by agrifood chain component (vertically) and by turnover (horizontally). The enterprises are balanced related to their turnover, showing a potential well-balanced network of enterprises, as well as for the number of enterprises per agrifood chain component. Further, the network of enterprises is presented in Fig. 28. The relationships between the enterprises were determined based on a hybrid implementation, which used both random and turnover-based requirements between the enterprises. The random approach simulated a real-life scenario, where relationships are not entirely based on aspects such as the turnover.

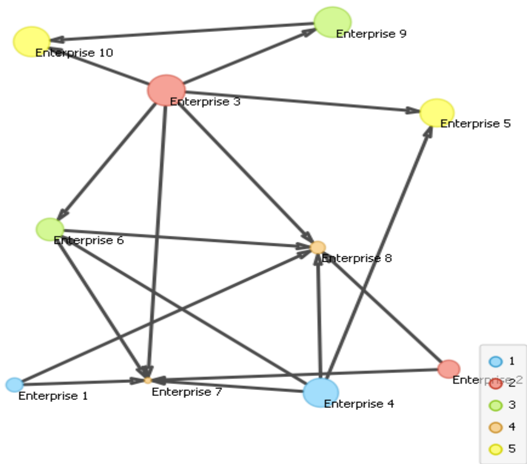

Fig. 28. The generated network based on the requirements
Source: Own results.

In Fig. 28, the enterprises network shows a potential configuration of the network, taking into account the economic power (turnover). In order to apply the model to the given example, a Petri net was considered. In this matter, the obtained result is shown in Fig. 6.

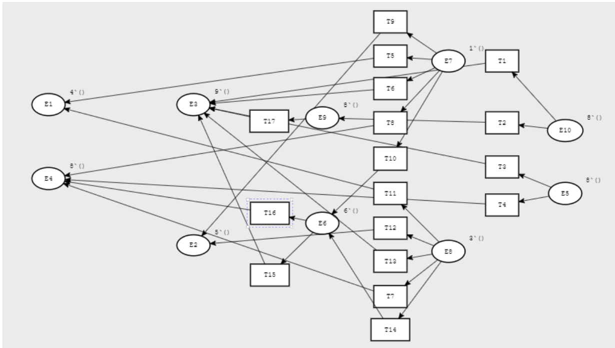

Fig. 29. The correspondent Petri net obtained for the generated network
Source: Own results.

As observed, the net represents the economic concurrency and the main aspects related to the economic power of the enterprises at each level of agrifood chain. After the simulation run, the less powerful enterprises were established as the ones with the lowest turnover (E7 and E8) and the highest were established E3 and E4. On each level, the results showed that:
-for level 5, the most powerful enterprise was E10;

-for level 3, the most powerful enterprise was E9;
-for level 2, the most powerful enterprise was E3;
-for level 1, the most powerful enterprise was E4.

For level 4, the enterprises had not established forward relationships with level 5, due to the low turnovers.

As for the cooperation within the network, the Leader Election algorithm was established. The algorithm was implemented using the Python library Network X. In this example, the election of the leader is done using the betweenness centrality algorithm, available in the library. This algorithm evaluates nodes based on how often they are passed through on the shortest paths among all pairs of nodes in the network.

Furthermore, related to power character of the nodes, we added the weight='revenue' (turnover) parameter to the library specific function to weight the entire centrality with revenue. Thus, nodes with a higher turnover will be more influential in choosing the leader.

After the run of the algorithm, the leader enterprise that respected the conditions described above was found to be E1.

CONCLUSIONS

In conclusion, our approach to modeling economic markets using a system-based methodology provides a new and holistic perspective on how economic agents interact within these complex systems. By integrating the dual characteristics of economic systems, namely competition and cooperation, we have succeeded in developing a robust framework for analysing the behaviour of markets and their dynamics.

The use of Petri nets allowed us to capture the competitive nature of economic activities, emphasizing the understanding of agents' behavioural patterns in terms of resource distribution and market share dynamics. On the other hand, the model based on Leader Choice was effective in modeling the cooperation between agents and in determining the influential actors that shape market behaviour.

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IMPORTANCE OF SOFT-SKILLS FOR MANAGING VETERINARY PRACTICES

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Abstract

In the past years the relatively new field of veterinary management faced incredible challenges. In order to maintain the fluent workflow and guide the veterinary practitioners through economic and health crises the profession itself demanded a new skill-set to be implemented focused on the so-called soft skills. The present study focused on a survey among owners, managers and employees at veterinary clinics and hospitals in order to establish the level at which they have implemented some non-technical skills in their work. We investigated the amount of time during the workhours which the respondents used for non-clinical tasks as communication with animal owners, suppliers, governmental officers, colleagues, financial management and time management. The conclusions drawn could be used for improvement of the curriculum for veterinary professionals, addressing their needs for acquiring and updating their non-clinical skills and competences in managing their businesses.

***Key words*:** *management, veterinary practice, soft-skills, communication*

INTRODUCTION

Veterinary medicine falls among the healthcare professions and as such it has to constantly maintain a high level of animal health and welfare, public health and food safety. To achieve these crucial goals and maintain their performance in service of the public, veterinary graduates have to be well prepared for their professional path. There is a framework and relevant legislation implemented at international, European and national level to ensure all veterinarians would be able to perform as expected on the first day upon their graduation [25, 11, 34].

However, besides all the clinical skills and competences that are mandatory for the profession, there is a need of a new set of skills related to the new emerging challenges for the veterinarians [12] in order to bridge the gap between the capabilities of graduates, and the requirements and demands of the work environment [2] – business and entrepreneurship skills [27], management competences (time, finance, human resources managing) [20], social and digital skills [8].

With the present study we aimed to investigate the level of understanding among veterinary practitioners in Bulgaria on the effect that non-clinical skills have on the success of their practices and to analyse the main areas of business management where the veterinarians have to apply their non-technical skills and allocate time to adequately manage their practices.

MATERIALS AND METHODS

Design of Survey

The survey was conducted through an anonymous written questionnaire that was distributed indirectly to veterinary practitioners in Bulgaria through fifth-year veterinary students at the Faculty of Veterinary Medicine at Trakia University – Stara Zagora, who willingly consented to distribute the questionnaires at random in the period February 2022 – February 2023. Thus the personal contact between the authors and the respondents was avoided and no conflicts of interest raised. The survey did not need ethics committee approval.

The questionnaire was divided into several sections, each focused on a particular theme – respondents` demographics (gender, location of practice, years of practice, type of practice, employment status at the practice), respondents` perceptions on time management related to practice operation (communication with clients, communication with authorities, staff management, financial issues and suppliers) and their overall perceptions how the business success was affected by the veterinarians` clinical and non-clinical skills. At the end of the survey there were 179 completed questionnaires in total.

Statistical Analysis

For the analysis of the received questionnaires upon their completion by the respondents, the answers were turned from textual statements into numerical values and afterwards they were statistically processed (IBM SPSS-Inc., 2019, SPSS Reference Guide 26 SPSS, Chicago, USA). Descriptive statistics (frequency distribution tables) and chi-square analyses were used to study the investigated parameters. A two-tailed $p<0.05$ was considered significant.

RESULTS AND DISCUSSIONS

The participants in the survey showed very diverse background (Table 1). From all 179 of them, 52.5% were male and 44.7% were females, both genders almost equally representing the practitioners in Bulgaria in line with the feminization of the profession [33, 10, 6]. In similar research among veterinary practitioners [5], it was found that female veterinarians represented 55.6% of all veterinary practitioners in France. [4], however, reported less women employed at veterinary clinics – 36.4%, which probably was related to the cultural characteristics in their country Turkey.

The majority of the veterinarians in the study had established their practice in urban settings – 95% in total (practice at the capital city, cities-regional or municipal administrative centres) and the rest were situated in less urbanized settlements (small towns and villages).

Regarding their position at the practice, slightly more than one-third or 36.4% were owners of co-owners of the business, thus being the managers entitled to leadership and practice management. About half of the respondents or 55.3% were full time employees that executed the every-day activities at the clinic, responsible for its operation and treatment of patients. The rest of the staff, like part-time employees, internship trainees, etc. had little impact on the practice performance as they were partially working when needed for a defined short period of time. In a survey among Hungarian practitioners [26] three-quarter of them appeared to be practice owners and 22% were employed veterinarians.

The amount of working experience was another factor to consider with regard to the forming clear understanding on the competences needed for practice management. The first two categories – respondents with less than one year of experience (2.8%) and between 1 and 3 years of practice (16.2%) were veterinarians who at this time tried to gain practical competences and hands-on experience dealing with clients, patients and other stakeholders while at the same time building their professional reputation. The rest of the respondents were distributed per their practical experience as follows: 4-5 years – 15.1%; 6-10 years – 20.7%; 11-15years – 15.6%; 16-20 years – 8.9%; more than 20 years – 10.1%. When compared to other surveys, [4] reported that on average the professional experience of veterinary practitioners was 17.1 years, with the lest experienced working for 3 years and the most experienced veterinarians working for 35 years. Similarly, [26] stated that small animal veterinarians being practice owners had worked about 16 years long.

The largest share of the respondents of 46.4% worked with companion animals, while almost equal part of the other participants in the study worked with farm animals – 20.7% or had mixed practice with pets and livestock – 19.6%. Less than one percent – 0.6% were the practitioners that treated exotic animals. This type of practice appeared as a relatively new trend during the last years as stated by the Federation of Veterinarians in Europe [10] and is still emerging.

Interesting profile of the type of veterinary practice in Bulgaria was defined when the respondents shared the number and professional background of the employees there. Close to one-fifth or 20.7% of the veterinarians operated as a one-man-business, being owner, manager and a single employee, thus responsible for all operational and strategic activities at the practice.

Table 1. Table 1. Respondents` demographic characteristics*

Respondents` Demographics	Count	Percentage
Gender		
1)Female	80	44.7
2)Male	94	52.5
Residence		
1) Capital city	13	7.3
2)City–Regional administrative centre	135	75.4
3)City–Municipal administrative centre	22	12.3
4) Town	2	1.1
5) Village	7	3.9
Occupational post at the clinic		
1) Owner	47	26.3
2) Co-owner	18	10.1
3) Full-time employee	99	55.3
4) Part-time employee	8	4.5
5) Veterinarian on internship	6	3.4
6) Other	47	26.3
Working experience		
1)less than 1 year	5	2.8
2) 1-3 years	29	16.2
3)4-5 years	27	15.1
4) 6-10 years	37	20.7
5) 11-15 years	28	15.6
6) 16-20 years	16	8.9
7) over 20 years	18	10.1
Type of practice		
1) Companion animals	83	46.4
2) Farm animals	37	20.7
3) Mixed practice	35	19.6
4) Exotic animals	1	0.6
Size of the practice (type and number of employees)		
1) 1 veterinarian, no other employees	37	20.7
2) 2-10 veterinarians	66	36.9
3) more than 10 veterinarians	9	5.0
4) veterinarians and other non-veterinary employees**	64	35.8

*Due to rounding of values and non-responders some indicators may not sum up to 100%

** Non-veterinary employees at the respondents` clinics – receptionists, hygienists, groomers, technicians, shop assistants, laboratory specialists, stray animal hunters, animal keepers

Source: Authors` data from the questionnaire survey.

Based on the estimations of [24] that one veterinarian could service approximately several thousands of clients depending on the country and varying from 4,000 in the USA to 6,000 in Austria to 10,000 in Germany, it become quite clear that a sole veterinarian enterprise would face difficulties with the completion of all clinical and non-clinical tasks of the business.

Higher share of 36.9% had the practices where 2-10 veterinarians were employed. This type of operation with several veterinarians allowed for structural and functional improvements, division of labour and responsibilities, offering various or new services to the clients with more profits for the practice. [26] estimated that on average there were 2.15 vets working at a small veterinary clinic in big cities. On a higher level, clinics with more than 10 veterinarians employed, accounted for 5% in our survey, usually appeared to be highly specialized large clinics with a wide and advanced profile of services offered which had occupied a particular market share not only among local animal owners but also clients from other areas due to their extremely solid reputation. Even higher was the share of clinics with more than 10 vets – 24% as reported by [9] for Germany which in fact corresponded to the global trend of increasing the veterinary market [1, 16].

More than one third or 35.8% of the respondents stated that their practices had both veterinary and non-veterinary personnel. Among the non-veterinary staff there were technicians, receptionists, hygienists, groomers, shop assistants, laboratory specialists, etc. – all of them performing specific tasks depending on the range of services offered to the clients and incorporating other business components to the veterinary clinic (pet hotels, shelters, pet shops, grooming saloons, etc.). On average there were 0.76 assistants and 0.5 other staff in small veterinary practices which operated with 2 veterinarians [26]. In another survey among German practitioners it appeared that 43% of practice owners employed 1-3 technicians [9] which seemed to be related to rural settings and the work with large animals there.

The contemporary veterinary practice has to perform in a way that has to ensure the expectations of clients, society and profession itself as a whole are met [12, 13]. In order to be able not only to meet these highly demanding expectations, the veterinarians nowadays had to properly execute time management at their clinics. The results from the survey showed that 82.2% of the respondents in total (Fig. 1) did not apply any kind of time management related to the main activities of their work pointing out that 0% of their time had been spent on communication with animal owners, communication with state authorities, working with suppliers, solving financial issues and managing the practice staff. The lacking or poor non-technical skills among veterinarians were commented with relation to the difficulties encountered later with clients, both in communication and financial matters [3]. It was argued that even during the university education future veterinarians should be enabled to communicate as per the relevant situation, appropriately and adapting their role regarding the circumstances [17]. However, as [21] reported 11% of the veterinary surgeons did not spent time at all on activities related to quality improvement and governance at the clinic.

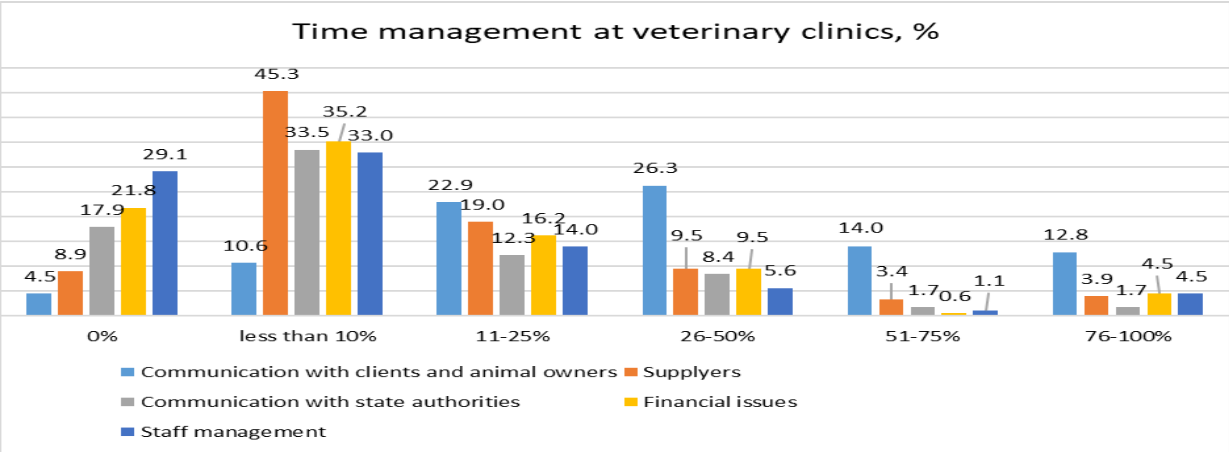

Fig. 1. Time management at veterinary practices as per the respondents` main areas of focus, related to non-technical activities
Source: Authors` data from the questionnaire survey.

on managing the practice, almost half of the respondents – 45.3% paid most of their attention to suppliers, while a third of them dealt with financial issues (35.2%), staff management (33%) and communication with the public sector (33.5%). In fact the time spent to work with the suppliers was significantly dependent on the residence as veterinarians from clinics in large cities devoted more time to supply management ($\chi 2$ =35.997; df=20; p=0.015) and at the same time to maintain regular communication with the authorities located in the capital and the administrative cities ($\chi 2$ =35.111; df=20; p=0.020). Communication with clients was among the important tasks for only 10.6% of our respondents. Even in case that communication was included in every day routine, it still was not considered effective if veterinarians, especially newly graduated with a couple of years of experience, did not possess the ability to talk to clients at the appropriate level [29]. The same authors argued that miscommunication could also lead to low-level staff management, lack of support and stress, resulting in young employees leaving the job. Furthermore, offering support to the veterinary staff and helping them develop interpersonal skills was believed to be beneficial to manage challenging clients and reduce stress and burnout [30].

Further analysis of data from Fig. 1 showed that with the increase of time allocated to non-clinical activities for managing the practice, the veterinarians used most of this managerial time to focus and develop proper communication with clients and animal owners compared to the other office tasks. This type of interpersonal skills was highly important for the performance of the clinic as low-level management skills were associated with sub-optimal economic conditions [22]. Moreover, communication was regarded as a crucial tool to achieve and modulate clients` satisfaction, especially when dealing with difficult clients [32, 28] which could be additionally enhanced as well by improving the veterinarian`s emotional intelligence and human personal performance as a whole [31]. Our study showed that communication with clients was significantly dependent on the gender of the veterinarians with women being more open-minded and striving to establish good interrelations with the animal owners ($\chi2$ =11.198; df=5; p=0.048) and the type of the practice –small animal practitioners were more aware of the need to maintain proper communication with their clients ($\chi2$ =25.054; df=15; p=0.049). Similar dependence was found for veterinary practitioners and their time to manage the practice staff as business owners ($\chi2$ =37.420; df=15; p=0.001).

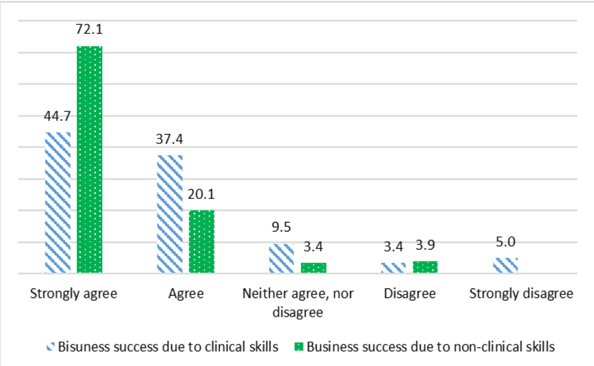

Fig. 2. Respondents` perceptions (%) on the effect of clinical and non-clinical skills for their business
Source: Authors` data from the questionnaire survey

The overall perceptions of the respondents in our survey regarding the level of success of their private business (Fig. 2) showed that besides the extremely important clinical skills in various field of specialization for 78.1% of them (44.7% who strongly agreed and 37.4% who agreed), the majority of the veterinary practitioners were without doubt sure that the business success and profitability was due to their non-clinical and managerial competences – 92.2% in total (72.1% strongly agreed and another 20.1% agreed). There were statistically significant differences among the employment status of the respondents, being business owners, and their understanding on the need to implement and use proper skills for staff management ($\chi2$ =64.129; df=20 p=0.000) and financial management ($\chi2$ =44.523; df=20; p=0.001) for the success of their practice. The profession itself expected from the veterinarians to be not only business owners but also leaders through personal growth and evolving skills like strategic thinking; team building; communications, influencing, and advocacy among the public and the private sectors [23]. Similar non-technical competences were identified as essential by [19] for other health professional and their successful performance.

The need for business skills among the set of competences of veterinary employees was discussed even in the light of provision of such non-technical skills during the undergraduate education [15, 14], including social competences [7] in order to have better prepared veterinary practitioners for real working environment. Well recognized practices like communication, team-work and team-morale, patient safety, and distributed leadership should be included in a Quality Improvement approach for veterinary clinics and thus to provide opportunities for improvements on a regular basis [21]. Similar approaches and competence models were proposed even on a larger scale, aiming at creation of Pan-European soft skills curriculum intended to develop competences among veterinary graduates in three main areas of expertise – communication, entrepreneurship and digitalization [18].

CONCLUSIONS

The survey on the current state of veterinary practice management in Bulgaria revealed some issues that need to be urgently addressed among the profession, academia, business and decision-makers, namely the lack of appropriate competences to solve non-clinical problems at veterinary hospitals and clinics. Most of the veterinarians did not deal at all or allocate very short time for managerial tasks related to communication, financial management, human resources management. However, the majority of the respondents considered the importance of the soft skills for the successful performance of their practice. The survey showed that the profession itself needs to evolve and create a model approach, even incorporate it in the higher veterinary education cycle, to gain knowledge and competences in business management and meet the expectations of the stakeholders and the society.

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ASPECTS REGARDING SUSTAINABILITY AND FOOD SECURITY IN ROMANIA IN THE CONTEXT OF EUROPEAN POLICIES

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Abstract

The aim of this research is to examine the present condition of food security within the framework of preparations for future adoption of reforms under the new Common Agricultural Policy, as well as the development of the National Strategy for the Development of Agriculture and Rural Area (SNDASR) for the period 2012-2027. It evaluates key indicators related to food security and culminates in an examination of a social survey conducted in the North-eastern Region of Romania. This study has specific objectives: to assess the level of food security within Romania and compare it with global and/or European standards using FAO-provided indicators, and to evaluate the extent of food security assurance specifically within the North-eastern Region of Romania. In recent years, there has been a growing focus on food security, particularly concerning food safety. It's important to clarify the distinction between food security and food safety, as they are often conflated. While food security encompasses indicators related to food access for the population, food safety is more concerned with the quality, sanitation, and safety of food products.

Key words: *food sustainability, consumption, agricultural, food policies, security*

INTRODUCTION

In the quest to achieve a sustainable and resilient agricultural sector, the interplay between policy reforms and strategic development is pivotal. This research delves into the current state of food security in Romania, set against the backdrop of impending reforms under the new Common Agricultural Policy (CAP) [21] and the formulation of the National Strategy for the Development of Agriculture and Rural Area (SNDASR) for the period 2023-2027 [18]. By scrutinizing key indicators of food security and analyzing the results of a social survey conducted in the North-eastern Region of Romania, this study aims to provide a comprehensive assessment of the nation's food security status.

The objectives of this study are twofold: firstly, to evaluate Romania's level of food security and benchmark it against global and European standards, utilizing indicators provided by the Food and Agriculture Organization (FAO) [15]; and secondly, to gauge the degree of food security assurance within the North-eastern Region, a critical area for agricultural development. Amidst the increasing emphasis on food security, particularly in relation to food safety, this research also seeks to elucidate the distinction between the two concepts. While food security is an umbrella term encompassing the availability and accessibility of food to the population, food safety zeroes in on the quality, hygiene, and safety of food products [16]. Understanding this differentiation is essential for addressing the multifaceted challenges of ensuring a food-secure future for all.

MATERIALS AND METHODS

The study relies on data gathered manually from the Eurostat European Statistics Institute, the National Institute of Statistics, and reports published on indicators related to agricultural sustainability, food security, and environmental sustainability over six years (2016-2022).

Methods of analysis employed:

The methodological and scientific underpinning of this study relied on a comprehensive array of direct and indirect documentation methods, including observation, qualitative, quantitative, and historical analysis, synthesis, comparison, systemic and monographic approaches, as well as statistical analysis. This multifaceted approach facilitated a thorough examination and depiction of the studied phenomena and economic processes. The significance of this work lies in its exploration of both intrinsic and extrinsic motivational factors influencing consumers.

A quantitative survey of consumers was conducted using a hybrid data collection method, with a sample size of 372 respondents aged 18 to 65. The questionnaire addressed product characteristics, individual requirements or preferences, intrinsic and extrinsic motivational factors, and demographic attributes.

The survey was conducted through a carefully designed questionnaire, administered via the Google Forms platform and distributed through social media channels, including Facebook and WhatsApp. The questionnaire comprised a predefined set of questions aimed at understanding consumer behaviour regarding agri-food products [25]. A maximum allowable error of +/- 5% and a probability level of 90% were established, and the number of respondents was determined based on this stratification, resulting in 326 participants. This choice was justified by the preference for reducing the confidence level in favour of the standard probability level of 95%.

The questionnaire focused on product characteristics, personal requirements or needs, intrinsic and extrinsic motivational elements, and demographic characteristics. The first dimension, accessibility, assesses consumers' ability to purchase food, their vulnerability to price fluctuations, as well as government policies and programs that can shield them from excessive price fluctuations [1]. Thus, following the calculation, it was determined that the sample size for the conducted survey is 372 people, at a confidence level of 95%. Applying the formula for a confidence level of 90%, the resulting number of people to be surveyed for the entire county is 326.

Table 1. Contingency Table between Education Level and Place of Residence

Education level - last school completed Place of residence (Urban / Rural) Cross tabulation			Residential environment (Urban / Rural)		Total
			Rural	Urban	
Education level	Only 10 classes	Count	35	9	43
	Vocational school	Count	21	8	29
	High school	Count	10	23	33
	Post-secondary school	Count	73	32	105
	University studies (Bachelor)	Count	16	30	46
	Post-graduate studies	Count	34	35	69
Total		Count	189	135	326

Source: Own calculation.

This approach ensured both the statistical relevance of the data and the efficiency in collecting the necessary information for analysing consumers' purchasing and consumption decisions in the agri-food sector. All the data used were processed using a computer, using the Microsoft Office package.

RESULTS AND DISCUSSIONS

During the 2023-2027 periods, the Common Agricultural Policy (CAP) will focus on ten main objectives [5]. These will concentrate on social, economic, and environmental.

The key objectives of the new CAP are illustrated in the graphical image shown in Fig.1.

The general public has their own ideas of food sustainability, which often include concepts like social justice, food security, animal welfare, fair labor and trade, local farming, organic food production, and the concept of “natural,” just to mention the most important ones [11, 26]. The new CAP [11] has emerged among the many challenges brought by the post-pandemic realities that have created a series of economic difficulties both for the European farmers and for the whole EU agricultural sector [5]. Despite those challenges the new CAP has established high ambitions regarding the sustainable rural development and the contribution of the European agricultural sector in order to create a more green and clean EU economy [2]. The new architecture of CAP is centered on the green policies and new ten objectives on sustainability related objectives (Figure 1) who are seeking to increase the competitiveness of EU's agricultural sector, while sustaining food security and high climate and environmental ambitions [6].

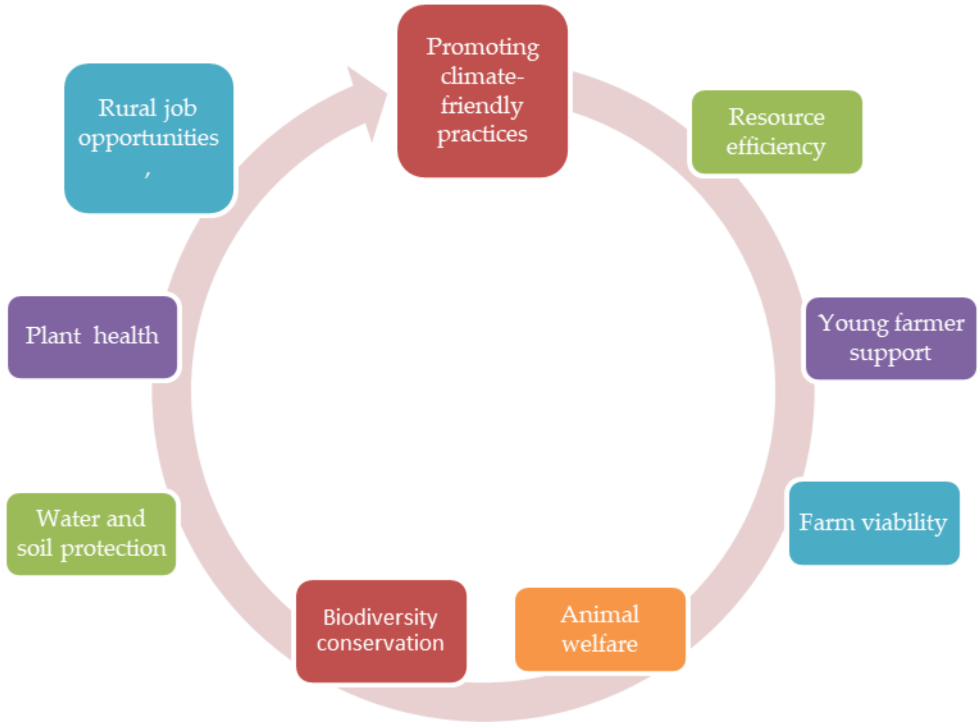

Fig. 1. Key objectives of the new CAP
Source: Own interpretation after (CAP) common-agricultural-policy [11].

Food security refers to the quantity of food necessary to meet the needs of a population. Over the past four decades, significant advancements have been made globally, including in Romania, in terms of food production and ensuring food security. However, progress in food security has been relatively slow and is heavily influenced by social and political conditions at various junctures. The rapid transformations occurring in global economic governance, the structures of agriculture and food industries at both local and global levels, as well as the processes of globalization and trade liberalization, contribute to swift changes in consumer preferences and heightened expectations regarding the quality, safety, nutritional value, legislation, and control of food [19].The development of new technologies and the acquisition of fresh knowledge about food aim to meet these diverse requirements to a certain extent [21].

Sustainability is characterized by the convergence of different dimensions that can be informed by indicators of economic profitability, environmental efficiency and social and societal well-being [22].

Romanian agriculture, which ensures the security and sustainability of food, is characterized by its highly polarized structure and a large number of small farms. Approximately 89% of Romanian farms (3.1 million) are less than 5 hectares, constituting 45% of the total Utilized Agricultural Area (UAA). This includes farms engaged in subsistence agriculture as well as those used for semi-commercial purposes. These farmers are generally older, use traditional farming methods, and often work part-time (i.e., in combination with other sources of income). Although the number of smallholder farmers is steadily declining, most continue to exist as stable rural households with diversified production and high consumption of home-grown food [4], all of which contributes to a significant degree of socio-economic resilience. In Europe, family farming is an umbrella concept that incorporates farms of many different types and sizes, with both full- and part-time farmers and farmers with and without other gainful activities, i.e., all activities other than those relating to farm work, carried out for remuneration. Some are specialized commercial operations, while others produce mainly to satisfy their own household food needs, the so-called semi-subsistence farms (SSFs).

Table 2. Number of small farms (size <5 ha) in the European Union (2020)

EU member	Total number of farms	Total number of small farms (farm size <5 ha UAA)	% of small farms (farm size <5 ha UAA)
State groups			
EU-27	10,487,780	6,648,580	64%
EU-15	4,217,650	2,096,350	50%
New Member States (NMS)	5,885,350	4,488,450	76%
Romania	2,890,350	2,254,473	78%

Source: Own calculation based on Eurostat's statistical data from 2020 [13].

In the Table 2 presents data of the sustainable performance of Romanian agriculture compared to the EU-28 and the individual countries analyzed. The value of total agricultural output is an indicator often used in international comparisons to express the performance of agriculture. This study aims to contribute to the current debate on improving diets with locally produced nutritious legumes and promoting greater food security and income generation among smallholder farmers [4]. In 2020, there were 2.89 million agricultural exploitations in Romania, down by 25.2% compared to 2010, reveals the latest agriculture census carried out by the National Statistics Institute (NIS) [20]. These trends have been supported by the EU funded programs for local farmers, which come with certain requirements in terms of farm size and economic viability. In the framework of the 2014-2020 financial programming, the main change to the CAP was the greening, which comprised the reservation of 30% of direct aid for a green payment, the allocation of which is subject to compliance with three conditions: the maintenance of permanent grasslands, crop diversification and the reservation of at least 5% of arable land for areas of ecological interest such as hedges or ponds [5].

Another factor that has contributed to the overall decline in the number of farms was the massive population migration in the last ten years. Many Romanians from the countryside have given up subsistence farming and left the country looking for higher income by working abroad.

Having farms of optimal size capable of using production factors efficiently is a global goal for agriculture on which the food security of populations depends [9]. This process involves the consolidation of the territory, but only up to a certain size, beyond which the overall marginal return decreases and negative economic, social and environmental effects begin to appear. Economic factors can lead small farmers to give up land exploitation, especially low market competitiveness. Furthermore, young people often prefer urban civilization to rural culture and government policies, including CAP subsidies, which favor large farms [11]. However, the farmer's attachment to his land is usually secure, but often coercion, deception or orchestrated publicity is used to create confusion, to take control of their land. Using land consolidation to obtain adequate agricultural structures is not a simple process; began in the second half of the last century and his practice continued to expand.

The agricultural holdings in Romania differ significantly from the EU ones, particularly manifested in the limited extent of utilized agricultural area, attributed to the fragmentation of land exploitation. Utilized agricultural area, abbreviated as UAA, is the total area taken up by arable land, permanent grassland, permanent crops and kitchen gardens used by the holding, regardless of the type of tenure or of whether it is used as a part of common land. Furthermore, diminished levels of technical equipment and resource consumption contribute to a markedly inferior economic performance. A summary of indicators, referring to the inputs and outputs of Romanian farms compared to the EU farms is presented in Table 3.

Table 3. Economic, social and environmental capital of agricultural holdings, Romania and EU

	Romania average on farm		**EU average on farm**		**Indicators/UAA 2022**		
	2018	2022	2018	2022	Romania	EU	RO/ EU %
Utilised agricultural area, ha	9.3	12.06	30.77	38.53	-	-	-
Machinery, euro	5,146	7,165	29,496	46,017	524.53	2,907.4	18
Total livestock units, LU	6.99	8.03	25.5	30.7	0.69	2.61	26.5
Consumption of energy, euro	859	1,105	4,205	6,306	94.39	430.65	21.9
Consumption of fertilizers, euro	859	1,105	4,205	6,306	72.15	349.96	20.6
Crop protection, euro	527	845	3,418	4,883	40.08	219.7	20.6
Total labour input, AWU	305	469	2,145	2,915	0,13	0,18	74,3
Environmental subsidies, euro	2	2	2	2	6.25	96.2	6.5
Total output, euro	7	73	939	1,320	1,307.7	6,028.3	21.7
Farm net value added, euro	11,809	15,312	58,870	84,073	726.94	2,575.9	28.2

Source: Own calculation based on the FADN database [12].

Within the commercial-type agricultural holdings in Romania, there has been an economic growth during the period (2018-2022), both in Romania and the EU, for each analyzed indicator. The phenomenon of expanding agricultural activities (increasing productive area and technical basis) has also modified the structure of production factors. During this period (2018-2022), it is noteworthy that farms in Romania have lower technical equipment than EU farms (18% machinery) and lower consumption of energy (21.9%), fertilizers (20,6%), and crop protection products (20.6%) [20]. The lower consumption of energy, fertilizers, and crop protection products, as well as the lower livestock density in Romanian farms compared to the EU, indicate a lower environmental impact of the applied agricultural practices [7]. Romanian agriculture has different results in terms of territorial performance. Romanian agriculture is characterized by a multitude of small-sized agricultural holdings with an excessively fragmented agricultural area [17]. The average area of a commercial-type agricultural holding in Romania had approximately 10 hectares, which is over three times smaller, and there are significant organizational, agro technical differences compared to the EU average and environmental subsidies represent only 6.5% compared to the EU average. In these conditions, the economic performance achieved by the farms in Romania is lower than the EU average (total output euro/ha: 21,7%; farm net value added euro/ha: 28,2%
Romania has favorable conditions for agricultural crop and livestock production. However, yields and labor productivity in agriculture are low. Clearly, the technical equipment, consumptions, and results are much lower [8]. We can gain insight into sustainable performance by analyzing comparatively the inputs and outputs per utilized agricultural area. This is an advantage for agricultural holdings in Romania in terms of land conversion to organic agriculture [3, 14].

Furthermore, the overall labor productivity in agriculture is less than a third of the European average, underscoring the need for strategic interventions to enhance efficiency and output in the sector. Addressing these productivity gaps will be crucial for maximizing the full potential of Romania's agricultural resources and improving its overall competitiveness in

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the European market [26]. Social capital, encompassing aspects like human re-sources, community engagement, and education, plays a crucial role in shaping food security. A skilled and educated workforce within the agricultural sector contributes to increased productivity and innovation. Furthermore, strong social cohesion within farming communities fosters collaborative efforts, knowledge sharing, and resilience in the face of challenges. Social capital also influences the equitable distribution of re-sources, ensuring that the benefits of agricultural activities reach diverse segments of the population.

In the Romanian context, there is an upward trend in preferences for imported foods, even though Romania enjoys its own agricultural wealth. This phenomenon has caught the attention of Western food producers, who are encouraged to expand their market in the country. It is important to mention that, although Romania is a country with a strong agricultural tradition, the consumption of imported food products from the West has increased significantly.

Romania demonstrates a growing interest in Western-origin food products, with significant imports that underline this trend. According to data from the National Institute of Statistics (NIS) [22], Romania imported food and live animals worth over 8 billion euros in 2021, an increase of over 12% compared to the previous year. This increase in imports can put pressure on local producers, who must adapt to changing consumer preferences and international competition.

However, there is also good news for the local agricultural sector. Food exports recorded an increase of 46.3% in 2021 compared to 2020, reaching a cumulative value of 6.3 billion euros. This suggests that, despite the increase in imports, Romanian food products remain competitive in foreign markets [24].

In total, in 2021, exports amounted to 74.7 billion euros, an increase of 20.1% compared to 2020, while imports recorded an increase of 22.1% to a value of 98.3 billion euros. Thus, INS announces a trade deficit of 23.6 billion euros for 2021, 5.3 billion euros above the level recorded in 2020. This expansion of the imported food market in Romania indicates an openness of Romanian consumers to international culinary diversity, thus surpassing local food traditions and religious preferences for moderate consumption [27].

The data provided offers a comprehensive view of the average total monthly income and expenditure per household in Romania, with a specific focus on food and beverages, across different macro-regions and development regions from 2016 to 2021. Here are some observations:

- Total Income: There has been a general increase in the total average monthly income at the national level, with a growth of 110.88% in 2021 compared to 2016. The Northeast region also shows an increase, although slightly lower at 109.02%.
- Total Costs: The total average monthly costs have similarly risen over the years, with the national average reaching 111.75% in 2021 relative to 2016. The Northeast region's increase is somewhat less at 107.03%.
- Expenditure on Food and Beverages: The percentage of total expenditures on food and beverages has remained relatively stable, with a slight increase from 19.94% in 2016 to 20.40% in 2021 at the national level. The Northeast region shows a slight decrease in the same category, from 19.87% to 18.94%.
- Regional Differences: The difference in regional spending compared to the national average has varied, with the Northeast region showing a significant difference of 2000.38% in the expenditure on food and beverages category, which could be due to a data entry error or require further context for clarification [25].

Overall, these figures indicate a steady growth in both income and expenditure, with food and beverages taking up a consistent share of the household budget. The data suggests that Romanian households have experienced an increase in their financial capacity, but also an increase in living costs over the years. The stability in the percentage of expenditure on food and beverages reflects a possible cultural consistency in spending habits, despite economic changes. It's also noteworthy that the increase in income and expenditure percentages exceeds the inflation rate, suggesting real growth in economic terms. However, the significant regional differences highlighted in the data may point to disparities in economic conditions across different parts of the country. All this translates into the need to direct investment in agricultural research and development, in order to keep high the other components of food sustainability (Table 4).

Table 4. Average total monthly income and expenditure per household and expenditure on food and beverages, by macro-regions and development regions (2016-2021)

	Macro-regions and development regions	Years						
		2016	2017	2018	2019	2020	2021	2021 vs. h 2016 %
		Unit of measurement: Euro						
Total income	**TOTAL ROMANIA**	474.00	513.35	505.63	498.61	523.70	525.55	110.88
	Northeast region	457.94	499.04	519.87	482.17	515.21	499.24	109.02
	Difference from Total Macro-region %	16.05	14.32	-14.24	16.44	8.48	26.31	163.87
		9.61	**9..21**	**102.82**	**96.7**	**98.38**	**95**	988.55
Total Costs	**TOTAL ROMANIA**	425.86	453.80	452.68	450.44	474.93	475.91	111.75
	Northeast region	420.14	446.33	465.21	431.24	467.41	449.67	107.03
	Difference from Total Macro-region %	5.71	7.47	-12.53	19.20	7.51	26.25	459.28
		98.66	**98.35**	**102.77**	**95.74**	**98.42**	**94.49**	95.77
Expenditure on food and beverages	**TOTAL ROMANIA**	94.52	100.99	100.13	98.31	106.31	107.22	113.43
	Northeast region	90.99	96.44	97.56	91.40	98.50	94.57	103.94
	% of Total Expenditures Romania	19.94	19.67	19.80	19.72	20.30	20.40	102.31
	% of total region expenditure	**19.87**	**19.33**	**18.77**	**18.96**	**19.12**	**18.94**	95.34
	The difference in regional spending compared to Romania	0.07	0.35	1.04	0.76	1.18	1.46	2,000.38

Source: Eurostat, 2021 [13**]**.

The cultural and traditional significance of local products in Romania is profound and plays a vital role in promoting the country's cultural identity and diversity. Both consumers and producers value these aspects and consider them essential in preserving and promoting Romania's cultural heritage [18**]**.

Price and accessibility are two important factors in the decision to purchase local products in Romania. These factors can significantly influence consumer preferences and the success of the local products market. Let's explore these aspects in detail:

(1)Price: Price is a key factor in the purchasing decisions of most consumers. Local products may be perceived as more expensive than imported alternatives or mass-produced items. However, many consumers are willing to pay a higher price for local products because they associate them with quality, freshness, and support for the local community.

(2)Quality and Value: Price can be evaluated in the context of quality and value. Consumers may be willing to pay more for local products because they perceive them to offer superior quality, freshness, and nutritional value. Thus, price can be a strong motivator when correlated with quality [26**]**.

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(3)Cost Awareness and Budget: For some consumers, price remains a major factor in their purchasing decisions. They may be constrained by a tight budget and may choose local products only if the price is competitive compared to available alternatives.
(4)Promotions and Discounts: Promotions, discounts, and special offers can influence the purchase of local products.
(5)Distribution and Logistics: The accessibility of local products in various regions of Romania can significantly affect consumer choices. If local products are only available in certain geographic areas, this can limit access for consumers in other regions [23].
(6)Market Availability: Local products need to be widely available to meet consumer demands. Consistent market availability can build trust and loyalty towards local products.
(7)Efficient Transportation and Logistics: Transportation costs can impact the price of local products. To maintain competitive prices, local producers may need efficient logistics solutions that minimize transportation costs.
(8)Consumer Awareness: Consumer education and awareness of the benefits of local products can influence their understanding of the quality-to-price ratio and stimulate demand for these products.

In conclusion, price and accessibility are important factors that can influence purchasing decisions for local products in Romania. A balanced approach that takes into account quality, value, and consumer needs is essential to ensure the success of the local products market and to satisfy the diverse requirements of consumers (Table 5).

The table you've provided outlines the intrinsic and extrinsic factors related to sustainability and food security in Romania, focusing on social qualities, benefits, and motivational factors. Here's a commentary on Table 5.

Table 5. Intrinsic and extrinsic factors

Social qualities and benefits	**Intrinsic (quality, appearance, freshness, taste, healthy, safety and being associated with selfish motivations or self-interest)**	**Extrinsic (savings, preserving farmland, increasing food security with altruistic motivations, or contributing to the "greater good.")**
Motivational factors	The desire to recreate nostalgic moments, full of shopping, fun and memories of the past, nostalgia for shopping,	Support for local farmers, producers and retailers
	health consciousness, quality of life and well-being values and emotional motivations	Environmental and social motivation
	Hedonic: culinary tourism, association and food novelty,	Environmental concerns
	Health consciousness egg nutritional value	Animal welfare, environmental sustainability, supporting rural communities, animal welfare
	The taste, freshness, association and novelty of food tourism products as purely hedonic consumption experiences, effective ways to create hedonistic and memorable experiences	Community-oriented motivations and motivations for participating in a community-supported agriculture scheme
	An experience that brings intrinsic reward or satisfaction without the need for external incentives.	Local heritage

Source: Own interpretation.

The factorial analysis yielded three distinct factors, which partially adhered to the Kaiser-Guttmann

Rule for retaining factors with eigenvalues exceeding 1 (KMO=0.86), collectively explaining 75.6% of the model's total variance. The primary factor comprised three items, elucidating 52.9% of the model's variance individually (eigenvalue=4.23), and was denoted as "Health, Natural, and Nutrition." The second factor, labeled "Fresh, Taste, Appearance," encompassed three items, each explaining 12.6% of the model's variance (eigenvalue=1.00). Meanwhile, the third factor, explaining 10.1% of the model's variance individually (eigenvalue=0.81), included two items.

However, the third factor exhibited cross-loading, with the item "Safer" demonstrating a factor loading of 0.51 for both factor one, "Health, Natural, and Nutrition," and factor three. Due to the low eigenvalue and cross-loading, a second factor analysis focusing on Consumption was conducted, resulting in a 2-factor solution instead of the initial 3-factor solution. Nevertheless, this alternative analysis offered a lower explanation of the total variance and introduced conceptual and logical ambiguity regarding factor labels.

Ultimately, in line with insights from [24], it was determined that "Safer" pertains more to confidence in understanding food production methods, aligning with factor three's interpretation, rather than solely focusing on the health, natural, or nutritional aspects of local food, as suggested by factor one. Consequently, the third factor was relabelled as "Safety and Trust" to better capture its underlying concept [10].

Table 6 summarizes the three factor solutions for participant attitudes.

Table 6.Three factor solutions for participant attitudes

No.	Community - Variable	Safety and Trust	Fresh, Taste, and Look	Health, Natural, and Nutrition
1	More healthful	0.16	0.32	**0.88**
2	More natural	0.19	0.17	**0.93**
3	More nutritious	0.13	0.29	0.24
4	More fresh	0.24	0.82	0.20
5	Better tasting	0.13	**0.94**	0.29
6	Better looking	0.08	**0.78**	0.56
7	Safer	0.56	0.48	0.19
9	More trustful	**0.93**	0.17	0.88
10	**Eigen value**	4.240	1	0.81
	% var/cov exp.	52.9%	12.6	

Source: Questionnaire interpretation administered via the Google Forms.

Attitudes

The factorial analysis solution for the Community dimension comprised two factors adhering to the Kaiser-Guttmann Rule, retaining factors with eigenvalues exceeding 1 (KMO=0.86). These factors collectively elucidated 75.2% of the model's total variance. The primary factor encompassed four items, individually accounting for 61.1% of the model's variance (eigenvalue=4.28), and was designated as "Community - Social Well-being." Meanwhile, the secondary factor, labeled "Community - Economic Well-being," comprised three items, each explaining 14.1% of the model's variance (Eigenvalue=0.99).

For the Environment/Sustainability dimension, the factorial analysis yielded a solitary factor aligning with the Kaiser-Guttmann Rule (KMO=0.85), elucidating 65.3% of the total variance of the model. This factor, denoted as "Environment," encompassed six items and exhibited an eigenvalue of 3.92. These eigenvalues signify the extent of association between each variable and its corresponding factor, with higher values indicating stronger associations.

Additionally, the eigenvalue represents the proportion of total variance explained by each factor. Variables such as “More money stays in my community” and “A more economically viable community” are associated with economic wellbeing, as indicated by high factor loadings (0.92). Variables such as “More money stays in my community” and “A more economically viable community” are associated with economic wellbeing, as indicated by high factor loadings (0.92).

Variables like “Establishing relationships with farmers/producers who provide my food” and “Supporting socially sustainable farming practices” are strongly associated with social wellbeing, with factor loadings of 0.95 and 0.99 respectively.

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Table 7. Factor solutions for environment participant attitude

No.	Environment -Variable	Social Wellbeing	Economic Wellbeing
1	More money stays in my community	0.24	**0.92**
2	A more economically viable community	0.36	**0.92**
3	Stimulating rural employment	0.25	**0.90**
4	Providing a fair income for the farmer/producer	**0.75**	0.51
5	Establishing relationships with farmers/producers who provide my food	**0.95**	0.39
6	Supporting economically sustainable farming practice	**0.93**	0.35
7	Supporting socially sustainable farming practices	**0.99**	0.17
8	**Eigen value**	4.28	0.99
	% var/cov exp.	61.1%	14.1%
	KMO=0.85	Total % var exp.=65.3%	

Source: Questionnaire interpretation administered via the Google Forms.

Table 7 presents a factor analysis of various environmental variables in relation to social and economic wellbeing. Here's a breakdown of the table.

Table 8. Factor solutions for sustainable farming practices

No.	Sustainable farming practices -Variable	Environment
1	Promoting greater biodiversity	0.74
2	Production practices that are better for the environment	**0.86**
3	Food less likely to be treated with chemicals or contain residues from pesticides, herbicides, or fertilizers	**0.72**
4	Supporting environmentally sustainable farming practices	**0.91**
5	Support animal health and welfare	**0.84**
6	Improving soil and water quality	**0.84**
7	**Eigen value**	3.92
	% var/cov exp.	65.3%

Source: Questionnaire interpretation administered via the Google Forms.

Subjective Norms

The Influence EFA solution consisted of three factors that partially met the Kaiser-Guttmann Rule to retain factors with Eigen values over 1 (KMO=0.73) accounting for 67.0% of the total model variance explained. The first factor of this solution consisted of four items and individually accounted for 35.8% of the variance in the model (Eigen value=2.51). This factor was labelled 'Others.' The second factor consisted of two items and individually accounted for 18.9% of the variance in the model (Eigen value=1.32).This factor was labelled 'Parent(s)and Kid(s).' The third factor solution consisted of one item and accounted for 12.3% of the variance in the model (Eigen value=0.86). Concern with an Eigen value under 1 prompted a second factor analysis of influence with a 2-factor solution rather than the current 3-factor solution. The 2- factor solutions of influence had lower total model variance explained (54.7%) as well as a cross-loading on item 'My children.' A 3-factor solution was retained for this analysis. This factor was labelled 'Partner or Spouse.'

CONCLUSIONS

In conclusion, the cultural and traditional significance of local products in Romania holds a profound importance, serving as a key element in preserving and promoting the country's rich cultural heritage and diversity. Both consumers and producers recognize and value these aspects, contributing to the preservation of Romania's cultural identity.

Price and accessibility emerge as critical factors shaping consumer preferences and the success of the local products market. Price considerations are complex, involving perceptions of quality, freshness, and support for the local community. Many consumers are willing to pay a premium for local products due to their association with superior quality and a commitment to community support.

The interplay of quality, value, and consumer needs is vital in influencing purchasing decisions. While some consumers prioritize cost and budget constraints, others may be motivated by promotions, discounts, and special offers. Market availability, efficient logistics, and consumer awareness further impact the success of local products.

The adoption of the locavore movement in Romania has the potential to bolster the local economy by keeping profits within the community.

By choosing local products over mass-produced alternatives, consumers contribute to reinvesting profits locally, fostering economic growth, and creating more jobs.

In essence, a balanced and comprehensive approach that considers various factors such as price, accessibility, quality, and consumer awareness is crucial for ensuring the sustained success of the local products market in Romania. This approach not only supports local traditions but also contributes to economic development and community prosperity.

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ASSESSMENT AND IMPROVEMENT OF FOOD SUSTAINABILITY AND THE FACTORS INFLUENCING CONSUMPTION PATTERNS

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Abstract

This study focuses on the assessment and enhancement of food sustainability, exploring the multifaceted factors that shape consumption patterns. In a world marked by growing concerns about food security and environmental sustainability, understanding the dynamics of food consumption becomes paramount. Through a comprehensive analysis, this research delves into various dimensions of food sustainability, encompassing environmental impact, social equity, and economic viability.The methodology involved evaluating primary food sustainability indicators and concluded with a social survey analysis. Forecasts for the average daily food consumption per capita were interpreted. The study examined the Global Food Security Index (GFSI) in Europe, reflecting food access levels and the population's ability to secure adequate, safe, and nutritious food. The aim was to identify the most precise and statistically valid forecast method. Romania ranks 23rd in the GFSI overall score, which is improving. It stands 25th in accessibility, 21st in food availability, and also 21st in quality and security. While the overall score, accessibility, and availability show positive trends, quality and safety exhibit a decline. The critical analysis led to recommendations for a unified strategy to boost food sustainability.

Key words**:** *assessment, enhancement, food sustainability, nutrition, consumption*

INTRODUCTION

The assessment and improvement of food sustainability in Romania, especially in comparison with other European countries, is a complex topic that involves examining various factors such as availability, accessibility, utilization, and stability of food. A comprehensive analysis would consider the impact of global events, social and economic inequalities, and climate change on food systems' stability.

Middle and lower-income families are thus forced to choose cheaper and lower-quality foods in order to make ends meet. This creates the perception of a more insecure environment regarding food [4].

For instance, a study from 2022 provides a detailed evaluation of Romania's food security status, comparing it with EU. The study also discusses the role of social and economic disparities in contributing to food insecurity and the effects of climate change on agricultural production.

Such analyses are essential for informing policy and decision-making processes aimed at achieving sustainable and resilient food security in Romania and the broader Eastern European region. They help in understanding how Romania can improve its food sustainability practices in line with other European countries and what measures can be taken to ensure a stable food supply in the face of global challenges [14].

Food security in Romania is closely linked to the European Union's Common Agricultural Policy (CAP), which aims to ensure food security for all European citizens at reasonable prices. Romania, as a member of the EU, contributes to and benefits from the CAP. The country has made progress in securing food security, influenced by various factors and risks. In the global context, challenges such as the Russian invasion of Ukraine have impacted food security, with the EU taking steps to restore it through international cooperation and humanitarian aid.

Romania's strengths in food security include its significant contribution to EU agriculture and the financial support it receives for its agricultural sector. However, there are also weaknesses and risks that need to be addressed, such as the impact of global crises on food availability and prices.For a detailed analysis, there are studies that reveal the progress made by Romania concerning food security, as well as the factors of influence and risk, and identify the strengths and weaknesses of Romania's food security in the European and global context. These analyses are crucial for Romanian decision-makers involved in devising policies and strategies in this field.

Essentially, food sustainability encompasses all the indicators related to how food reaches the population [6], while food security pertains more to aspects concerning product quality, sanitation, and safety. Based on this definition from the FAO, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization and stability (vulnerability and shocks) over time (FAO). It is indeed true that without ensuring a minimum level of product quality, discussions about the economic aspect of ensuring access to food for individuals become futile. Food security, on the other hand, revolves around generating food at a productivity level sufficient to sustain the human population.

Food sustainability, food security, and food safety are three critical concepts related to the production, distribution, and consumption of food. In summary, food sustainability focuses on the long-term environmental impact of food production, while food security emphasizes access to food for all, and food safety concerns the protection of consumers from foodborne illnesses [1]. Together, these concepts are essential for creating a healthy, equitable, and resilient food system that can meet the needs of the present and future generations[Food safety and security are two complementing elements of sustainable future [18]. This paper will argue that in the long run the aims of food safety and security must be aligned to achieve sustainability, and the trade-offs between these three goals must be managed carefully and based on evidence.

MATERIALS AND METHODS

The study relies on data gathered manually from the Eurostat European Statistics Institute, the National Institute of Statistics, and reports published on indicators related to agricultural sustainability, food security, and environmental sustainability over six years (2016-2022) [16]. Overall objective: - Establishing strategies to achieve a higher level of food security in Romania. In order to determine the factors influencing consumption patterns for certain agri-food products and to assess how the findings can be utilized in marketing activities, the method of sampling was chosen. In this research stage, a probabilistic, multistage stratified sampling model was employed to ensure the representativeness and accuracy of the data [8]. The survey was conducted through a carefully designed questionnaire, administered via the Google Forms platform and distributed through social media channels, including Facebook and WhatsApp.

The questionnaire comprised a predefined set of questions aimed at understanding consumer behaviour regarding agri-food products.

A maximum allowable error of +/- 5% and a probability level of 90% were established, and the number of respondents was determined based on this stratification, resulting in 274 participants.

This choice was justified by the preference for reducing the confidence level in favour of the standard probability level of 95%.

The questionnaire focused on product characteristics, personal requirements or needs, intrinsic and extrinsic motivational elements, and demographic characteristics. The first dimension, accessibility, assesses consumers' ability to purchase food, their vulnerability to price fluctuations, as well as government policies and programs that can shield them from excessive price fluctuations. Thus, following the calculation, it was determined that the sample size for the conducted survey is 326 people, at a confidence level of 95%. Applying the formula for a confidence level of 90%, the resulting number of people to be surveyed for the entire county is 272.

Table 1. Contingency Table between Education Level and Place of Residence

Education level - last school completed * Place of residence (Urban / Rural) Cross tabulation			Residential environment (Urban / Rural)		Total
			Rural	Urban	
Education level	Only 10 classes	Count	34	7	41
		Expected Count	10	10	20
	Vocational school	Count	21	8	29
		Expected Count	20	10	30
	High school	Count	10	12	22
		Expected Count	25	30	55
	Post secondary school	Count	74	29	103
		Expected Count	25	25	50
	University studies (Bachelor)	Count	15	30	45
		Expected Count	40	60	100
	Post-graduate studies	Count	34	0	34
		Expected Count	40	40	80
Toatl		Count	188	86	274
		Expected Count	160	175	335

Source: Own calculations based on the questionnaire

This approach ensured both the statistical relevance of the data and the efficiency in collecting the necessary information for analysing consumers' purchasing and consumption decisions in the agri-food sector.All the data used were processed using a computer, using the Microsoft Office package.

RESULTS AND DISCUSSIONS

Romanian agriculture, which ensures the security and sustainability of food, is characterized by its highly polarized structure and a large number of small farms. Approximately 89% of Romanian farms (3.1 million) are less than 5 hectares, constituting 45% of the total Utilized Agricultural Area (UAA). This includes farms engaged in subsistence agriculture as well as those used for semi-commercial purposes. These farmers are generally older, use traditional farming methods, and often work part-time (i.e., in combination with other sources of income). Although the number of smallholder farmers is steadily declining, most continue to exist as stable rural households with diversified production and high consumption of home-grown food [12], all of which contributes to a significant degree of socio-economic resilience. In Europe, family farming is an umbrella concept that incorporates farms of many different types and sizes, with both full- and part-time farmers and farmers with and without other gainful activities, i.e., all activities other than those relating to farm work, carried out for remuneration. Some are specialized commercial operations, while others produce mainly to satisfy their own household food needs, the so-called semi-subsistence farms (SSFs).

Table 2. Number of small farms (size <5 ha) in the European Union (2022)

EU member	Total number of farms	Total number of small farms (farm size <5 ha UAA)	% of small farms (farm size <5 ha UAA)
State groups			
EU-27	10,487,780	6,648,580	64%
EU-15	4,217,650	2,096,350	50%
New Member States (NMS)	5,885,350	4,488,450	76%
Romania	2,890,350	2,254,473	78%

Source: Own calculation based on Eurostat statistical data from 2022 [9, 12].

In the Table 3 presents data of the sustainable performance of Romanian agriculture compared to the EU-28 and the individual countries analyzed. The value of total agricultural output is an indicator often used in international comparisons to express the performance of agriculture. This study aims to contribute to the current debate on improving diets with locally produced nutritious legumes and promoting greater food security and income generation among smallholder farmers [1]. In 2020, there were **2.89 million** agricultural exploitations in Romania, down by 25.2% compared to 2010, reveals the latest agriculture census carried out by the National Statistics Institute (INS) [15]. These trends have been supported by the EU funded programs for local farmers, which come with certain requirements in terms of farm size and economic viability.

The agricultural holdings in Romania differ significantly from the EU ones, particularly manifested in the limited extent of utilized agricultural area, attributed to the fragmentation of land exploitation. Utilized agricultural area, abbreviated as UAA, is the total area taken up by arable land, permanent grassland, permanent crops and kitchen gardens used by the holding, regardless of the type of tenure or of whether it is used as a part of common land. Furthermore, diminished levels of technical equipment and resource consumption contribute to a markedly inferior economic performance [5]. A summary of indicators, referring to the inputs and outputs of Romanian farms compared to the EU farms is presented in Table 3.

Table 3. Economic, social and environmental capital of agricultural holdings, Romania and EU, 2022

No	Indicators	U:M	**Indicators/UAA 2022**		
			Romania	EU	RO/ EU %
1	Utilised agricultural area, ha	ha	60.4	80.77	74.8
2	Machinery, euro	Euro /ha	524.53	2907.4	18.0
3	Total livestock units, LU	Euro /ha	0.69	2.61	26.4
4	Consumption of energy, euro	Euro /ha	94.39	430.65	21.9
5	Consumption of fertilizers, euro	Euro /ha	72.15	349.96	20.6
6	Crop protection, euro	Euro /ha	40.08	219.7	18.2
7	Total labour input, AWU	Euro /ha	0.13	0.18	72.2
8	Environmental subsidies, euro	Euro /ha	6.25	96.2	6.5
9	Total output, euro	Euro /ha	1,307.7	6,028.3	21.7
10	Farm net value added, euro	Euro /ha	726.94	2,575.9	28.2

Source: Eurostat statistical database processing [9].

The Utilised Agricultural Area (UAA) is the total area taken up by arable land, permanent grassland and meadow, permanent crops and kitchen gardens that is used by the holding, regardless of the type of tenure or whether it is used as a part of common land.

Farmers need to strike a balance between crop protection and sustainable chemical management [11].

The comparative analysis of agricultural indicators between Romania and the European Union (EU) for 2022 reveals several key insights into the state of Romanian agriculture.

-*The utilised agricultural area* (UAA) in Romania is substantial, with 60.4 hectares, representing 74.8% of the EU's average, indicating a robust use of land for agricultural purposes.

-*Machinery Investment*: The investment in machinery per hectare in Romania is significantly lower than the EU average (524.53 Euro/ha vs. 2,907.4 Euro/ha), which could imply a potential gap in agricultural technology and mechanization.

-*Livestock Units*: Romania’s total livestock units per hectare are about a quarter of the EU’s average, which may reflect differences in livestock farming intensity or agricultural focus. Energy consumption in Romanian agriculture stands at approximately one-fifth of the EU average, which could reflect either more efficient energy use or a less intensive approach to farming. Similarly, expenditures on fertilizers and crop protection are considerably lower in Romania, which may have implications for agricultural yields and productivity.

-*Labour input* in Romania's agriculture is relatively high, at 72.2% of the EU average, hinting at a more labour-intensive sector, potentially due to lower levels of mechanization. Environmental subsidies per hectare are also notably lower in Romania compared to the EU, which could influence the adoption of sustainable farming practices.

The lower consumption of energy, fertilizers, and crop protection products, as well as the lower livestock density in Romanian farms compared to the EU, indicate a lower environmental impact of the applied agricultural practices. Romanian agriculture has different results in terms of territorial performance [3]. Romanian agriculture is characterized by a multitude of small-sized agricultural holdings with an excessively fragmented agricultural area [20].

The Food Security indicator aims to comprehensively capture the intricacies of the domain, addressing the imperative of ensuring an ample agricultural supply and the economic accessibility of food to construct sustainable food systems. The primary responsibility for guaranteeing food availability lies with agriculture, which is tasked with meeting the nutritional needs of the population. Access to food is contingent on the socio-economic landscape, influenced by factors such as household income, represented by GDP per inhabitant (at CFP), reflecting each household's capacity to attain sufficient nutrition.

Table 4. Food Security Indicator in Romania, in 2022 compared to 2020

Category	Score	Change in 2022 versus 2020	RO place worldwide	Global score
Overall score	**69.11**	**+0.1**	**38.11**	**58.58**
1) ACCESSIBILITY	**67.5**	**0.7**	**43**	**56.3**
1.1) Food consumption (family expenses)	43.33	0.10	73.22	55.77
1.2) The poverty rate global	82.15	-1.91	33.10	75.63
1.3) Gross Domestic Product/ per capita	100	0	1	65.5
1.4) Food standards	100.00	0	1	62.6
1.5) Implementation of food safety programs	69.01	2.81	35.11	60.48
1.6) Access to funding for farmers	65.86	0.80	20.06	56.97
2) AVAILABILITY	**25.08**	**+0.3**	**19.06**	**15.65**
2.1) Adequacy of the supply	52.06	0.00	60.18	58.88
2.2) Sustainability programs	69.41	0.90	103.31	86.66
2.3) Infrastructure in agriculture	64.89	5.92	24.07	46.94
2.4) Sufficiency of production	85.6	-3.9	49.15	37.71
2.5) Risk of political instability	100	100	100	100
2.6) Corruption level	95.59	0.00	15.05	85.15
2.7) Urban absorption capacity	72.82	-1.8	32	58.2
2.8) Food waste	94.5	-2.21	55.17	56.17
3) QUALITY AND SAFETY	**100**	**-2.2**	**1**	**80.1**
3.1) Volatility of agricultural production	56,07	-2.7	37.11	44.03
3.2) Adherence to nutritional standards	65,90	-1.8	32.10	47.34
3.3) Protein Quality	74,7	-7.6	13	36

Source: Own calculation.

Comparing the level of the Food Security Indicator for Romania in 2022 with the one in 2020, there is only a slight increase (by + 0,1 point).

If we talk about the scores registered by Romania broken down on each component indicator of the global food sustainability index, the biggest improvements are important in terms of implementation of food safety programs (+2.81), infrastructure in agriculture (+5.92), urban absorption capacity (+5.8 and access to funding for farmers line (+0.8).

Instead, the quality of proteins (-7.6), the sufficiency of production (-3.9), the volatility of agricultural production (-2.7) and the adherence to nutritional standards (-1.8) decreased.

Romania's strengths in terms of ensuring food sustainability are the indicators that obtained the highest scores, namely: food standards (100), the share of the population below the food waste (94.5), sufficiency of production (85.6), food sustainability (85.3), the poverty rate global (82.15), import tariffs in agriculture (81.7), the presence of food sustainability programs (69.41 and farmers' access to finance (65.86).

Understanding these indicators helps policymakers, researchers, and organizations develop strategies to enhance food security. It involves addressing issues related to both the availability and accessibility of nutritious food. Moreover, considering the environmental impact of food production is increasingly crucial for ensuring sustainability in the long term. Subsequently, we made forecasts for the future evolution of Romania's population based solely on the previous population trends over time. Similarly, we followed the same approach for the sex ratio within the total population. After completing the population forecast, we presented the evolution of the average annual daily per capita food consumption for all nutrients.

In the first scenario, we made forecasts for the future consumption of nutrients based solely on the previous consumption trends for each type of nutrient individually. Since this was an empirical and crude estimation, we projected daily food consumption both in terms of total kilocalories and broken down by types of nutrients. In terms of calories 61% per person per day are lost or wasted by consumers and 81% per person per day are lost or wastes in production, storage, transport etc [17].

From the analysis of the 274 surveyed subjects, it is evident that income plays a pivotal role in accessing higher-quality food products. Individuals with higher incomes tend to have a broader array of options at their disposal, allowing them to select foods that are not only nutritious but also of superior quality, including organic products.

Romanian consumers have started to buy and consume more organic products [10]. Conversely, individuals with lower incomes may find themselves restricted to cheaper alternatives, which often lack nutritional value and are of inferior quality.

This observed income disparity in food access can significantly contribute to public health issues, such as obesity and malnutrition. When individuals are constrained to opt for cheaper, less nutritious foods due to financial limitations, their overall health can suffer. Moreover, the prevalence of these health issues can exacerbate existing societal inequalities.

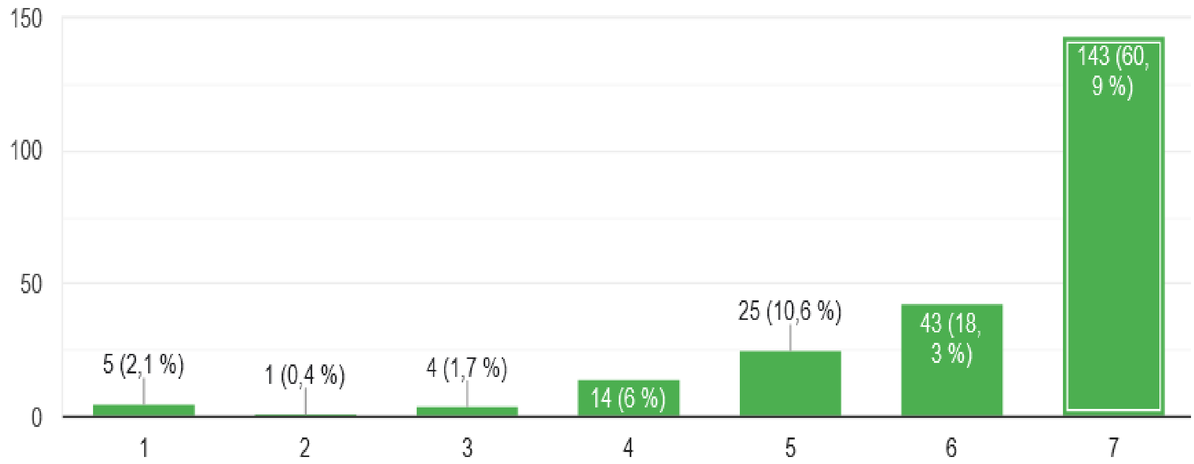

Fig. 1. The influence of income on access to higher-quality food products
Source: Own calculations based on the questionnaire.

Figure 1 reflects responses to the question regarding the extent to which income influences access to higher-quality food products. A significant majority believe that there is a strong influence. This underscores the common perception that income plays a crucial role in determining the quality of food individuals have access to. It is a relevant aspect in discussions concerning food security and social equality.

Therefore, it is imperative for public policies to address these disparities comprehensively. By implementing measures that ensure equitable access to healthy and quality foods, regardless of income level, policymakers can work towards mitigating the adverse health effects associated with socioeconomic inequalities. Initiatives such as subsidies for nutritious foods, community food programs, and educational campaigns on healthy eating habits can help bridge the gap and promote a more inclusive approach to food access and nutrition [11]. Ultimately, by prioritizing such policies, societies can strive towards a healthier, more equitable future for all individuals.

In the study conducted on a sample of 274 subjects, we assessed various community-related variables such as safety and trust, freshness, taste and appearance, accessibility, availability, and quality.

The solution for the factorial analysis consisted of three separate factors that partially met the Kaiser-Guttman Rule for retaining factors with eigenvalues greater than 1 (KMO=0.86), explaining 75.6% of the total variance of the model. The first factor in this solution included three items and individually explained 52.9% of the model's variance (eigenvalue=4.23). This factor was labeled "Accessibility, Availability, and Quality and security." The second factor included three items and individually explained 12.6% of the model's variance (eigenvalue=1.00) and was labeled "Fresh, Taste, Appearance." The third factor included two items and individually explained 10.1% of the model's variance (eigenvalue=0.81). This third factor had a cross-loading. "Safer" had a factor loading of 0.51 for factor one "Accessibility, Availability, and Quality and security" as well as for factor three. The analysis results are presented in the form of the following average scores:

Table 5. Summarizes the three factor solutions for participant attitudes

No . crt	**Community - Variable**	**Safety and Trust**	**Fresh, Taste, and Look**	**Accessibility, Availability, and Quality**
1	Accessibility	0.16	0,32	**0.88**
2	Availability	0.19	0.17	**0.93**
3	Quality	0.13	0.29	0.24
4	More fresh	0.24	0.82	0.2
5	Better tasting	0.13	**0.94**	0.29
6	Better looking	0.08	**0.78**	0.56
7	Safer	0.56	0.48	0.19
9	More trustful	**0.93**	0.17	0.88
10	**Average**	**0.269**	**0.441**	**0.463**

Sources: Own calculation.

A low eigenvalue accompanied by cross-loading prompted a second factor analysis of Consumption with a 2-factor solution instead of the current 3-factor solution. This second analysis had a lower explanation of the total variance, and the 2-factor solution was conceptually and logically unclear in terms of factor labels. Keeping the 3-factor solution, it was decided that "Safer" refers more to confidence in knowing how food is produced, as suggested by factor three, than to how healthy, natural, or nutritious local food is, as suggested for factor one [13]. The third factor was labeled "Safety and Trust". As seen in the Table 5, the ranking of factors is led by "Better tasting" with 0.94, encompassing "Fresh, Taste, and Look", followed closely by 0.93 for "More trustful" and "Availability" in relation to "Safety and Trust." The highest average across all analyzed factors is represented by "Accessibility, Availability, and Quality."The solution for the Community of Factorial Analysis consisted of two factors that met the Kaiser-Guttman Rule for retaining factors with eigenvalues greater than 1 (KMO=0.86), explaining 75.2% of the total variance of the model. The first factor in this solution included four items and individually explained 61.1% of the model's variance (eigenvalue=4.28). This factor was labeled "Community - Social Well-being." The second factor included three items and individually explained 14.1% of the model's variance (eigenvalue=0.99) and was labeled "Community - Economic Well-being"[7].

The solution for the Environment/Sustainability of Factorial Analysis consisted of a single factor that met the Kaiser-Guttman Rule for retaining factors with eigenvalues greater than 1 (KMO=0.85), explaining 65.3% of the total variance of the model. This factor included six items and was labeled "Environment" (eigenvalue=3.92).

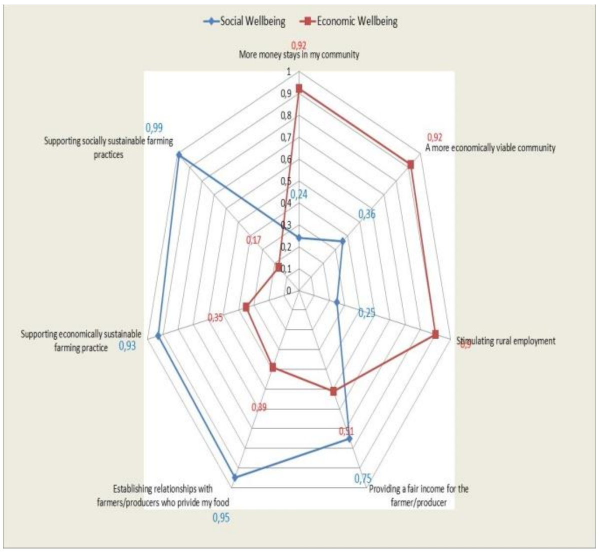

Fig. 2. Factor solutions for environment participant attitude.
Source: Own calculation.

Subjective Norms

The Influence EFA solution consisted of three factors that partially met the Kaiser- Guttman Rule to retain factors with eigenvalues over 1 (KMO=0.73), accounting for 67.0% of the total model variance explained. The first factor of this solution consisted of four items and individually accounted for 35.8% of the variance in the model (eigenvalue=2.51). This factor was labeled "Others." The second factor consisted of two items and individually accounted for 18.9% of the variance in the model (eigenvalue=1.32). This factor was labeled "Parent(s) and Kid(s)." The third factor solution consisted of one item and accounted for 12.3% of the variance in the model (eigenvalue=0.86).

Concern with an eigenvalue under 1 prompted a second factor analysis of influence with a 2-factor solution rather than the current 3-factor solution.

The 2-factor solution of influence had lower total model variance explained (54.7%), as well as a cross-loading on the item "My children."

A 3-factor solution was retained for this analysis. This factor was labeled "Partner or Spouse."

The cultural and traditional significance of local products in Romania is profound and plays a vital role in promoting the country's cultural identity and diversity. Both consumers and producers value these aspects and consider them essential in preserving and promoting Romania's cultural heritage [7].

Overall, the data suggests a diet that is heavy in grains, vegetables, and dairy, with less emphasis on legumes, nuts, seafood, and sugar.

The standard deviations and percentiles indicate varying consumption patterns among individuals, which could be due to personal preference, availability, or cultural dietary habits [2].

If we explore the similarities and differences between the three terms: food sustainability, food security, and food safety, we observe than food sustainability is focusing on the environmental impact of food production, promoting sustainable agriculture, reducing waste, and conserving natural resources.

It encompasses practices that are environmentally responsible, socially equitable, and economically viable.

On the other hand, the food security is looking to ensure that all individuals have access to sufficient, safe, and nutritious food to meet their dietary needs and lead a healthy life.

It addresses issues of hunger, malnutrition, and poverty and involves efforts to improve food availability, access, utilization, and stability. Finally, food safety is dealing with preventing contamination and foodborne illnesses throughout the food supply chain.

It involves maintaining strict standards, proper handling, and storage practices, and regular inspections to protect consumers from harmful substances and ensure safe food consumption. Also, consumer behaviour has changed being more oriented to a healthier food [19].

Consumers' option for short food supply chains becomes an alternative once they become more interested in healthier products and thus are oriented towards local products [16].

Table 6. Food consumption

Name of agroalimentar products	Number of consumers	Mean consumption in grams/day	Standard Deviation of consumption in grams/day	5th percentile of consumption in grams/day	10th percentile of consumption in grams/ day	Median consumption in grams/ day
Foodex L1	Nr Consumers	Mean	STD	P5	P10	Median
Grains and grain-based products	274	194.92	102.59	63.92	84.39	180.78
Vegetables and vegetable products	274	420.45	213.27	161.44	198.40	378.93
Starchy roots and tubers	267	126.41	79.26	11.80	30.70	117.68
Legumes, nuts and oilseeds	172	19.94	25.18	0.00	0.00	12.60
Fruit and fruit products	262	169.06	159.04	1.10	18.97	130.19
Meat and meat products	27	211.82	102.99	73.36	93.44	201.24
Fish and other seafood (including amphibians)	113	19.45	36.11	0.00	0.00	0.00
Milk and dairy products	274	163.74	108.03	25.19	40.54	146.58
Eggs and egg products	264	39.00	28.93	2.36	8.34	33.15
Sugar and confectionary	243	18.43	18.94	0.00	0.00	12.90
Animal and vegetable fats and oils	274	56.08	25.13	21.53	26.77	52.80
Fruit and vegetable juices	155	9.41	35.80	0.00	0.00	2.36
Non-alcoholic beverages (excepting milk based beverage	270	238.67	221.49	29.13	55.10	183.14

Source: Own calculations based on the questionnaire.

Analyzing the table, here are some insights on food consumption:

- Grains and grain-based products are consumed at a mean of 194.92 grams/day, indicating they are a staple in the diet.

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- Vegetables and vegetable products have the highest mean consumption at 420.45 grams/day, showing a strong preference or availability in the diet.
- Starchy roots and tubers show a lower mean consumption of 126.41 grams/day with a wide range of consumption (standard deviation of 79.26 grams/day), suggesting varied intake among consumers.
- Legumes, nuts, and oilseeds; Fish and other seafood; and Sugar and confectionary have the lowest mean consumption rates, which could indicate these are less common or less preferred foods.
- The median consumption figures generally follow the mean trends but are slightly lower for most food categories, which may imply that a smaller portion of the population consumes these foods in larger quantities, skewing the mean upwards.
- The 5th and 10th percentiles for several food categories, such as legumes, nuts, oilseeds, fish, and sugar, are at 0 grams/day, indicating that a significant portion of the population does not consume these foods regularly. Percentiles are descriptive statistics that divide a data set into 100 equal parts. Each percentile indicates the value below which a certain percentage of the data falls. For example, the 5th percentile (P5) shows that 5% of the data are less than or equal to that value, and the 95th percentile (P95) shows that 95% of the data are less than or equal to that value. These are useful for identifying the distribution and trends in food consumption, such as observing that a small percentage of people consume very small amounts or none at all of certain food categories.

CONCLUSIONS

Having the intention of analyzing the agricultural sustainability of Romania, in comparison with European countries in economic, environmental, social, and political terms, by analyzing the central agricultural food policies related to food sustainability worldwide, the authors started from the assumption that food security policies are indeed an integral part of agriculture-food policies. We observed that the inclusion of food security measures within broader agricultural and food policies is crucial to ensure the production, processing, distribution, and consumption of safe and wholesome food. These policies aim to protect public health, prevent foodborne illnesses, and maintain consumer confidence in the food system.

Given Romania's fluctuating position in the Global Food Security Index and the identified indicators related to food security improvements, it is advisable to implement comprehensive educational campaigns and awareness initiatives targeting consumers, producers, and stakeholders. These efforts should emphasize the importance of safe food handling, adherence to food security standards, and informed dietary choices to mitigate risks associated with excessive calorie consumption and promote healthier eating habits.

The disaggregated scores by indicators provide a more detailed insight into the weaknesses of food security: agricultural production volatility and political commitments regarding access (including the absence of an officially endorsed food security strategy and a coordinating agency for this field), as well as the insufficient coordination and consistency of policies addressing climate-related impacts on natural resources. Vegetable agricultural production focuses on cereal production, primarily wheat and maize, while animal agricultural production centers around the production of milk, eggs, and meat. These findings are applicable at the level of the entire macro-region, including Iasi County.

In general, average household incomes are over 10% higher than average household expenditures, with expenditures on food and beverages accounting for over 20% of total expenditures in the entire macro-region. There is a noticeable trend of decreasing expenditures on food and beverages.

The solution for factorial analysis consisted of three separate factors that partially met the Kaiser-Guttman Rule for retaining factors with eigenvalues greater than 1 (KMO=0.86), explaining 75.6% of the total variance of the model. The first factor in this solution included three items and individually explained 52.9% of the model's variance (eigenvalue=4.23). This factor was labeled "Accessibility, Availability, and Quality, and Security". The second factor included three items and individually explained 12.6% of the model's variance (eigenvalue=1.00) and was labeled "Freshness, Taste, Appearance". The third factor included two items and individually explained 10.1% of the model's variance (eigenvalue=0.81). This third factor had a cross-loading. "Safer" had a factor loading of 0.51 for the first factor "Accessibility, Availability, and Quality, and Security", as well as for the third factor.

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ASSESSMENT OF THE POTENTIAL OF THE HUMAN FACTOR FOR SUSTAINABLE DEVELOPMENT OF THE RURAL TERRITORIES IN REPUBLIC OF BULGARIA

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Abstract

The primary trends defining the paths toward sustainable development in rural areas of Bulgaria underscore the significant influence of human resources., and the priorities are oriented towards stimulation of the vocational training and science based skills, obtained through appropriate education and specialized training, and leading to success in the development and management of the local economy. The tendency, related to the problem is highlighted as the shortage of adequately educated and skilled entrepreneurs capable of harnessing technological advantages in agricultural production and implementing innovative technologies. The goal of our study is related to investigation and summarization of basic tendencies in this aspect, within Bulgarian agricultural enterprises, the emphasis lies on the crucial connection between theoretical knowledge and hands-on experience, particularly highlighting the importance of educating and training agricultural producers. The education and practical application of scientific knowledge by those engaged in agriculture are vital components for achieving success and ensuring the sustainability of economic endeavours at the local level. By promoting education and training for individuals involved in agricultural activities in the agrarian sector, the agriculture guarantees its sustainable and efficient development, which without doubt reflects on the increase of the sustainability of the rural territories, as a whole. The results of the study formulate guidelines, conclusions and recommendations related to recognition of the need of ensuring the proper education and training of agricultural producers, especially in the realm of environmentally friendly practices and innovative technologies. In conclusion, the synthesized research findings provide insight into the tendencies in basic strategic documents supporting knowledge, as well as data for the educational status in the Bulgarian agrarian sector regarding the potential and significance of the human factor. Future guidelines for the study in the sphere of human resources are outlined in the modern agriculture and the Bulgarian rural territories.

Key words: *human factor, education, training, agricultural producers, rural territories.*

INTRODUCTION

The Common Agricultural Policy (CAP) [7, 19], for the period 2023-2027 has decisive significance for *the development of rural areas* and for guaranteeing the future of the agriculture. *The main factor for the successful fulfilment of the planned goals are the human resources* [33, 36], In the present report we turn the attention towards *the significance of the human thought for the future* ***via transmission and reception of knowledge*** and we emphasize precisely on this *potential of the human factor*. The new legislation, in effect from 1st January 2023, suggests a fairer and more ecological CAP, based to a greater extent on the results, which will be implemented by the practices and the approach of the agricultural producers in their practical work [13]. Here is the point of intersection, on which we are placing our emphasis in the present study, between the following ***factors for achieving the capacity required for the contemporary requirements and conditions and scientific and vocational training of the human resources, as well as conditions for achieving sustainability in the development of the rural territories***:

-the relation between ***the theoretical training and practical work*** (all changes and guidelines in the new CAP are based on accumulated tendencies and scientifically substantiated facts and new necessities, which are to be applied in the work of farmers in the Bulgarian rural territories);

-***basic guidelines, emphasises, conditions and incentives in strategic documents***, related to the education and the training of the agricultural producers [23, 34, 37].

-environmentally-oriented ***thought*** for protection of the environment and health of people and ***actions*** on the part of the agricultural producers for achieving of these goals;

-***role of the institutions, centres and trainers organizations*** in the stimulation and the vocational training of the agricultural producers;

-***the relation - trainers and trainees*** (uncontested fact for the development is the appropriate education in higher schools and vocational trainings of the agricultural producers, held by specialized centres).

This combination of factors enables the transition to a fairer, environmentally-oriented and sustainable economy, based on knowledge and innovations. We are looking for and specifically analyse the listed factors and their application during the implementation of two of the ten main goals of the new CAP, and namely – which is the most important, according to us: ***stimulation and application of knowledge and innovations (education and training)***, without which there can be no sustainable development and successful future for the agriculture and the significance of this factor for another main goal of CAP, and namely - ***development of the rural areas(in the particular case - in Bulgarian rural territories)***.

The European Commission has outlined the Long-Term Vision for EU rural areas up to 2040, delineating areas of focus to foster stronger, interconnected, sustainable, and prosperous rural communities. Through initiatives like the Rural Pact and the EU's action plan for rural areas, featuring key projects and novel tools, the objectives of this vision are pursued. The Rural Vision Ten Shared Goals represent the collective aspirations of rural communities and stakeholders regarding the desired state of EU rural areas by 2040. These goals emerged from extensive dialogues with diverse voices across various rural regions. Central to this vision are the perspectives, intentions, needs, and drive of the human element, serving as the foundation upon which the vision and goals are built, aligning with the objectives of the EU Rural Action Plan and the Rural Pact. *The main engine for implementation of the symbiosis between scientific theoretical intentions and the practical application in the real situation of the rural areas is the inexhaustible potential of the human resources* - ***qualified people with entrepreneurial spirit and forward-looking thinking****, who jointly create the technological, ecological and social progress* [14].The latter is also supported by the new CAP, which ensures the sustainable development of the agricultural holdings, providing support for the smaller ones with an opportunity for adaptation of the planned measures to the specifics of the particular rural territories and conditions. We specify the guidelines, ***evaluate the human potential for environmentally-friendly intention and conscientious fulfilment of ideas behind the policies and we emphasise again on the role of the human factor*** for improvement of the future condition of the agrarian sector via:

-*More environmentally-oriented CAP* – through greater commitment to conditions-the payments are bound by mandatory requirements, for example, at least 3 % of the arable land in each farm should be intended for elements related to the biological diversity; eco-schemes - allocating a minimum of 25% of the budget for direct payments to incentivize agricultural practices and methodologies that promote climate and environmental sustainability; rural area development - dedicating at least 35% of funds to initiatives supporting climate resilience, biodiversity preservation, environmental enhancement, and animal welfare.

[18, 22, 32];

-*Fairer CAP* - through support for the redistribution of income support, in order to better meet the needs of the smaller and medium agricultural holdings; active farmers, and only they will be able to receive certain support from the EU; support for the young farmers; equality between sexes and increase of participation of women in the agriculture;

-*Improvement of competitiveness* – by strengthening the position of the farmers in the supply chain and increasing the competitiveness; stronger position for negotiations, by encouraging the farmers to work jointly.

Priority emphasis of the CAP for the period 2023-2027 is on *the results and implementation* of the goals set, and outline the ten *specific goals* (as mentioned herein above), related to the social, ecological and economic sustainability in the agriculture and the rural areas, and namely: provision of fair income to farmers; increasing the competitiveness; improvement of the position of the farmers in the food supply chain; actions to combat the climate change; care for the environment; preservation of the landscape and biological diversity; supporting the change of generations; viable rural areas; preservation of the quality of food and health; ***stimulation of knowledge and innovations***. All of them are fundamentally connected to the opportunities and potential of the human resources and their work for application and implementation of the scientific formulations in a practical environment [14]. The outlined goals lie behind the National CAP Strategic Plan, which combines financing to support the income, development of the rural areas and marketing measures, created depending on the national necessities and capacity [27] and, as emphasised at the beginning of the report, we underline those, which concern the direction of the present research – ***assessment of the human factor potential in the Bulgarian rural territories***:

-*Attraction of young and new farmers* (in the period 2005-2020 the share of the young farmers decreases, and the average share of young women-farmers is particularly low);

-*Dependence between the age of the agricultural producers and the size of the holding* (the average farm, managed by an older farmer, is considerably smaller in comparison with all other age groups both in terms of farm land, and in relation to potential production value, the smaller quantity of agricultural holdings owned by young farmers is offset by the rise in the average size of each holding. [16, 30];

-Promotion of growth and equality in rural areas: Fostering employment, economic growth, and gender equality, including active involvement of women in agriculture, social integration, and local development in rural regions. These objectives are closely linked with the circular bioeconomy and sustainable agricultural practices.

-Creation of employment opportunities in rural areas: Stimulating job growth in rural areas is crucial for enhancing quality of life, ensuring access to essential services, and halting the decline in rural population.

-***Training*** (there are many differences in the level of training, acquired by the young managers of agricultural holdings; improvement of educational status of the agricultural producers and provision of access to vocational training remains priority for the policies, oriented to viable production of foods and sustainable use of natural resources);

-***Increasing the cooperation for sharing of knowledge*** (support for exchange of knowledge, training, advises and innovations is of crucial importance for the provision of smart and sustainable agriculture in the rural territories. It includes investments in transfer of knowledge and information actions, consultancy services, etc.);

Encouragement and sharing of knowledge, innovations and digitalization (modernization of agriculture and rural areas via encouragement and sharing of knowledge, innovations and digitalization and their adoption by the agricultural producers through improved access to scientific research, innovations, exchange of knowledge and training).

Achieving progress in the sphere of scientific researches, sharing of knowledge and innovations are of crucial importance for ensuring intelligent and sustainable agricultural sector. EC supports the scientific researches and the innovations in the agriculture, and allots funds for projects, related to food, agriculture, development of rural areas and bioeconomy, while CAP utilizes the increased investments through inclusion of stronger ***Agricultural Knowledge and Innovation Systems (AKIS)***, in order to stimulate development of innovatory projects, spread out the results of them and encourage their widest possible use. ***Consultancy services*** in the sphere of agriculture are a key instrument for exchange of new knowledge and ideas [24, 25, 26].

Scientific researches and innovations play decisive role, in order to guarantee that EU develops to meet the challenges, it encounters, and at the same time to keep on achieving the goals of its policy, being guided by the long-term strategic approach, oriented towards encouragement of the innovations in the rural areas. This is extremely important instrument in combating problems such as climate change, deterioration of the state of the environment and loss of biological diversity.

In this context, the purpose of the paper is to investigate and summarize the basic tendencies in the characteristics of human resources in the Bulgarian agricultural holdings, emphasizing on the significance of the relation between theoretical training and practical work, with the focus being on the role of education and training of agricultural producers.

MATERIALS AND METHODS

The **methods** used **for the study** of significance and evaluation and the potential of the human element in attaining sustainability in Bulgarian rural areas encompasses various approaches, including standard scientific research methods such as investigation, observation, and review of scholarly literature. Additionally, it involves summarizing and synthesizing statistical data sourced from official channels, employing logical methods, and graphically representing characteristics and trends.

These investigations facilitate the gathering of data regarding the educational attainment of farmers, we can analyse the experience of individual producers and how education affects their agricultural practices, the observational investigations provide information for analysis of the behaviour of farmers with different education and the subsequent decision for action under different conditions, according to the scientific preparation and the skill for its application. The review of the literature provides the opportunity to analyse the existing studies and new guidelines to consider the effect of education and training on the agricultural practices.

Combining these methods, the research workers can get a more in-depth understanding about the way education and specialized training intensify the effect and provide the opportunity to apply and deploy the potential of the human factor in the modern agriculture.

The study aims to highlight the key factors, as perceived by us, concerning the characteristics of human resources that are essential for ensuring sustainability within agricultural holdings, particularly within an economy transitioning towards sustainability.

To accomplish this objective, we will analyze the development opportunities and potential of human resources, focusing on factors such as education and training within the agricultural sector. We will explore their significance in enhancing efficiency and promoting sustainability.

in the Bulgarian rural territories.

RESULTS AND DISCUSSIONS

In Bulgaria, the agricultural sector holds significant importance for the economy. Approximately 4% of the Gross Value Added (GVA) and over 6% of the total employment in the country stem from agriculture. This sector also makes a positive contribution to the country's trade balance. With around 47% of the nation's territory designated as agricultural land, and rural areas occupying 22% of Bulgaria's landmass, they are home to 13% of the population.

During the economic year 2021/2022, the total number of registered farmers stood at 72,371, which decreased slightly to 69,669 as of June 2023. Moreover, the total number of agricultural holdings amounted to 132,742.

[15, 24].

This data confirm *the decisive role of the human factor in the agrarian sector*, but *among the positive tendencies, there are certain problems*, which delay introduction of innovations in the practical work of farmers in the Bulgarian rural territories. Using technologies, introduction of new agricultural ecological and sparing practices, achievements of the agrarian scientific thought are to be inevitably and indispensably adopted in the sphere of the agrarian sector, but this is only possible through transfer of knowledge, of specialized trainings, of vocational education in the area. This is the critical point, which we pay attention to in the present report – the statistics points out a large number of aged producers with experience, but without the necessary education and training and a small number of young educated farmers, who need support. And here comes the role of all strategic documents, which set their goals in this aspect, because it is extremely important to popularise the measures, incentives, conditions and opportunities, so that they will successfully implement their intended use and functions [35, 37].

All strategic documents concerning the advancement of modern agriculture affirm that supporting the exchange of knowledge, training, advice, and innovations is crucial for fostering smart and sustainable agricultural practices and rural development. Therefore, one of the primary objectives is the modernization of agriculture and rural areas through stimulation and sharing of knowledge, innovations and digitalization and through encouragement for their use by the farmers with the help of improvement of the access to researches, innovations, exchange of knowledge and training [25, 21].

As affirmed [8, 9, 10, 11], a deeper understanding of agricultural science is essential in agribusiness and education and training play a crucial role in modern agriculture.

In this aspect, information sheets and the Bulgarian analytical reference book [12] offer an updated and organized overview of the agricultural sector and rural development in Bulgaria. The provided information encompasses key indicators related to agriculture and rural development. The goal of the information notes is to systematize knowledge and facts related to modernization of the agriculture, and to intensify the cooperation and exchange of knowledge and to improve the agricultural qualification.

The current study sheds light on significant disparities in the level of education attained by young managers of agricultural holdings. Enhancing the educational qualifications of agricultural producers and ensuring their access to vocational training remain key priorities for policies aimed at fostering sustainable food production and the responsible utilization of natural resources.

Data from the agricultural holdings census in the preceding programming period reveals that only a mere 3% of agricultural holdings managers possess agricultural education. Among them, 2.08% have completed secondary vocational agricultural education, while 0.83% hold higher agricultural education degrees. Comparative data illustrating the agrarian training of agricultural holdings managers in Bulgaria, in comparison with the EU, can be found in Figure 1.

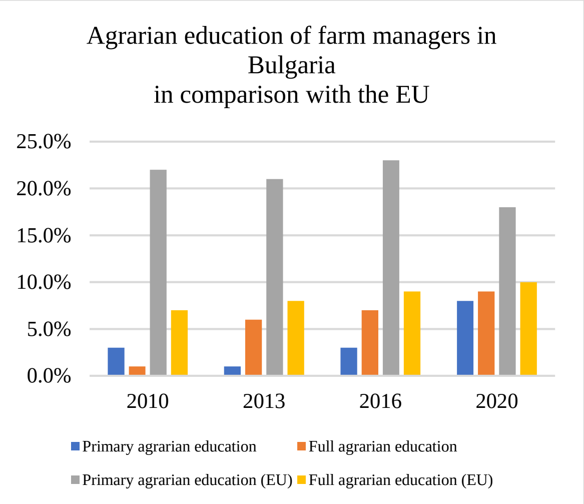

Fig. 1. Agrarian training of managers of agricultural holdings in Bulgaria in comparison with EU
Source: Authors' figure on the basis of data from the Ministry of Agriculture, Agrostatistics [20].

We found the educational status by years, and report positive tendency of weak increase, but still the agrarian sector has an indispensible need of educated managers, who will apply new scientific approaches and innovations in the practical work. Modern dynamic environment necessitates increasing of the educational capacity, because the European standards and mostly, the complicated ecological situation require much more work and measures in this aspect.

By age group - the managers with secondary vocational education aged between 25 and 44 years are just above – 4%. These values are lower in the age group above 55 years – around 1-2 %. The next graphic represents the age – education dependence and confirms the thesis for predominance of mainly young educated entrepreneurs and the tendency for the older ones to relay mostly on practical experience and to be more reserved towards the continued education and training. This makes them less prepared for the contemporary ecological and technological requirements and challenges.

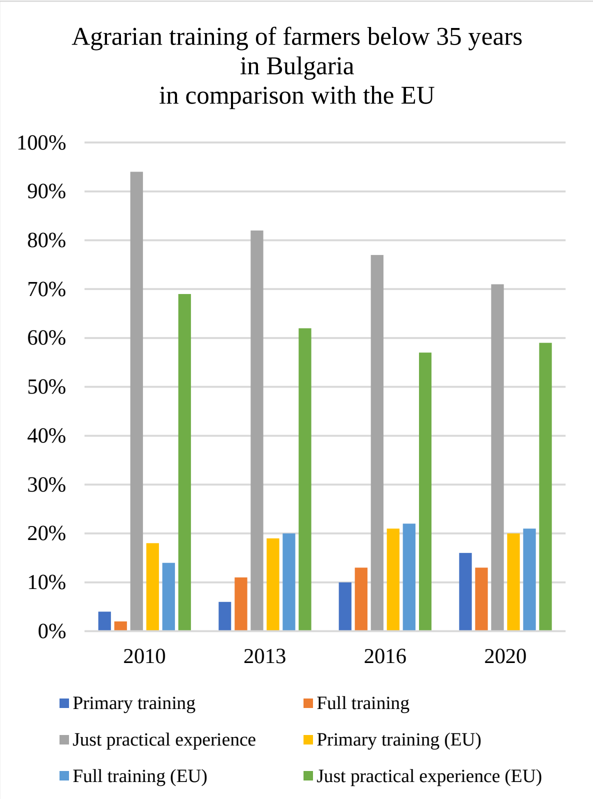

Fig. 2. Agrarian training of farmers below 35 years in Bulgaria in comparison with the EU
Source: Authors' figure on the basis of data from the Ministry of Agriculture, Agrostatistics [20].

With the managers with higher agricultural education there is no particular difference by the age groups, and their share is slightly higher than - 2 % only in the group between 25 and 34 years [19]. It is exactly this unsatisfactory data regarding the educational status of the agricultural producers in the Bulgarian rural territories, which with the rest of the member states is not much higher, that brings up inclusion of promoting training and education within the agricultural sector is highlighted as one of the main goals in the new programming period. Emphasizing capacity building is a primary focus, with a range of measures, incentives, and conditions established to ensure the effective utilization of human resources potential.

CAP provides opportunities for encouragement of the inclusion of young people with specialized agricultural education in the sector of the agriculture and furthermore for increasing of the professional qualification of farmers. The Rural Development Programme sets eligibility conditions for supporting agricultural producers, if they have the respective professional skills and knowledge, and namely: secondary education in the sphere of agriculture or veterinary medicine or secondary economic education with agricultural orientation; higher education in the sphere of agriculture or veterinary medicine or higher economic education with agricultural orientation; completed course of minimum 150 hours under measure 111 of the RDP. Measure 111 is related to courses and information activities, and the training organizations can be Vocational Training Centres, professional high schools, higher schools.

Research of the scientific literature related to the problems and tendencies in the Bulgarian rural territories [1, 5, 6, 28, 29].

Prospects and obstacles in marketing agricultural produce from small and family-owned farms in Bulgaria, were analyzed by [17, 31] who made the review of basic strategic documents, and mostly, the shared opinions and experience from the practical work found that everybody, who is into agriculture, consultations, scientific analyses, training and education, finds difficulties and challenges in his/her adaptation to this ever changing environment.

The main problems, which we could be outlined are:

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-A major part of the agricultural producers are already making use of the digital technologies, but there are still hindrances, which stop them from using their full potential, due to lack of qualification and appropriate education and training;

-Most agricultural producers need support, so that they can become familiar with the new technologies and adopt them, as well as for make decisions on using information and communication technologies (ICT), adapted to their particular necessities, and here comes the role of the specialized services, systems, centres, strategies, programmes.

On the basis of the studied research works [2, 3, 4] and the analyses done and authors' findings, we would suggest and consider that the working ***solutions*** for the problems specified can be:

-The relation between the agricultural producers, the society and the natural world changes due to the diminishing resources, the increasing population and the pressure on the environment, the changing expectations of the society, the new technologies and the increasing effect of the climate change. It is due to these particular reasons that the agricultural producers need ***new knowledge, new skills and innovative ideas for*** development and management of smarter and more sustainable production systems;

-All over Europe ***new instruments and approaches*** for improvement of exchange of knowledge and development of the rural areas are being used. Agricultural community becomes more and more creative and inventive. Valuable successful approaches are being shared, such as comparison of the results of the agricultural holdings, which help the agricultural producers in adapting and improving the management of their holdings;

-EIP-AGRI's „Interactive model for innovations", knowledge is already created jointly by agricultural producers, scientists, consultants, enterprises, NGOs, etc.;

-Agricultural Knowledge and Innovation Systems (AKIS) are used to describe the entire ***system for exchange of knowledge***: the ways in which people and organizations interact in a given country or region. AKIS can include practices in agriculture, businesses, bodies, research works, etc. and can vary within broad limits depending on the country or the sector. Upon developing of a new AKIS it is necessary to take into account the technical, organizational and social dimensions („*systemic approach*"), as this *helps in filling the gap between the science and the practice*;

-The „linear transfer of knowledge" model, where researchers, trainers and technical experts develop solutions for problems in the agriculture, whereupon they hand them over to the agricultural producers, becomes less and less corresponding to the present reality. Significance of ***learning through partnership*** increases - agricultural producers and consultants start working through interactive methodologies, which provide better support of the innovations and changes. *New skills for wise and efficient use of the new necessities and opportunities in the agricultural sector are required, along with focusing on the real problems, the agricultural producers are faced with*. This way will be provided solutions applicable in practice, and the agricultural producers will be motivated to integrate and make use of them;

-There is an increasing number of practical ***„networks for knowledge"***, which provide information for the agricultural producers. Example in this aspect are the topical networks, funded by the programme „Horizon 2020", which emphasize the collection and distribution of the best practices and useful findings among the agricultural producers. Integration of these networks for knowledge in the regional AKIS is of critical importance;

-***Exchange of knowledge between agricultural producers.*** Most agricultural producers resolve alone their problems and experiment. They know the specific situation in their holding and adapt their agricultural systems to improve productivity and cost-efficiency. However, when the agricultural producers try or test something, they do it independently, because testing in the sphere of agriculture are not concentrated sufficiently on the specific necessities of the agricultural holdings. Exchange of information with another agricultural producer can lead to breakthroughs in dealing with the challenges;

-Comparative analysis for better results of the agricultural holdings. The comparative analysis provides the opportunity for the agricultural producers to juxtapose the results of their own holding with the ones of similar other holdings. The parameters, which are usually measured, are quality, time and price. Holdings with the best practices are identified and compared with the results and processes of the other studied holdings, and this is called comparative analysis. This way the agricultural producers learn how well they work and more importantly, why some holdings are successful. Comparative analysis is an important instrument for exchange of knowledge and for improvement of productivity and sustainability of the agricultural holdings, and it can be innovative instrument for advisors.

The proposed solutions delineate specific measures and efforts, underscoring the human element as pivotal for sustainability within agricultural holdings. Hence, this report particularly highlights the importance of educating and training human resources. Education and specialized training enhance agricultural producers' knowledge, refine their skills, bridge theory and practice, enable the adoption of modern environmentally friendly practices, and facilitate informed decision-making. These improvements optimize management processes, enhance overall agricultural operations, boost yields, and improve efficiency. Proper education also equips producers with essential knowledge for environmental conservation.

An important benefit of educated farmers is their ability to introduce and utilize new technologies and innovations, thereby enhancing productivity and cost-effectiveness. Moreover, educated agricultural producers are well-informed and knowledgeable on the opportunities for financing [1] and inclusion in different programmes for supporting.

As emphasised at the beginning, the active relation between scientific researches and the condition in practice is of extremely crucial importance. Therefore, we will back our thesis about the need of measures in the direction of increasing the vocational training of the farmers through real and particular statistical data from the practice by regions in the Bulgarian agrarian sector, which bind the education with another factor – upon examining the data on agricultural holdings, we observed that the count of managers with varying levels of education, as detailed in the table below, does not correlate significantly with the number of agricultural holdings. This is because the numbers are nearly identical across the six planning regions. Here comes the summarized data in Table 1.

The most educated in the sphere they work in are the managers of agricultural holdings in South central and in North central region. This can be seen in the statistical table published on the web site of the Ministry of agriculture and food. South central region comprises the areas Plovdiv, Stara Zagora, Haskovo, The most educated in the sphere they work in are the managers of agricultural holdings in South central and in North central region. This can be seen in the statistical table published on the web site of the Ministry of agriculture and food.

South central region comprises the areas Plovdiv, Stara Zagora, Haskovo, graduates among the population aged 25-64 years are more than 30% and above the average level for the country, the industrial area of Gabrovo attracts more people with secondary education – 66% (with 54% for the country), and in the areas of Razgrad and Silistra the share of the population with primary and lower education is significant – more than 31% (with 17% for the country) [19].

We can summarize that the training and education of people working in agriculture, according to the statistics specified, plays important role for its development and sustainability.

The interplay between age and education fosters the cultivation of distinct skills and knowledge within agribusiness. Older individuals impart invaluable experience in traditional agricultural practices, while younger counterparts bring familiarity with new technologies and innovations. This balance of skills enhances the efficiency and productivity of agricultural work [31].

Table 1. Level of education in the sphere of agriculture of the manager of the holding

Level of education in the sphere of the agriculture of the manager of the holding					
Level of education in agriculture of the holding's manager					
Regions	Only with practical experience	Primary agricultural training (completed course in agriculture of at least 150 hours)	Secondary vocational agricultural education	Higher agricultural education	
	Only practical agricultural experience	*Basic agricultural training (a course in Agriculture with a minimum of 150 hours)*	*High-school specialization in agricultural training*	*Higher university degree of agricultural education*	*Statistical regions*
North-western	27,894	487	1,471	529	*Severozapaden*
North central	25,121	485	2,188	839	*Severentsentralen*
North-eastern	25,104	379	1,862	654	*Severoiztochen*
South-eastern	33,731	698	1,644	682	*Yugoiztochen*
South-western	49,871	422	1,493	295	*Yugozapaden*
South central	74,315	886	2,228	864	*Yuzhen tsentralen*
BULGARIA	**236,036**	**3,357**	**10,886**	**3,863**	**BULGARIA**

Source: Authors' figure on the basis of data from the Ministry of Agriculture, Agrostatistics [20].

Among the most significant conclusions from the present study we can outline that the new, common agricultural policy appears to be the intersection point of education and training in agriculture. The guidelines in the development of the rural areas are based on *leading priorities*, which reflect the respective *topical goals of the Common strategic framework* with an emphasis on the following areas, which fully confirm the thesis defended by us about leading role of the education of human resources: stimulation of the transfer of knowledge and the innovations in the sphere of the agriculture and rural areas; strengthening of the relations between agriculture and scientific and research work and innovations; encouraging the lifelong learning and vocational training in the sectors of the agriculture.

CONCLUSIONS

The conclusions drawn from the study regarding the importance and impact of education on the human element in agriculture offer valuable insights into the practices and behaviors of agricultural producers. Younger farmers demonstrate a greater inclination and motivation to enhance their education and pursue specialized training, driven by their innate innovativeness and open towards the contemporary challenges of the economy transforming towards sustainability. The analysis done by regions found predominating in statistical aspect better educated or less scientifically prepared producers, but with an increase of the tendency for introduction of young educated entrepreneurs in the agrarian sector;

Education and training play a crucial role in modern agriculture as a deeper understanding of agricultural science is essential in agribusiness. Moreover, education enables agricultural producers to stay abreast of the latest technologies and practices, facilitating informed decision-making regarding their operations. Entrepreneurs with higher levels of education tend to be more inclined towards adopting sustainable agricultural practices, whereas older farmers may exhibit greater resistance to change. The examination of the education factor reveals a prevailing trend in Bulgaria favoring individuals with primary agricultural training or secondary vocational agricultural education over those with higher education. This underscores the necessity of elevating the educational attainment of agricultural producers. The research proves that improvement of the agricultural training is required, because ***knowledge*** allow farmers to better cope with the economic, ecological and public challenges. In the EU most managers of agricultural holdings acquire knowledge through practical experience in the farm. Although the share of those, who obtain basic training (any kind of training courses, completed in comprehensive agricultural college or similar institution, or completed agricultural internship) and full agricultural training (equivalent to at least two regular years after the compulsory education), is increasing, it remains relatively low. An integrated package of knowledge, information, advises and training is required to cope with this problem along with an updated and thorough approach, combining advises with research and education, and at the same time including other stakeholders and organizations.

The influence of education and training on the agricultural practices varies depending on the distinct context and culture of the agricultural community under examination, it is crucial to interpret the results of each study with care, considering the unique attributes of the agricultural holdings in Bulgarian rural areas. Education among individuals involved in agriculture stands out as a pivotal factor for the sector's success and sustainability. Therefore, fostering the education and training of the next generation of agricultural entrepreneurs who are to enter the agrarian sector, the agriculture guarantees its continuous success and growth. Acquiring of new knowledge, corresponding to the necessities of agricultural producers and stimulation of changes, encourages agricultural producers to introduce new technologies, implement new techniques, enhance their education level, which is to correspond to the ever changing external and internal environment in the agricultural organizations.

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SOCIO-ECONOMIC CHALLENGES IN THE TRANSITION TO A LOW-CARBON ECONOMY AT REGIONAL LEVEL IN BULGARIA

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Abstract

A number of dynamic events have taken place in recent years, leading to an uncertain global and national situation. One of these is the signing of the European Green Deal, which attempts to make Europe a climate-neutral continent. This, in turn, has further worsened the situation of some European countries, including Bulgaria. The presence of three active coal mining complexes in the country largely exposes it to serious challenges in the transition stages and hinders the finding of appropriate methods and instruments to reduce carbon dioxide emissions. The aim of the study is to explore the main socio-economic challenges in the transition to a low-carbon economy at a regional level and to present some of the author's views on limiting the negative impacts on regional development. The analysis of the available data shows that the sustainable dimensions of the three coal mining regions is highly threatened.

Key words: *Bulgaria, low-carbon economy, regional level, socio-economic challenges, transition*

INTRODUCTION

Climatic changes in the 1950s have led to serious negative consequences on the climate and the environment. The EC is taking a stand on this global problem, developing a mechanism to deal with the current situation, namely the signing of the European Green Deal. This strategic document aims to "turn the EU into a fair and prosperous society with a modern, resource-efficient and competitive economy in which there will be no net emissions of greenhouse gases in 2050 and economic growth does not depend on the use of resources" [5]. The European Green Deal is essential for the efforts of the EU to contribute to reducing climate change and protecting the environment by achieving sustainable economic growth and creating better living conditions for its citizens. Certain measures that meet these goals have been implemented, among which the transition to a low-carbon economy. The reduction of greenhouse gas emissions is also an important commitment on a European scale.

Essentially, it attempts to limit the effects of climate change, which requires the collaboration and input of all parties. Active governmental initiatives, involving businesses, citizens and public organizations are needed to face these challenges and guarantee a successful pathway to a low-carbon economy.

The transition to a low-carbon economy, or *decarbonization*, poses a serious socio-economic burden that necessitates complex solutions and efforts on government level, including the business sector and citizens. The following main issues can be highlighted:

(1)*Transformingt he energy system*: Reforms are needed to shift the current energy system to a low-carbon economy. Using renewable energy sources, such as solar and wind, may require the closure or adaptation of old coal-fired power plants. In this context, in 2011, the "Energy Roadmap to 2050" was adopted and published, underscoring the ambition to reduce greenhouse gases by 80-90% by 2050 [3].

(2)*Retraining and training*: With the introduction of new technologies and innovations in a significant amount of activities, many workers, especially in carbon-intensive sectors, such as coal mining and oil refining, will need retraining and training to find new jobs in the low-carbon economy.

(3)*Social consequences*: The social element is also a key point of the transition, including social hazards, such as job losses in carbon-intensive sectors and a change in the economic structure. This can lead to social tension and insecurity. The initiative promotes economic and social development in the less developed regions of the EU by providing financial support and investment [6].

(4)*Economic investment*: Clean energy and infrastructure can be an expensive endeavour, but these investments are essential for the successful transition to a low-carbon economy. Cooperation between governments and private investors can raise funds for such projects.

(5)*Government policy and regulation*: Effective government policy and regulation underlie the transition to a low-carbon economy. The actions envision creating incentives and encouraging innovation, as well as more restrictive measures on carbon emissions.

(6)*Effective public participation*: Informed and involved citizens will benefit the transition process, as they have the opportunity to share their views and participate in decision-making [5].

In this context, it is necessary to make concrete proposals on alternative employment opportunities that would limit the negative effects of the disruptions that potentially exist in the regional labour market. One effective suggestion would be to exploit the local tourism potential as well as to look for new forms of agriculture. Both tourism and agriculture are sectors that are constantly diversifying, both in terms of the resources used and the expected results.

MATERIALS AND METHODS

Based on a review of the possible scenarios for the European energy transition, we offer an analysis of the situation in Bulgaria. Various methods and tools have been used in this research. Mainly advocated is the analysis of dynamic series and the formulation of some socio-economic and demographic projections that impact the creation of policies during thetransition to a low-carbon economy. Based on a review of possible scenarios for the European energy transition, we propose an analysis of the situation in Bulgaria. Different methods and tools are used in this study, among which qualitative research with descriptive analysis as a methodological approach.

The Bulgarian National Statistical Institute [14] provides reliable quantitative data that can provide a solid basis for the analytical process.

Regression calculations have been used to establish the presence of a certain trend, which can serve to derive short and medium-term forecasts.

The expert assessment provides suggestions on future scenarios for sustainable regional development.

RESULTS AND DISCUSSIONS

Historically, coal has been one of the main fuels for the European economy. Since the 1990s, however, a transformation in utilizing coal as a fuel has been taking place in the EU. In order to reduce greenhouse gas emissions and promote cleaner energy sources, most EU member states (21 in total) have implemented measures to phase out the use of coal by 2030. This process has led to a reduction of jobs in coal mining and related industries. According to data from the Joint Research Centre, "between 2010 and 2018, the reduction of the labour force in Bulgaria (-21%) was the lowest among the member states" [11]. This has resulted from the specifics of the economic and social context in Bulgaria and the slower transformation of the coal mining sector, compared to other countries. A negative trend and serious hazards are observed as a result of decommissioning plans coming into force, especially in the energy and industrial sector, where disruptions can have a detrimental impact on jobs, as these sectors are among the biggest polluters and most carbon-intensive processes.

The fact that member states have different baseline conditions and available resources explains how some show a much faster economic development compared to others. The connecting element lies in the ecological transition, which must become an economic and social opportunity for all regions of Europe.

The strategic location of the Balkan Peninsula on the map of Europe, constitutes a great challenge to green transformation. The fact that not all countries are members of the EU complicates the implementation of carbon neutrality policies. An example of good practices in this context are Greece and Romania, as member countries and countries in the Western Balkans.

Stara Zagora region in the context of the "green deal" - social challenges

The European Green Deal affects countries from all over Europe, including the three main regions with developed coal mining in Bulgaria - Stara Zagora, Kyustendil and Pernik. In order to meet the EU requirements, all member states presented an Integrated National Energy and Climate Plan (INPEC). For Bulgaria, this plan envisages "removing administrative barriers to enter the RES market and stimulating the development of RES in industrial zones and the urban environment, mainly for own consumption", reaching up to 27% [12].

According to an EU-funded report on the challenges, needs and action plans for the most affected areas, the Stara Zagora region is also defined as such a region, which faces "the highest potential job loss in the mining and energy industries (total between 11.9 – 16.0 thousand jobs in 2026)" [20]. There is a relatively good diversification of the regional economy, however, this does not give the necessary grounds for complacency. The need for reorganization of core economic activities is glaring, as is the immediate redeployment of personnel to sectors other than energy. The same report lists the available unrealized resources, including "a strong base for the development of scientific research and development (R&D) and innovation; current notable energy infrastructure; significant potential for alternative land use; varied cultural and historical heritage, tourist infrastructure; opportunities for workforce skills transfer" [20].

The transition to a green economy requires socio-economic transformation in Bulgaria. According to those presented in the EC, Bulgaria should limit the production of energy from fossil fuels, including lignite coal, which is the basic resource of the Maritsa East energy complex.

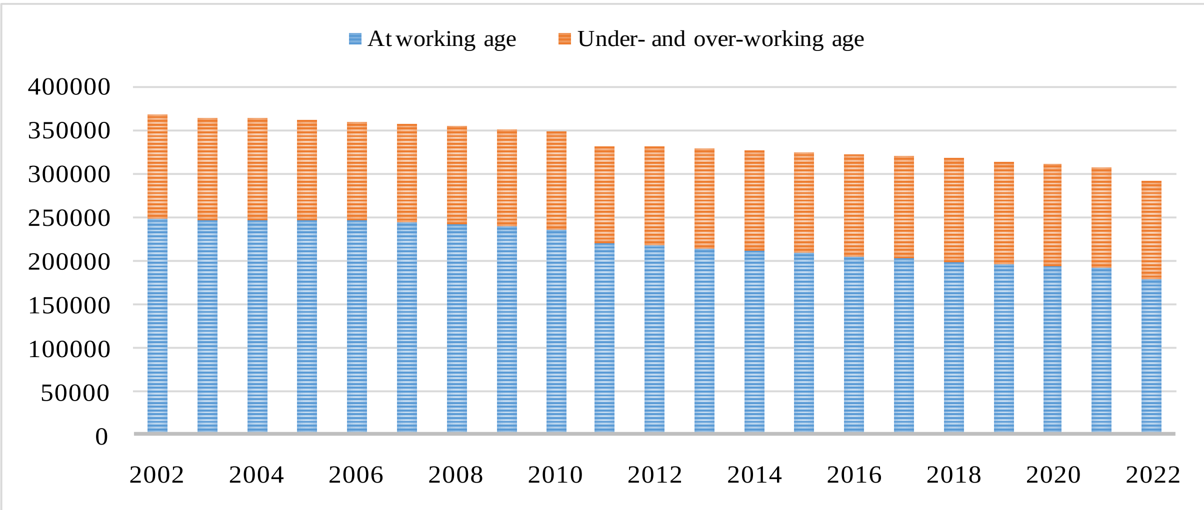

Fig. 1. Population dynamics in Stara Zagora region
Source: NSI, 2023 [14].

With its more than 10,000 direct employment jobs and even more employed in related industries, the energy complex is a kind of economic engine for the region. The reduction in the activity of coal power would have a direct impact on the socio-economic profile of the region.

Figure 1 shows the dynamics of the general population of the Stara Zagora region.

Figure 1 shows a clear decline in the population level in the region. Although there are no shocks in the regional economic situation its attractiveness is decreasing. Figure 2 shows a growth in population numbers in the region.

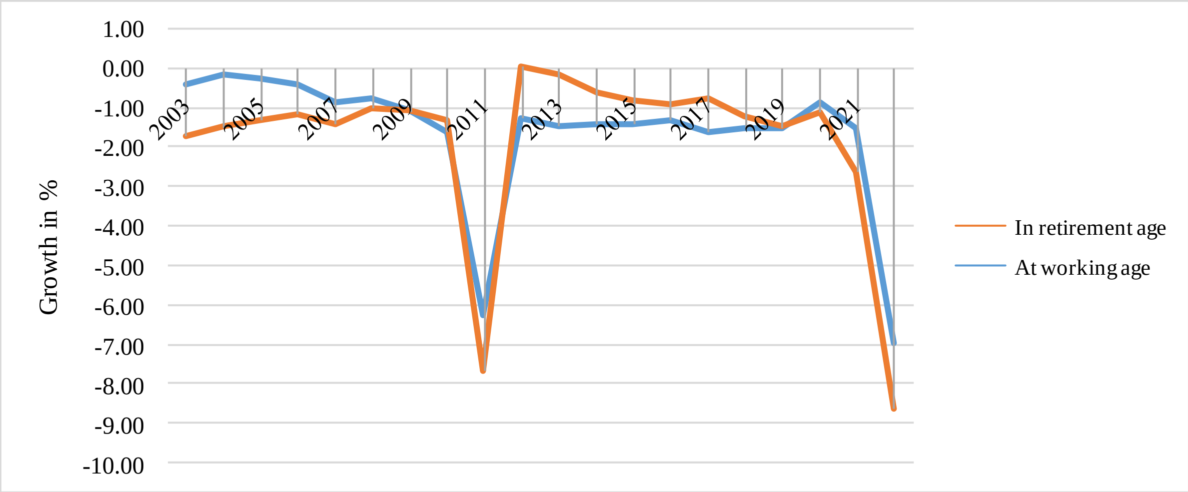

Fig. 2. Population growth in Stara Zagora region for the period 2002-2022
Source: NSI, 2023 [14].

Figure 2 shows two important trends in population dynamics:
-Since the beginning of the century, approximately every 8-10 years the population has repeatedly changed with the same force and importance. Both of the most pronounced negative declines were caused by exogenous events, such as the recession of 2011 and the Corona virus crisis of 2021-2022.
In these two downturns, negative growth has reached 7-8%.
-If the trend continues, the next major downturn will occur around 2030.
This year coincides with the manifestation of the measures against fossil energy and the subsequent socio-economic upheavals.

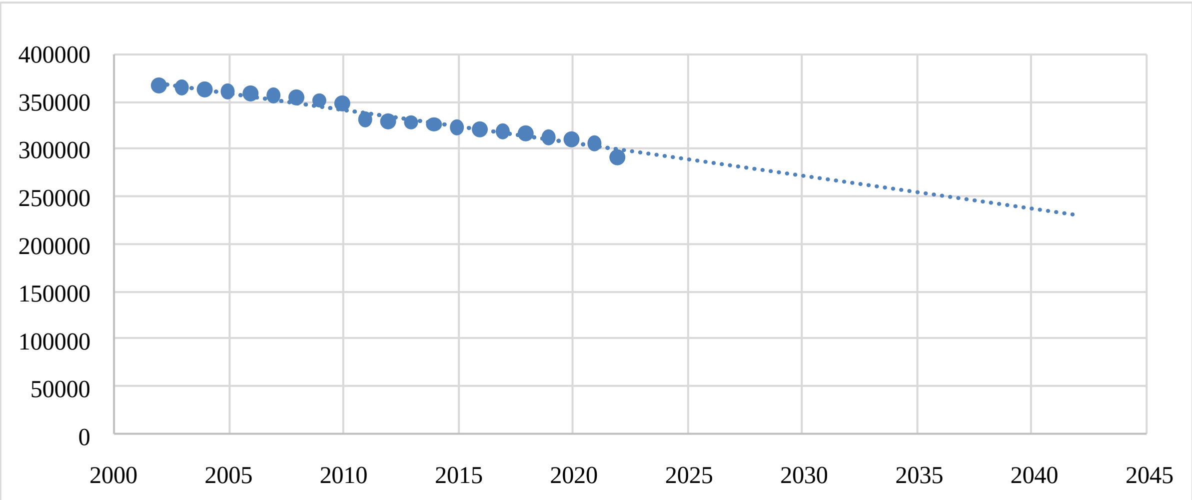

Fig. 3. Regression analysis for the population of the Stara Zagora region with a linear trend
Source: NSI, 2023 [14].

Figure 3 visualizes the data from a performed regression analysis. In this analysis, a simple test of the effect of time periods on the total population of the district was performed.

A linear regression was selected for the analysis of a dynamic series of 21 values. Based on the reliable data (provided by NSI) and the length of the dynamic series, which covers data for the period from 2002 to 2022,

the initial hypothesis that the regression model will have a high explanatory value was confirmed.
Evidence for this is the significance of Sig. F (0.0001) and P- value (0.00001) values for the free term (a) and the regress or parameter (b).
The results show that there is a clear linear trend in population change.

Regression Statistics
Multiple R = 0.9830
R Square = 0.9664

If this linear trend continues, the population will drop to 230,000 people in 2042, which is almost a 40% population loss for the first half of the 21st century. These figures are surprising because until recently, the region was thought to be attractive, largely due to the opportunities provided by coal-fired employers.

Tourism and land reconversion of the mining surfaces into agricultural land solutions for sustaining a green development of Stara Zagora region

In the context of the current work, it is logical to pay attention to what the alternative options will be after the transformation of the economy in the region. Emphasis should also be placed on the issue of the future of the open mine sites that have been decommissioned, their drainage, reclamation and possibilities for new usage. A potential opportunity is the search for a way of using them subsequently in different directions, one of which is "brownfield" tourism. However, clarification needs to be made as to which lands can be classified as such. There are many different definitions of "brownfields" in scientific literature. The concepts of European and American authors are radically different in the interpretation of this term. In a study carried out in 2020 [8]was propose selected definitions of brownfields in different countries around the world. In the Americas, specialists in the field have the understanding that brownfields are abandoned areas of different origins that are considered environmental burdens, significantly damaging the environment. In their view, there are a number of environmental, economic and legislative barriers that prevent the reuse of these brownfield sites. Following this logic, it can be noted that there is untapped resource potential in these areas in countries on both continents. However, this is not the case in Central and Eastern European countries, where researchers in the field believe that these abandoned areas have the potential to be further exploited despite their contamination.
According to the European Commission's guidance [4], brownfields refers to abandoned disused industrial sites or disused former industrial, railway, military or commercial sites that may be contaminated or are considered to be so. They occur mainly in urban areas of regions where heavy industry used to be highly developed but has now ceased. Their appropriate usage requires coordinated intervention by owners, local authorities and citizens.
In a number of European countries, positive levels of interest from visitors and tourists in abandoned sites have been reported. Public policies in these countries have focused efforts on their redevelopment and promotion as tourist destinations.
Good practices in this non-traditional activity can be found in more developed countries such as the USA (Texas Commission on Environmental Quality, 2024) [15], Canada (Government of British Columbia, 2023) [13], the United Kingdom (Alker, S. & Stone, C., 2005) [1], Poland (The salt mine “Wieliczka”, 2023) [16], the Czech Republic(Stáhlík, Z., 1994) [22], Slovakia (Rybár, P., 2017) [21], France (Bachimon, P., 2012), [2], where the re-use of such sites for tourism, recreation and leisure is considered economically viable.
"Brownfields" enable a specific type of tourism activity to take place. Practice shows that they are successfully developed in the countries of Central and Eastern Europe and this model can be applied in Bulgaria, in the coal mining areas that will undergo modifications.
Abandoned areas are transformed into places for cultural and social events thanks to creative imagination and freedom of experimentation. An example of such use is the Zollverein Park [17] in Germany, which

is a centre of cultural, artistic and educational institutions. Another example of a successful cultural space is the former steelworks turned into the Duisburg-Nord Landscape Park [10].

One can also point to the defunct Beringen Mine, a unique 10 hectare coal mining heritage site in Flanders, Belgium, converted into an integrated tourism leisure project in the coal mining area, the old power station of Saint-Denis, north of Paris, built in 1933. designed and maintained by the French director and producer Luc Besson, and last but not least, the impressive Hlubina Mine in the traditionally industrial post-socialist city of Ostrava, Czech Republic, an interesting example of cultural regeneration with a temporary use(Luca, 2019; Bosák et al, 2020) [8, 9].

A common feature of these parks is the heavy pollution of the areas in the recent past. Transforming abandoned areas into green spaces requires a lot of time and public funding, with often uncertain results, when residents may be afraid to use the already restored areas due to the unpleasant and infamous image of these abandoned areas in the past [19].

The seriousness of the problem is related to the damage to the land, and hence the disruption of environmental balance. This can be addressed by "optimizing the open land of former mines into agro-tourism land that focuses on education about agricultural and plantation activities that can attract tourists" [18]. Optimizing the open land of defunct mines for agro-tourism is a promising way to restore and reintegrate degraded land into the economy and ecosystem. However, this process requires careful planning and efforts in several key areas such as land condition assessment, land rehabilitation, agro-tourism planning and sustainable management.

CONCLUSIONS

The Green Deal actually represents a new economic model. For regions in transition, such as Stara Zagora, economic activities with a higher added value must be selected. This will lead to high personal revenues that can guarantee sustainable regional development. The main challenge is the problem related to the employed in the sector - the lack of a clear plan for the future offered by the Bulgarian government. All the activities of the interested parties should be in the direction of preserving jobs and increasing income – this is a mandatory part of the transition to a new type of economy. In summary, we are suggesting the following main conclusions and recommendations:

-The unpredictable political and institutional environment poses a huge challenge to implementing the overall policy in the field of decarbonization. The adopted sustainability and transition plans were adopted without a clear debate about the interests of the local community. This created tensions that delayed the implementation of adequate replacement policies, which had not been well-defined.

-Stara Zagora region needs a comprehensive concept for its socio-economic development until 2050, in which to clearly define the basic branches of the regional economy. This is of key importance, as no one can yet commit to forecasting the development of the local economy.

-It is necessary to reduce the negative demographic growth by at least 50%, in order to at least preserve the basic demographic reserves. This is the most difficult task, requiring an extremely diverse toolkit. This recommendation corresponds to the previous one, since the strategic planning until 2050 must be based on a comprehensive analysis that unites all spheres of regional sustainable development.

-It is extremely important to involve the local community in the key decisions for the future of the region. Up to this point, the central government mainly determines the course of development for the Stara Zagora region. This goes against all modern principles of close-to-people decision-making. The principle of subsidiarity is key in the transformation process, which implies a more active participation of self-governing bodies (municipalities) in Bulgaria.

-It is necessary to increase the resilience of the region to exogenous impacts. The path to higher sustainability goes through higher public investment in technical and social infrastructure to increase the attractiveness of the region. This is of particular importance for the peripheral areas of the region, which are represented by smaller municipalities, where a high natural tendency to depopulation is reported.

Shifting land use from mining to agriculture and tourism is a complex, multifaceted process that requires careful planning, environmental restoration, and community involvement. Although challenging, this can lead to sustainable land use that benefits local economies and ecosystems.

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TOURISM SECTOR IN BULGARIA - POST-PANDEMIC RECOVERY OR DECLINE

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Abstract

The past few years have been marked by significant economic, political, and health-related changes, including the COVID-19 pandemic, which has adversely affected Bulgaria's tourism sector, highlighting its crucial role in its economic development. Ensuring health and safety measures has become a top priority, forcing hotels, restaurants, and tourist attractions to adapt to provide a safe environment for visitors. However, these measures have exposed the sector to serious economic challenges and have undermined its sustainability. This paper aims to present the current economic development of the Bulgarian tourism sector and answer the question, "Has the sector recovered from the disastrous economic and social consequences of the COVID-19 pandemic?". To achieve this goal information from the World Tourism Organization and official data from regional statistics in Bulgaria were analyzed. The results indicate that the pandemic resulted in a significant drop in the gross domestic product generated by tourism and a rising level of unemployment in the sector. However, there has been a recovery sign in the last two years.

Key words: *Bulgaria, COVID-19, economic challenges, tourism*

INTRODUCTION

A huge number of scientists and inventors contributed to the development of human civilization. During the last two decades, the tourism sector played an important role in the economy of Bulgaria [8, 9]. In this period the tourism provided jobs for many people. For the reviewed period the persons employed in this sector decreased by 50% and in December 2023 they were about 124 000 (according National Statistical Institute). The tourism industry formed a significant part of the gross domestic product (GDP), but the pandemic had major impact and changed that. Expectations for GDP recovery have a longer-term horizon until year 2027. The vision laid down in the Strategy for the Sustainable Development of Tourism in Bulgaria, with a horizon until 2030, defines our country as "a well-known and preferred year-round tourist destination with a recognizable national identity and preserved culture and nature, occupying a leading place among the five top destinations in Central and Eastern Europe". However, since the onset of the COVID-19 pandemic, the tourism sector has been faced with the difficult task of dealing with several issues and challenges.

This industry has undergone significant changes and health and safety measures have become a priority and accommodation, restaurants and tourist attractions have adapted to provide a safe environment for visitors. Border closures, travel restrictions, and other preventive measures imposed by the World Health Organization [21] and the Ministry of Health at the national level [10] have had a major impact on tourism attendance and revenue. Many hotels, restaurants, and tourism-related activities faced serious economic challenges. The governments of the individual countries needed to develop an immediate plan of action to save the tourism sector. The need to find proper and effective mechanisms to deal with the situation is glaring. During this period, the Ministry of Tourism of the Republic of Bulgaria performed research on that topic and prepared specific proposals to stabilize the tourism development until 2040. At the beginning of May 2021, the Ministry of Tourism published a document entitled "Long-term Development of Tourism" [11] there were pointed specific measures and priorities that can also be included in a long-term tourism development strategy.

The biggest problem for tourism sector in the post-pandemic years has been finding a way to restore the previous levels and positions of the tourism sector in the economy. Tourism researchers report that one of the effects of the health pandemic is economic hardship and uncertainty, which can reduce people's ability to afford travel and vacations. The impact of the economic and financial crises caused by the restriction of the free movement of people and the contraction of the activities of many economic sectors has also been reported to a very strong degree. Often these crises have "lasting and devastating macroeconomic consequences" [3], including in the tourism sector. This in itself led to a reduced tourist volume.

Bulgaria National Board of Tourism [10] announced at the beginning of the summer of 2020, that Bulgaria is already part of a "Safe Travels Stamp" tourist destination approved by the World Travel and Tourism Council. This shows that Bulgaria's policy is increasingly focused on health security, which turns out to be the focus of many tourists when planning their trip.

Part of the recommendations of the Ministry of Tourism of the Republic of Bulgaria were aimed at stimulating the digital transformation of the sector and the implementation of "new business models, value chains and ecosystems", with the aim of "modernizing regulations to support innovation and a competitive environment" [11]. The possibility of realizing virtual tours and digital experiences is also an innovative method for our country, which is required as an alternative or addition to traditional ways of travel. Authors in the field of tourism describe the essence and specificity of the digital ecosystem of a tourist destination and claim that "digitalization of tourism places high demands on participants in tourist destinations and at the same time increases competition between individual tourist destinations". They take into account new levels of development of the destination and the possibility of creating new innovative services for tourists [5]. The fact that digitization is leading in many sectors and is a mechanism for their successful development, including tourism, must be taken into account. By introducing digital innovations, exceptional opportunities and advantages are created both for consumers of tourism goods and services, and for manufacturers and suppliers of the same components. Based on these advantages, it can be argued that the introduction and implementation of digital technologies in tourism create the necessary conditions for this business to be "more flexible, adapted to modern conditions and competitive in the dynamic "digital world" [2].

Competition with other destinations is also an important aspect that the tourism sector and stakeholders need to analyze and take into account. Bulgaria has to compete with other tourist destinations to attract visitors. To attract tourists, destinations often need to invest in tourism infrastructure and marketing. This is largely possible through the joint work of the regional tourism management organizations in Bulgaria [7]. A report by The Organization for Economic Co-operation and Development analyzes the legislative aspects of destination management and recommends that the country assist stakeholders in "reducing regional disparities by developing strong regional brands and specialized forms of tourism based on local tourism resources" [14].

Innovation and competitiveness are directly related to finding a systematic approach to discover new tourist destinations and tourism products [1]. "Tourism diversification combined with increasing its inclusive role" [11] is another key recommendation that the country should comply with. This is where alternative forms of tourism find their place, which offer experiences specific in their nature and way of proceeding, and simultaneously have a low degree of health risk. Different forms of tourism can be used as a mechanism to promote regional tourism natural and/or anthropogenic resources. To a large extent, this is a suitable method for building characteristic local events, having the character of "special local events" (Hallmark events) [17]. These events are seen as an important driver in tourism and as an effective stimulator to improve the image of the destination [4, 6]. In this way, the tourist flow will be directed to the interior of the country and the seasonality of the Bulgarian tourism sector will be avoided. The preparation of tourist routes and the organization of tourist clusters will facilitate and support this type of economic activity in small settlements, contributing not only economically, but also in a social aspect to the stabilization of the sector and its return to a stable state, as before the COVID pandemic -19.

The aim of the paper is to present the current economic development of the Bulgarian tourism sector and answer the question, "Has the sector recovered from the disastrous economic and social consequences of the COVID-19 pandemic?".

MATERIALS AND METHODS

To achieve the goals and tasks set in the research, a range of economic indicators measuring the contribution and development of tourism in the national economy has been selected.

The data used for their calculation are collected from various official statistics such as SNA [18]; NSI [12]; Infostat [13]; (EUROSTAT) [16]; (OECD.stat) [15]; WTTC [21].

The indicators are part of the internationally recognized framework for measuring tourism activity - TSA:RMF 2008 (UNSD, Eurostat, OECD and UNWTO, 2010) [19, 20] and reflect the contribution of tourism to the economy and how many jobs it creates.

The TSA framework unites together 10 tables relating to tourism supply and demand based on macroeconomic variables such as gross value added, gross domestic product, and employment.

The information presented by the framework allows periodic monitoring, assessment, modelling and forecasting, and on this basis, decisions could be made.

The reference period covers 2018-2022, the period before and after the COVID-19 pandemic.

RESULTS AND DISCUSSIONS

Tourism is a sector that is recognized in the economic literature as a sector of significant economic importance, as it manages to recover quickly from unforeseen negative situations and simultaneously contributes significantly to the growth of the national economy, the prosperity of local communities and the conservation of nature.

According to WTTC [21] and NSI [12], in 2018, the total contribution of the tourism sector to the Bulgarian economy was about 11,5% and also affected employment by around 10% (Table 1).

The predictions for development in that sector are for a gradual increase of 2-3% by the year 2030.

We are witnessing the effect of the COVID-19 pandemic and its role in affecting different businesses in the service sector.

We can also monitor the impact on the GDP and employment affecting that sector and they both drop significantly in the year 2020, with 59 % and 21 % respectively.

On the other hand, the pandemic has again highlighted the importance of the tourism industry for the economic development of the country and the livelihood of hundreds of people employed in it.

Although the past two to three years have seen a large growth in GDP generated by tourism, respectively of over 30% for 2021 and over 25% for 2022, its levels remain low at around 6.5% for 2022 and employment – just over 7%, compared to those of the pre-pandemic period – over 12% for 2019 and employment around 10%.

The new WTTC forecasts for tourism's contribution to the country's economy are for a recovery to pre-COVID-19 levels only after 2033 – 10.2% of the country's GDP and over 11% employment.

The data collected by the WTTC show that in 2018 the total revenues from tourism in the country amounted to BGN 1455,70 million (Table 2), with almost 75% of them received from foreign tourists and the same structure is preserved in the following year. After the end of 2019 and significant periods of blocked borders, suspended travel around the world, for 2020 tourism revenues marked a remarkable drop of over 42%, reaching a value of BGN 645 million, with 52% being accumulated by Bulgarian tourists. In the next 2 years, there is a significant growth in revenue levels, respectively over 66% for 2021 and over 56% for 2022 compared to 2021 and a smooth increase in the share of revenue formed by foreigners (over 60% for 2022).

Table 1. Key economic indicators 2018-2022

Year	Total T&T GDP (MN BGN)	Total GDP contribution in BG economy (%)	Annual change (%)	Total T&T jobs (000s)	Share of total jobs (%)	Annual change (%)
2018	12,626	11.49	8.53	346.794	9.85	2.39
2019	14,789.6	12.29	17.14	316.3	8.95	-8.79
2020	6,137.684	5.09	-58.50	247.98	7.18	-21.60
2021	8,006.942	5.76	30.46	252.1	7.29	1.66
2022	10,025.2	6.5	25.21	270	7.83	7.10
2023	19,138	10.2		364.1	11.7	

Source: Own calculations based on data from SNA, NSI, Infostat, WTTC [18, 12, 13, 21].

The value of revenues for 2022 reaches BGN 1 675,87 million, which is an increase of 15% compared to 2018. Despite the reported higher revenues at the end of the period, it cannot be said that tourism has reached the contribution levels, noted by the sector in 2018 and 2019. The period after 2019 is marked not only by a period of global pandemic, but also by geopolitical crises and the outbreak of military conflicts, directly affecting the world economy. All these contingencies led to significant inflation.

Table 2. Tourism receipts and Nights spent in accommodation establishments, %

Bulgaria	2018	2019	2020	2021	2022
Revenue from the nights spent in accommodation establishments (%)					
by Bulgarians	25.45	27.91	51.12	45.49	39.83
by foreigners	74.55	72.09	48.88	54.51	60.17
Nights spent in accommodation establishments (%)					
by Bulgarians	33.88	35.63	61.10	54.63	46.69
by foreigners	66.12	64.37	38.90	45.37	53.31

Source: Own calculations based on data from SNA, NSI, Infostat [18, 12, 13].

Table 2 shows that by the end of 2019, overnight stays in the country increased to over 27 million visitors, with foreigners making up an average of about 65% of the total. This confirms Bulgaria as a favorable tourist destination, ranking it in 5th place in terms of attendance among the countries in South-Eastern Europe. Traditionally, tourism in the country has been dominated by recreational tourism, such as visiting family and friends, vacationing or transit. For 2020, the number of overnight stays decreased by 56% to almost 12 million tourists. By 2022, their number will reach over 24 million visitors. In the period after the COVID-19 pandemic, the structure of overnight stays is dominated by those made by Bulgarians (55% on average).

In 2018, Bulgaria received 12,4 million international visits (inbound tourists), an annual increase of 6,66% year-on-year (Figure 1). Of these, foreigners spent a total of 17,75 million nights in all types of accommodation, which is an increase of nearly 4% on an annual basis. The closure of the borders was felt most drastically in inbound tourism, with visits falling by more than 60% in 2020 compared to 2019, reaching around 5 million visitors, and overnight stays by them with a drop of 73%. For 2022, the number of incoming tourists is approaching 11 million, which is an increase of almost 119% of tourists and 176% of realized overnight stays compared to 2020 growth. Despite the significant increase in the number of tourists and overnight stays, the figures are far from those recorded in 2018 and 2019. Traditionally, the countries of the Balkans continue to be the leading markets for inbound tourism, accounting for an average of 55% of international arrivals. The leading five inbound markets are Romania and Turkey (about 1,8 million each), Greece (about 1 million), Germany (nearly 800,000) and the Republic of North Macedonia (over 400,000).

Outbound tourism is showing a better recovery trend. From figure 1 it is clear that by 2019 the outbound tourists are about 7 million, reaching in 2020 nearly 4 million, and in 2022 they are already over 7.2 million tourists (a growth of 82.5 % compared to 2020 and 8.2% compared to 2018). As with inbound tourism, traditionally the five most visited destinations are located mainly in the Balkans, namely Turkey (over 1.5 million), Greece (over 1.3 million), Romania (over 500 thousand), Serbia (nearly 500 thousand) and Germany (about 400 thousand).

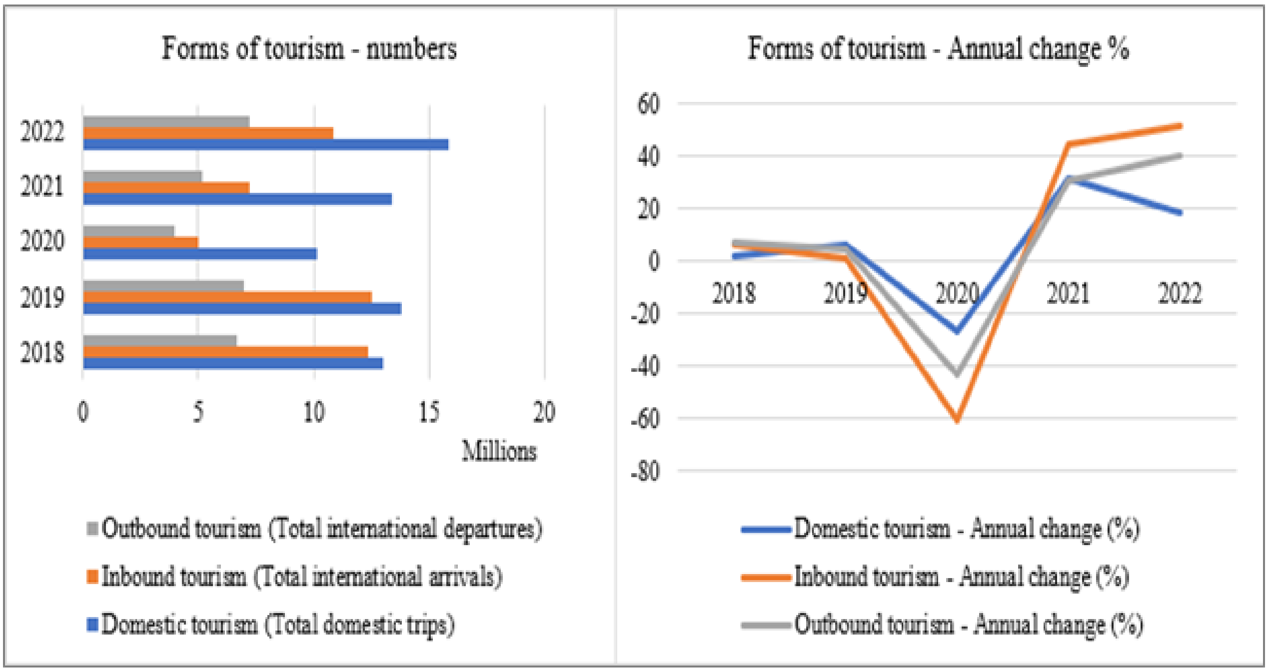

Fig. 1. Forms of Tourism of Bulgaria for period of 2018-2022 and their annual change %
Source: Own design.

Domestic tourism saw the smallest drop in visitor numbers in 2020 at 26% compared to other forms of tourism. In 2022, it marks nearly 16 million tourists, which is 56% more compared to 2020 and 22% compared to 2018.

CONCLUSIONS

The period of recovery from the COVID-19 pandemic of the country's economy, including the tourism sector, proved to be extremely difficult. Crisis management has undoubtedly proven to be a very complex and time-consuming process. Tourist traveling is becoming an important factor for some countries, providing large foreign exchange earnings and employment. The history of tourism has always been related to social, economic, cultural and political areas, which is the main engine and motivation of people to travel and feeling the need to restore their strength through travel, to get to know new places and people. Despite the COVID-19 pandemic that humanity experienced, people do not give up travelling around the world.
Although the slightly inspiring results from this research, we need to build an effective

crisis action plan for future force major circumstances, so we can react on the best possible way and avoid potential decline in that sector.

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