Volume 22, Issue 2/2022 PRINT ISSN 2284-7995

E-ISSN 2285-3952

SCIENTIFIC PAPERS

SERIES "MANAGEMENT, ECONOMIC ENGINEERING IN AGRICULTURE AND RURAL DEVELOPMENT"

Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development"
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Volume 22, Issue 2/2022
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To be cited: Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Volume 22, Issue 2/2022.

Publishers:
University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania. Address: 59 Marasti Blvd., District 1, 011464 Bucharest, Romania, Phone: + 40213182564, Fax: +40213182888**,** www.managusamv.ro
Ceres Publishing House, Address: 29 Oastei Street, District 1, Bucharest, 013701, Phone/Fax: +40213179023, Email: edituraceres@yahoo.com

This volume includes the scientific papers presented at the International Conference **"Agriculture for Life, Life for Agriculture",** June 2-4, 2022, University of Agronomic Sciences and Veterinary Medicine, Bucharest, Romania, Section 7: Management and Economics of Rural Areas, Topics: Production economics and Agro-marketing, Farm and cooperatives management, Agricultural and rural policies, Agri-Business and agricultural extension, Agritourism and Rural tourism, Environmental economics and Bio-economy, Digital economy and innovation in modern agriculture and food chain, Miscellaneous.

C O N T E N T

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ALFALFA PRODUCTION COSTS AND PROFITABILITY STATUS IN AKSARAY PROVINCE IN TURKEY

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Abstract

This study aims to determine alfalfa's production costs and profitability in Aksaray Province. Clover producers were visited directly, and prepared forms related to the subject were applied to 70 clover producer enterprises. The surveyed enterprises were selected by chance. Data from clover-growing enterprises cover the 2019 production season. On average, the cost of clover per decare is 0.90 TL/kg, the sales price is 1.09 TL/kg, and the profit margin is 0.19 TL/kg for clover-producing enterprises. The relative profit in enterprises was calculated as 1.21. The average value of gross profit and absolute profit for enterprises was determined as TL 890.11 and TL 373.70, respectively.

***Key words**: alfalfa, production cost, profitability, relative profit, Turkey*

INTRODUCTION

Alfalfa (*Medicago Sativa L.*), the most widely grown forage plant globally [11], is known as the Queen of forage plants and has a higher forage value than the Queen of forage plants in almost all forage plants cultivated. Dry and wet alfalfa grass, which has a high protein yield per unit area, is delicious for all kinds of animals, nutritious, and rich in vitamins [25]. Meat, milk, eggs, and products obtained by processing these raw materials are of great importance in human nutrition. Because of this, an animal production is an important place in agricultural production. In order to meet the need for coarse feed needed for healthy and adequate nutrition in animal production, it is necessary to make optimal use of pastures and give importance to feed plant production. In Turkey's animal husbandry, the production of forage crops in the supply of coarse feed also has a significant share [15].

Beneficial for both humans and animals and sensitive alfalfa roots and leaves dried (powder, tablets, and tea used to lose weight) are long used in traditional Indian medicine for the treatment of central nervous system disorders [12]. One of the most important sources of high-quality feed, which is alfalfa, forage crops, and feed for animals, is grown all rich in minerals and vitamins and has a value between high yield and reproductive performance of animals with their impact on this feature is Lamech [18, 4].

Alfalfa is also an important plant source of pollen and nectar for honey bees [22].

Healthy macro and microdata are needed when planning future sustainable production in agricultural enterprises. Microdata occupies a vital place when calculating costs at the business level. Micro-data is a substantial base, especially in the profitability status of enterprises, input costs, investment projects, and future planning [19].

The agricultural activity requires more capital, the necessity of enterprises to keep up with market conditions, and the rapid development of technology makes the management of agricultural farms even more complex [6].

In this context, enterprises' essential characteristics, determination of aquaculture practices, attitudes, and judgments [1].

Turkey's alfalfa harvested area increased by 74% in 2019-2021 compared to 2004-2006. Turkey's alfalfa area was 379,676.5 ha in 2004-2006 and 659,049.6 ha in 2019-2021. Alfalfa production increased 810% in 2019-

2021 compared to the 2004-2006 average. Alfalfa production, which was 2,071,663 tons in 2004-2006, increased to 11,762,867 tons in 2013-2015 and rose to 18,850,247 tons in 2019-2021. Alfalfa yield in Turkey is per hectare increased from 2,028 kg to 2,623 kg in 2013-2015 and reached 2,877 kg in 2019-2021. This rise is due to the high efficiency of alfalfa seeds used next to the width of the machine park and the fact that the producers who planted alfalfa in the past process have become more knowledgeable and conscious.

The most important alfalfa production provinces in Turkey were Konya, Iğdır, Muş, Aksaray and Aydın, respectively. Konya ranks first in production with 1,883,423 tons and 9.99% of Turkey's production. Aksaray was followed Konya by with 1,652,096 tons and 8.76% share, Iğdır with 1,505,204 tons and 7.99%, Muş was 1,184,297 tons and 6.28%, Aydın was 1,023,682 tons and 5.43% share, respectively (Table 1).

Aksaray alfalfa forage plant cultivated areas were concentrated in three districts. The Central district area was 120,200 ha, and its share was 44.95% of the alfalfa planted areas. Eskil district was 74,200 ha, and the share was 27.75%. Sultanhani district's cultivated area was 62,500 ha, and the share was amounted to be 23.37%. The alfalfa area share in Aksaray of other districts was about 3.93%.

Table 1. Development of alfalfa production in some provinces in Turkey

	2004-2006	2007-2009	2010-2012	2013-2015	2016-2018	2019-2021
Provinces	**Production quantity (tonnes)**					
Konya	438,635	222,015	977,320	1,099,340	1,196,809	1,883,423
Iğdır	71,750	69,879	386,734	453,529	1,371,901	1,505,204
Aksaray	150,180	76,017	166,895	785,442	1,216,785	1,652,096
Muş	0	173,183	1,354,607	1,289,558	1,325,062	1,184,297
Aydın	4,575	22,310	526,685	687,810	745,209	1,023,682
Turkey	2,071,663	1,763,094	11,762,867	13,333,035	16,940,172	18,850,247
	Index (2004-2006 = 100)					
Konya	100	51	223	251	273	429
Iğdır	100	97	539	632	1,912	2,098
Aksaray	100	51	111	523	810	1,100
Muş	0	100	782	745	765	684
Aydın	100	488	2,361	15,034	16,289	22,376
Turkey	100	85	568	644	818	910
	The share of Turkey (%)					
Konya	21.17	12.59	8.31	8.25	7.06	9.99
Iğdır	3.46	3.96	3.29	3.40	8.10	7.99
Aksaray	7.25	4.31	1.42	5.89	7.18	8.76
Muş	0.00	9.82	11.52	9.67	7.82	6.28
Aydın	0.22	1.27	4.48	5.16	4.40	5.43
Turkey	100.00	100.00	100.00	100.00	100.00	100.00

Source: [24].

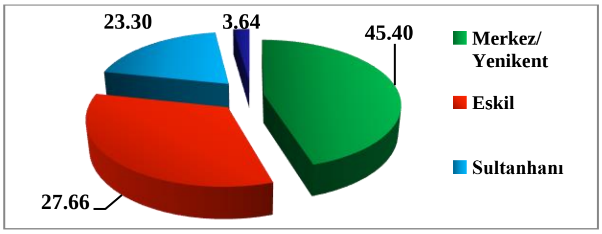

Fig. 1. Alfalfa production quantities in Aksaray districts
Source: Own results and design.

The Central district met 45.40% of Aksaray alfalfa production with 913,520 tons. On the other hand, the Eskil district had 556,500 tons of alfalfa production and met 27.66% of the province's production. The share of alfalfa production in Sultanhani district in the province was 23.30%, and its production was 468,750 tons. Other districts' production amounts had 73,330 tons and accounted for 3.64% of the total production (Figure 1).

Various research has stated that feed costs are the most important production cost factor in enterprises engaged in multiple livestock activities. For example, [7] on sheep farms; [13], [3, 10, and 16] on buffalo farms, and [26] on dairy farms stated that feed expenses were the highest cost factor on animal farms.

[21] interviewed the method of stratified sampling of 129 forage producers, and intensive doers of forage production Gevas district of Van in the province. Research data from the 2008 production period was

collected through a survey from interviewed business owners in villages.

[5] evaluated the rapid increase in red meat prices in Turkey in 2010 regarding animal feed costs and offered suggestions that may render the feed production quality and cheap. They stated that the problem in question could end with sustainable solutions that spread to the base, that would comfort all producers and consumers, instead of instant and temporary solutions such as animal import.

[23] reported that the coarse feed needed by livestock in Van was obtained from meadows and pastures, straw, and forage crop farming. They stated that the livelihood of a significant portion of the people in Van province is based on agriculture and their livestock breeding potential is high.

[27] analysed the current state of organic forage production in Turkey. They stated that one of the most important requirements of organic animal production activities is to meet the need for organic roughage.

They said that in meeting the demand for organic roughage, organic meadow pastures and organic forage plants production areas are of great importance.

As a matter of fact, 93% of the organic roughage production areas in the world are organic meadow-pasture areas. They stated that 7% are met from organic feed plants production areas, as of the year 2012 in Turkey, that no organic pasture detected the presence of an organic field in about 22 provinces.

This study aims to analyse the costs and profitability of alfalfa-producing farms in Aksaray province.

MATERIALS AND METHODS

Materials

Aksaray province was included in the scope of the study. Therefore, the study's data was created from the information obtained from farmers that grow alfalfa in Aksaray province. The received data covers the 2019 production period. In addition, statistical data from the Aksaray Provincial Directorate of Agriculture and Forestry and data from TUIK were also used. Districts where alfalfa production was intensive, the Central, Yenikent, Sultanhani, and Eskil districts of Aksaray were represented by its technical staff's opinions. These districts met approximately 96.36% of Aksaray alfalfa production. In this context, these districts' farmer registration system data made up the primary audience by applying the stratified Neyman sampling method to this population. The sample volume was calculated as 70 with a confidence interval of 99% and a margin of error of 10%. A face-to-face survey technique was applied as a data collection tool. According to the calculated sample, farmers from the main audience were randomly selected.

Farm groups were based on alfalfa cultivated areas (I. group had less than 50.00 decares alfalfa cultivated areas; II. group had alfalfa cultivated areas ranged 50.00 decares to 99.99 decares; III. group had 100 decares or more) and cross-tables between costs and profitability variables interpreted the data. The existence of the relationship was questioned by analysing variance between continuous variables and business groups.

Since the "Neyman method" applied in the sampling takes more samples from the layer with high variance, the application of the arithmetic means in the calculations will not reflect the research area average. Therefore, the total width of the frequency of the operation groups by the number of falling in proportion to the number of frequencies was obtained. A coefficient for each layer of the data obtained in the study while evaluating the overall coefficient obtained by multiplying the calculated values for each layer was calculated as the weighted average value for each layer [8, 9].

Map 1. Research region
Source: [28].

According to the data for 2021, the research area covers about 3.97% of the alfalfa-growing area in Turkey. It accounts for 7.18% of the alfalfa production in Turkey (TURKSTAT, 2022) [24]. The research area was given in Map 1.

Methods

Statistical package programmes were utilised to analyse the respondents' socio-economic and farm characteristics using descriptive statistics such as percentages, mean, frequency distribution, and tabulation. The alfalfa producers' production cost was calculated using a single Farm Budget Analysis, and their profitability was utilised to assess their production performance.

In an agricultural enterprise, production activities carried out through various inputs and services constitute the expenditure, which is termed production costs. Production costs in a farming enterprise are called expenses for inputs and services used to perform production activities during the production period. Production costs are divided into variable and fixed costs. Variable costs are increasing or decreasing costs depending on the volume of production. These costs arise when production is carried out and vary depending on the amount of production [17]. 3 percent of the total variable expenditures is used to calculate the general administration cost. The interest rates charged differ by production activity, reflecting the capital's potential cost [2].

The cost of establishment is computed by applying half (4%) of the interest rates charged by Ziraat Bank on agricultural production loans (8 percent in 2019). In the research area, the interest rate on bare land was 5% of the current trading value.

After calculating total production costs, gross margin, net profit, and relative profit, these indicators were calculated as follows:

Total Production Cost = Variable cost (VC) + Fixed cost (FC)

Gross Margin (GM) = Gross Production Value (GPV) - Variable cost (VC)

Net Profit (NP) = Gross Margin (GM) - Fixed Cost (FC)

Relative Profit (RP) = Gross Production Value (GPV) / Total Production Cost (TPC) [2, 20, 14].

RESULTS AND DISCUSSIONS

The ages of the alfalfa producers interviewed were between 26 and 78 years. Their mean age was 48.33 years. The level of education of alfalfa growers was between 5 and 14 years. On average, their education level was 7.6 years. The household size of the producers varied between 2 and 7 people. The average household size was calculated as 4.1 people. 18.6% of the farmers were engaged in only plant production. 81.4% of them were doing both plant production and animal production together. The agricultural experience of the producers ranged from 2 years to 60 years. Their average agricultural experience was calculated as 24 years. 70% of the alfalfa farmers interviewed had computers, and 98.6% of them had internet. 74.3% of the interviewed farmers also had social security. 52.9% of alfalfa producers stated that they have a non-agricultural job besides agricultural activity. 47.1% of the farmers stated that they only engage in agricultural activities. The main reason for the farmers to produce alfalfa is to meet the needs of the enterprise (meeting the needs of the animal branch) and both to meet the needs of the enterprise and to sell it (74.3% of the farmers). 25.7% of the businesses have grown alfalfa to sell it. The farmers stated that they cultivated the alfalfa plant for 4 to 8 years in the same plot. It was determined that alfalfa producers in Aksaray irrigate the alfalfa plant 3 to 4 times during one harvesting time (84.3% of the farmers).

Alfalfa GPV share in the study area was recorded to be 36.53 percent in the 2019 production season in the research region average. Group III had the highest alfalfa GPV share with 53.92 percent, followed by group II with 16.18 percent. For Group I, the share of GPV from other crop products was the highest, with 34.10 percent. For Group II, the GPV from the animal production branch was the highest, at 57.76 percent. Therefore, the GPV from the animal production branch was higher in smallholder groups.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. Gross production value of alfalfa farms (%)

Groups	Alfalfa	Other crops	Animal	Total
I	12.28	34.01	53.71	100.00
II	16.18	26.06	57.76	100.00
III	53.92	30.33	15.76	100.00
FA	45.95	30.26	23.79	100.00
RA	36.53	30.43	33.04	100.00

FA: Farms average; RA: Research region average
Source: Own results

The average farm size in the study area was 328.59 decares. Alfalfa land share in the study area was recorded to be 46.17 percent in the research region average. Group III had the highest alfalfa planted area share with 56.63 percent, followed by Group II with 31.10 percent and Group I with 19.49 percent of farmland. Farms generally carried out their agricultural activities on their own land. In their agricultural activities, it was also possible for them to rent land or to shareholder land (Table 4).

Table 3. Farmland structure of investigated farms (%)

Groups	Property land	Rental land	Shareholder land	Total
I	87.39	12.61	0.00	100.00
II	90.75	7.08	2.18	100.00
III	75.46	24.00	0.53	100.00
FA	77.27	22.13	0.60	100.00
RA	79.75	19.61	0.65	100.00

Source: Own results

The monetary worth of the inputs necessary for alfalfa production can be characterised as production costs. As a result, Table 4 shows the alfalfa production cost per decare (1 decare equals 0.1 hectares). The production costs per decare in alfalfa were found to range from 1,736.91 TRY to 2,351.70 TRY, with the farms average being 1,775.38 TRY and the examined area average of production cost per decare being 1,839.13 TRY (Table 4).

The cost items were examined under the variable and fixed costs, of which variable cost had the highest modal production cost with 1,309.86 TRY, whiles fixed cost amounted to 529.28 TRY (Table 4).

Machine rental, labour, fertiliser, agrochemical, water charge, electricity, marketing, and revolving fund interest were the variable cost factors in alfalfa production. Variable costs are those that change based on the amount of the production. Electricity prices are the biggest modal, accounting for 27.14 percent of total variable costs, followed by fertiliser (19.59 percent), agrochemicals (9.28 percent), machinery rental costs (4.31 percent), and labour expenses (4.00 percent) (Table 4).

Administrative costs, labour, land rent, interest and depreciation costs of establishment capital were all fixed costs in alfalfa production. The land renting cost accounted for 20.01 percent of the overall fixed cost, followed by 3.75 percent and 2.14 percent for depreciation and administrative costs, respectively (Table 4).

Large farms have drillings systems for irrigation, and this situation decreases water charges.

In the research region, the gross production value (GPV) was ranged between 2,177.67 and 2,357.09 TRY. The average gross production value in the investigated farms average was 2,301.93 TRY, whereas the research region average was 2,298.37.

The gross margin (GM) was ranged from 400.20 TRY to 1,090.28 TRY, with an average of 1,051.05 TRY and 988.51 TRY in the research area.

The net profit (NP) variation was varied from -155.35 TRY to 568.50 TRY, with a mean average of 459.24 TRY. The relative profit was ranged from 0.93 to 1.33, with a mean of 1.25 for the research area.

On average, the firms had a relative profit of 1.25. For a 100-unit production cost, the surveyed farms obtained 125 units of GPV. In other words, alfalfa producers made a profit of 0.25 TRY on a 1.00 TRY cost.

Table 4. Production cost in alfalfa production

Cost items	Farms group I	Farms group II	Farms group III	FA	RA
	Cost per decares (TRY)				
Machine rental	144.38	112.10	69.35	72.91	79.19
Labour (hired)	97.69	90.76	69.32	70.87	73.50
Fertiliser	526.19	777.96	299.98	323.91	360.33
Agrochemical	145.33	123.44	178.03	175.12	170.58
Water fee	219.10	126.88	8.86	18.77	36.27
Electricity	504.33	443.70	504.52	502.22	499.16
Marketing	68.80	34.28	38.33	38.97	40.44
Revolving fund interest	68.23	68.36	46.74	48.11	50.38
Variable cost total	1,774.05	1,777.48	1,215.13	1,250.87	1,309.86
General administrative expenses	53.22	53.32	36.45	37.53	39.30
Land rent	320.30	327.13	376.96	373.61	367.99
Labour (permanent and family workforce)	94.47	61.21	30.71	33.52	38.56
Depreciation cost	89.60	94.35	64.35	66.14	69.03
Establishment cost interest	20.06	19.53	13.31	13.72	14.40
Fixed cost total	577.65	555.55	521.78	524.50	529.28
Production cost	2,351.70	2,333.02	1,736.91	1,775.38	1,839.13
	Ratio (%)				
Machine rental	6.14	4.80	3.99	4.11	4.31
Labour (hired)	4.15	3.89	3.99	3.99	4.00
Fertiliser	22.37	33.35	17.27	18.24	19.59
Agrochemical	6.18	5.29	10.25	9.86	9.28
Water fee	9.32	5.44	0.51	1.06	1.97
Electricity	21.45	19.02	29.05	28.29	27.14
Marketing	2.93	1.47	2.21	2.19	2.20
Revolving fund interest	2.90	2.93	2.69	2.71	2.74
Variable cost total	75.44	76.19	69.96	70.46	71.22
General administrative expenses	2.26	2.29	2.10	2.11	2.14
Land rent	13.62	14.02	21.70	21.04	20.01
Labour (permanent and family workforce)	4.02	2.62	1.77	1.89	2.10
Depreciation cost	3.81	4.04	3.70	3.73	3.75
Establishment cost interest	0.85	0.84	0.77	0.77	0.78
Fixed cost total	24.56	23.81	30.04	29.54	28.78
Production cost	100.00	100.00	100.00	100.00	100.00

Source: Own results.

The requirement for the aforementioned measure is that relative profit be more than one (1), and relative profit was 1.25 in the study region, indicating that alfalfa production is profitable.

In the study area, 1 kilogramme of alfalfa cost was amounted to be 0.91 TRY on average. On farms, the cost of producing a kilogramme of alfalfa varied between 0.48 and 2.36 TRY (Figure 2).

In the 2019 crop season, the mean alfalfa (as dry grass) yield in the research area was 2,013.06 kg per decare. Group I recorded the modal output of about 2,186.21 kg per decares of alfalfa per year, followed by group III with 2,000.68 kg per decares.

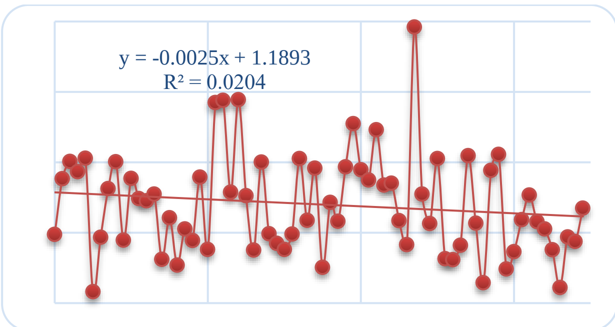

Fig. 2. Alfalfa production cost per kg in enterprises
Source: Own results.

1.25 was found to be the relative profit. The relative profit ranged from 0.48 to 2.22 for 70 alfalfa enterprises. Although the increase in alfalfa cultivation area seems to increase the relative profit (Figure 3), we have determined that this situation is not significant statistically.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Relative profit and also kg production cost had a bigger standard deviation or variance in the farms' groups, which might be due to the differences in farm management practices of the alfalfa farmers, mechanisation structures, farm size, and varying capital amounts and their basic production goals.

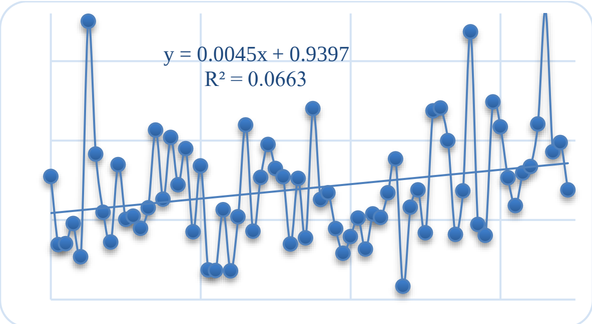

Fig. 3. Relative profit in alfalfa production
Source: Own results

Table 5 showed the farms' relative profit status for the alfalfa growing. Group III had the highest share with 69.23 percent relative profit (equal to 1 or more), followed by the group I with 43.33 percent.

Table 5. Relative profit status in the alfalfa-growing farm (%)

Groups	Relative profit: Less than 1	Relative profit: Equal 1 or more	Total
I	56.67	43.33	100.00
II	57.14	42.86	100.00
III	30.77	69.23	100.00
Total	47.14	52.86	100.00

Source: Own results.

In the negotiations with farms, the low rainfall and the decreasing or changing direction of the groundwaters cause a water problem. The high input prices, parallel to this, the lack of the same high price in the product price, climate change, and price differences were among the problems encountered in alfalfa production.

CONCLUSIONS

In this study, input usage levels, costs, and profitability status of production periods were determined using data obtained by survey method from 70 enterprises producing alfalfa in the central district Yenikent town, Sultanhani district, and Eskil districts, where alfalfa production is heavily carried out in Aksaray province (about 97.72% of Aksaray alfalfa production).

When the cost elements of enterprises were examined the variable costs were 70%, and the fixed costs are around 30%.

The share of the variable cost for large enterprises was less than for small enterprises, due to the high level of mechanisation of enterprises.

But the high level of mechanisation has also ensured that fixed costs for large enterprises were higher than for other enterprises.

Among the variable costs, electricity costs were 28.67%, and fertilisers were 18.49%. Among fixed costs, the highest expense item was the land rent with 21.01%.

When the profitability status of enterprises was examined, the decare yield was 2,004.35 kg, average GPV was 2,190.93 TRY, gross profit was 952.08 TRY, absolute profit was 438.91 TRY, relative profit was 1.25, kg cost was 0.87 TRY, the average kg sales price was 1.09 TRY. Here it is understood that small and medium-sized enterprises have difficulty in saving their costs, and solving the problem of mechanisation, especially large enterprises that reduce labour costs earn more.

The manufacturer has stated that the product loses value when the product is in excess. Some alfalfa trading enterprises also said that unfair competition has been made by breaking the price.

A cooperative such as Konya Karapınar Alfalfa Producers Association established here to determine the market price, it becomes easier to create solutions to problems.

It has become clear that most of our farmers do not have clear information about the water problem. In the project of bringing water from the Hirfanlı dam, which is still working at the moment and will be completed soon, to the region via the Ağağören district with large pipes, the process of transporting pipes and digging pits into which pipes will enter is progressing very quickly.

Infrastructure work will be completed to bring water to the region in the near future. According to the rate at which enterprises use mechanisation in alfalfa farms, their profitability status increases.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DEVELOPMENT OF DRY ONION PRODUCTION, FOREIGN TRADE, AND SEASONAL PRICES IN TURKEY

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Abstract

This study examined the change in the dry onion market in the world and Turkey. The study used data from FAO and TURKSTAT institutions from 1980-to 2021. Considering the developments in the production and foreign trade of dry onions in the world and Turkey, the world production of dry onions, which was 21.71 million tons compared to the average of 1980 at the beginning of the period, increased by 382% rose to 104.55 million tons in 2020. India occupies the first place in the world production of dry onions 8% of the onions produced in the world are exported. During the studied period, the amount of world dry onion exports increased by six times, and its value increased by 12.8 times. The Netherlands has the highest share of dry onion export values (22.10%). According to the period of 1980, the production of dry onions in Turkey has increased by 2.5 times. Compared to 1980, the production area increased by 3%. Therefore, productivity improvements have a primary impact on production growth.

Key words: *dry onions, production, foreign trade*

INTRODUCTION

Onion (*Allium cepa* L.) although it is one of the most important vegetables worldwide, it is a plant known for its unique taste and aroma due to the sulphur compounds it contains. In recent years, dry onions with high-quality characteristics have been the reason for preference in the food industry [13, 14].
Onions (*Allium cepa* L.) are very consumed in Turkey and are an important source of nutrients. It is also one of our vegetables with extremely high economic importance. In addition to its use as a food, it is used to treat chickenpox, common colds, and diseases such as flu, measles, and rheumatism [12].
[6] focused on the fluctuations in onion prices in the 1975-1994 period and its measurement and calculated the marketing margins according to both current and real prices in Turkey.
In a study conducted in the Polatlı district of Ankara province, the level of physical input usage, production costs, gross and net profit levels of dry onions were calculated [3]. Another study revealed the physical utilisation levels of average production inputs of onion per decare in aqueous conditions in the Konya region and dry conditions in the Bursa and Tokat regions [2]. [15]analysed the onion prices and seasonal fluctuations received by the producers in the 1970-1989 period.
[16] discussed the changes in onion production and prices in the world and Turkey. They reported that dry onion production increased 4.37 times in the 1980-2017 period due to the cultivation area and yield expansion. Turkey ranks 7th in the world's dry onion production. They determined that the dry onion trade has made significant development globally, and the amount and value of exports increased by 3.94 and 6.73 times, respectively. They reported that Turkey's share in world production and exports decreased. They found that dry onion producer prices fluctuated significantly, and the marketing margin increased in Turkey. They reported that mainly the increasing exchange rate increased producer prices. [10] analysed the causal relationship between harvested area and the profit in onions and potatoes. [8] investigated the compatibility of

onion production and price with the spider web theory using annual data between 1980 and 2017 for Turkey.
[7] evaluated onion producers' production and marketing processes (Amasya province center district example) with 2018 data.
In this study, the changes in the production and foreign trade of onions in the world and Turkey and the developments in the prices of onions in Turkey were examined.

MATERIALS AND METHODS

The main material of the study was the statistical data of FAO and TURKSTAT. In this context, the areas, yields, production and export data of dry onions between 1980 and 2020 in the countries important for the production of dry onions were evaluated. The data was analysed using indices and ratios. While the annual onion prices received by the producers and consumer prices were analysed, the 1980-2021 TURKSTAT data set was used [17]. For the monthly prices received by the producer, TURKSTAT data was obtained for the period 1994:01-2021:12, and the monthly consumer prices series for the period 2003:01-2021:12.
The prices received by the farmers were converted into real prices (2003 prices) by taking into account the 2003=100 based monthly Producer Price Index (PPI) and the monthly consumer prices by considering the Consumer Price Index (CPI). Year-to-year fluctuations in prices and seasonal fluctuations were calculated. Coefficients of variation and price volatility were calculated. Theoretically, volatility refers to an uncertain movement of a random variable over a period of time. The volatility in agricultural product prices is of great importance as the associated uncertainty is one of the main factors affecting the income security of producers and traders, which threatens the performance of agriculture and the welfare of consumers [19, 11]. Therefore, in general, variable agricultural product prices are a policy priority that attracts the attention of economists and policymakers.
For the 2003-2021 data set, the difference between the price received by the farmer and the price paid by the consumer was calculated as the "Marketing Margin".

RESULTS AND DISCUSSIONS

The amount of dry onion production in the world amounted to 104,554 thousand tons in 2020. The two most important countries in the production of dry onions are India, with a production of 26,738 thousand tons and a share of 25.57%, and China with a production of 23,660 thousand tons and a percentage of 22.63%. These two important producing countries are followed by the USA with 3,821 thousand tons, Egypt with 3,156 thousand tons and Turkey with 2,280 thousand tons respectively. The world production of dry onions has increased by 5.06% compared to the previous year and by about 7.33 times compared to 1961 [4].
According to the 1980 production data, the amount of world onion production increased by 382% in 2020.
India ranks first with 25.57% of the production volumes in 2020, while China's share of world onion production is 22.63%. The USA follows it with a rate of 3.65%, Egypt with a rate of 3.02%, and Turkey with a rate of 2.18%. Over the past 30 years, the contribution of China and India to the world production of dry onions has increased. India's share in world onion production in 1980, which was the beginning of the semester, was 10.49%, while the end-of-semester production rate was 25.57%. On the other hand, China's share in world onion production increased from 15.31% at the beginning of the period to 22.63% at the end of the period. Turkey's onion production accounts for 2.18% of world production (Table 1).
The amount of dry onion production in the world amounted to 104,554 thousand tons in 2020. According to the 1980 production data, the world production of dry onions increased by 382% in 2020. It is also seen that the expansion of the harvested area by 250.72% and the increase in the yield obtained from the unit area by 37.46% are effective in increasing the amount of production (Table 2).

Table 1. World onion production quantities of countries (thousand tons)

	India	China	USA	Egypt	Turkey	Other Countries	World
1980	2,277	3,324	1,625	653	889	12,938	21,706
1985	2,747	4,048	1,854	709	1,097	14,841	25,296
1990	2,974	4,780	2,142	657	1,371	17,315	29,239
1995	3,841	6,555	2,687	554	1,920	19,042	34,599
2000	4,467	11,234	3,134	644	2,194	23,436	45,109
2005	6,584	17,200	3,333	853	2,012	26,915	56,897
2010	13,118	20,698	3,407	1,778	1,876	32,145	73,022
2015	18,390	22,483	3,269	2,195	1,890	38,156	86,383
2016	20,931	23,727	3,801	2,459	2,121	41,910	94,949
2017	22,427	23,699	3,737	2,965	2,176	41,776	96,780
2018	23,262	23,604	3,284	3,067	1,931	41,731	96,879
2019	22,819	23,677	3,551	3,077	2,200	44,197	99,521
2020	26,738	23,660	3,821	3,156	2,280	44,899	104,554
2020 index (1980=100)	1174.26	711.79	235.14	483.31	256.47	347.03	481.68
2020	25.57	22.63	3.65	3.02	2.18	42.94	100

Source: [4].

Table 2. The world onion production, area, and yield

Years	Production Quantity (thousand/ton)	Cultivated Area (ha)	Yield(tonnes per ha)
1980	21,705.79	1,562.12	13.88
1985	25,296.42	1,697.13	14.89
1990	29,238.96	1,840.98	15.88
1995	34,598.86	2,114.84	16.37
2000	45,108.78	2,679.90	16.81
2005	56,896.64	3,207.63	17.72
2010	73,022.03	3,976.30	18.35
2015	86,382.80	4,624.11	18.69
2016	94,948.86	5,076.33	18.70
2017	96,780.28	5,144.04	18.81
2018	96,878.76	5,146.73	18.82
2019	99,521.44	5,152.42	19.31
2020	104,554.46	5,478.65	19.08

Source: [4].

Figure 1 shows the change in onion production quantities in the World, India, China, and Turkey. It is observed that the world onion production volumes have been increasing since 1970. The world onion production increased by 6.24 times from 16.75 million tonnes in 1970 to 104.55 million tonnes in 2020. India's onion production increased by 14.85 times from 1.8 million tonnes in 1970 to 26.74 million tonnes in 2020. China's onion production also increased 8.75 times in 2020 compared to 1961. China’s dry onion production was 2.71 million tonnes in 1970, and 23.66 million tonnes in 2020. Turkey's onion production increased from 0.68 million tonnes in 1970 to 2.28 million tonnes in 2020. This 3.35-fold increase in Turkey's onion production indicates that the efficiency of onion production in our country is high.

When the shares of selected major countries in onion harvested areas were examined based on 1980, onion harvested regions of India and Nigeria have increased worldwide. The percentage of onion harvested areas in Russia has started and continued to decrease between the periods 1990-1995. Turkey's share in onion harvested areas increased to the highest rate in 1995 with 4.7% and began to decline in later periods. When the percentage distributions of the world onion harvested areas based in 1970 were examined, it increased from 12.4% to 26.2% in India, from

10.5% to 19.8% in China, and from 1.9% to 12% in Nigeria.

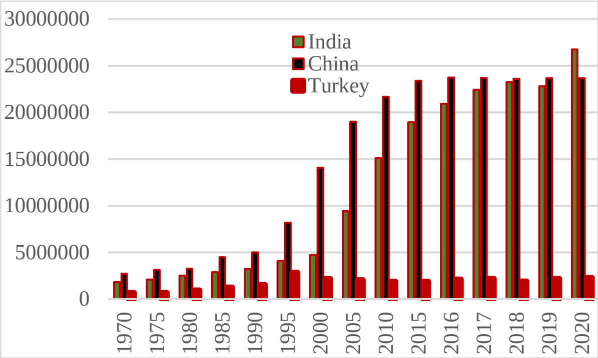

Fig. 1. China, India, and Turkey dry onion production quantities
Source: [4].

It decreased from 9.8% to 1.1% in Russia and from 5.2% to 1.3% in Turkey. Although the cultivation area in 1970 and the cultivation areas in 2020 in Turkey are close to each other, the reason for the difference between the rates is the high increase in the onion cultivation areas in the world.

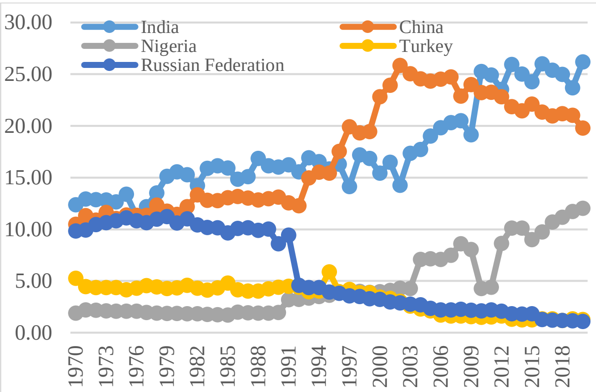

Fig. 2. Change of harvested areas by year in selected countries
Source: Our Calculation from FAOSTAT data.

The yield of dry onions per hectare between 1970-2020 in the world, China, India, and Turkey were given in Figure 3. The average yield in the world, China, India, and Turkey have increased overall. The yield of dry onions in Turkey has risen above the world yield since 1985. In 2020, the yield of dry onions per hectare in the world was 19.1 tonnes per ha. The yield per hectare in China was 21.8 tonnes per ha. The yield per hectare in India was 18.6 tonnes. In Turkey, the yield of dry onions per hectare was 32.4 tonnes. According to 1980, the average yield of dry onions in the world has increased by 37%. The average yield of dry onions in India has increased by 72%, while it has increased by 19% in China. In Turkey, the average yield of dry onions has increased by 150% compared to 1980. According to 1970, the average onion yield in Turkey has increased by 3.34 times [4].

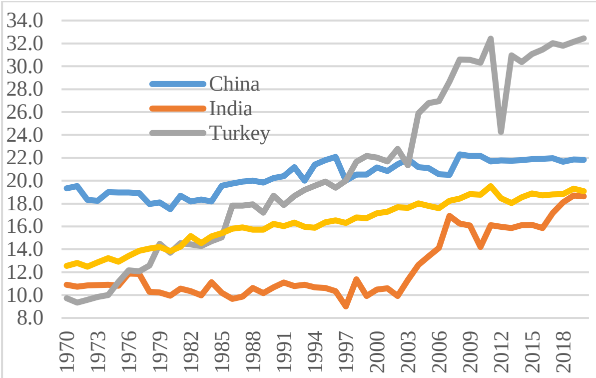

Fig. 3. India, China, World, and Turkey dry onion yield (tonnes per ha)
Source: [4].

In Turkey, the dry onion harvested area, which was 788,000 ha in 2004, decreased by 13.08% to 684,910 ha. The production of dry onions, which was 2,040,000 tons in 2004, also increased by 11.76% to 2,280,000 tons. Harvested area of dry onions was increasing and decreasing slightly over the years, and by 2020, it was observed that onion harvested areas were reduced compared to 2004. There are also increases and decreases in the production of dry onions. However, despite the reduction in harvested areas, the production amount in 2020 increased compared to dry onions in 2004 (Table 3).

The Netherlands, India, and China occupy the first three places in the world in terms of exports of dry onions. The Netherlands occupies first place with 1,751.4 thousand tons, while India occupies second place with 1,448.7 thousand tons.

China follows them with 881.3 thousand tons, Mexico with 424.4 thousand tons, Egypt with 369.2 thousand tons, and the United States with 365.4 thousand tons, respectively. Turkey's world onion export volume was 220.7 thousand tons with 10.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 3. Development of harvested and production of dry onions in Turkey

Years	Cultivated area (decare)	Cultivated area index (2004=100)	Production (ton)	Production index (2004=100)
2004	788,000	100.00	2,040,000	100.00
2005	772,800	98.07	2,070,000	101.47
2006	654,664	83.08	1,765,396	86.54
2007	649,228	82.39	1,859,442	91.15
2008	656,292	83.29	2,007,118	98.39
2009	605,579	76.85	1,849,582	90.67
2010	626,979	79.57	1,900,000	93.14
2011	661,185	83.91	2,141,373	104.97
2012	722,319	91.66	1,735,857	85.09
2013	616,324	78.21	1,904,846	93.37
2014	600,441	76.20	1,790,000	87.75
2015	577,040	73.23	1,879,189	92.12
2016	604,026	76.65	2,120,581	103.95
2017	576,918	73.21	2,175,911	106.66
2018	527,133	66.90	1,930,695	94.64
2019	613,588	77.87	2,200,000	107.84
2020	684,910	86.92	2,280,000	111.76
2021	698,972	88.70	2,500,000	122.55

Source: [17].

Based on 1980, the amount of Dutch dry onion exports increased by 4.60 times in 2020. It is observed that India's export volume has increased by 13.5 times, and the amount of onion exports in China for 2020 has increased by 45.9 times compared to 1980. According to the data from 1980, the amount of onion exports increased by 6.8 times in Turkey (Table 4).

Table 4. World onion export volume (1,000 tons)

	Netherlands	India	China	Mexico	Egypt	USA	Spain	Pakistan	Peru	Turkey	Other Countries	World
1980	380.9	108.5	19.2	46.8	54.1	107.4	189.4	28.5	0.2	32.4	429.2	1,396.6
1985	438.8	207.5	20.7	72.1	21.5	104.8	267	51	0	130	496.8	1,810.3
1990	441.3	227.9	3.7	144	42.8	115	263.5	57.6	0.1	138.9	640.3	2,075.0
1995	538.4	350.8	29.3	200.3	100.5	242.8	231.1	10.8	1.5	138.2	1,037.8	2,881.3
2000	506.8	316.3	122.9	254.9	122.3	299.9	226.3	49.7	27.2	134.5	1,375.3	3,436.2
2005	745	737.2	398.4	266.4	286.3	320	211.9	58.1	47.3	115.1	1,451.3	4,636.9
2010	1,085	1,420.6	586	301	230.4	311.1	242.1	46.8	95.4	150	1,747.7	6,216.2
2015	1,244	1,285.9	741.6	379.4	429.6	337.9	300.4	124.3	177.6	147.4	1,678.1	6,845.9
2016	1,231.1	1,837.2	711.1	412.9	457.3	325.6	356.4	76	209	105.9	1,812.5	7,534.9
2017	1,551.5	1,621.7	920.9	421	452.4	327.9	338.3	60	191.3	248.2	1,533.3	7,666.6
2018	1,511.4	1,688.4	910.1	432.6	237	359.7	356.3	210.6	219.2	101.3	1,564	7,590.5
2019	1,596.1	1,460.5	983.7	352	487	402.4	412.3	166.3	248.7	235.2	2,141.3	8,485.7
2020	1,751.4	1,448.7	881.3	424.4	369.2	365.4	357.5	304	255.7	220.7	2,073.8	8,452.2
2020 index (1980-=100)	459.81	1,335.21	4,590.10	906.84	682.44	340.22	188.75	1,066.67	127,850.00	681.17	483.18	605.20
%	20.72	17.14	10.43	5.02	4.37	4.32	4.23	3.60	3.03	2.61	24.54	100.00

Source: [4].

The world onion export volume was 8,452.2 thousand tons in 2020 and the export value was $ 3.16 billion. 53.31% of onion exports were carried out by the Netherlands, India, China, and Mexico. The fact that countries such as India and China, which also took the first place in production, lost the first place in trade to the Netherlands was due to the fact that their domestic consumption was high (Table 5).

The first place in the world onion export value for 2020 was occupied by the Netherlands with $ 797.4 million. The Netherlands was followed by China with $ 495.4 million, while these two countries followed Mexico with $ 419.8 million. India ranks first in production with 26,738 thousand tons and ranks fourth in the world onion export value with $ 346.6 million. The United States ranked fifth in the world onion export value with $249.9 million. Turkey was the 11th with a world onion export value of $ 51.4 million (Table 5).

Table 5. World onion export value (US$ million)

	Netherlands	China	Mexico	India	USA	Egypt	Spain	Pakistan	Peru	Poland	Turkey	Other Countries	World
1980	82	3	4.4	18.3	26	13.7	25.8	4.9	0	5.8	5.7	91.8	281.3
1985	77.9	4.1	8.4	38	33.7	7.4	43.7	6.2	0	6.5	18.5	109.6	354.2
1990	99.4	0.6	50.8	43	35.6	10.7	55.6	4.7	0	13.2	13.8	141.6	468.9
1995	158.4	8.5	128.3	60.5	91.3	16.3	70.1	1.3	0.3	23.4	21.2	268.1	847.5
2000	128.3	27.5	155.9	56	101.9	12.9	57.8	10.6	7.9	15.8	20.2	309.6	904.4
2005	181	79.2	201.8	120	124.6	27.7	60.2	6.3	13.4	26.5	12.6	328.5	1,181.7
2010	407.6	167.9	259.4	375.3	188.6	88.1	107.1	8.5	25.9	56.9	21.5	533.6	2,240.4
2015	470.3	367.2	343.8	403.9	229.8	202.2	137	26.9	57.8	53	24.9	580.2	2,896.9
2016	479.4	456.5	415.9	382.4	230	197.8	154.3	13.1	70	51.3	12.5	536.9	3,000.1
2017	515.5	506.8	386.7	423.2	219.5	206.5	133.4	11.9	69	51.9	40.6	462.9	3,027.9
2018	656.1	509.5	428.3	419.6	231.7	118	177	48.6	74.1	82.6	16.6	535.7	3,297.9
2019	763.6	604.4	360.9	367.3	287.7	243.9	213	67.3	87.6	102.8	54	722.9	3,875.4
2020	797.4	495.4	419.8	346.6	249.9	175.1	155.9	124	94.9	87.8	51.4	609.5	3,607.7
2020 index (1980-=100)	972.44	16,513.33	9,540.91	1,893.99	961.15	1,278.10	604.26	2,530.61	31,633.33	1,513.79	901.75	663.94	1,282.51
% Share	22.10	13.73	11.64	9.61	6.93	4.85	4.32	3.44	2.63	2.43	1.42	16.89	100.00

Source: [4].

1980-2020 annual price movements in Turkey

When current prices were analysed from 1980 through 2021, in 2020, the prices of dry onions, which were received by Turkish farmers, increased by more than 3.7 million times compared to 1980. On the other hand, the Producer Price Index rose more than 17 million times in the same period. This indicates that the increase in dry onion prices was below the rise in the index, and therefore there is a situation against the dry onion producers. The coefficient of variation covering forty-two years was found to be 115.75 for Turkey at current prices. The concepts of volatility and uncertainty express two basic meanings of volatility. Here, variability refers to all movements, uncertainty refers to unknown movements [18]. The volatility in the current prices of dry onions was calculated as 69.78% in the period under consideration. Price volatility is defined as an important economic problem.

When the real prices (2003 prices) were analysed, while the dry onion prices received by the farmers on average in Turkey in 1980 were 587.07 TRY per ton, they decreased by 78.69% in 2021 and became 125.08 TRY. In Turkey, the highest price was 875.38 TRY in 1994, and the lowest was 125.08 TRY in 2021 (Figure 1). In this period, the coefficient of variation in real prices was calculated as 38.49 for Turkey. As a matter of fact, this variation can be observed in Figure 4. Therefore, the annual variation is high in the provinces examined.

From 1980-to 1989, dry onion prices received by the producers were 371.43 TRY on average. Prices followed a fluctuating course between 248.20 TRY and 587.07 TRY. It reached its peak in 1980 and its lowest value in 1986. 1984, 1985 and 1981 were the years when it showed peak points. Dry onion price volatility was 36.86% in this period. In this period, prices showed bottom and top values every two years. From 1990-to 1999, onion prices per ton, which were received by producers, increased to 511.61 TRY on average. Prices rose to 875.38 TRY from 288.39 TRY. It reached its peak value in 1994. In addition, there were four peak values in 1990, 1998, and 1997. Prices were very volatile and in an upward trend. As a matter of fact, the price volatility received by the producer rose to 52.65%. From 2000-to 2010, the prices of dry onions received by the producer per ton decreased to 348.68 TRY on average. Prices declined from 273.14 TRY to 514.61 TRY band and showed a much less volatile trend. As a matter of fact, the price volatility received by the producers in this period decreased significantly to 21.03%. It reached its peak value in 2010, 2004, and 2000. In the years 2011-2021, the price received by the manufacturer was between 125.08 TRY and 395.59 TRY. It decreased to 251.29 TRY on average during this period. The bottom and top values of the prices were at intervals of one or two years. As a matter of fact, the price volatility received by the producer increased to 27.03%. It reached its peak in 2011, the second peak in 2019, the third peak in 2016, and the fourth peak in 2015.

The volatility of real onion prices received by farmers in the analysed period was 35.41%. High price volatility also caused significant risk and uncertainty in farmer incomes.

Fatima et al. [5] found that the average annual wholesale prices of onions and potatoes in Pakistan's major markets (Lahore, Hyderabad, Peshawar, and Quetta) increased over time. They found that the wholesale prices of onions in the markets increased by 8.97%, 8.82%, 8.53%, and 8.88%, respectively. They suggested that the rising prices of these two basic foodstuffs would be difficult for consumers to manage.

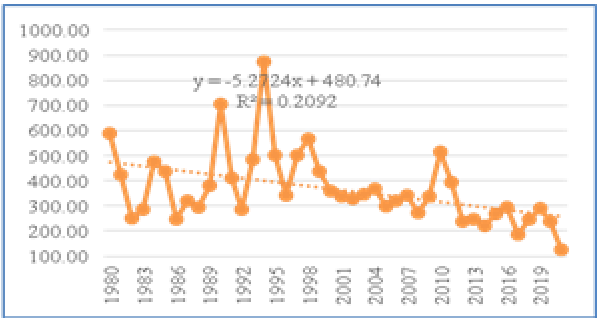

Fig. 4. Development of annual real onion prices received by farmers in Turkey (TRY per ton)

Source: Our Calculation from TURKSTAT data.

Therefore, the government should take some measures, rules, and regulations regarding price control.

Seasonal fluctuations-Producer level

Seasonal analysis of the prices received by the dry onion farmers and the prices paid by the consumer was made in order to help the dry onion producers make the right decisions for production planning, marketing, and storage.

Real prices were calculated and interpreted in order to eliminate the effect of the increases in the general price level on the onion price. For this purpose, the current prices received by the onion farmers were found by using the PPI (with Producer Price Index-2003=100) in the 1994-2021 period, and the general trend of the obtained real price series, seasonal index, and coefficients of variation were calculated using the simple average method.

The real prices of onion farmers received their lowest value in December 2021 and November 2021 and reached their highest value in May 1994 and April 1994. In general, the prices were at their highest during the first season of onions. In 2014, however, the high export volume pushed the prices up. In the 1994-1999 period, prices fluctuated between 170.36 TRY and 1,191.07 TRY per ton, with an average of 546.32 TRY. Price volatility was 16.34% (Figure 5).

In the 2000-2009 period, prices were at the lowest level of 224.32 TRY, and the highest 540.23 TRY band, showing a downward trend and realised as 332.85 TRY on average. Price volatility also fell to 8.53% (Figure 5).

Prices were low at 80.22 TRY and high at 983.09 TRY in the 2010-2021 period. They continued their downward slope and averaged 273.52 TRY, but price volatility increased to 11.83% (Figure 5). In fact, prices tend to decrease with the introduction of first-season onions. Significant annual and seasonal fluctuations were observed in the analysed period, but the prices of onion producers generally showed a decreasing trend, and price volatility continued ($Y_{1994\text{-}2021} = -0.036x + 1{,}771.7$; $R^2 = 0.3872$) (Figure 5).

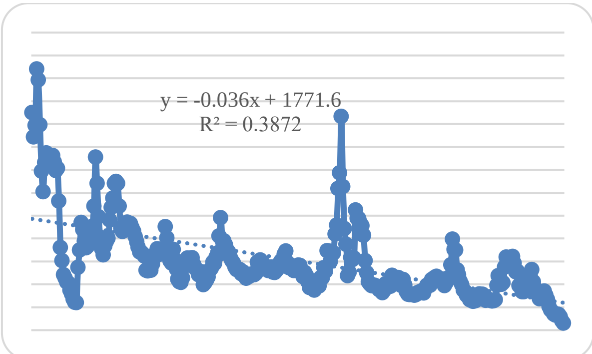

Fig. 5. Development of monthly producer prices of dry onions in the period 1994-2021 at real prices (TRY per ton)

Source: Our Calculation from TURKSTAT data.

When the seasonal index and coefficients of variation are analysed for 1994-2021 with the simple average method [1], the price per ton

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

reaches its highest value in April with 398.24 TRY. The coefficient of variation in this month is 61.01. The season index was 113 for this month. It was above the average value in May, March, February, January, and June (Table 6). The seasonal index had the lowest values in October, September, and November. In the Central Anatolian provinces, where dry onion production is intense in Turkey, the dry onion harvesting periods are also in these months.

The January-June period, when the real prices of onions were the most favourable, also had the highest value of the coefficient of variation (Table 6).

Table 6. Seasonal index of dry onion monthly producer prices

	Average real price (TRY per ton)	Standard error	Coefficient of variation (%)	Seasonal index (%)
January	372.70	183.25	49.17	106
February	378.11	182.20	48.19	107
March	380.30	193.64	50.92	108
April	398.24	242.97	61.01	113
May	392.04	229.75	58.60	111
June	371.07	180.19	48.56	105
July	348.46	135.22	38.81	99
August	326.64	118.62	36.31	92
September	312.31	125.78	40.28	88
October	311.22	130.89	42.06	88
November	317.60	134.68	42.40	90
December	329.31	135.88	41.26	93

Source: Our Calculation from TURKSTAT data.

Seasonal fluctuations-Consumer level

Seasonal analysis of the prices paid by the dry onion consumer was also made. Accordingly, real prices were calculated in order to eliminate the effect of inflation increases on **onion** prices, current prices were used in the CPI (with the Consumer Price Index-2003=100) in the 2003-2021 period, and the general trend of the obtained real price series, seasonal index, coefficients of variation were calculated with the simple average method.

The real prices paid by the consumer for dry onions reached their lowest value (303 TRY per ton) in April 2005 and reached their highest value (1,552 TRY per ton) in April 2010. The real prices paid by the consumer for dry onions had an increasing trend (Y2003-2021 = 0.0027x + 429.04; R^2 = 0.0006). In the 2003-2021 periods, the second-highest consumer price paid for dry onions was April 2019 (1,462 TRY per ton), and the third-highest price was in March 2004 (1,262 TRY per ton). Price volatility was also 17.25% (Figure 6). In the 2003-2009 period, prices were at the lowest 302.69 TRY, and the highest 1261.88 TRY band, showing an increasing trend and amounting to 509.26 TRY on average. Price volatility was also 12.39% (Figure 6).

Prices were at a low of 386.67 TRY, and a high of 1,552.10 TRY in the 2010-2014 period. They continued their upward slope and averaged 552.18 TRY, but price volatility increased 15.45% (Figure 6).

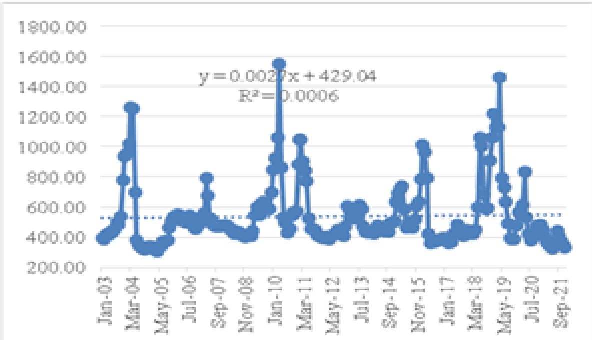

Fig. 6. Development of consumer monthly onion prices in real prices in the period 2005-2021 (TRY per ton)
Source: Our Calculation from TURKSTAT data.

Prices were at a low of 358.36 TRY, and a high of 1,461.86 TRY in the 2015-2019 period, continuing the upward slope and rising to an average of 602.30 TRY, which was reflected in the price volatility and increased to 19.90% (Figure 6). During the 2020-2021 pandemic period, prices declined to the lowest 321.11 TRY and the highest 837.11 TRY band, showing a downward trend and amounting to 442.57 TRY on average. Price volatility was also 14.77% (Figure 6).

When the seasonal index for the consumer and the coefficients of variation for the 2003-2021 period are examined with the simple average method [1], with a ton price of 686.33 TRY in April, consumers pay the highest price. The coefficient of variation in this month was 54.40. The season index was 128 for this month. In March and February, consumers pay the highest prices (628.61 and 615.14 TRY), but the coefficients of variation are also high. In January and May, consumers pay above the average value (Table 7). The seasonal index has its lowest values in September, October, and August. The increase in dry onion supply in Turkey in this period is the biggest reason for this (Table 7).

As onions pass from the field to the consumer, values are added by the companies that store, transport, sort, package, and even process these products. When ownership changes in the marketing chain, there are different onion prices. Dry onion prices vary from grower to packer, wholesaler, retailer to consumer. The difference between two prices in a marketing chain is called the marketing margin. The margin from the farmer at the head of the marketing chain to the consumer at the other end of the chain is of great interest.

Table 7. Seasonal index of dry onion monthly consumer prices

	Average real price (TRY per ton)	Standard error	Coefficient of variation (%)	Seasonal index (%)
January	592.44	239.42	40.41	110
February	615.14	269.12	43.75	114
March	628.61	291.59	46.39	117
April	686.33	373.37	54.40	128
May	548.80	153.28	27.93	102
June	493.43	166.03	33.65	92
July	495.20	150.43	30.38	92
August	472.78	89.13	18.85	88
September	445.50	65.09	14.61	83
October	456.16	75.61	16.57	85
November	491.90	147.87	30.06	91
December	529.91	190.57	35.96	98

Source: Our Calculation from TURKSTAT data.

The share of the price paid by the consumer for onions in the grower was 66.88% in 2003, and this decreased to 34.7% in 2021.

Characteristics of onion production (small scale), characteristics of the product (volume and high loss rate), characteristics of its supply (seasonal), price instability and fluctuation, the narrow application area of qualitative standards, classification, classification, packaging problems, an abundance of intermediaries, export price, product price, and exchange rate are significantly effective in price formation and increasing the marketing margin. The creation of marketing cooperatives with the participation of producers can have a reducing effect on these margin and price fluctuations.

CONCLUSIONS

Compared to the 1980 average, world onion production, 21.71 million tons, increased by 382% and rose to 104,554 thousand tons in 2020. With this increase in onion production, the contribution of the expansion in the world dry onion cultivation areas was more important (250.72% production area increase). As a matter of fact, world onion yield increased by 37.46% in this period.

India takes first place in the world’s dry onion production. India is followed by China, USA, Egypt, and Turkey. In the analysed period, significant increases were experienced in the dry onion production of China, USA, Egypt, and Turkey. In these increases, the expansion of dry onion cultivation areas and yield increases were important. Especially the production of India and China increased considerably compared to 1980.

8.08% of dry onions produced in the world were exported. In the period under review, the amount of dry onion exports increased six times, and its value increased 12.8 times. The country with the highest share in dry onion export values was the Netherlands. The Netherlands was followed by China, Mexico, and India, respectively. Compared to the 1980 period, Turkey's dry onion production increased 2.5 times; the increase in yield had a primary effect on this. 9.67% of dry onions produced in Turkey in 2020 became the subject of export. The share of Turkey in the world dry onion export value was 1.42%.

Input prices and the selling price of onions are important issues in the supply of onions. There have been significant annual and seasonal changes and fluctuations in onion prices in the historical process. The coefficient of variation was high, and the volatility in prices was high. There is a direct relationship between current prices, production, world export price, and Turkey’s export price. On the other hand, real prices had an inverse relationship with production and world export prices. The characteristics of dry onion production, the product’s features, the characteristics of its supply, the abundance of intermediaries, and the exchange rate are significantly effective in price formation and increasing the marketing margin. At this point, unions or marketing cooperatives to be formed by producers may be important in price fluctuations and in returning the margin to the producer.

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MAIN ASPECTS OF BUILDING A DIGITAL BUSINESS MODEL OF A RUSSIAN AGRICULTURAL ENTERPRISE

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Abstract

The article discusses the work of researchers devoted to various aspects of digitalization, design and creation of digital business models. The analysis of actual data demonstrated Russia's position in the world community in terms of the level of development of digital technologies. An assessment of the depth of digitalization in the sectors of the Russian economy is given and the backlog of agriculture is revealed, inducing the relevance and possibility of rapid and large-scale implementation of IT in this area. A conceptual digital business model of the activity of an agricultural enterprise has been developed, reflecting its business processes and allowing to identify development directions. The practical application of the business model will increase the efficiency of communications and labor productivity through the use of electronic digital communication channels, reduce the transaction costs of the enterprise, which will affect the competitiveness of Russian food products.

Key words**:** *agribusiness, digital business model, Russia*

INTRODUCTION

In modern conditions of global economic development, the level of digitalization of business is a determining factor of successful activity in the market, organization of interaction with suppliers and customers, and, accordingly, the efficiency and competitiveness of the enterprise. Russian agriculture is currently implementing digitalization projects in various industries, which requires the transformation of existing production and economic processes. However, among the types of economic activity, agriculture lags behind the leading industries in terms of digitalization, which leaves ample opportunities for the development of information technology or IT. At the same time, a universal digital business model of an agricultural organization can become the basis for increasing the level of digitalization of the agroindustrial complex (AIC) [5].

To date, the theoretical and methodological foundations of business modeling, digitalization, as well as digital business models of activities, including agroindustrial and agricultural enterprises, are considered in the works of many Russian and world scientists. For the first time, the scientific term "business model" appeared in the 1960s, and gained the greatest popularity at the turn of the XX and XXI centuries [9, 10]. In 2000 J. Linder and S. Cantrell's research turned to the main method of creating consumer value, the essence of which can be revealed through the elements of a business model, an operational model and a model of change [11]. According to the authors, the classical business model can be presented in the form of a static scheme reflecting the current state of the organization, with an incorporated model of changes demonstrating the transformations necessary for the organization in the future to preserve the mass of profits. The key factor of these transformations today is the digitalization of business. A little later H. Chesbrough formulated an expanded definition of the term "business model of the firm", according to which it should be understood as a way of creating value and making profit by the organization [6]. Following him, M. Rozeia and H. Werthner proposed to interpret this concept as a description of the organization's business processes (purchase and sale of goods, profit) [16]. However, the above definitions are very general, insufficiently specified, and therefore need to be clarified. The attention of the authors is focused on generalization, analysis and use of practical experience of entrepreneurial activity, while management theory is undeservedly ignored. Swiss business analysts A. Osterwalder and Y. Pigneur, considering the business model as a tool reflecting the business logic of the organization and including a system of objects, concepts and their connections, attach dominant importance to the relationship of the enterprise with the external environment, which ultimately determines the level of its competitiveness [15]. At the same time, the authors unreasonably neglect internal factors, the importance of which increases markedly in the conditions of uncertainty of the external environment. In turn, researchers from Brunel University of London proposed their interpretation of the concept of "business model", according to which it should be understood as "an abstract representation of an organization, whether conceptual, textual and/or graphical of all interrelated structural, operational and financial mechanisms developed by the organization, as well as all products and/or services which the organization offers on the basis of these mechanisms, which are necessary to achieve strategic goals and objectives" [13]. Summarizing the scientists who study the concept of a business model, it can be noted that most of the author's definitions combine not a functional, but a process approach to management and the inclusion in the structure of the model of influencing factors that contribute to the creation of key values for customers, ensuring the competitiveness of firms, mainly due to external factors.

Regarding the definition of a digital business model, the authors' opinions are much more differentiated and diverse. In particular, S. Shen, A. Basist and A. Howard interpret the digital model through the prism of digital agriculture as an aggregated combination of digital databases (climatic, landscape, soil, etc.) that ensure the adoption of more competent management, production and marketing decisions [18]. N. Venkatraman and J. Henderson understands the digital business model as a digital strategy demonstrating the construction of a virtual organization according to three priority vectors: interaction with customers, asset configuration and the use of knowledge [19]. Osterwalder also believes that a digital business model is a conceptual tool that contains a set of digital elements and their relationships and allows you to express the business logic of a particular firm. It is a digital representation of the value that a company offers to one or more customer segments, as well as the technological architecture of the firm and its network of partners to create, market and deliver this capital of value relationships to generate profitable and sustainable revenue streams [15]. V.I. Medennikov in his works defines the agroindustrial complex business model as a transformed digital database model within a specific digital platform [12]. A.A. Ilyina and A.A. Kudryashov propose an interpretation of the digital business model in the agroindustrial complex as a digital platform model that takes into account the structure of the AIC of the region and promotes the active introduction of advanced information technologies in activities of small and medium-sized agricultural producers [7]. At the same time, it can be noted that, despite the large number of publications, there are still difficulties regarding the use of a single terminology of these two concepts ("digitalization" and "business model"), since the category "digital business model" has not yet been clearly formulated.

In order to increase the level of digitalization of the agroindustrial complex of Russia, it is necessary to develop a concept of a digital business model for the activities of an agricultural organization. This conceptual digital business model of an agricultural enterprise should be a strategic management tool used for the purpose of demonstrative presentation of business processes to determine promising business development options [3, 14]. The application of the model in the practical activities of agricultural organizations will contribute to increasing the level of interaction of all participants in business processes in real time based on the use of electronic and digital communication channels that provide them with equal access to data arrays and their reliability. The final result of building activities based on the digital business model will be the acceleration of the efficiency of decision-making and production and economic processes, entailing a reduction in transaction costs and a corresponding increase in the efficiency and competitiveness of agricultural organizations.

MATERIALS AND METHODS

In preparing the article, data from the Ministries of Economic Development, Agriculture, Science and Higher Education of the Russian Federation, the Federal State Statistics Service of Russia, information from higher educational institutions and scientific institutes at the federal and regional levels, the works of Russian and world economic scientists on the formation of business models and digitalization of various sectors of the economy, materials from research organizations of various countries of the world. When studying the theoretical and methodological foundations of various organizational and economic aspects of digitalization of enterprises, monographic and logical methods were used. The study of the current state of digitalization of business processes was conducted on the basis of statistical, economic and comparative analysis. The directions of digitalization of agricultural organizations' activities were determined using abstract-logical and computational-constructive methods.

RESULTS AND DISCUSSIONS

The analysis of the indicators of the level of digitalization of various sectors of the economy demonstrates that today Russia is at an average level in the development of digital technologies in the world, ahead of some developed countries in some indicators. Today, due to the growing awareness of the importance of digitalization at both the public and private levels, the processes of digitalization of all sectors of the Russian economy have intensified, specialized departments are being created, IT companies are being opened, targeted programs are being implemented, including in agriculture. According to the Higher School of Economics (HSE), Russia's gross domestic expenditures on the development of digitalization in the period 2017–2019 increased from 3.6 to 3.7% of Gross Domestic Product (GDP), amounting to 63.34 billion US dollars. At the same time, during the same time, the internal costs of Russian organizations for the creation, distribution and use of digital technologies and related products and services increased from 1.9 to 2.2% of GDP, amounting to $38.62 billion [1]. At the same time, the costs of Russian households for the use of digital technologies and related products and services increased from 1.3 to 1.5% of GDP, amounting to $24.71 billion.

In the structure of the total costs of Russian enterprises for the creation, distribution and use of digital technologies and related products, the largest share, naturally, is made up of information and communication organizations. Among the leaders are also: professional, scientific and technical activities, financial, insurance and educational organizations (Table 1). Agriculture, along with cultural and sports organizations, is in the outsiders, which may indicate a large reserve for the growth of digitalization of these industries.

According to the business digitalization index, Russia (32) occupies an average position (for example, for Romania this value is 27, and for Finland it is 52). Along with the expansion of the use of information technologies, the understanding of the need to protect information and technological infrastructure is also growing. The leaders in the use of antiviruses in Russia are providers, followed by IT companies, processing and energy sectors by a small margin (Table 2). Most often electronic signatures are used by the energy and processing sectors, as well as IT companies. Tools that prevent unauthorized access, as well as spam filters, intrusion detection systems and system security analysis tools are widely used in the communication and IT spheres. Meanwhile, in the matter of information encryption, these two industries have reversed places. At the same time, it should be noted that, in general, the use of various means in the business sector is not equivalent. Thus, antiviruses and electronic signatures are the most common, followed in descending order by: authorization tools, antispam, encryption, intrusion detection tools and security controls. At the same time, the latter are 2 times less popular than, for example, encryption.

Table 1. Structure of internal costs of Russian organizations for the creation, distribution and use of digital technologies and related products and services by type of economic activity in 2019

Branches of the economy	Structure, %
Information and communication	21.6
Professional, scientific and technical activities	19.7
Financial and insurance activities	15.5
Education	12.0
Manufacturing industry	7.2
Wholesale and retail trade	6.1
Public administration, social security	3.6
Transportation and storage	3.2
Real estate transactions	2.4
Healthcare	1.6
Energy supply	1.6
Construction	1.3
Mining	1.1
Culture and sports	0.6
Agriculture	0.6
Other	1.9
Total	**100,0**

Source: Compiled by the authors according to the HSE [1].

Table 2. The use of information security tools in organizations of various sectors of the Russian economy in 2019 (share in the total number of organizations, %)

Types of activities	Business Digitalization Index	Regularly updated antivirus programs	Means of digital electronic signature	Software and hardware that prevent unauthorized access of malware	Spam filter	Encryption tools	Computer or network intrusion detection systems	Software tools for automating the processes of analysis and control of the security of computer systems
Business sector, total (average)	**32.2**	**79.0**	**73.4**	**61.0**	**56.2**	**43.8**	**43.4**	**35.5**
Mining	29.4	78.8	70.5	65.2	59.5	45.8	43.7	35.9
Manufacturing industry	35.8	83.7	83.6	68.0	61.0	51.4	46.8	34.1
Energy supply	30.2	83.5	84.6	64.8	54.2	50.0	41.5	34.2
Water supply, sanitation, organization of waste collection and disposal	24.9	68.1	80.7	37.1	30.6	31.4	22.6	20.8
Construction	25.3	69.6	69.3	49.9	45.0	35.5	35.7	27.6
Wholesale and retail trade	39.2	82.1	61.4	69.4	69.0	43.4	52.5	44.0
Transportation and storage	29.3	82.1	77.8	64.1	54.9	48.2	45.6	36.0
Activities of hotels and catering establishments	34.1	71.9	76.4	50.3	48.8	36.1	35.8	30.6
Telecommunications	44.5	91.4	78.2	81.0	74.2	66.0	64.5	61.5
Information technology industry	35.6	87.8	83.3	76.0	69.6	67.8	59.8	50.1
Real estate transactions	23.8	67.1	78.2	43.7	38.3	34.2	28.6	23.7
Professional, scientific and technical activities	26.6	75.4	77.9	54.4	48.8	42.3	36.6	29.0

Source: Compiled by the authors according to the HSE [1].

Thus, it can be noted that the Russian economy is actively implementing digital technologies in all spheres of production and economic activity [8, 4]. At the same time, the agroindustrial complex and agriculture are still in the rearguard of these trends, which leaves a large field of activity for the implementation of IT projects and requires measures to develop digitalization. In order to support these initiatives, the concept of a digital business model for the activities of an agricultural organization at the regional level of Russia is proposed within the framework of this study.

The presented conceptual digital business model of the agricultural organization's activities in the region was based on a business model template developed by Alexander Osterwalder and Yves Pigneur. This template was presented in the work "Building business models. The Strategist and Innovator's Handbook" is currently widely and actively used by companies of various levels (from startups to multinational corporations).

The process of digitalization of agribusiness induces the need to reconstruct the applied business model by replacing its central element. This process is accelerated by the following factors:

– advantages of digital technologies (a significant increase in the scale of the market, which does not involve significant capital investments, reduction of transaction costs, increase in the speed of service);

– diffusion of digital solutions into the daily lives of customers, turning them into an immanent component of any activity;

– "digital maneuvers" of competing enterprises, inspiring other market participants to IT evolution.

The use of platform business models creates the possibility of continuous interaction of all participants in business processes in real time based on the use of electronic and digital communication channels that provide them with equal access to data arrays and their reliability. As a result, the probability of unfair competition is significantly reduced.

Within the framework of the developed business model, two groups of factors are identified that sequester the opportunities for increasing the competitiveness of an agricultural enterprise. The first group is related to the manufactured product and includes: 1) resources, 2) partners, and 3) actions. The second group characterizes the market: 1) values, 2) consumers (target groups, customer relationship technologies), 2) results. In addition, the model reflects the main financial indicators of the organization's activities: expenses and income, integrally demonstrating its financial efficiency.

The developed conceptual business model of an agricultural enterprise is a strategic management tool used for the purpose of a spectacular presentation of business processes and the subsequent search for "bottlenecks", identification of potential growth points and promising business development scenarios. Within the framework of this business model, the organization's activity is considered as a dynamic process in which two main parts are distinguished: the left – "input" (or expenses) and the right – "output" (or income). The transition from one part to another (from the past to the future of the organization, from expenses to income) is carried out through the introduction of IT technologies.

The proposed business model is a closed-loop model in which the starting point is $Capital_0$ and the end point is $Capital_1$, but in the future $Capital_1$ becomes the basis for the next cycle. In addition, in the model, the agricultural organization is considered not in isolation, but in direct contact and mutual influence with the external environment.

The global structure of the business model is determined by a logical chain of questions facing any enterprise: "How? → What? → Why?". At the same time, each question corresponds to a specific answer: "Product → Market → Finance". The question "How?" refers to the way of creating a product, "What?" – the value of this product for the consumer, "Why?" – the purpose of the enterprise (Profit). The cycle of the model, considered in a different sequence, solves the problems of the development of society: starting from the Problem that generates demand in the market, an agricultural organization offers its solution (Product), while consuming Finance and creating Value in the course of its activities.

The first block is the resources that make up the capital of an agricultural organization.

This block accumulates the most important assets necessary for the functioning of the business model. These assets determine the eventuality of the creation and delivery of value propositions by an agricultural enterprise to the consumer, its entry into the market, the formation of strong ties with consumer segments and as a consequence, making a profit.

Key resources can be classified as follows:

- natural (land, climate, terrain, water);
- innovative (applied technologies, product quality control systems, experience in implementing innovative projects);
- production (physical objects such as buildings, equipment, vehicles, production facilities, points of sale and distribution networks);
- intellectual (intellectual property objects, in particular, trademarks, secret information protected by property rights, know-how, patents, licenses and copyrights, partner and customer bases, organizational structure and management structure of the enterprise);
- investment (cash, credit lines or reserve fund funds; can be converted into any other type of resources);
- communication (various options for collaboration with other enterprises to launch new startups and implement business projects);
- social (availability of managerial personnel, specialists with the necessary qualifications, experience and age);
- information (arrays of data and information products, for example, programs).

It is important to note that IT technologies have had a significant impact on the business model block under consideration. In particular, the intellectualization of business dictates increased requirements for the competencies of employees, who must now possess relevant knowledge in the field of Big Data, Data Science, mathematics, analytics, robotics and skills to work with digital devices. As a result, it is necessary to solve the problem of attracting and retaining highly qualified IT specialists in agriculture. All graduates of universities specialists in the field of information technology are in high demand in the market, most of them are employed in the process of training. However, unfortunately, they do not consider the agricultural sector of the economy to be a promising area of application of professional competencies acquired during their studies. Personnel "hunger" is today the most important obstacle to the introduction of modern digital solutions in agricultural enterprises, because without experience with digital technologies it is impossible to fully use the software product, comprehensively revealing its potential, and, therefore, to obtain the expected economic effect.

The second block is the main partners. This block clearly demonstrates the network of partners who ensure the effective functioning of the business model. Building partnerships with an agricultural organization is inspired by its desire to achieve the following goals:

– cost reduction (rational use of both own and attracted resources);

– risk reduction (joint activities in the development, implementation and promotion of individual projects);

– aggregation of resources and differentiation of functions (organizations often do not have the entire set of resources necessary for the implementation of activities or are unable to perform the entire set of actions independently).

The introduction of digital technologies provides additional benefits from cooperation with partners, for example, reducing the transaction costs of interaction between subjects of market relations by significantly accelerating the communications of platform users and eliminating intermediaries.

The third block is the types of activities of an agricultural enterprise that determine the effectiveness of its functioning. Intelligent solutions are also reflected in this block of the business model. Activities related to the use of digital technologies and platform solutions come to the fore [17]. An important role in the transformation of this block is played by personnel, as well as cooperation, integration and clustering [2].

The fourth block is digital technologies. The basis of the conceptual digital business model of an agricultural organization is made up of digital technologies that are being implemented or are already actively used in the industry:

- big data (in agriculture, we constantly have to work with big data, and therefore this end-to-end technology of their distributed processing has been widely used in the AIC business platform);
- artificial intelligence algorithms (artificial intelligence systems that perform the functions of tractor drivers, combine harvesters, etc., will be used in agriculture in the foreseeable future);
- blockchain (these technologies are used for maintaining distributed databases on land purchase and lease transactions, solving other tasks);
- mobile platforms (used to fully automate the processes of monitoring the state of soil, crops, the environment, vehicles, agricultural machinery for precision farming, obtaining consulting services on meteorological conditions, monitoring the condition of domestic and wild animals, automating the processes of storage and processing of agricultural products, etc.);
- Internet of things (communication technologies and information transmission over the Internet directly between equipment and machinery are already widely used, the scale of this process will only expand);
- geo-positioning (used for creating and maintaining land and water cadastres, developing a digital terrain model, measuring fields, monitoring meteorological conditions, monitoring agrotechnical operations and the condition of crops, planning and analyzing the use of agricultural machinery, assessing the amount of damage and compensation payments in emergency situations, etc.);
- wireless communication (these technologies are of particular importance in agriculture, characterized by the territorial separation of infrastructure and production units);
- unmanned transport (used for creating electronic maps of fields in 3D format, analyzing the state of the soil, planting seeds, calculating the normalized vegetation index for the purpose of effective fertilization of crops, monitoring the state of the crop and its processing, inventory of agricultural work, protection of land, etc.);
- augmented reality (an example is the ItorumMR application, which involves the use of augmented reality glasses in order to train employees to manage complex equipment, agricultural machinery and transport, conduct work rationing and remote production audit);
- robotics, sensors (sensors and robotic systems are used in the agricultural sector to perform standard repetitive operations and replace a number of working professions);
- cloud computing (used in the process of collecting, consolidating and analyzing data in agriculture).

The fifth block is value propositions. Digitalization has brought to this block the possibility of using IT technologies to digitize analog products, an example of which is the equipping of agricultural machinery with navigation systems and fuel consumption sensors in order to save resources and reduce downtime.

The sixth block is consumer segments, sales channels and customer relationship technologies. This structural block identifies potential buyers of agricultural products, ways of interacting with consumer segments and communicating value propositions to them. In order to maximize customer satisfaction, it is advisable to aggregate them into groups. At the same time, classification features can be, for example, their needs, gender characteristics, behavioral characteristics, income levels, sales channels through which interaction with them is carried out. Differences in needs determine the differentiation of supply. The presented model covers one or more consumer segments. Strategically important for the organization is the decision on the design and sequestration of the serviced segments. This will allow us to construct a business model based on a clear understanding of the specific needs of customers of selected segments. At the same time, it is important to note that the digital transformation of business is undoubtedly also reflected in this block of the business model. The pattern of consumer behavior under the influence of digital technologies is undergoing significant changes. The Internet has become the main channel for informing them (advertising in search engines, social networks, mobile applications and web sites, e-mail of the enterprise).

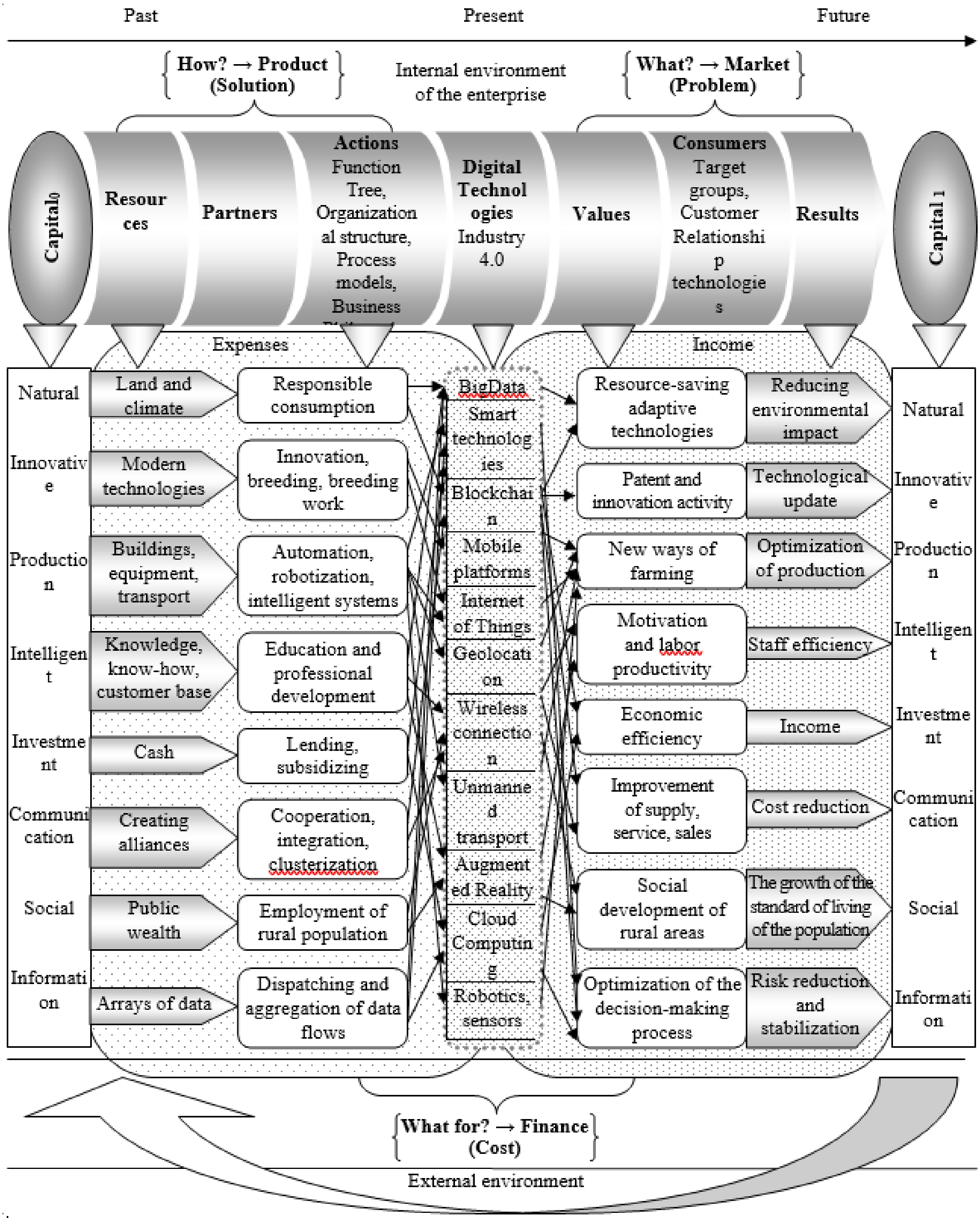

Fig. 1. Conceptual digital business model of an agricultural organization
Source: Compiled by the authors.

Consumers want to be able to purchase products online as well. Approaches to the study of consumer preferences have also changed – it is becoming popular to map the user path by tracking digital points of contact of the consumer with the organization in order to enter new consumer segments and increase consumer loyalty.

The seventh block is the results obtained as a result of the use of digital technologies in an agricultural organization (reduction of anthropogenic load, introduction of innovative production and management technologies, cost reduction, professional development of workers and labor productivity, growth of welfare and improvement of the quality of life of the rural population, minimization of enterprise risks).

The concept of a digital business model presented in Figure 1 is a theoretical construction that assumes practical filling with specific production and economic elements.

The implementation of the organization of agricultural enterprises in the Russian regions on the basis of the presented digital business model will accelerate the introduction of information technologies and bring the agricultural sector to the level of other sectors of the national economy.

CONCLUSIONS

Over the past decades, many aspects of the introduction of information technologies in various sectors of the world economy have been sufficiently studied and theoretical and methodological foundations for the digitalization of enterprises have been formed. Currently, scientists around the world continue to work on studying and improving the mechanism of digitalization of many areas of agriculture, exploring the role of science and obstacles in the development of digital agriculture, new management methods in the context of digitalization, the interaction of government and business in digital transformation and digitalization as a tool to overcome the consequences of the pandemic. In addition, specific digitalization tools are considered: the creation of a single digital platform, the introduction of artificial intelligence elements (fuzzy logic, neural networks, pattern recognition), cloud and unmanned systems, digital grain platforms, monitoring and feedback. At the same time, large-scale studies are being conducted on the issues of training specialists in the field of digital agriculture and digitalization of educational processes.

These initiatives are being actively implemented in practice. Currently, digitalization processes of various branches of the Russian agroindustrial complex are underway everywhere, projects for the development of information technology are being developed and implemented. However, the level of use of information technologies in agriculture today is still significantly lower than the average for the sectors of the economy. The main application of IT is reduced to the use of computers and general-purpose software for communication, accounting and reporting. Few agricultural enterprises use digital technologies to monitor the condition of fields, crops and animals. At the same time, one of the obstacles to the widespread spread of IT in agriculture is the shortage of qualified personnel, the main reason for which is the low attractiveness of work in rural areas.

Thus, it is necessary to establish effective cooperation of IT developers (innovative companies) with the management of large industrial enterprises in the process of forming a register of relevant digital proposals in order to adjust the development programs of the Russian AIC in accordance with the needs of enterprises. In addition, it is advisable to regularly monitor the needs of the regional economy in specialized companies that develop and implement digital technologies. The implementation of a unified digital model of agricultural organizations' activities will allow us to comprehensively solve the tasks set. The implementation of these measures will eventually allow attracting the necessary number of enterprises to the agricultural sector of the Russian regions for the development, implementation and operation of digital production and management systems. The development of digitalization of all spheres of activity of agricultural enterprises will create prerequisites for increasing efficiency and competitiveness in the international market of Russian agricultural and food products.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC ANALYSIS OF THE PRODUCTION AND PRODUCTION COSTS OF CARP FISH FARMS IN IRAQ

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Abstract

Fish farming is the fastest growing sector in fish production, so it is seen as a major source of fish production in large quantities. Therefore, Iraq has moved towards developing fish farming, as it has a major role in investment expansion and a pillar of economic development. Environmental diversity has led to the availability of the vast water bodies in Iraq, which allow the breeding of different types of fish, lead to the success of fish farming projects in Iraq. The results of the research showed that the cost of fingerlings, pesticides and rented labor is the highest, as it constitutes 20% of the total variable costs, followed by the cost of fodder, then the costs of medicines, and finally the costs of transportation. As for the total fixed costs, the cost of renting land constitutes the highest percentage, followed by the construction of ponds and family work. The results of the research also showed that there is a big difference between the area and the optimum size of fish production, which is equal to 74 dunums of area and 693 tons of production with the actual level of area and production, which equals 46 dunams of area and 166 tons of production. So farmers must be helped to increase production that achieves economic efficiency by increasing areas through participation and union between farmers

Key words: *economic analysis, fish farms, fixed costs, variable costs*

INTRODUCTION

Fish is an important source of food needed to build the human body because it is one of the sources of animal protein necessary to maintain human health and safety. As fish protein is characterized by ease of digestion, absorption and assimilation compared to the protein found in red meat and poultry meat. In addition to containing fatty acids necessary for human protection. From heart and circulatory diseases [12].
Where studies and statistics have shown that the percentage of protein in fish meat ranges between 20-90% of the dry weight and 18.5% of the wet weight. as its percentage exceeds the percentage of protein in each of the beef, which is about 16.18%, and eggs, which is about 13.6%. In addition, in milk, which is about 3.8%, and this protein has a high nutritional value because it contains essential amino acids in human nutrition, as well as the containment of fish fat on high amounts of vitamins and many important minerals such as calcium, phosphorus, iodine and iron [8].
Fish farming is the fastest growing sector in fish production, so it is seen as a major source of fish production in large quantities. Therefore, Iraq has moved towards developing fish farming, as it has a major role in investment expansion and one of the pillars of economic development. And the establishment of fish farms [10].
As a result of the nutritional and economic importance, the state has been concerned with diversifying the sources of fish production and moving towards fish breeding. Therefore, fish farming began in ponds (fish farming) in the form of lakes and hatcheries in Iraq since 1954 [11].
As a result of a comprehensive development plan for the development of livestock, including the development of fisheries, by expanding the establishment of fish farms or what is related to the provision of elements of support to the elements of production.

Therefore, the number of fish farms in the beginning of the nineties reached about (13,383 farms). with a total area of (5,252 hectares). And about (18 hatcheries) with a production capacity of About (239) million fingerlings. In 2003 the number of farms increased to (1,787) farms with an area of (19,406) hectares, and the number of hatcheries increased to (25 hatcheries),

As a result of the political and economic conditions that passed through Iraq after 2003, the number of fish farms decreased (534), A farm after the world of 2006, which represents 30% of the total fish farms [7].

As for hatcheries, which are the main source for equipping fish breeders with fingerlings necessary for the fish farming process, Iraq is poor in this aspect, and reliance on imports was for most of the production elements [1].

Among the species that were used in fish production in Iraq, fish of the type of carp, where there are several types, such as the Common Carp, Grass Carp and Sliver Carp. Where this type of fish was officially, introduced to Iraq in the sixties of the last century, as it is considered a low-cost, fast-growing fish that is suitable for the Iraqi environment [2].

Although Iraq has all the capabilities that enable it to produce fish at great rates.

There is a decline in the level of production and this is due to several reasons.

The most important of which are the low volume of investments, high costs, and the suspension of government support, in addition to the large decrease in the quantities of water, the high rate of salinity and pollution in the water [3].

The research problem is the high costs of production And the farmers' failure to achieve production volumes that are close to the optimum volume of production and optimum areas, then the lowest possible production costs are achieved and profits are maximized.

The research aims to study the reality of fish farm production costs, determine the optimum size for production, determine the optimum area, and compare it to the size and area actually achieved.

MATERIALS AND METHODS

Research Hypothesis

The research assumes that despite the capabilities that Iraq has in general for fish production, the quantities produced of fish are still very low because production costs are high. Therefore, it is important to estimate the production cost functions because of these indicative and economic applications of agricultural policy that can lead to Increasing production if the breeders are directed to produce according to optimum production rates and the use of optimal spaces.

Research method

Data were collected from fish farms, where we had cross-section data for the farms, and it was unloaded and analyzed using the SPSS statistical program. The sample reflected the great interest of the breeders in raising three main types of fish, at the forefront of which is (Common Carp), which forms the largest part of the fish farm owners' production, The other two types of carp (grass and silver) are produced in less quantity than the first type. From the information collected through the study sample, the breeding season for carp lasts between three to six months, during which farmers provide all production requirements such as feed, pesticides, therapeutic drugs, etc.

Data Sources

The study adopted on the collection of information from several fish production farms, in addition to the use of previous studies and research related to the subject matter of the study.

RESULTS AND DISCUSSIONS

The relative importance of variable and fixed costs for fish farms

The importance of variable costs and fixed costs for fish farms has been clarified by studying each item of these costs, as Table 1 Shows each of the variable costs that include (provender, workers' wages, medicine, water cost, fingerlings cost, transportation) and the percentage their respective contribution to total variable costs.

Table 1 Shows that the percentage of the contribution of pesticide costs, workers' wages and fingerling is the highest, Followed by the fodder, then the costs of treatment, the wages of watering, and finally the costs of transportation. The reason for the high costs of pesticides is because they are imported from outside the country. As for the high percentage of the costs of rented labor in the total variable costs, it is due to the higher labor wages. Where it needs a relatively large number of workers and because the percentage of family work is low because the breeding farms are far from the areas where the breeders live. Either as for the cost of fingerlings is high because they are the main and important factor in the production process.

As for the proportion of the relatively high cost of provender because part of the comment used is imported from the outside like Protein and soybean and other parts have high local prices such as Barley. The lack of fish diseases. As for water costs, they are due to the need to install pumps to draw water from rivers and lakes to supply farms with water. As for transportation costs, we note from Table 1 that their percentage is relatively low, due to the fact that producers sell their fish production at the farm gate, and few of them do Transfer it to the market.

Table 1 shows the items of fixed costs and the percentage of their contribution from the total fixed costs, where the table shows the high costs of renting the land because the rents are high in general.

And as for the costs of establishing ponds, they are considered fixed because they are paid once at the beginning of the establishment of the farm family work is limited to one or two people whose work is restricted to managing the work only.

Table 1. The items of variable costs, fixed costs items and their share in total costs

Items of variable costs	**Share in total variable costs, %**	**Items of fixed costs**	**Share in total fixed costs, %**
Cost of Fingerlings	70	Land Rental Cost	20
Workers' Wages	20	Family Business	3
Treatment Costs	10	Create Basins	27
Costs provender	14		
Watering Costs	10		
Pesticide Costs	20		
Transportation Costs	6		
Total	100	Total	100

Source: The table is made by the researchers based on the records of some fish farms.

Table 2 indicates that the percentage of variable costs contribution to total costs is higher than that of fixed costs, as it constitutes about 55% of total costs, while fixed costs constitute about 45% of total costs.

Therefore, the reduction of total costs will be through Minimizing variable costs.

Table 2. Contribution of variable costs and fixed costs to total costs

Cost items	Share of variable and fixed costs in total costs, %
Variable costs	55
Fixed costs	45
Total	100

Source: The table is made by the researcher based on the previous table.

Estimating the optimal size of fish farms

- *Standard model estimation*

When performing the statistical analysis of the study sample data, the cubic function was adopted to calculate costs because it is significant, as this model is borrowed that meets the absence of multiple linear relationship between the independent variables (Multicollinearity) The model is non-linear in terms of variables that take the following form [4].

$$TC = b_0 + b_1Q + b_2Q^2 + b_3Q^3 + U$$

where:

Tc: represents the total costs of production.

Q: represents the quantity of output (tons)

Q^2: represents the square of the quantity of output (tons)

Q^3: represents cubic quantity of output (tons), U: represents the random variable.

Table 3. statistical analysis of cost data

Variable	The equation	R^2	F	$R^{/2}$	D. W.
The Cost	TC = 27,671.916 + 566.7Q-2,577Q^2+0.001Q^3 (0.77) (1.45) (3.02)	**0.67**	**23.27**	**0.63**	**1.48**

Source: The table is made by the researcher based on records of some fish farms.
The value in parentheses indicates the calculated (t) value, (R^2) the coefficient of determination, (F) the estimated value of the model significance selection, (D. W.) Autocorrelation measurement.

Table 3 shows the existence of a self-correlation problem through the value of (D.W.) because the data used are cross-sectional data, so this problem was addressed by using the (Generalized Differences) method. This method is used to estimate the correlation coefficient ($\hat{p}$) from the estimated production function error limits, according to the Least Square Method. Where the other independent variables and the dependent variable are transformed so that the error limits of the transformed equation are not self-related, and the data transformation [5], takes the following form:

$\hat{p}$ = 1-d / 2

X*t = (Xt - $\hat{p}$ Xt-1)

Y*t = (Yt - $\hat{p}$ Yt-1)

Table 4 shows the estimated model for the regression equation after using the transformed variables to address the self-correlation problem, as the model became as presented below.

Table 4. Estimated model of the regression equation after using the transformed variables

Variable	The equation	R^2	F	$R^{/2}$	D. W.
The Cost	TC = 18,956.45 + 506.667Q-2,771Q^2+0.004Q^3 (2.812) (-2.913) (3.417)	**.071**	**29.714**	**0.69**	**.191**

Source: The table is made by the researcher based on records of some fish farms.
The value in parentheses indicates the calculated (t) value, (R^2) the coefficient of determination, (F) the estimated value of the model significance selection, (D. W.) Autocorrelation measurement.

Table 4 shows that the parameters of the model were significant, and by comparing the calculated (**F**) value with the tabular (**F**) value, it was found that the model was highly significant, and this reflects. The importance of the variables included in the model, and the model shows through the value of the adjusted coefficient of determination (**$R^{/2}$**) that (0.69 %) of the changes in total costs are due to production, while (0.31%) of the changes in total costs were the result of other factors not included in the model.

The Durbin-Watson coefficient of the auto-correlation test was adopted in the model, which showed that there was no auto-correlation problem, as its D.W. value was about (1.91), which confirms the absence of this problem.

-Determine the optimum volume of production

To determine the optimum size for production of carp fish. The long-run average cost (LR ATC) must be known, as all production costs in the long run are considered variable, as there are no fixed costs in the long run, therefore, the average total cost can be extracted by dividing the total costs by the quantity of output after excluding the fixed term as it represents fixed costs. [9], Table No. (5) Shows the estimated equation for the average total costs for fish farms, as follows:

$$LRATC = 506.667 - 2.771Q + 0.004Q^2$$

In order to determine the optimal level of production, which is determined when the average total cost in the long run reaches the lowest point, we apply the necessary condition for the minimization of the function by taking the first derivative of the function and set it equal to zero [6], as follows:

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

$LRATC = 506.667 - 2.771Q + 0.004Q^2$ =
-2.771+0.004 Q …….. First derivative
0.004 Q = 2.771
Q = 693

It was found that the optimum production quantity is (693) tons, which is the same as the production quantity that minimizes costs and maximizes profit. We can estimate the optimum area for a carp fish farms by entering the area as a variable in the cost function as follows:

$$TC = b_0 + b_1Q - b_2Q^2 + b_3Q^3 + b_4QA - b_5A^2$$

where:
QA: = Area in volume of production.
A^2: = Square area.
The function can estimated as shown in Table 5.

Table 5. Estimate the optimum area for carp fish farms

Variable	The equation	R^2	F	$R^{/2}$	D. W.
The Cost	$TC = 157{,}439.502 + 438{,}457Q - 2.804Q^2 - 5.758QA + 26.908A^2$ (2.407) (-2.779) (3.345) (3.442) (3.242)	**.077**	**28.064**	**0.74**	**.196**

Source: The table is made by the researcher based on records of some fish farms.
The value in parentheses indicates the calculated (t) value, (R^2) the coefficient of determination, (F) the estimated value of the model significance selection, (D. W.) Autocorrelation measurement.

Take the first derivative for (A) as follows:

= - 5.758 Q + 53.816 A

Since (Q) is known Therefore, the optimum area is as follows:

= - 3990.294+ 53.816 A
53.816A = 3990.294
A= 74

We note that the optimum area for carp fish farms, which lowers costs and maximizes profit, is (74) dunums, and when comparing the area and the optimal size for producing carp fish with the actual level of area and production, which equals (46) dunums of area and (166) tons for production, we notice that there is a big difference.
Therefore, in order to increase the production of carp fish, the area of carp farms in Iraq must expanded**.**

CONCLUSIONS

- The cost of seed, pesticides and rented labor constitutes a large proportion of the total variable costs, as it constitutes 20% for each of the total variable costs, followed by fodder, as it constitutes 14% of the total variable costs, followed by irrigation and treatment wages for each of them, 10% of the total variable costs, then costs Transportation, which constitutes 6% of the total variable costs**.**

- The high costs of renting agricultural land compared to the costs of family work and the costs of establishing breeding ponds because the rents of agricultural land are relatively high.

- The contribution ratio of the total variable costs is higher than the contribution rate of the total fixed costs, which means that the variable costs make up the bulk of the costs of fish farming.

- The farmers do not achieve the optimum volume of production nor the optimum area required to achieve that volume.

Based on the obtained results, the following recommendations were issued:

- Supporting fish producers by providing special loans to expand the areas of carp farms to increase production to meet the needs of the local market and to export the surplus abroad.

- Activating the role of the Agricultural Extension Department in the agricultural directorates in the governorates, through holding seminars and training courses for fish breeders in order to guide them about modern fish breeding methods.

- Work to increase fish production by providing all production requirements of medicines and pesticides for fish farms by the state.

- Encouraging investment in the fish production sector and encouraging individuals to adopt fish farm projects by individuals in order to increase fish production in Iraq.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIAN WINE CONSUMER BEHAVIOUR ANALYSED IN 2021: PARTICULARITIES OF GENDER, AGE GROUPS AND INCOME GROUPS

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Abstract

The paper analyses the Romanian wine consumer behaviour and expectations in 2021, based on a questionnaire administered online to a representative number of people, including 166 men and 97 women. The analysis is taking into account the gender, age groups and income groups, to point out the segments of consumers who are more interested in wine consumption and to find the most appropriate ways to stay informed and engaged, as well as offer some additional informal education. Evaluated aspects included the wine consumption frequency as a part of the diet, the preference for certain types of wines, the self-assessment of the level of basic knowledge of viticulture and winemaking and the interest to participate to organized wine events. The main findings show that 40.6% of the men and 18.6% of the women drink wine several times a week, most of those drinking wine several times a week being men in the age group of 40-49 years old (23.5%) and with a monthly income of over 5,000 RON. Also, it was observed that men tend to prefer dry red wines, dry white wines, semi-dry whites and semi-dry reds, while the women tend to favour sparkling wines, semi-dry rose wines, semi-dry aromatic wines, dry red wines and sweet white wines. Compared to women, men tend to be more confident around wine, especially those having faculty or master degrees declaring that they have average to above average knowledge on viticultural and winemaking practices. People interested and very willing to participate at wine events are men aged 40-49 and women aged 30-49. The study shows the particularities of the Romanian wine consumers, with implications for the wine market and event organisation.

Key words*: *Romanian wine consumers, wine preferences, consumption behaviour, wine events

INTRODUCTION

Wine is a traditional and very popular product in Romania, enjoyed by a large segment of population on special occasions or on a daily basis. For many it is a part of life style and is often selected as a companion to food, which is the right choice for a healthy life and well-being. Romania's wine consumption in 2020 was 3.8 million hectolitres, only 1.9% less than in 2019, which makes for a consumption of about 23.5 wine l/capita/year. This is much lower than the first three ranking countries in the world, Portugal 51.9, Italy 46.6 and France 46 l/capita (OIV 2021) [16]. Considering the total alcohol consumption by year Romania is ranking number 10th in the world, with 12.34 l/capita/year, after Latvia, Moldova, Germany, Lithuania, Ireland, Spain, Uganda, Bulgaria and Luxembourg (World Population Review, Alcohol consumption by country, 2021) [17], but this is rather due to beer and strong alcoholic beverages, not to wine consumption, which, assuming an average of 13% of alcohol in wine, can only account for a maximum of 3 l/capita/year. In beer consumption Romania ranks 14th in the world, with 90.64 l/capita/year (World Population Review, Beer Consumption by Country 2021) [18], which represents, assuming an average of 6% of alcohol in beer, a 5.5 l/capita/year. The difference of 3.84 l of alcohol are coming from hard spirits and possibly from some other fermented beverages. Taking this into account, promoting the wine consumption associated with gastronomy could cut down some of the unhealthy habits of drinking alcohol on its own and in large quantities. There is also a marked difference between women and men in the total alcohol intake, that is 5.68 vs 19.5 l/capita/year (World Population Review, Alcohol consumption by country, 2021) [17]. To shift the consumption of alcoholic drinks to wine and other lower alcohol content beverages, knowing the local market is of utmost importance. However, only few studies tried so far to identify the consumer preferences for wine (Chivu-Draghia and Antoce 2016; Ladaru and Beciu, 2014; Antoce and Paduraru, 2012a; Antoce 2003 abc) [9, 13, 1, 3, 4, 5] and none is recent enough to help grasp the present state of our wine market segmentation based on age or gender. Worldwide, several papers investigated the influence of age and gender on the wine market segmentation (Kim *et al* 2019; Bruwer and Li 2019) [12, 8] showing that both age (Barber et al, 2008) [7] and gender (Ferreira *et al.*, 2019; Nicolson, 1990; Barber *et al.*, 2006) [10, 6] can clearly influence consumer wine preference, but also the choice and the information they use for their selection (Hammond, *et al.*, 2013; Mitchell and Walsh, 2004) [11, 14].

The present study evaluates the segmentation of preferences for wine in accordance to gender, income and age.

MATERIALS AND METHODS

Based on previous experience in designing questionnaires for assessing wine preferences and consumer behaviour (Antoce and Păduraru, 2012b) [2] a cross-sectional survey was designed to collect responses to questions related to wine consumption and preferences in 2021, along with other wine related topics. The survey contained a total of 34 questions uploaded and managed on the www.questionpro.com™ platform. The survey was sent out on social networks to a number of 672 Romanian persons, of which 263 responded: 166 men and 97 women. For this paper only the questions related to wine preferences and behaviour were analysed, taking into account gender, monthly income groups of <1,500 RON, 1,501-3,000 RON, 3,001-5,000 RON and >5,001 RON and age groups of 19-29, 30-39, 40-49, 50-59 and > 60. Data were processed by Microsoft Excel Professional Plus 2019 and statistical analysis performed with OriginLab 2018 applying Mann-Whitney test (U-statistics), for significance levels of 0.05. As the numbers of each gender respondents were not equal, for the analyses and comparisons percentages of the total women and men were used.

The demographic profile of the respondents is included in Table 1.

Table 1. Demographic profile of the respondents

Specification		No.	Percentage of total respondents
Gender	Women	166	63.0%
	Men	97	37.0%
Location	Urban	238	90.5%
	Rural	25	9.5%
Age group	19-29	31	11.8%
	30-39	84	31.9%
	40-49	115	43.7%
	50-59	26	9.89%
	>60	7	2.66%
Educa-tion	Highschool	20	7.6%
	Faculty	120	45.6%
	Master	108	41.1%
	Ph.D.	13	4.9%
	other	2	0.8%
Civil status	Single	64	24.3%
	Married (no children)	63	24.0%
	Married (with children)	122	46.4%
	No answer	14	5.3%
Religion	Christian orthodox	172	65.4%
	No religion or other	91	34.6%

Source: Own results based on the answers of the respondents.

RESULTS AND DISCUSSIONS

1. Wine consumption frequency

To evaluate how the consumers relate to wine as part of their diet, a question regarding the frequency of wine consumption was used. Figure 1 presents the overall behaviour regarding wine consumption in accordance with the gender.

Women look to be more reserved, 48.5% of them drinking wine rarely, while 40.4% of men are drinking wine several times a week. The two distributions of frequencies for men and women are significantly different at the 0.05 level.

Figure 2 shows the distribution of our respondents belonging to various age groups as a function of their monthly income. It indicates that the higher incomes are generally found in the group ages 30-39 for women (32% of the women respondents) and 40-49 for men (41% of men respondents).

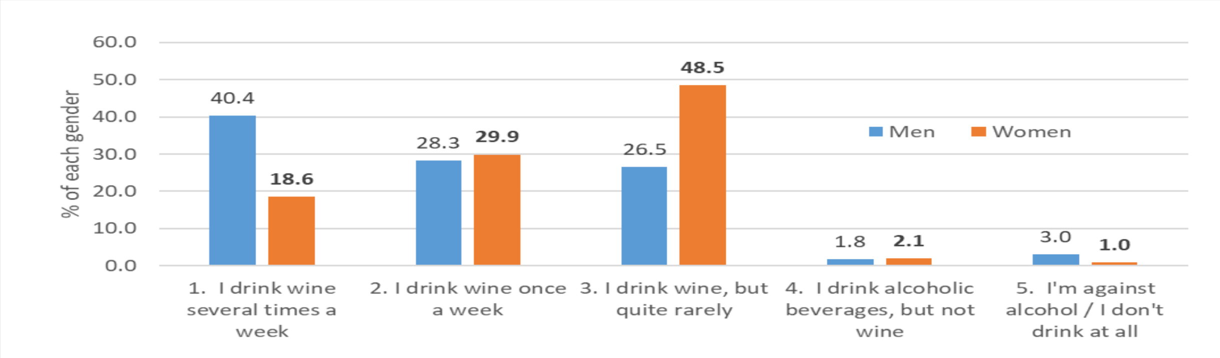

Fig. 1. Wine consumption frequency – gender differences (median for women = 3, median for men = 2, U=3797)
Source: Own results based on the answers of the respondents.

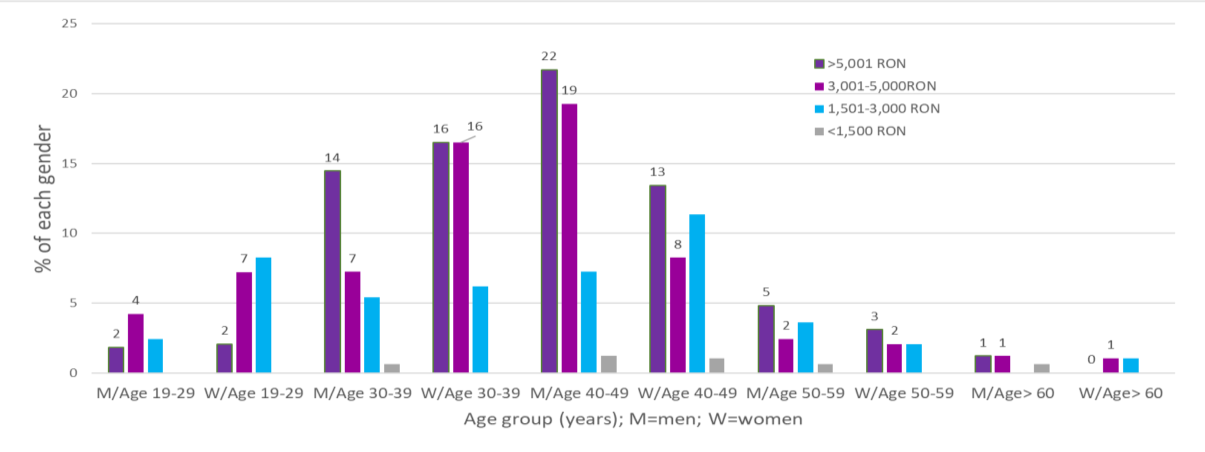

Fig. 2. Income distribution across the age groups and gender (W=women; M=men)
Source: Own results based on the answers of the respondents.

These age groups with higher income, as demonstrated later on, are also the ones in which the frequency of wine consumption is higher and knowledge about wine is superior.

In Figures 3 and 4 the wine consumption frequency is analysed for income groups and age groups, respectively, in each groups differences between women and men being also emphasized. In both figures, the segments of people who drink several times a week (dark green bars) and once a week (light green bars) can be considered Core consumers, therefore in the discussion hereafter they will be reported as the sum of the green bars, light and dark.

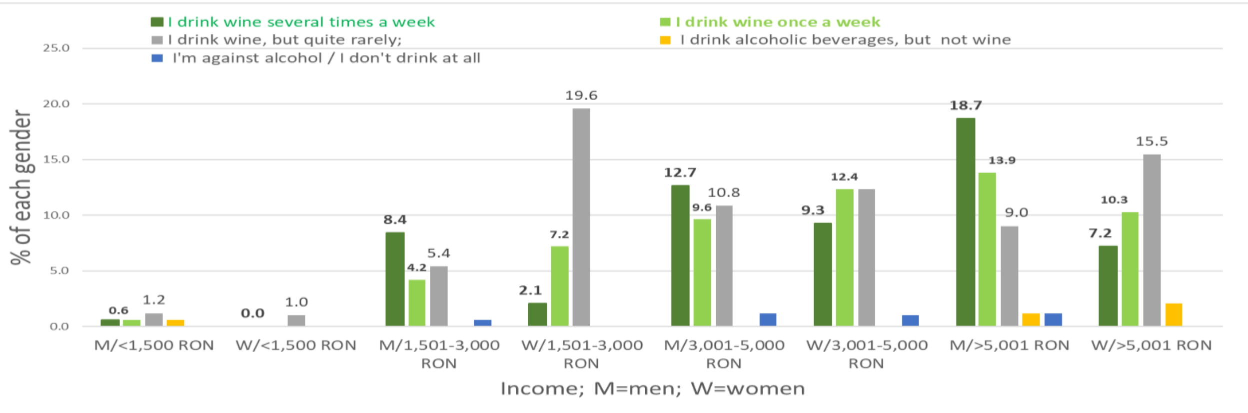

Fig. 3. Wine consumption frequency – income and gender differences
Source: Own results based on the answers of the respondents.

The grey bars represent the segment of Marginal consumers, while the yellow and blue bars describe the Occasional and No alcohol consumers, respectively.
The magnitude of each bar is the percentage of responders in that consumption frequency category, within their own gender (the sum of all bars for men is 100%, and same for women).
As seen in Figure 3, this survey indicates that both men and women with average to high incomes (which were identified above in Figure 2 as being mainly men aged 40-49 and women aged 30-39) tend to buy and consume wine rather constantly, while in the lower income segments (under 3,000 RON) only some men are still found to be interested in wine.
Figure 4 indicates that the segments of people drinking wine rather constantly (sum of dark green and light green bars) are men aged 40-49 (36.2% of all men) and women aged 30-39 (20.6% of all women).
Thus, Figures 3 and 4 are confirming the correlation of wine consumption frequency with the income and age distribution observed in Figure 2.

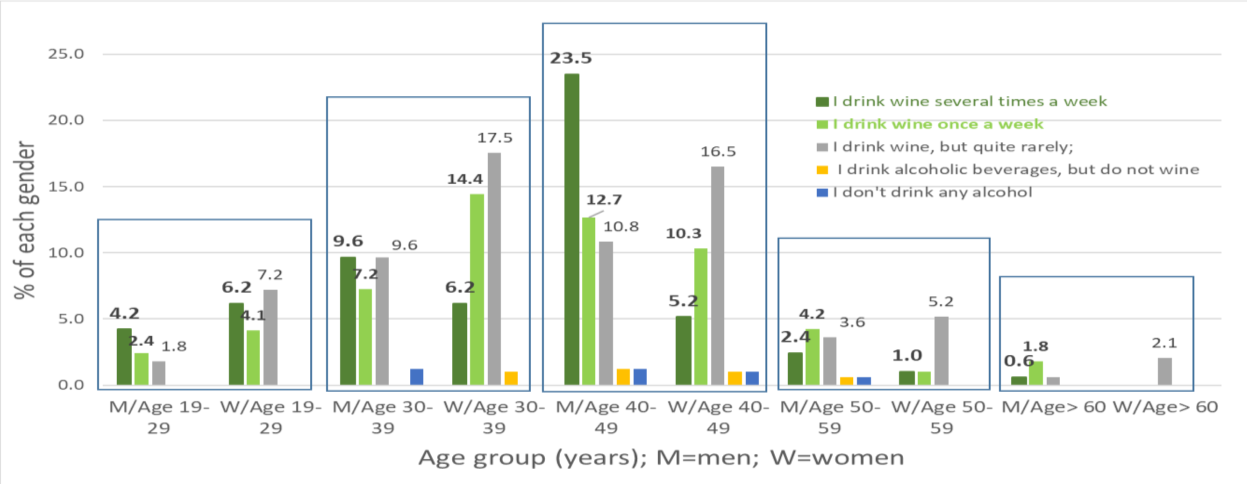

Fig. 4. Wine consumption frequency – age and gender differences
Source: Own results based on the answers of the respondents.

Also, Figures 3 and 4 point out that, irrespective of age or income, women tend to drink less than men (the sum of the magnitudes of grey bars, which mean rarely drinking wine, being 48.5% for women as opposed to 26.5% for men).
These results can be interpreted as suggesting that in Romania wine is not perceived as a commodity, which is necessary to be purchased often and irrespective of income for daily meals, but sometimes it is viewed as a luxury product. Therefore, the income is also an important factor for wine consumption and, as a result, men and women with higher incomes tend to also be more frequent buyers and consumers of wine.

2. **Preference for type of wine**

To assess the preference for the types of wine, the main wine categories in accordance to the colour, sweetness level and flavour were included in the survey as multiple-choice answers.
As shown in Figure 5, there are clear differences regarding the wine categories preferred by women as opposed to men.
Women tend to prefer the sweet white wines, rose wines dry or with sugar, aromatic wines with sugar and surely the sparkling wines. Men prefer dry and semi-dry white and red wines. It is to be noticed as well that the interest for sweet and aromatic wines decreased as compared to the previous two decades in Romania (Antoce, master thesis 2004, unpublished data).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

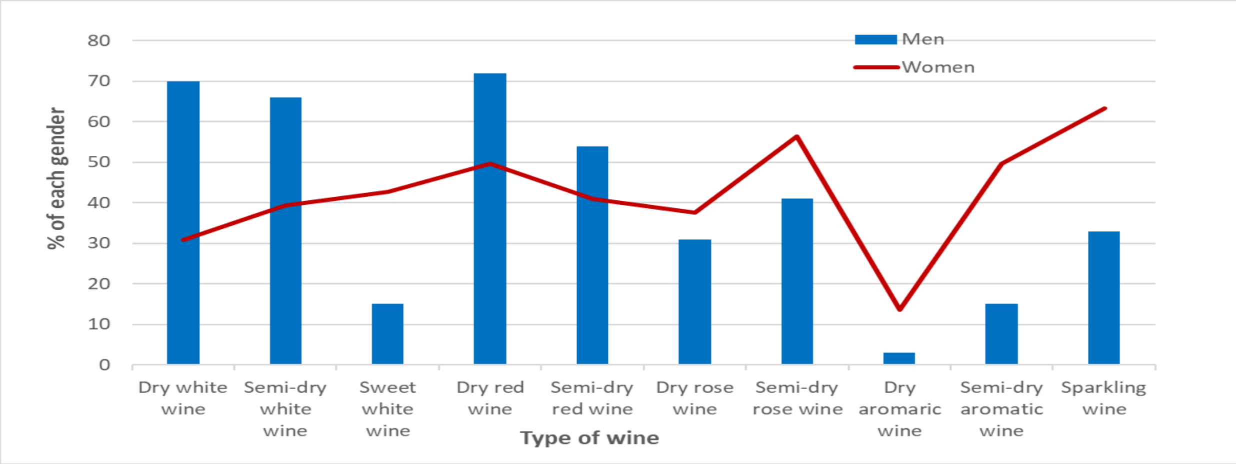

Fig. 5. Wine type preferences - gender differences
Source: Own results based on the answers of the respondents.

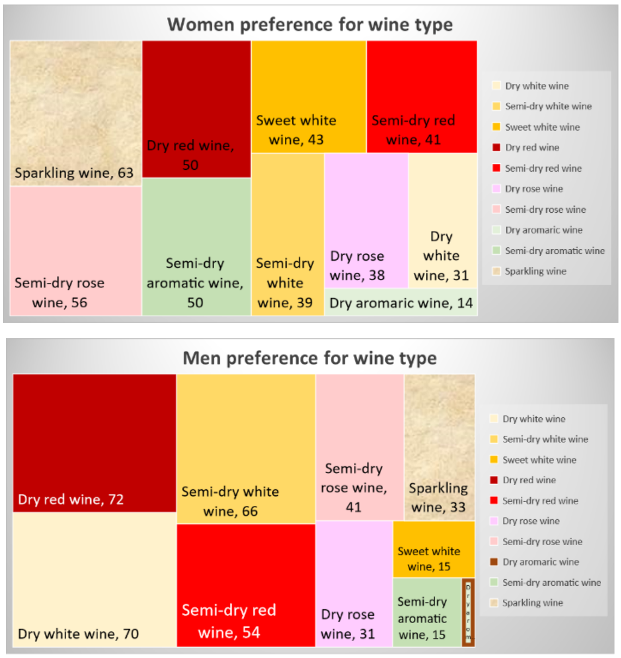

Fig. 6. Tree-map charts of women and men preferences for wine type
Source: Own results based on the answers of the respondents

3.Interest to participate in wine promotion events

In order to determine the importance of wine promotion, the interest to participate in wine events such as wine fairs and guided wine tastings was evaluated (Figure 7).

It can be seen that the majority of respondents would be interested in wine events, but not very interested. Surprisingly, women (61%) seem to be more interested than men (46%) to participate in wine fairs or tastings, possibly with an aim to socialize or the learn more about the product.

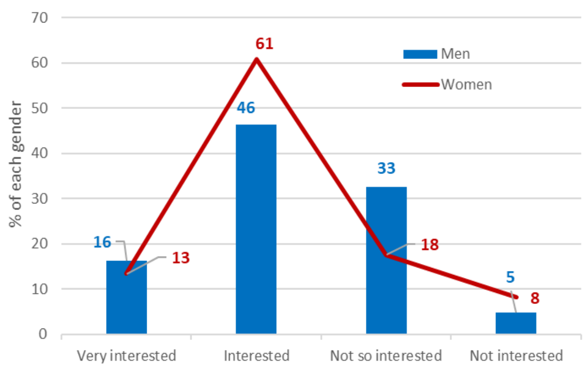

Fig. 7. Interest in wine events
Source: Own results based on the answers of the respondents.

The level of basic knowledge about viticulture and winemaking was also considered important in order to understand the degree of interest in wine events (Figure 8).

This level was self-assessed by the respondents and the answers show a higher degree of confidence for men with university and post university studies (29% of the total men respondents), followed by the women with university studies (14% of the total women respondents).

However, it is also important to underline that, even among the persons with higher education, 37% of men and 53% of women declared that they have little knowledge about wine in general.

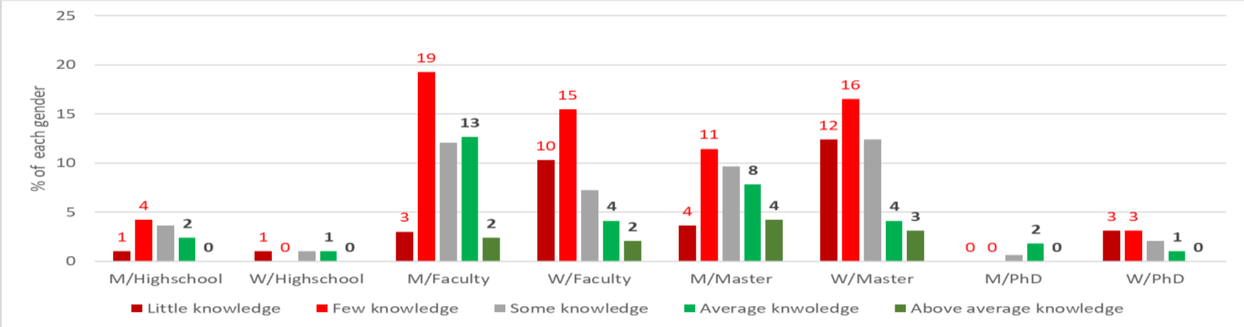

Fig. 8. Level of basic knowledge about viticulture and winemaking
Source: Own results based on the answers of the respondents.

CONCLUSIONS

The results of this study and previous statistics, show that in Romania wine is consumed in moderation. The consumption is in direct correlation with the income, as wine is generally expensive, especially when compared to the average income. Because of this, the age groups with a higher wine consumption are those with the higher income (women aged 30-39 and men aged 40-49). Men have more "traditional" preferences, going usually for white and red wines, dry or sometimes semi-dry. Women are less interested in wine, overall, but when they are interested, they show more variability in taste, selecting rather sparkling, aromatic or rose wines, which are easier to understand and more related to emotions and festive events. Furthermore, women are more interested than men to go out and participate in wine events.

However, considering the frequency of consumption, preferred types of wine and knowledge about wine, the typical wine consumer is male, 40-49 years old, with a higher education and higher income.

The study also shows a clear need to increase the number of wine events and any other opportunity to provide more wine-related knowledge, which in turn may lead to a higher consumption of wine, instead of other stronger alcoholic beverages.

Limitations:

The respondents come mostly from urban locations, have broad access and usage of the internet tools and, by choosing to complete the survey, showed that they also have some interest in wine. The religion declared by the respondents is mostly Christian orthodox, which is a religion that values wine, being in this sense no barrier for wine consumption.

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ROMANIAN CONSUMER PREFERENCES FOR OENOTOURISM IN 2021

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Abstract

With 190,000 ha of vineyards and ranking 13th in the world for wine production and 14th for wine consumption, Romania has a high potential for oenotourism, which has been underexploited for years. In order to find solutions to encourage oenotourism, Romanian consumers were questioned regarding their preferences for winery visit experience such as: the distance which they would have to travel, the number of days and the amount of money they would be willing to spend and their expectations from a visit to a winery. To improve the offer and to make the information easily available to the interested wine tourists the survey included also questions regarding the approaches for obtaining information and recommendations, as well as the frequency of social media usage. The main results pointed out that Romanian wine consumers would prefer to go on trips to wineries recommended by friends rather than travel agencies, with a group of friends, for 2 or 3 days, especially in autumn, expecting to pay between 750-1,200 RON. Romanians would mostly go anywhere in Romania rather than abroad, men especially preferring to go to places reachable within 3 hours drive from their residence. The second most important information source, after the recommendation from friends, is the social media, showing the importance of advertising more on such media.

Key words*: *Romanian wine consumers, tourism and oenotourism preferences, consumption behaviour, wine events

INTRODUCTION

Wine is not only a great companion to food, but it is also part of culture and life style [6, 12].
Refined and diverse food and wine experiences are sought by growing numbers of tourists [11], thus it is no surprise that going out to visit wineries developed into a special type of tourism. In Romania too, oenotourism emerged as a niche within the tourism market [3].
In turn, this type of tourism can generate important incomes not only for the tour organizers, but also for small wineries, who get to promote and sell their products. Wineries which understood the benefits started to attract their clients, by offering immersive experiences, with educational and entertainment activities centered around the wine.
Wine consumers are more and more inclined to practice oenotourism, but the decision to travel depends highly on their previous experiences and information received from advertisements or from other wine tourists [12].
To make oenotourism a successful business wine producers and tour organizers should align their offers with their clients' expectations [10].
Moreover, in the digital era, the use of various tools of internet is indispensable [7], especially considering that the funding is not always sufficient [5].
Lacking an efficient organized oenotourism Romania offers many possibilities for smaller companies to take initiative and propose services and information in this field.
Some challenges exist, of course, as many Romanian wineries are not prepared to receive guests, especially for overnight stays, an estimation of 2009 showing that only 10% of the wine producers could offer accommodation [14].
To help find appropriate solutions to boost wine tourism among Romanian nationals, consumers were questioned regarding their preferences for a winery visit experience such as the activities expected, the distance to

travel, the number of days and the amount of money they would be willing to spend. To offer oenotourism information through most appropriate communication channels, consumers were also asked about their preferred sources of information and the frequency of social media usage.

MATERIALS AND METHODS

The study was performed by using a questionnaire containing questions regarding wine consumption, wine preferences, consumer behaviour and attitudinal aspects, most of which were specific to wine tourism. Several demographic data [2] were collected as well and used in analysis.

The questionnaire contained several sections designed to cover a range of topics relevant for oenotourism and the responses were analysed by taking into account the gender differences, and, where appropriate, the age groups and/or the income groups.

The responses were collected by means of www.questionpro.com™ platform in April-May 2021, from 263 persons (response rate 39.1%).

The survey contained 34 questions, but only those relevant for wine tourism were processed, using Microsoft Excel Professional Plus 2019 and OriginLab 2018 applying Mann-Whitney test (U-statistics), ANOVA and pairwise comparisons by Tukey tests to determine significant differences at $p<0.05$.

RESULTS AND DISCUSSIONS

Previous visits to a winery

To evaluate the interest for oenotourism, firstly, it was checked whether the respondents had previous wine tourism experiences (Figure 1).

According to the Mann Whitney test, at the level of 0.05 the two-gender distributions are not significantly different (asymptotic p-value = 0.721, U=5658).

In accordance to the age, the most interested groups in wine tourism, based on the fact that they participated in previous wine tourism experiences (Figure 2), are the men aged 30-49 years old (35.5% of the men) and women aged 30-49 years old (35.1% of the women).

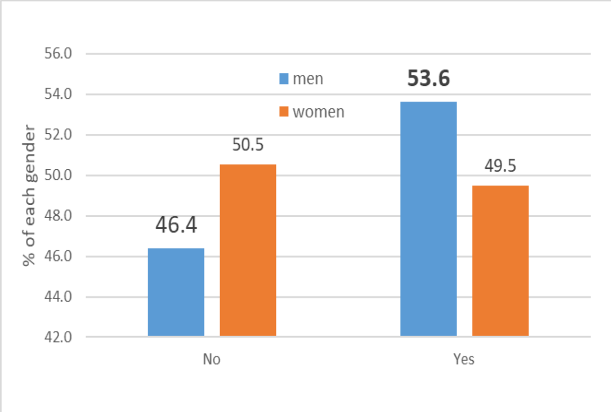

Fig. 1. Previous experience of visiting a winery – gender differences.
Source: Own results based on the answers of the respondents.

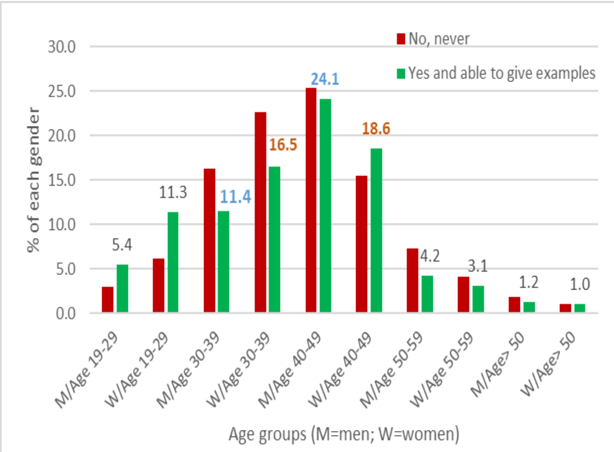

Fig. 2. Previous winery visits in accordance to the age groups. Source: Own results based on the answers of the respondents.

Regarding the influence of income (Figure 3), a very good direct correlation is observed between winery visits and monthly income (R^2=0.895, green bars).

In case of no previous visits the income is not part of the decision (there is no statistical correlation, R^2=0.398).

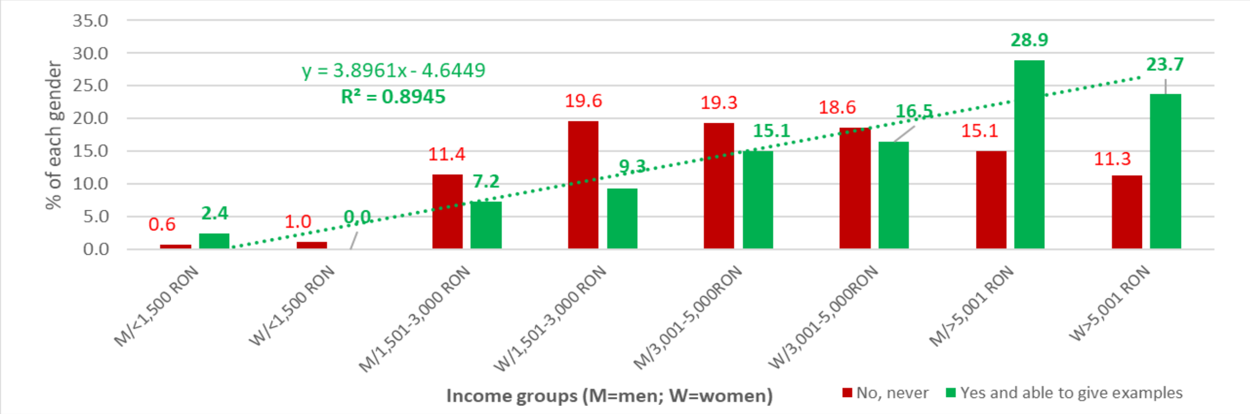

Fig. 3. Previous winery visits in accordance to income
Source: Own results based on the answers of the respondents

Preferred distance for travelling to a winery

The distance of travelling is an important factor for the comfort of the tourist, but also for the financial implications. Figure 4 shows that generally there is a preference for short trips or within the country, irrespective of the respondent's gender.

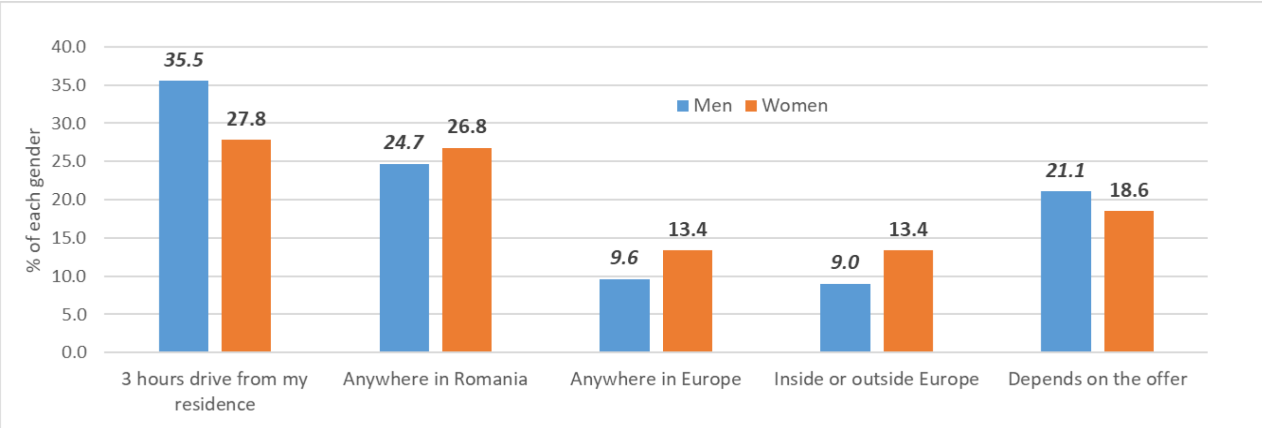

Fig. 4. Preferred distance for travelling to a winery – gender differences
Source: Own results based on the answers of the respondents.

The income is clearly influencing the decision to travel (Figure 5), but the higher income (light and dark green bars) is not correlated with a higher willingness to travel further.

Women with higher incomes (above 3,000 RON) prefer to go anywhere in Romania (20.6% of women), but those earning above 5,000 RON would go as well anywhere in Europe or outside Europe (Figure 5a).

Men with high incomes, however, (Figure 5b), would mainly prefer to go for short distances of 3-hour drive (27.7% of men), but would also go anywhere in Romania (20.4% of men).

Preferred means for travelling to a winery

The decision to take a trip to some wineries requires a bit of documentation, to find out what it is available and is also worth visiting. Figure 6 shows that respondents preferred to obtain their information first of all from friends.

There is no significant difference at the level of 0.05 (asymptotic p-value = 0.9998; U=5,001) between the two-gender distributions in their way of travelling to a winery. However, there is clear difference when it comes to choosing the means for taking a decision to travel, confirmed by ANOVA, Tukey test.

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PRINT ISSN 2284-7995, E-ISSN 2285-3952

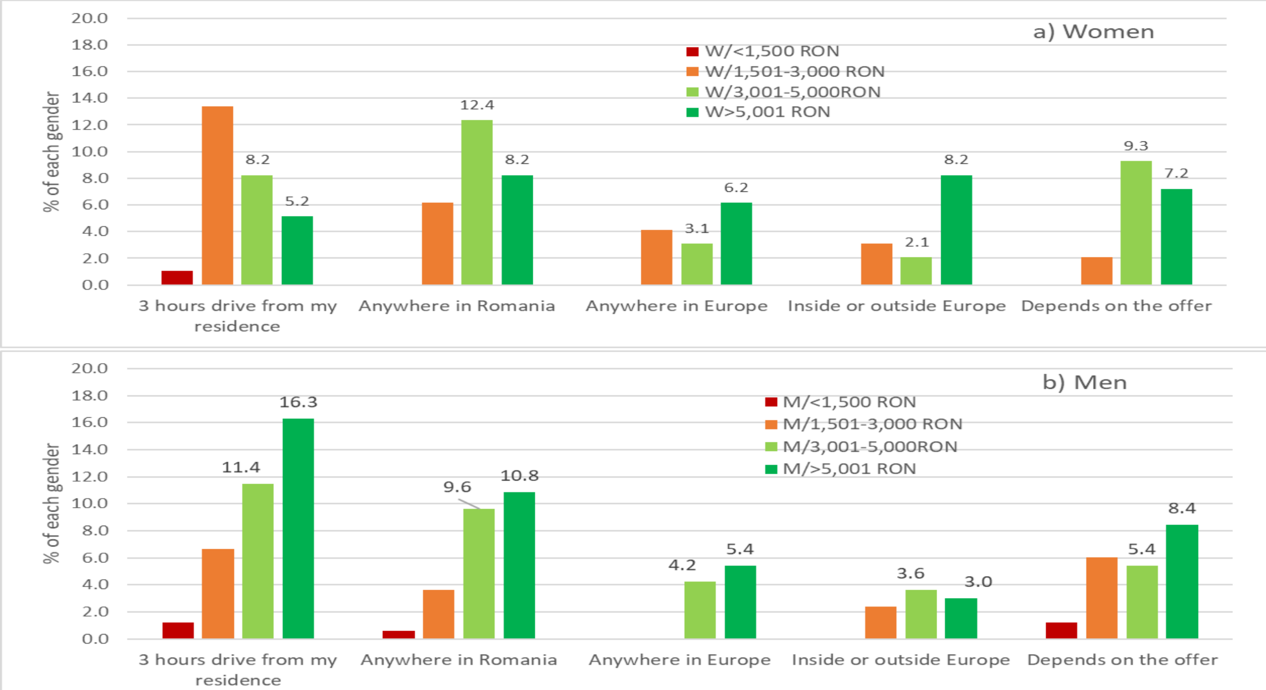

Fig. 5. Income influence on the preferred distance for travelling to a winery: a) Women; b) Men
Source: Own results based on the answers of the respondents

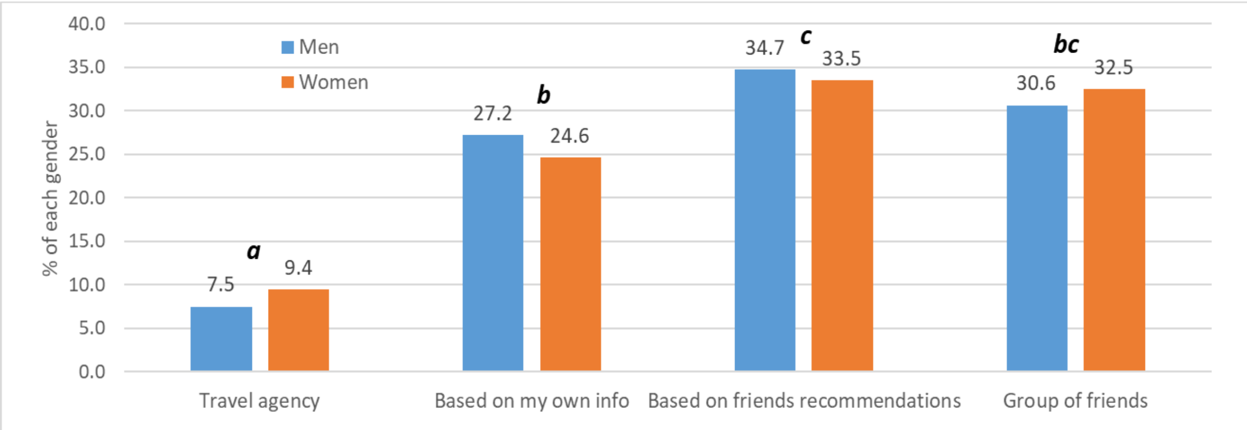

Fig. 6. Preferred means for travelling to a winery (different letters show significant differences among groups of travelling ways at p=0.05, ANOVA, Tukey test)
Source: Own results based on the answers of the respondents.

It is obvious that the influence of friends is major, while travel agencies are avoided for this type of tourism or the tour operators simply do not organize enough winery visits to be taken into account as sources of information.

Men with higher incomes (over 5,000 RON) are more confident than women with similar incomes to obtain reliable information by their own documentation (Figure 7b). Otherwise, they prefer as well to consult and to travel with friends in a larger proportion than women. For women (Figure 7a), belonging to a certain income group does not seem to make a big difference when looking for wine trip information.

Particularities regarding winery visits

To evaluate the interest for specific activities, a multiple-choice question was formulated, with 9 different answers, which were grouped in accordance to the 4Es model of the experience economy defined by [8] and adapted by [9] for wine tourist activities into Entertainment, Educational, Esthetical or Escapist.

Fig. 7. Income influence on the preferred means for travelling to a winery: a) Women; b) Men
Source: Own results based on the answers of the respondents

Table 1 is summarizing the specific preferences of respondents, by gender, showing where significant differences are observed for certain activities.

Table 1. Expectations from a visit to a winery

	Specific preference	% of total Women	% of total Men	Sig *
	Entertainment			
1	Winetasting	11.8	14.6	a
2	Winetasting and some food	13.0	13.4	a
3	Have a wine shop	**15.7**	**13.8**	**ac**
	Esthetical			
4	Visits to other local cultural, historical or natural sites	13.2	10.0	a
	Escapist			
5	Visits in the vineyard by bicycle	9.2	8.0	a
6	Horseback riding/ coach ride	**8.4**	**5.5**	**ab**
	Educational			
7	Detailed presentation of viticulture	10.4	13.1	a
8	Detailed presentation of winemaking	7.1	11.4	a
9	Classes of gastronomy/ wine and food pairing	11.2	10.3	a

*Significance at p=0.05 (different letters show significant differences among groups of travelling ways at p=0.05, ANOVA, Tukey test)
Source: Own results based on the answers of the respondents.

Different letters in the column Sig* show significant differences among groups of travelling ways at p=0.05, ANOVA, Tukey test.

It turns out that the highest expectations from a winery is to have a wine shop and the lowest to organise escapists activities such as horseback riding or coach rides. All the other activities proposed do not show significant differences.

The activities most preferred by both genders are those included in the Entertainment group, followed by the Educational group (Table 1, Figure 8 a and b).

Similar results are also obtained in international studies. For instance, regarding the motivations that determine the wine tourists from the Rioja and Bordeaux wine regions to repeat visits to a wine region, the results show that entertainment and education, such as participation in wine events need to be combined to promote the intention to return [1].

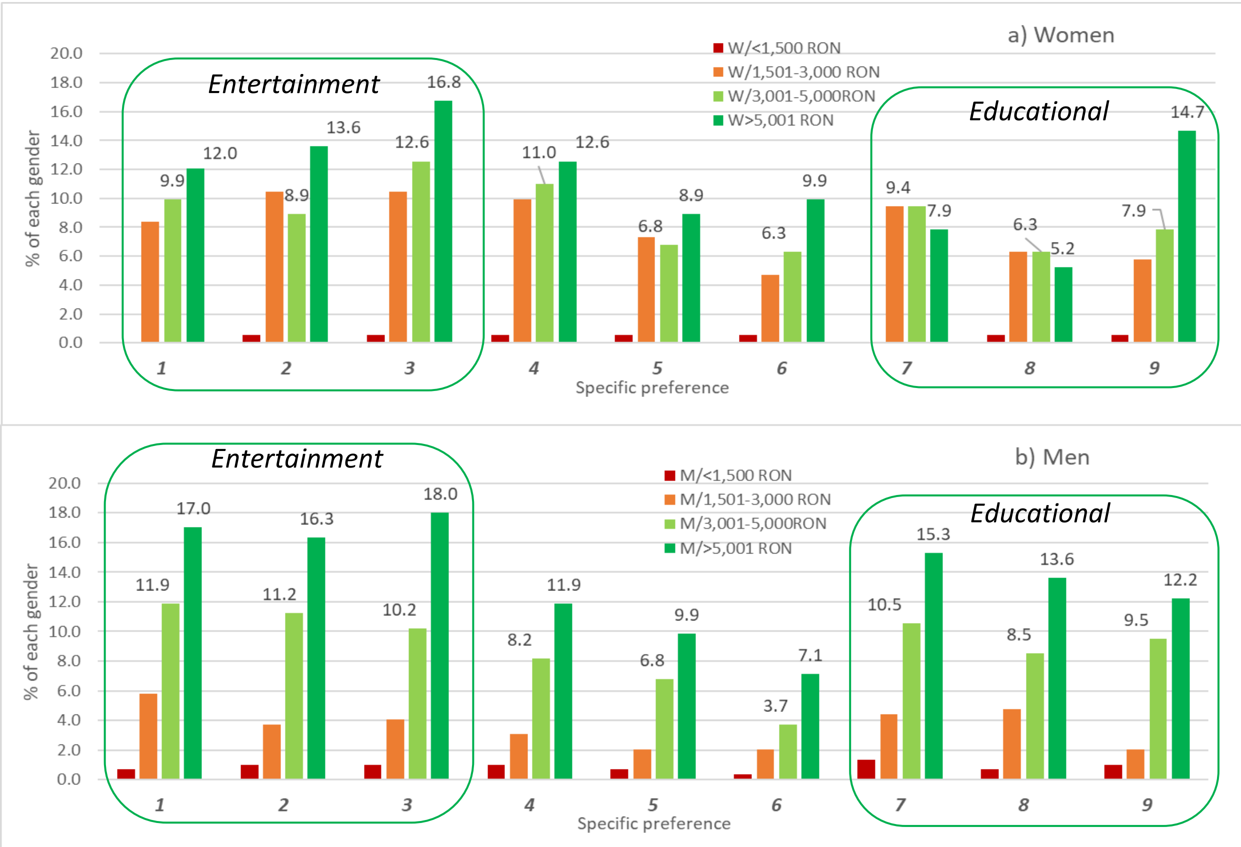

Fig. 8. Income influence on the expectations from a visit to a winery: a) Women; b) Men (Each specific preference is described in Table 1)
Source: Own results based on the answers of the respondents.

Table 2. Specific oenoturism preferences

Specific preference		Women %	Men %
Preferred visit frequency	**Several times a year**	**45.4**	**43.0**
	Once a year	**46.4**	**46.7**
	Once in a lifetime	6.2	8.5
	Never	2.1	1.8
Preferred season for winery visit	Spring	24.2	23.9
	Summer	21.1	28.7
	Autumn	**53.1**	**45.7**
	Winter	1.6	1.6
Preferred length for a winery trip	1 day	24.7	18.7
	2 days	**39.2**	**36.7**
	3 days	**33.0**	**36.1**
	More than 3 days	3.1	8.4
Type of entourage for trips to wineries	Alone	7.0	7.0
	With another person	21.9	21.9
	With family members	17.5	17.5
	With a group of friends	**50.9**	**50.9**
	In a group organized by a travel agency	2.6	2.6

Source: Own results based on the answers of the respondents.

The income (Figure 8) does not seem very important when it comes to the activities expected to be organized at the winery. Therefore, for all types of visitors, Entertainment and Educational activities should absolutely be included in the offer.

Other specific preferences to be taken in consideration when preparing tourism offers are included in Table 2.

Thus, it should be noted that almost 50% of men and women would be willing to visit a winery at least once, if not several times a year; the preferred season is autumn, probably expecting inclusive activities related to harvest; and they would definitely like to go with a group of friends.

The length of the trip is mostly 2-3 days, surely no more than 3 days. To this type of customer, it should be highlighted the accommodation and dining facilities of the destination.

Information sources for planning winery visits

To enhance oenotourism, placing the advertisement in the right information media and with the appropriate tools is crucial. Taking into account that the wine tourists are usually 30-49 years old and well educated, they are expected to also have a good knowledge and usage of internet tools.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Figure 9 confirms that the information to plan a wine tour is taken from friends, followed by online sources and social media. Ads on TV or radio have little impact and this is an aspect which wine trip organizers and wineries should take into account.

A previous study showed that Romanian consumers, especially marginal drinkers, use their smartphones mostly to find information about products online or to seek advice from their friends when they cannot decide what to buy [4] and here we also find that the most preferred source of information for wine tourism is also the internet or word-of-mouth from friends.

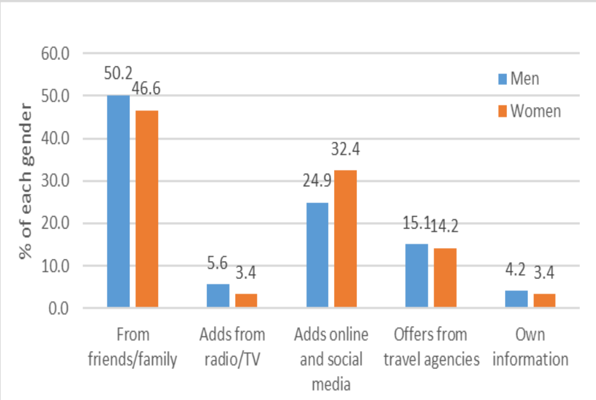

Fig. 9. Information source used to plan trips to wineries
Source: Own results based on the answers of the respondents.

Regarding social media used to gather information to plan a trip it is clear that it has an impact (Figure 10).

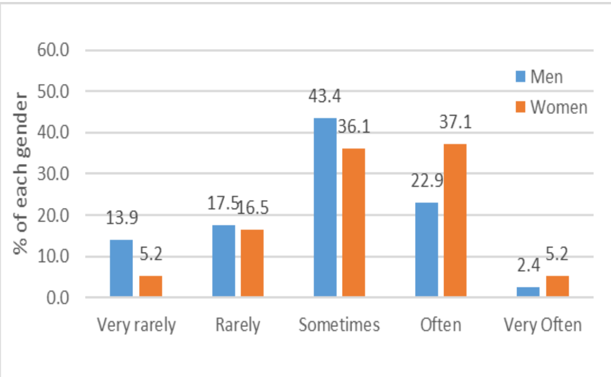

Fig. 10. Frequency of social media use to gather information for trips to wineries
Source: Own results based on the answers of the respondents

66.3% of men and 73.2% of women would use social media from "sometimes" to "often", in order to find information regarding wineries to visit.

Financial resources to spend for winery visits

Finally, to provide a meaningful offer, the financial aspects should be carefully assessed. As the respondents considered that the most appropriate length for a trip to wineries is 1 day (short distance) or 2-3 days, they were also questioned about the amount of money they would be willing to spend for such a trip for 2 persons.

Table 3. Amount of money willing to spend for a tip to wineries

Amount to spend for 2 persons		Income (RON*)	Women %	Men %
One day-trip with a meal included	250-400 RON	<1,500	0.0	1.8
		1,501-3,000	10.3	9.0
		3,001-5,000	**16.5**	**15.7**
		>5,001	**10.3**	**12.7**
		All	37.1	39.2
	401-600 RON	<1,500	1.0	0.0
		1,501-3,000	8.2	6.6
		3,001-5,000	**11.3**	**16.3**
		>5,001	**7.2**	**13.3**
		All	27.8	36.1
	601-800 RON	<1,500	0.0	1.2
		1,501-3,000	6.2	3.0
		3,001-5,000	4.1	1.8
		>5,001	**11.3**	**12.0**
		All	21.6	18.1
	801-1,000 RON	<1,500	0.0	0.0
		1,501-3,000	2.1	0.0
		3,001-5,000	1.0	0.0
		>5,001	**3.1**	**1.8**
		All	6.2	1.8
	over 1,000 RON	<1,500	0.0	0.0
		1,501-3,000	2.1	0.0
		3,001-5,000	2.1	0.6
		>5,0011	**3.1**	**4.2**
		All	7.2	4.8
3-day trip with 2 hotel night and meals included	750-1,200 RON	<1,500	0.0	1.2
		1,501-3,000	**13.0**	**10.9**
		3,001-5,000	**17.0**	**15.8**
		>5,001	**10.0**	**13.9**
		All	40.0	41.8
	1,201-1,500 RON	<1,500	1.0	0.6
		1,501-3,000	**7.0**	**3.6**
		3,001-5,000	**9.0**	**13.3**
		>5,001	**4.0**	**10.9**
		All	21.0	28.5
	1,501-2,000 RON	<1,500	0.0	1.2
		1,501-3,000	8.0	3.0
		3,001-5,000	4.0	3.6
		>5,001	**16.0**	**12.7**
		All	28.0	20.6
	2,001-2,500 RON	<1,500	0.0	0.0
		1,501-3,000	0.0	1.2
		3,001-5,000	3.0	1.2
		>5,001	4.0	4.2
		All	7.0	6.7
	over 2,500 RON	<1,500	0.0	0.0
		1,501-3,000	0.0	0.0
		3,001-5,000	1.0	0.0
		>5,001	3.0	2.4
		All	4.0	2.4

* Prices are in Romanian currency RON; 2021 average exchange rate was 1 EUR = 4.9204 RON.
Source: Own results based on the answers of the respondents.

The results, also fragmented for gender and income groups, are included in Table 3.

As expected, even the customers with higher incomes prefer the lower-priced offers. For a one day-trip with a meal included, the amount comfortable for most clients would be between 250-600 RON for two persons, women tending to be more willing to go to the upper end of this range.

For a 3-day trip, where also accommodation is required, the customers are willing to pay between 750-1,500 RON, but those having incomes of more than 5,000 RON can go higher to 1,501-2,000 RON.

CONCLUSIONS

The study revealed the necessity to develop communication strategies that increase the use of internet and social media, targeting the segments of people 30-49 years of age, which also have higher income and education.

Entertainment and educational activities available at the winery should be diversified and emphasized, while keeping in mind that some esthetical and escapist experiences could be a plus.

Also, the travel packages for two persons should be kept around average prices of a maximum 600 RON (120 EUR) for 1 day and 2,000 RON (400 EUR) for 3 days.

The promotion should include more advertisements in social media, but providing good experiences is also a must, as positive ‘word of mouth’ is also very important for the Romanian tourists.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC ASPECTS OF SUSTAINABLE PRODUCTION OF APPLE ROOTSTOCKS, ACCORDING TO BIOECONOMY'S CIRCULAR USE OF ORGANIC MATTER

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Abstract

The quality of rootstocks is very important for the long term production results of apple trees. It depends on many factors, such as good air and water regime of the soil, good supply of nutrients etc. Different methods of enriching the soil are practiced in order to produce high quality planting material. Bearing in mind the concepts of sustainable agriculture and bioeconomy's principles of production, the authors of this paper, also scientists at the Agricultural University – Plovdiv, Bulgaria undertook a 3 year experimental project aiming to discover efficient ways for improving quantity and quality of apple rootstocks per unit area, while using cheap soil additives or even organic wastes in an environmentally friendly manner. To what extent the use of natural humates and pyrolysis residue from biogas production can change soil conditions and improve quality of apple rootstocks; have positive environmental impact; reduce production cost and guarantee higher economic results was the unifying idea of the project. This article's main objective is to evaluate the impact of the use of natural humates and pyrolysis residue on apple rootstock's production efficiency from technical and economic perspectives. Natural humates contain a certain amount of moisture-absorbing crystals and pressed organic substances, the use of which drastically reduces the use of water and fertilizers in the production system. These have positive economic as well as environmental impact. Pyrolysis residues are obtained as a result of using biogenic fuels for heating greenhouses. They are waste, but can be used as a valuable resource for soil improvement.

Key words: *apple rootstocks, natural humates, pyrolysis residue, bioeconomy, economic assessment*

INTRODUCTION

The concepts of both the bioeconomy and the circular economy have been introduced in the European Union in response to concerns about the long-term viability of the prevailing resource-intensive economic model. Although different in origin – the first mostly driven by an innovation agenda and the second by environmental concerns and resource scarcity – both aim to contribute to strategic and operational EU policy objectives, such as those described in the Seventh Environment Action Programme (7th EAP) for living well within the ecological limits of the planet [4].
In circular economy, the value of products and materials is maintained for as long as possible. What has previously been considered waste is now a resource that can be reused and reintroduced to the production cycle. Therefore, waste management of both technical and bio-based waste streams plays a central role in the transition towards circular economy. In bioeconomy, the materials are to a certain extent circular by nature. However, biomaterials may also be used in a rather linear way [9]. Bioeconomy is not necessarily always sustainable.
In fact, [6] have identified bioeconomy as a form of „weak sustainability" due to its technological aspect, where a complete change in our consumption patterns is not regarded as necessary. On the other hand, circular economy is seen as supporting „strong sustainability", based on its aim of closing the material loops [9].
Bioeconomy can be seen as a knowledge-based production and use of natural/biological resources, together with biological processes and laws, that allow providing economy goods and services in an environmentally-friendly way. The European commission states byoeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops,

forest, fish, animals, and micro-organisms – to produce food, materials and energy [10].

According to the European commission, bioeconomy is Europe's response to key environmental challenges the world is facing today. It is meant to reduce the dependence on natural resources, transform manufacturing, promote sustainable production of renewable resources from land, fisheries and aquaculture and their conversion into food, feed, fibre, bio-based products and bio-energy, while growing new jobs and industries.

In recent years, the EU produces about 138 million tons of bio-waste per year, which has high potential added value as a feedstock for other productive processes. Biological resources and ecosystems could be used in a more sustainable, efficient and integrated manner. The principles of bioeconomy could be applied to the primary production sectors, such as agriculture, forestry, fisheries and aquaculture, as well as to industries using or processing biological resources, such as the food, pulp, paper industries and parts of the chemical, biotechnological and energy industries. In brief, bioeconomy can contribute to build a more competitive, innovative and prosperous Europe [3].

In recent years, the bioeconomy has also become a key focus of political and technological interest both nationally and internationally [2].

The concept of bioeconomy has gained wide popularity. The topic became part of various reports and strategies in a number of countries. Bioeconomy definitions and perspectives shift from factor substitution to biotechnology innovation perspective and nowadays the concept is much more complex and environmentally oriented than before [1].

In this context, the purpose of the paper is is to evaluate the impact of the use of natural humates and pyrolysis residue on apple rootstock's production efficiency from technical and economic perspectives.

MATERIALS AND METHODS

This article and the research project completed by the authors, lay on the understanding that more sustainable and efficient production systems should abandon technologies based on fossil carbon and transform to technologies using renewable carbon raw materials. Any possibilities for development of a circular bioeconomy in which basic carbon, water and nutrient resources are recovered and reused should be sought. Efficient use of raw materials, including residues where possible and new technologies for recycling and reuse of carbon-based materials can contribute to the sustainable transformation of economy on micro- and macro- level.

The experiment on which this article was built on was conducted in the study field of the Department of Fruit Growing at the Agraricultural University – Plovdiv, located on the territory of Brestnik village, Plovdiv region, South-Central Bulgaria. According to [8], the annual precipitation in the region is below the national average. Rain is very unevenly distributed, both by seasons and by months. Summer is very dry and hot. The high average daily temperatures further increase the effect of the drought during summer time [8].

The study was carried out, based on the block method of Fisher (four replicates with ten plants for each combination). In the soil were introduced two different amounts of natural humate tablets and two different amounts of pyrolysis residue. The following options of the experiment have been observed and analyzed:

•*Natural humate tablets*:
Option I – with 0 kg/da;
Option II – with 25 kg/da;
Option III – with 50 kg/da;

•*Pyrolysis residue*:
Option I – with 0 kg/da;
Option II – with 250 kg/da;
Option III – with 500 kg/da;

The natural humates and respectively the pyrolysis residue were imported at the beginning of vegetation, at the base of the root shoots in the covering soil layer. This application is enough for about four years. A total of three soil coverings were carried out during the vegetation.

Agricultural systems have to be technically and economically viable in order to guarantee their long-term sustainability. Technical efficiency is a function of production technology and represents the way in which incoming resources are transformed into a useful result. Economic efficiency on the other hand compares income from production volumes and the cost of utilised factors of production. The greater the difference between the two, the greater the economic efficiency of production.

The current study analysed the technical and economic efficiency of the apple rootstock production process by taking into consideration the final quantitative and qualitative values and by accounting for the influence of the added natural humates and pyrolysis residue on economic performance of the system.

The main goal of the production unit (farm), based on the principles of sustainability and circular bioeconomy is to achieve the highest possible return on resources, to maximize its profits, to create the greatest benefit for society and to minimize its harmful impact on the environment. The organization, management and control of the production process must focus on the use of such a combination of resources as to enable all these objectives to be achieved simultaneously.

For the purposes of this analysis, a simple methodology for optimization of relationships between the production factors and the obtained technical and economic results was used. The Production Function in short-term (Type A production function) makes it possible to optimize the level of input resources in connection to desired level of output.

$$Y = f(x1).(x2, x3, \dots xn) \quad (1)$$

where:

x1 is the variable factor,

x2, x3,… xn are fixed resources within the production cycle.

Thus, one can evaluate and analyze how the change in x1 affects the final result Y (yield) of production.

Depending on their dynamics in the production process, production factors are divided into constant ones and variable ones. The constant factors don't change within one production cycle (sown area, crop variety, machines, buildings, etc.). The variable factors may change within the production cycle (rate of fertilization, rate of irrigation, chemical spraying, etc.). In the short term, the area of the land, the variety of cultivated crops cannot be changed, but the norms of fertilization, chemical spraying or irrigation may vary.

Based on the methodology, used for the purposes of this study, we assume that there is only one variable factor, the influence of which was measured on the final results. In the last three years, two experiments have been performed with two different soil additives for the studied parameter, excluding the influence of other factors during sowing (Table 1).

Table 1. Quantities of natural humate tablets and pyrolysis residues used

Experiment 1		Experiment 2	
Option	Natural humates	Option	Pyrolysis residues
	kg/da		kg/da
1	0	1	0
2	25	2	250
3	50	3	500

Source: Own experiments 2019-2021.

The amount of the variable factor x1 (natural humate tablets or pyrolysis residue) is optimized in order to maximize the economic effect. The economic added value of the used soil improvers was calculated as a difference between additional revenue from the extra rootstocks sold on the market and the additional costs paid for the delivery of the natural humate tablets or pyrolysis residue as variable production factors, using the formula:

$$TFI = TFR - TFC \quad (2)$$

where:

TFI (total factor income) – income received from the use of the input factor;

TFR (total factor revenue) – revenue from the extra rootstocks sold on the market;

TFC (total factor cost) – the cost, payed for delivery of the input factors;

From the producer's point of view, TFI should be maximized. TFI will keep rising until each additional unit of input, invested in the production system contributes to higher revenue than the price, payed for it. The economic result will improve as long as the marginal income from the factor assumes positive values:

MI = MR – MC > 0....................................(3)

where:
MI (marginal income)
MR (marginal revenue) – the revenue from the last unit of input used in the system;
MC (marginal cost) – the cost, spent for the last unit of input used in the system;

MR = MPP. Py ....(4)

where:
MPP – marginal physical product;
Py – market price of the final product;

MPP = ΔTPP/Δx ....(5)

where:
ΔTPP – the change of total physical product (yield);
Δx – the change of quantity of input resource [7].

RESULTS AND DISCUSSIONS

Regarding the content of organic matter in the soil for both options with lower and higher amount of natural humate tablets, an increase in its values was observed, which improves the growing conditions and the better yields were expected. In the two options with lower and higher amounts of pyrolysis residue, a positive change in the content of organic matter was also reported. In this experiment, the organic carbon present in the pyrolysis residue, acts as water absorbent and doesn't allow indiscriminate movement of nutrients, but retains them in the area of the root system. The lowest level of organic matter was observed in the option without natural humate tablets or pyrolysis residue.

Table 2. Technical efficiency of natural humate tablets in apple rootstock production

Option	Natural humates tablets	Number of shoots/plants	Number of plants per da	Rootstocks	Change
	kg/da			units/da	%
1	0	16.32	1,666	27,189.12	0,00
2	25	17	1,666	28,322	+ 4.17
3	50	17.33	1,666	28,871.78	+ 6.19

Source: Own experiments 2019-2021.

The technical efficiency, measured in this case as the number of rooted apple rootstocks per unit of area, was improved when natural humate tablets were used. The yield of quality rooted apple rootstocks increased by 4.17% in the variant with 25 kg/da humate tablets and by 6.19% in the variant with 50 kg/da. In the first case it is an increase of 1132 pieces, and in the second case, the increase is by 1682 pieces, compared to the option 1 (without soil improvers) (Table 2).

Economic efficiency of apple rootstock production was also positively affected by the addition of natural humate tablets in the soil.

As it can be seen above, the yield y (TPP) grows with the increase of natural humate tablets per unit area (Fig. 1). According to the methodology, the variable input resource must follow increasing trend as long as the revenue generated from the sale of last unit of additional product is greater than the cost of the last unit of input that caused this increase. In other words, if the marginal revenue is greater than the marginal cost (the price of one unit of input resources), MR > MC (Px1), the option is cost effective and creates added value per unit of production. In both cases of adding natural humate tablets, this is met and it can be seen from the values of marginal income (MI), which is positive (Table 3).

Table 3. Economic results

Option	x1	y (TPP)	APP	MPP	Py	Px1 (MC)	MR	MI
1	0	27,189.12	0.00	0.00	0.30	0.00	0.00	0.00
2	25	28,322.00	1,132.88	45.32	0.30	2.50	13.59	11.09 > 0
3	50	28,871.78	577.44	21.99	0.30	2.50	6.60	4.10 > 0

Source: Own experiments 2019-2021.

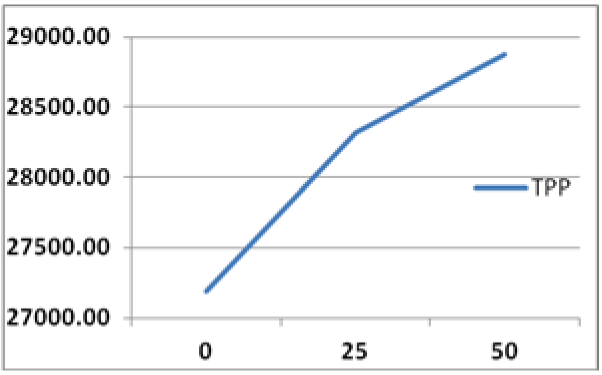

Fig. 1. Number of rooted apple rootstocks (pc/da) under the 3 technologies
Source: Own experiments 2019-2021.

In order to isolate the net economic benefit from the two technological options, the methodology for calculation of the factor income was used.

TFI = TFR – TFC.....................................(6)

Calculations on economic efficiency, shown in the following table are made on the bases of market price of humate tablets of BGN 10/kg and market prices of the finished apple rootstocks of BGN 0.30/pc (Table 4). As pointed out in the methodology part, natural humate tablets are introduced into the soil once every four years, enough for maintaining the necessary soil composition to provide optimal conditions for the development of apple rootstocks.

Table 4. Revenue, cost and income of natural humate tablets (BGN/da)

Option	TFC	TFR	TFI
1	0	0	0
2	62.50	339.86	277.36
3	125.00	504.80	379.80

Source: Own experiments 2019-2021

Graphically, the utility of natural humate tablets, added as soil improvers in the apple rootstock cultivation is presented in Fig. 2. It is obvious that under option 2, spending the cost of BGN 62.5/da for humate tablets per year provides BGN 339.86/da more revenue, which guarantees a net added value of BGN 277.36/da. In option 3, the extra revenue is BGN 504.80/da and the added value is BGN 379.80/da (Table 4).

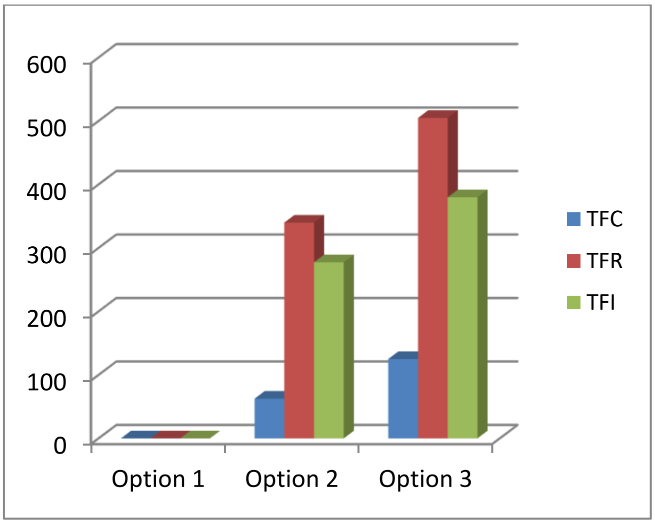

Fig. 2. Factor revenue, factor cost and factor income (BGN/da)
Source: Own experiments 2019-2021.

It can be concluded that using natural humate tablets for improving the soil composition when producing apple rootstocks is technically and economically efficient.

From the conducted experiments it is obvious that Option 3, with 50 kg/da humate tablets is more efficient, providing 6.19% more rootstocks and almost BGN 380/da added value.

The technical efficiency, measured as the number of rooted apple rootstocks per unit area, increased by the use of pyrolysis residue. The yield of quality rooted rootstocks went up by 5.5% in the case with 250 kg/da and by 11.75% in the case with 500 kg/da. Under option 2, this was an increase of 1,466 pieces over option 1. Under option 3, the increase was even higher (+3,132 pieces), over the base option (Table 5).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 5. Technical efficiency of pyrolysis residue used in apple rootstock production

Option	Pyrolysis residue	Number of shoots/plant	Number of plants per da	Rootstocks	Change
	kg/da			units/da	%
1	0	16	1,666	26,656	0.00
2	250	16.88	1,666	28,122.08	+5.50
3	500	17.88	1,666	29.788.08	+11.75

Source: Own experiments 2019-2021.

The economic efficiency of the production of apple rootstocks was also positively affected by the use of pyrolysis residue.

As it can be seen above, the yield y (TPP) grows when the quantity of pyrolysis residue added to the soil is going higher.

Table 6. Economic results

Option	x1	y (TPP)	APP	MPP	Py	Px1 (MC)	MR	MI
1	0	26,656	0	0	0.3	0	0	0
2	250	28,122.08	112.49	5.86	0.3	0.25	1.76	1.51
3	500	29,788.08	59.58	6.66	0.3	0.25	2.00	1.75

Source: Own experiments 2019-2021.

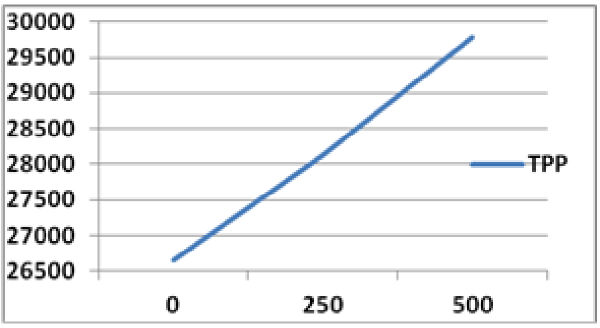

Fig. 3. Number of rooted apple rootstocks (pc/da) under the 3 technologies
Source: Own experiments 2019-2021.

Again, according to the methodology, the variable input resource must follow increasing trend as long as the revenue generated from the sale of last unit of additional product is greater than the cost of the last unit of input that caused this increase.
In other words, if the marginal revenue is greater than the marginal cost (the price of one unit of input resources), MR > MC (Px1), the option is cost effective and creates added value per unit of production. In both cases of adding pyrolysis residue, this is met and it can be seen from the values of marginal income (MI), which is positive (Table 6).
In order to isolate the net economic benefit from the two technological options, the methodology for calculation of the factor income was used.

TFI = TFR – TFC ....(7)

Calculations on economic efficiency, shown in the following table are made on the bases of market price of pyrolysis residue of BGN 1/kg and market prices of the finished apple rootstocks of BGN 0.30/pc.
Pyrolysis residue too is introduced into the soil once every four years.
This is enough to maintain the necessary soil composition to provide optimal conditions for the development of apple rootstocks.

Table 7. Revenue, cost and income of pyrolysis residue (BGN/da)

Option	**TFC**	**TFR**	**TFI**
1	0	0	0
2	62,5	439.82	377.32
3	125	939.62	814.62

Source: Own experiments 2019-2021.

Graphically, the utility of pyrolysis residue, added as soil improver in the apple rootstock cultivation is presented in Fig. 4. It is obvious that under option 2, spending the cost of BGN 62.5/dka for pyrolysis residue per year provides BGN 439.82/dka more revenue, which guarantees a net added value of BGN 377.32/dka. In option 3, the extra revenue is BGN 939.62/dka and the added value is BGN 814.624/dka (Table 7).

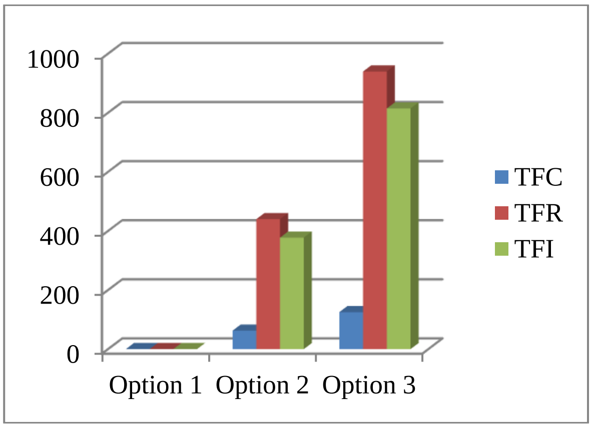

Fig. 4. Factor revenue, factor cost and factor income (BGN/da)
Source: Own experiments 2019-2021.

It can be concluded that using pyrolysis residue for improving the soil composition when producing apple rootstocks is technically and economically efficient. From the conducted experiments it is obvious that Option 3, with 500 kg/da pyrolysis residue is more efficient, providing 12% more rootstocks and more than BGN 800/da added value.

CONCLUSIONS

Reducing the environmental pressure along the products life cycle, increasing efficiency in the consumption of resources and use of renewable raw materials, and shifting the economic system toward a circular and a climate-neutral model represent the heart of the current macro-trends of the European Union (EU) policy agendas. The circular economy and bioeconomy concepts introduced in the EU's Circular Economy Action Plan and the Bioeconomy Strategy support innovation in rethinking economic systems focusing on market uptaking of greener solutions based on lessintensive resource consumption (Gatto, F.; Re, I. 2021).
The impact of two soil additives (natural humates and pyrolysis residue) in two different quantities each on the technical and economic efficiency of appale rootstock production was evaluated and assessed. The results shown in the analyses were obtained during a three year experiment at the Agricultural University – Plovdiv. This eloquently showed that the innovative technology, consisting of some simple, easy and cheap steps and practices, turned out to be efficient and at the same time sustainable. The economic and environmental benefits, obtained by the use of natural humates and pyrolysis residues should be further popularized. They improve the soil organic conditions, which impact on the quantity and quality of the production of apple rootstocks. The technology could be used in other agricultural production sectors with the same or even better success. In the era of technological, scientific and educational innovations, such possibilities should be employed in order to achieve society's higher demand for food and fiber, with less natural resources and ever challenging social, economic and environmental conditions and policies.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

YOUNG FARMERS - A FUNDAMENTAL FACTOR IN THE DEVELOPMENT OF THE AGRICULTURAL SECTOR

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Abstract

Generational renewal plays an important role in strengthening resilient agriculture at EU level. The low number of young people working in agriculture is, on the one hand, a major concern both in Romania and at EU level, but also the subject of political stimulus measures.The purpose of this study is to analyze the changes that occur at the level of agricultural structure according to the age group of farm managers in Romania between 2005 and 2016. Thus, the analysis carried out assesses the effects of agricultural policies aimed at generational renewal. Although a number of measures to stimulate the young people's entry into agriculture have been introduced in recent years, there is a significant decrease in this category between 2010 and 2016. The ratio between young farmers and farmers aged 65+ indicates that the agricultural community is aging. In order to highlight the significant potential that young farmers have in supporting the sustainable economy, economic growth and competitiveness, a number of key variables were analyzed in relation to the age group, such as: number of holdings, agricultural area, number of livestock farms, standard production (SO), but also the number of farms with self-consumption. The analysis shows that farms run by young farmers are much more profitable compared to older farmers, but the factors that encourage young people to remain in the agricultural sector as farms leaders it does not seem sufficient to enough maintain it in this sector.

***Key words*:** *young farmers, generational renewal, potential, agricultural policies*

INTRODUCTION

The age structure of farm managers is unfavorable in Romania, following the general trend of an aging population. The lack of young people in the agricultural sector is a cause for concern in the context of the renewal of generations of farmers and the competitiveness of this sector as well as for territorial development. In less-favored areas, agriculture can play an important role, but skills is need to be attracted, especially trained and dynamic young people.

Young farmers have a number of qualities that can help revitalize agriculture, and they are open to innovation and new approaches to business.

Davis et al, (2009) [4] analysing the economic data of agricultural holdings found that there are no significant age differences in farmers' performance, but young farmers were oriented towards longer-term planning with investments focused on the development of farms compared to their older counterparts. [6]noted that young farmers have a better chance of expanding production (in the case of livestock farms).

[7] points out that there is a positive relationship between the number of young farm managers and a number of variables such as gross agricultural product, labor productivity and the amount of subsidies.

[15] also discuss the need for young farmers in European agriculture, which would lead to economic development if productivity increases. Many studies agree that there is a link between young farmers and higher productivity.

Although a number of works and researches have been carried out in the field to support the integration of young farmers into the agricultural sector, the renewal of generations of farmers seems to be a difficult one [2, 10]. The transfer of farms from older to younger generations can face a number of barriers that can be both administrative and legal and moral, facing the refusal of senior farmers, although the farm remains low in productivity [3, 13, 12].

The initial motivation for young people and newcomers to the sector is the knowledge gained from family members but also from the education system. [14] stated that young farmers face certain impediments to effectively enter the industry, thus being discouraged. Socio-economic factors such as difficult access to land and credit, lack of rural infrastructure, drive young people away from this sector [11].

The need for young people in agriculture is not only a problem for the sector, but also for regional development. Reducing the decline of the rural population, rejuvenating the active population are factors that play an important role in promoting geographical cohesion. Public policies can help break this cycle. This generational update has also been supported by the EU's Common Agricultural Policy (CAP) since the 1992 Mac-Sharry reforms aimed at early retirement measures.

The purpose of this study was to analyze the changes in the agricultural structure in the age group of Romanian agricultural operators in the period 2005-2016.

MATERIALS AND METHODS

In an attempt to assess the effects of agricultural policies on stimulating and supporting young farmers, statistics provided by Eurostat from EU-28 Farm Surveys, the National Institute of Statistics (INSSE) and the Agency for the Financing of Rural Investments (AFIR) were processed.

In order to highlight the importance of young farmers in the agricultural sector, the variable "replacement rate" was calculated. According to the Regidor methodology (2012), this represents the ratio between the number of farms managed by farmers under 35 years and the number of farms managed by farmers over 65 years (number of farmers <35 years/ number of farmers ≥ 65 years).

In order to identify the results of the agricultural policy on the installation of young farmers in the short and medium term, a number of key variables were analyzed in relation to age group: number of farms, agricultural area, number of livestock farms, standard output and number of self-consumption farms.

RESULTS AND DISCUSSIONS

The agricultural sector has been among the main sectors providing jobs for the EU's working population, with around 9.9 million people in employment in agriculture, accounting for 4.1% of total employment in the EU [5].

The agricultural sector has a significant labor force in Romania, approximately 22.3% of the total employed population works in this field.

The total number of farmers at EU-28 level decreased by 24.3% in the period 2007-2016, from 13.8 million farmers to 10.5 million, the process of consolidating EU farms. leading, on the one hand, to an increase in the average size of the holding and to a reduction in the number of holdings. At the same time, the number of young farmers up to the age of 44 years in the U.E. decreases both in absolute numbers, from about 3 million in 2007 to 2 million in 2016, but also as a share in the structure of farm managers in 2016, by 2.3%, the largest decrease being recorded by the category of farmers with age under 35 years. The process of consolidating farms in the EU is achieved not only by the exit of the elderly population from agriculture but also by reducing the number of young managers, which leads to a more careful analysis of the incentive measures used. The result is an aging age structure of farm managers, more than half of EU farm managers. belong to the category of farmers aged 55 and over.

The number of farm managers in Romania decreased by 19.5% between 2005 and 2016. However, following this process of consolidation of farms, we have at the end of the analyzed period an age structure in which the share of managers aged 65 years and over is higher. high compared to 2005 (44.3% vs 42.6%), contrary to the trend registered at EU level, in the same period. Moreover, the share of farmers under 35 years in the age group structure of farm managers in 2016 is reduced by about 42%. The age structure of farm managers in Romania in 2016 seems even older than in 2005, the number of farmers under 35 years reaching half by 2016 (Figure 1).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

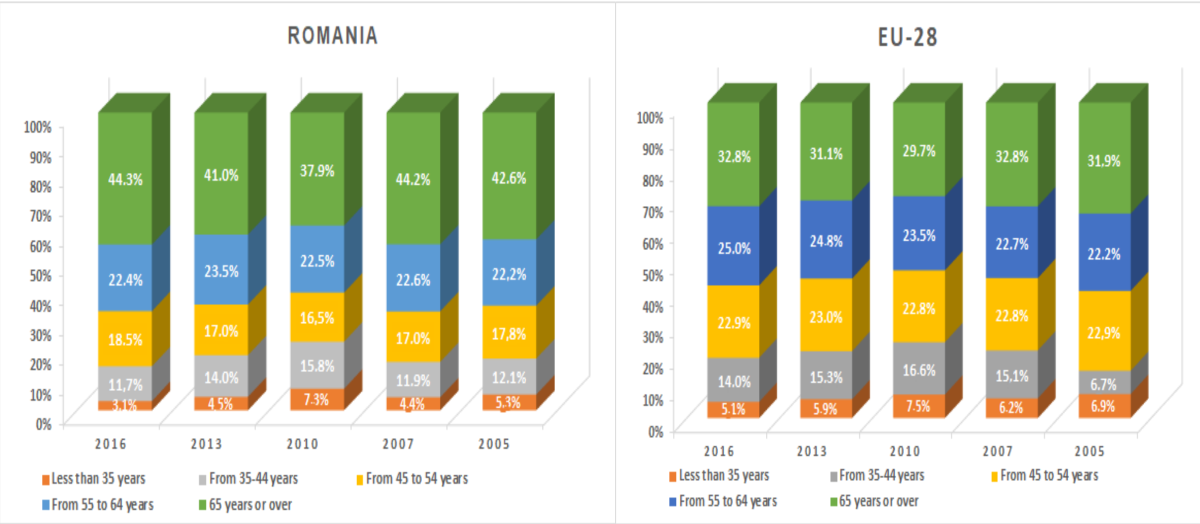

Fig. 1. Farm managers by age in Romania and on average in 28 EU Member States, %.
Source: Eurostat Database, accessed in 13/01/2022 [5].

Analyzing according to the age category, it is found that the number of farmers under the age of 25 years, decreased by up to 59% in 2013 compared to 2010, this decrease being felt in the case of the age category 25-35 years, 39%. The only period in which there was an increase in the number of farm managers was 2007-2010, in the categories up to 45 years; the number of young up to the age of 25 years, doubling by 2010, then halving by 2013 (Table 1).

Table 1. Number of holding manager by age group of the Farmer in Romania

	2005		2007		2010		2013		2016		Rate of change				Change rate
	No.	%	No.	%	No.	%	No.	%	No.	%	2005/ 2007	2007/ 2010	2010/ 2013	2013/ 2016	2005 /2016
Total	4,256,150		3,931,350		3,859,040		3,629,660		3,422,030		-8%	-2%	-6%	-6%	-20%
Less than 25 years	11,130	0.3%	10,480	0.3%	33,290	0.9%	13,700	0.4%	7,280	0.2%	-6%	218%	-59%	-47%	-35%
From 25 to 34 years	215,100	5.1%	160,950	4.1%	247,150	6.4%	151,070	4.2%	98,310	2.9%	-25%	54%	-39%	-35%	-54%
From 35 to 44 years	513700	12.1%	467,060	11.9%	609,610	15.8%	506,810	14%	399,850	11.7%	-9%	31%	-17%	-21%	-22%
From 45 to 54 years	756,300	17.8%	666,810	17%	636,370	16.5%	617,070	17%	632,780	18.5%	-12%	-5%	-3%	3%	-16%
From 55 to 64 years	946,830	22.3%	886,550	22.6%	868,910	22.5%	853,300	23.5%	765,450	22.4%	-6%	-2%	-2%	-10%	-19%
65 years or over	1,813,090	42.6%	1,739,490	44.3%	1,463,720	38%	1,487,710	41%	1,518,370	44.4%	-4%	-16%	2%	2%	-16%

Source: Eurostat Database, accessed in 13/01/2022 [5].

Statistical data indicate that the number of young farmers has declined faster than the age group over 44years, although young people have been financially supported through the 2007-2013 and 2014-2020 PNDR programs to set up farm management, it seems that many of them are leaving the agricultural activity.

The need to install young farmers is also highlighted by the calculation of the variable "replacement rate". At European level in 2016, the replacement rate for farmers over the age of 65 years by young farmers was 16%. Using as the denominator of the report no. of farmers aged 55-64 years, this replacement rate is higher by 20% (Table 2).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. Replacement rates

Year	*2005*	*2007*	*2010*	*2013*	*2016*	*2005*	*2007*	*2010*	*2013*	*2016*
Age Group	*RO*					*EU-28*				
<35/from 55 to 65 years	0.24	0.19	0.32	0.19	0.14	0.31	0.27	0.32	0.24	0.20
<35/65 years or over	0.12	0.1	0.19	0.11	0.07	0.22	0.19	0.25	0.19	0.16

Source: Eurostat Database, accessed in 13/01/2022 [5].

However, the replacement rate of farmers over 65 years in Romania is below 50% of the EU average, reaching 7% in 2016, being among the lowest replacement rates recorded at EU level, compared to the replacement rate of farmers aged over 65 years old by young farmers in countries such as Austria and Germany (167% and 91% respectively).

The impact of measures to stimulate the establishment of young farmers does not seem to be visible yet, although the substitution rate is very low, in Romania there was a high number of young people who applied in the National Rural Development Programs 2007-2013 and 2014- 2020. Under the first NRDP, the number of young farmers installed as beneficiaries of Measure 112 “Installation of young farmers” was 12,549, to which are added the young farmers who accessed Sub-Measure 6.1. ,,Support for the installation of young farmers ,, 10,277 young farmers, the NRDP support being continued in the period 2020-2027 [1].

Table 3 shows the number of farms managed by farmers aged 35 years (<35 years) and those managed by farmers in the age group 35-44 years.

Table 3. Evolution of the number of holdings

	2005	*2007*	*2010*	*2013*	*2016*	*2007 /2005*	*2010/ 2007*	*2013/ 2010*	*2016/ 2013*
Less than 35 years	226,230	171,430	280,440	164,770	105,590	-24.3%	63.6%	-41.3%	-35.9%
From 35 to 44 years		467,060	609,610	506,810	399,850		30.5%	-16.86%	-21.1%

Source: Eurostat Database, accessed in 13/01/2022 [5].

If in the period 2007-2010 there was an increase in the number of farms within the two age groups, the rate of change of the age group 35-44 years in the period 2010-2016 was very low, given that the number of holdings in the age group of less than 35 years has decreased by more than 35 %. Thus between the two age groups there seems to have been no transfer whatsoever. Analyzing the statistical data, it is found that the number of holdings managed by young farmers has been steadily decreasing, not indicating a transfer to the next age group, an exception being in the case of the last age groups, where the transfer is carried out naturally, due to the ageing of the farm managers, an increase in the number of farmers being observed.

Table 4 presents some key variables that can help assess the role and importance of young farmers in the agricultural sector in Romania. For this purpose, a comparison was made between the values of some economic indicators for different age categories of farmers, namely the categories of: young farmers (<35 years), farmers aged between 55 and 64 years, who represent steadfast farmers in the agricultural sector and in the market, as well as farmers over the age of 65, they have a length of service in the agricultural field and who will be at the head of the holdings after retirement. How these indicators evolved between 2005 and 2016 shows the impact of these age groups.

Both at European and national level, it has been found that young farmers (under 35 years) are of particular importance in the transformation of agriculture, with farms managed by young farmers being more productive compared to farmers in the other age groups.

Taking into the study the so/hold variable, it is observed that, for the age group 35 years, in relation to no. total managers as well as in relation to the two groups of farmers (the 55-

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
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PRINT ISSN 2284-7995, E-ISSN 2285-3952

65 years old and the one over 65 years old), the indicator calculated for the standard production per hold in the case of young farmers is higher than the resulting indicators for the 3 groups. It is worth mentioning that in 2013 and 2016, this indicator is about 3 times higher than that of the group of farmers over the age of 65 years; this indicates that young farmers come to the field with a new knowledge, modernising the agricultural sector, thus there is also an increase in standard production.

Table 4. Variables of agricultural holdings by age group of the manager, Romania

Specification	***2005***	***2007***	***2010***	***2013***	***2016***
Variables per holding (all age groups)					
UAA (Ha/Hold)	3.3	3.5	3.4	3.6	3.7
Nº farms with livestock/hold	0.8	0.8	0.7	0.8	0.8
self-consumption> 50% Final Prod /Hold	0.8	0.8	0.9	0.9	0.9
SO/HOLD: 1,000 Euros/Hold	2.5	2.6	2.6	3.3	3.5
Farm variables managed by farmers <35 years of age in total age group holdings					
UAA (Ha/Hold)	2.6	3.6	3.9	5.6	6.1
Nº farms with livestock/hold	0.8	0.8	0.6	0.6	0.6
self-consumption> 50% Final Prod /Hold	0.8	0.8	0.9	0.9	0.8
SO/HOLD: 1,000 Euros/Hold	2.4	2.7	2.9	6.2	7.4
Farm variables managed by farmers aged ≥55 and ≤64 years in the total of age group holdings					
UAA (Ha/Hold)	3.5	3.9	4.0	3.8	3.4
Nº farms with livestock/hold	0.8	0.9	0.7	0.7	0.7
self-consumption> 50% Final Prod /Hold	0.8	0.8	0.9	0.9	0.9
SO/HOLD: 1,000 Euros/Hold	2.7	2.8	2.8	3.4	3.4
Farm variables managed by farmers aged ≥65 years in the total of age group holdings					
UAA (Ha/Hold)	2.4	2.4	2.0	2.1	2.1
Nº farms with livestock/hold	0.8	0.9	0.8	0.8	0.8
self-consumption> 50% Final Prod /Hold	0.8	0.8	0.9	0.9	0.9
SO/HOLD: 1,000 Euros/Hold	2.0	2.0	1.8	2.2	2.3

Source: Eurostat Database, accessed in 13/01/2022 [5].

Taking into the study the so/hold variable, it is observed that, for the age group 35 years, in relation to no. total managers as well as in relation to the two groups of farmers (the 55-65 years old and the one over 65 years old), the indicator calculated for the standard production per hold in the case of young farmers is higher than the resulting indicators for the 3 groups. It is worth mentioning that in 2013 and 2016, this indicator is about 3 times higher than that of the group of farmers over the age of 65 years; this indicates that young farmers come to the field with a new knowledge, modernising the agricultural sector, thus there is also an increase in standard production.

It should be noted that in the case of young farmers, the self-consumption of farms remains constant during the period under study, while the SO registers increases especially between 2013 and 2016. During the same period, the age group 55-64 years registered a significant increase of SO and self-consumption farms, and the age group over 65 recorded an increase in SO, the rest of the variables being constant.

Comparing the SO incomes of young farmers in Romania to those in the EU (calculated SO/ hold indicator in 2016 is 56) it is observed that they are 8 times lower; while self-consumption values appear to be higher than in the EU (calculated self-consumption indicator in 2016 is 0.3).

Regarding the variable number of farms with livestock/hold, in the case of young farmers the calculated indicator is lower compared to other age groups in the period 2010-2016, which shows that the interest of young people to invest in livestock farms is one lower.

The indicator calculated for UAA/hold (utilized agricultural area) for young farmers (up to 35 years old) has a higher relative weight than the total at national level. Both at EU level and in Romania, the indicator of the variable UAA per holding is much higher in the case of young farmers compared to the total groups of farmers and the age groups studied. The resulting indicator for UAA per hold in the case of the group of farmers over 65 years is low, in the period 2010-2016 being approximately 2 times lower than of the category of young farmers. UAA is an important variable because the larger the area, the more competitive and productive the farm is considered. The physical size of farms is an intense topic of discussion in various research studies, presenting a relationship between market competitiveness, innovation and farm size.

CONCLUSIONS

The age structure of managers of agricultural holdings in Romania is not a favorable one, following the general trends of population aging, a similar situation is found in most European countries.

Young farmers are a key element in the development of the agricultural sector, their lack being considered an impediment to the general renewal of farmers. Through this generation of young farmers, a number of problems affecting the rural area can be remedied, especially the high degree of aging and the migration of young people from rural to rural areas. Thus, these measures can have an important impact on sociological aspects as well [8].

The resulting indicators show a need for the integration of young farmers as they have great potential for economic growth and competitiveness of the agricultural sector.

The study found that farms run by young farmers are more productive and competitive. Both SO and UAA showed an upward trend under the management of young farmers compared to farmers over 55 years. Perhaps a complementary and effective approach, taking into account the results of this study, would involve the renewal of generations of farmers and the creation of an appropriate context for the development of family-run farms run by young people [9].

U.E. supports the renewal of generations through the instruments of the common agricultural policy including direct payments and financial assistance through the National Rural Development Program. Policies are key to addressing the challenges of the demographic crisis, social inequalities and territorial cohesion. The installation of young farmers can help to solve this problem, but the incentives do not seem to be attractive enough to have the desired effect.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

VARIATION OF FLOWERING TIME IN CROCUS IN RELATION TO THE PLANTING PERIOD AND THE GROWING SUBSTRATE

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Abstract

The flowering period of the crocus was studied in relation to the planting period and the growing substrate. The "Queen of the Blues" variety was used as biological material. Sand (Gs1), a mixture of sand and compost (Gs2) and garden soil (Gs3) were used as growing substrate. Crocus bulbs were planted on three different dates in 2020: October 20 (PD1), November 3 (PD2), and November 17 (PD3), simultaneously on each of the three types of substrate used. Flowering time (FT) was assessed in the spring of the following year (2021). By planting the bulbs on the three substrates at three different times, the whole experiment recorded flowering in the spring between March 2 and April 1, 2021, but differentiated depending on the planting date and substrate. The earliest flowering (March 2) was recorded in the case of planting on PD1Gs2 conditions. The latest flowering (March 22) was recorded in the case of planting on PD2Gs3 condition. The longest flowering time was recorded in the case of planting on PD1Gs2 condition, with a period of 29 days, between March 2 and March 30. Regression analysis facilitated the obtaining of models that described the variation of FT in relation to the time from the date of planting (PD) to the beginning of flowering (B-Flo), considered as T1, and the time from the date of planting (PD) to at the end of flowering (E-Flo), considered as T2. According to PCA, PC1 explained 81.613% of variance, and PC2 explained 18.387% of variance.

Key words: *crocus, floral attributes, flowering time, growth substrate, model, open field, regression analysis*

INTRODUCTION

The ornamental aspect of open spaces, public or private, can be ensured by a large number of methods, techniques, models, etc., which are composed of natural and / or artificial elements, of different categories of representation (ecological, economic, socio-cultural, historical, etc.), or combinations thereof [7], [9], [5], [8], [14], [26], [3].
The ornamental elements, of vegetal category, of an open space are in close connection with the topoclimates conditions that characterize the locality [25].
Green spaces have been studied and analyzed often in relation to the desired spatial patterns [25], with building types [24], historical texture [3], sustainable urban strategies [24] and other elements, for a balance of the urban ecosystem.
In the conditions of the use of vegetal components in the open ornamental spaces, are taken into account vegetative aspects or attributes [16], [15], [35], and floral attributes [36], [23], [28], [20], [32].
In urban ecosystems, some studies have evaluated physiological and parametric biometric indices of plants in response to urban habitats [10], and other studies have evaluated plants relative to soil suitably in urban open space [34].
The importance and social significance of green systems have also been considered in studies in relation to urban ecosystems [11].
Ornamental plants, as components for open spaces, have been studied in relation to planting conditions, such as planting data, growth substrates and other elements that determine the growth and ornamental appearance of plants [22], [17], [31], [2], [37], [21], [27]. Numerous components of organic, mineral, and organo-mineral category are known that can be used singly or in mixtures (variable proportion) to make suitable substrates for plant growth [4], [18], [30], [1]. Noninvasive techniques have been promoted

for the study of plants, which can be used to evaluate ornamental plants without affecting the ornamental attributes of plant organs [12], [13], [16], [29].
Some studies on urban ecosystems have evaluated the floristic composition of green spaces, ornamental, and highlighted the absence of some species from late winter - early spring (eg. Crocus, Galanthus) [6].
The present study analyzed the ornamental aspect of the crocus, through the flowering time in relation to the date of planting and the growing substrate, in open space conditions.

MATERIALS AND METHODS

The study evaluated the variation of the flowering time of the crocus, "Queen of the Blues", depending on the planting date and the growing substrate. The planting of crocus bulbs, "Queen of the Blues", was done in the fall of 2020, at three different dates (planting date - PD), October 20 (PD1), November 3 (PD2) and November 17 (PD3), Figure 1.

Fig. 1. Aspects from the crocus experiment, "Queen of the Blues"
Source: Original figure, author’s photo.

Three growing substrates were used, represented by sand (Gs1), mixtures of sand and compost (Gs2), and respectively garden soil (Gs3), Figure 1. All substrates were used at each planting date, so that from the combination of the two factors (planting date and substrate) resulted in 9 experimental variants.
The time of beginning of flowering (B-Flo), the flowering time (FT), the time of the end of flowering (E-Flo), the time from the date of planting (PD) to the beginning of flowering (T1), and the time from the date of planting (PD) to the end of flowering (T2) were recorded. Determinations were made for each variant.
The data obtained were analyzed in terms of statistical certainty and the presence of the variance (ANOVA test). To evaluate the FT variation according to the time parameters considered (T1, T2), regression analysis was used. PCA was used to obtain the distribution diagram of the variants in relation to the variables considered (PD, Gs) and the elements of ornamental interest, with reference to flowering (T1, T2 and FT).
The safety of the results was assessed based on the statistical parameters R^2, p, F-test.
PAST software [19] and Wolfram Alpha (2020) [33] were used for statistical data analysis and graph generation.

RESULTS AND DISCUSSIONS

By planting on three different dates (PD1, PD2, PD3) the biological material of the crocus (bulbs), 'Queen of the Blues', on the three substrates considered (Gs1, Gs2, Gs3), was registered in the spring of 2021, between March 2 and April 1, the variation of flowering, in terms of the beginning of flowering (B-Flo), the end of flowering (E-Flo) and the flowering time (FT).
In relation to the planting date (PD), a longer flowering time interval was recorded in the case of planting on October 20 (PD1).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The substrate also had a differentiated influence on the beginning and end moments of flowering (B-Flo, E-Flo), as well as on the flowering time (FT).

The substrate consisting of the mixture of sand and compost (Gs2) provided the most suitable substrate for crocus ('Queen of the Blues'), under the study conditions, and on this substrate (Gs2) a longer flowering time was recorded, in all the three planting dates (PD1, PD2, PD3).

During the planting on October 20 (PD1), on the Gs2 substrate, a flowering period of 29 days was registered, the longest of all the experimental variants.

Long flowering time were also recorded in the case of planting variants on October 20 (PD1), on the soil substrate (Gs3), and in the planting variant on November 17 (PD3), on the sand and compost substrate (Gs2). The flowering diagram is presented in Figure 2.

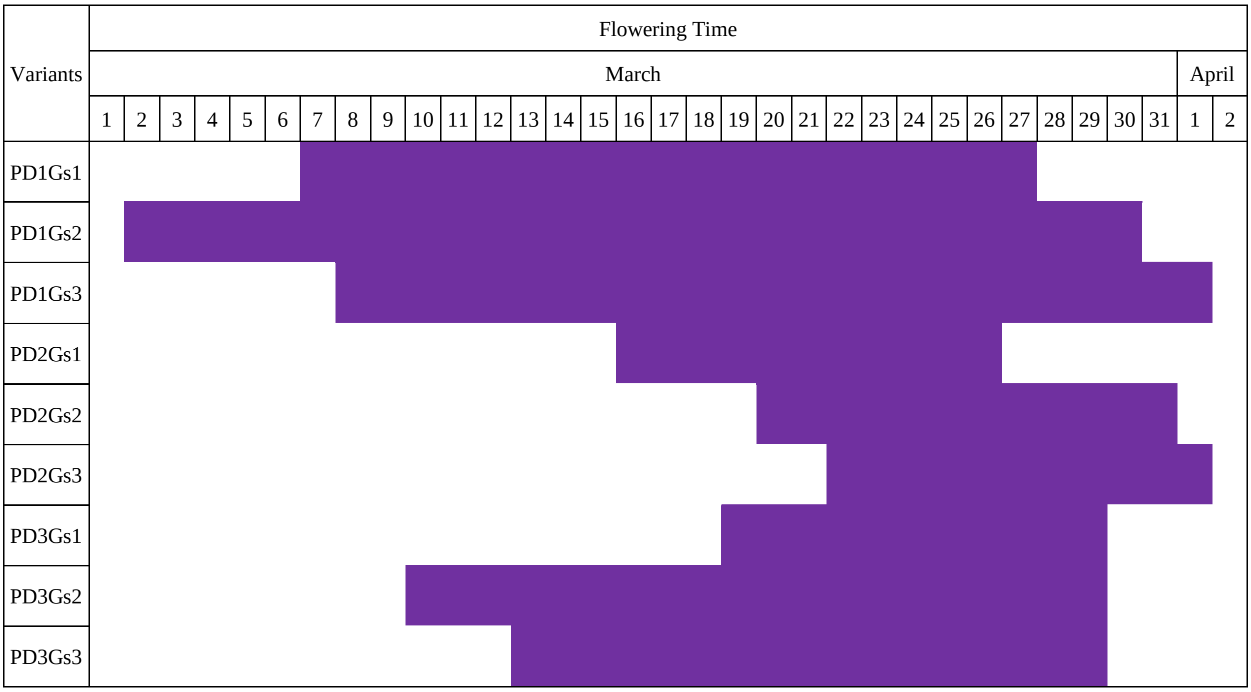

Fig. 2. Crocus flowering diagram, 'Queen of the Blues' in relation to the planting date (PD) and substrate (Gs)
Source: Original diagram, based on experimental data.

Regression analysis was used to evaluate the variation of flowering time (FT) as a function of time T1 (PD to B-Flo) and T2 (PD to E-Flo).

The variation of flowering time (FT) in relation to T1 and T2 was described by equation (1), under conditions of $R^2 = 0.999$, $p < 0.001$. The graphical distribution of the FT variation in relation to T1 and T2 is shown in figure 3 as a 3D plot model respectively in figure 4 as Contour plot.

$$FT = a\,x^2 + b\,y^2 + c\,x + d\,y + e\,xy + f \qquad (1)$$

where: FT – flowering time (days);
x – the time from the planting date to the beginning of flowering (T1, days);
y – the time from the planting date to the end of flowering (T2, days);
a, b, c, d, e, f – coefficients of the equation (1);
a= -3.18658711069832E-16;
b=-2.51611368586273E-16;
c= -1;
d= 1;
e= 5.69575914870252E-16;
f=0.

Based on PCA, the diagram in Figure 5 was obtained. PC1 explained 81.613% of variance, and PC2 explained 18.387% of variance.

According to the PCA diagram, the PD1Gs1, PD1Gs2 and PD1Gs3 variants had an orientation and distribution associated with FT and T2 as bi-plot. The PD1Gs1, PD2Gs2 and PD2Gs3 variants were closely associated with T1 as a bi-plot.

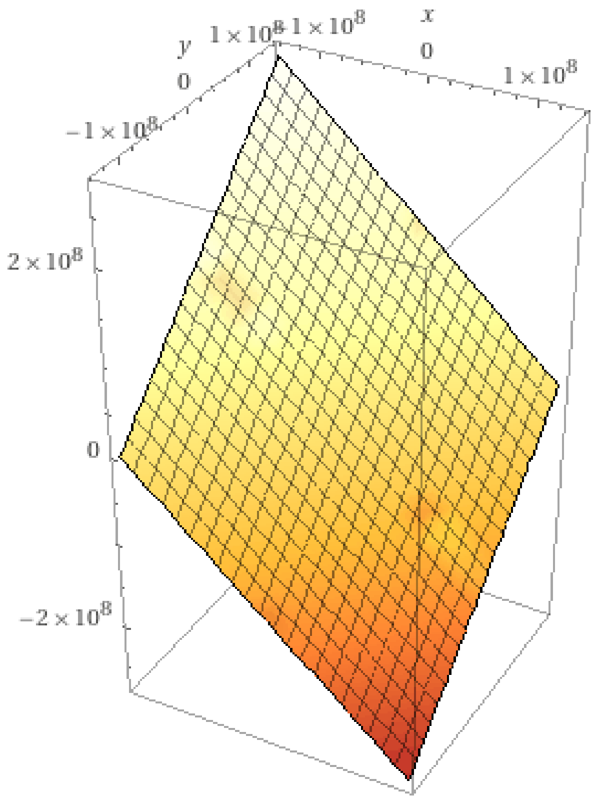

Fig. 3. 3D plot model for variation of flowering time (FT) in relation to T1 (x-axis) and T2 (y-axis) in crocus, 'Queen of the Blues'
Source: Original graph generated based on data.

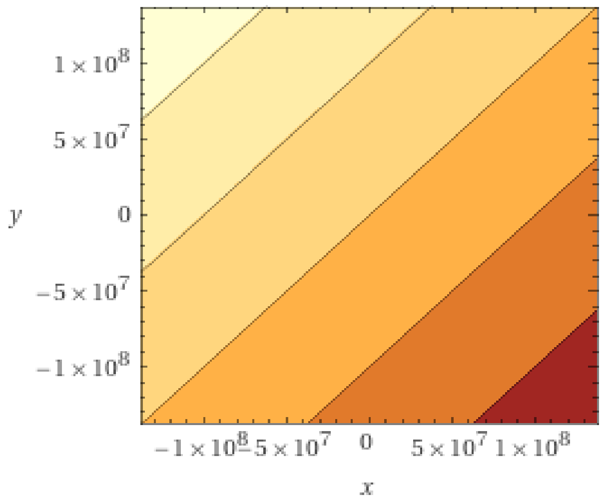

Fig. 4. Representation model as a Contour plot of the FT variation in relation to T1 (x-axis) and T2 (y-axis) in the crocus, 'Queen of the Blues'
Source: Original graph generated based on data.

The cluster analysis led to the grouping of variants in relation to the degree of similarity, in relation to the element of floral attributes, flowering time (FT). It was found the formation of two distinct clusters, in conditions of statistical safety condition, Coph.corr. = 0.787, figure 6.

A C1 cluster comprises variants with low values for FT (PD2Gs1, PD2Gs3, PD3Gs1, PD2Gs2), and cluster C2 comprised two subclusters; C2-1 with intermediate values for FT (PD1Gs2, PD1Gs3), and C2-2 with the highest values high for FT (PD1Gs1, PD3Gs2 and PD3Gs3).

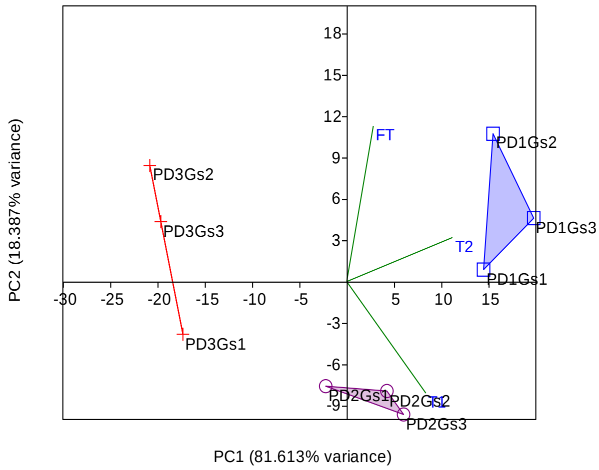

Fig. 5. PCA diagram of crocus FT, 'Queen of the Blues' in relation to planting date (PD) and growth substrate (Gs)
Source: Original figure, generated based on experimental data.

The variation of the flowering time generated by the planting date (PD) in relation to each type of growing substrate (Gs) was analyzed, as well as the variation of the flowering time generated by the growing substrate (Gs) in relation to each planting date (PD).

For this, the average values were calculated in relation to the two basic criteria (PD, Gs) taken into account, and the differences from the experimental variants were also calculated.

The average values (days) in relation to PD1 was T1 = 136.67, T2 = 161.67, FT = 25; the average values (days) in relation to PD2 was T1 = 136.33, T2 = 147.67, FT = 11.33, and the average values (days) in relation to PD3 was T1 = 117.00, T2 = 133.00, FT = 16.00.

The average values (days) in relation to the growth substrate Gs1 was T1 = 131.00, T2 = 145.33, FT = 14.33. The average values (days) in relation to Gs2 was T1 = 127.67, T2 = 148.00, FT = 20.33, and the average values (days) in relation to Gs3 was T1 = 131.33, T2 = 149.00, FT = 17.67.

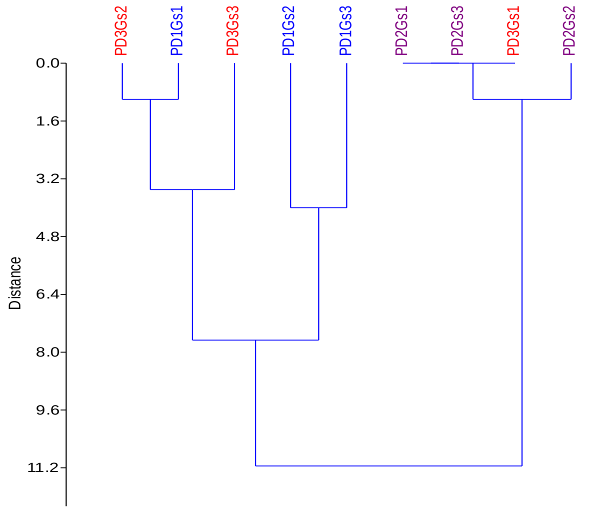

Fig. 6. Variant grouping dendrogram in relation to FT for crocus, 'Queen of the Blues'
Source: Original figure, generated based on experimental data.

The differences calculated on each variant, in relation to the average values, are presented graphically in figure 7 (in relation to PD) and in figure 8 (in relation to Gs).
Compared to the calculated average value, in relation to the planting date (PD), there were positive differences (days) for flowering time (FT) in the PD1Gs2 variant (4.00 days), in the PD2Gs2 variant (0.67 days), in the PD3Gs2 variant (4.00 days), and in the PD3Gs3 variant (1.00 days). Negative differences for FT, compared to the mean value in this case, were recorded in PD1Gs1, PD2Gs1, PD2Gs3 and PD3Gs1.

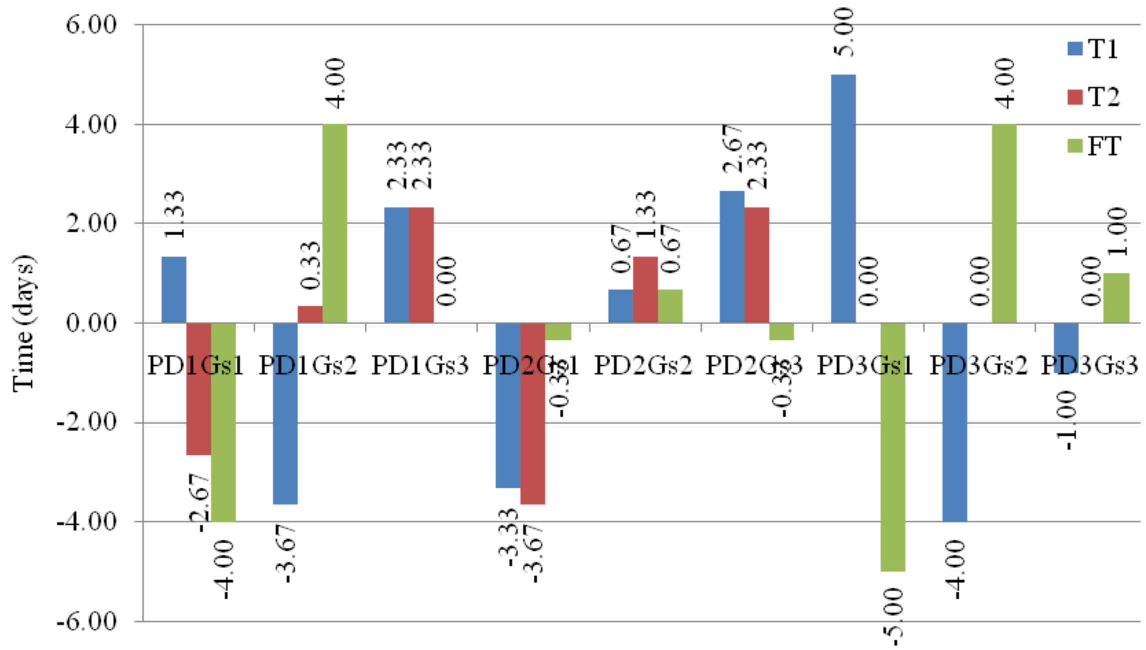

Fig. 7. Graphical representation of the differences (days) generated by planting date (PD) in relation to growth substrates (Gs), crocus 'Queen of the Blues'
Source: Original graph generated based on calculated values.

Compared to the average value calculated in relation to the growth substrate (Gs), there were positive differences (days) for flowering time (FT) in the PD1Gs1 variant (6.67 days), in the PD1Gs2 variant (8.67 days), and in the PD1Gs3 variant (7.33 days). Negative differences for FT, compared to the mean value in this case, were recorded in PD2Gs1, PD3Gs1, PD2Gs2, PD2Gs3 and PD3Gs3.
From the evaluation of the values of differences, compared to the calculated averages, we can appreciate the result generated by each variant, and in relation to the concrete conditions of the 'Queen of the Blues' crocus cultivation space for ornamental purposes, we can choose the variant that corresponds best, based on the present study conditions.
In all conditions, the 'Queen of the Blues' crocus provides a suitable ornamental appearance, but, in association with other ornamental plants, with the general and

specific context of the place, one variant may be more appropriate than another

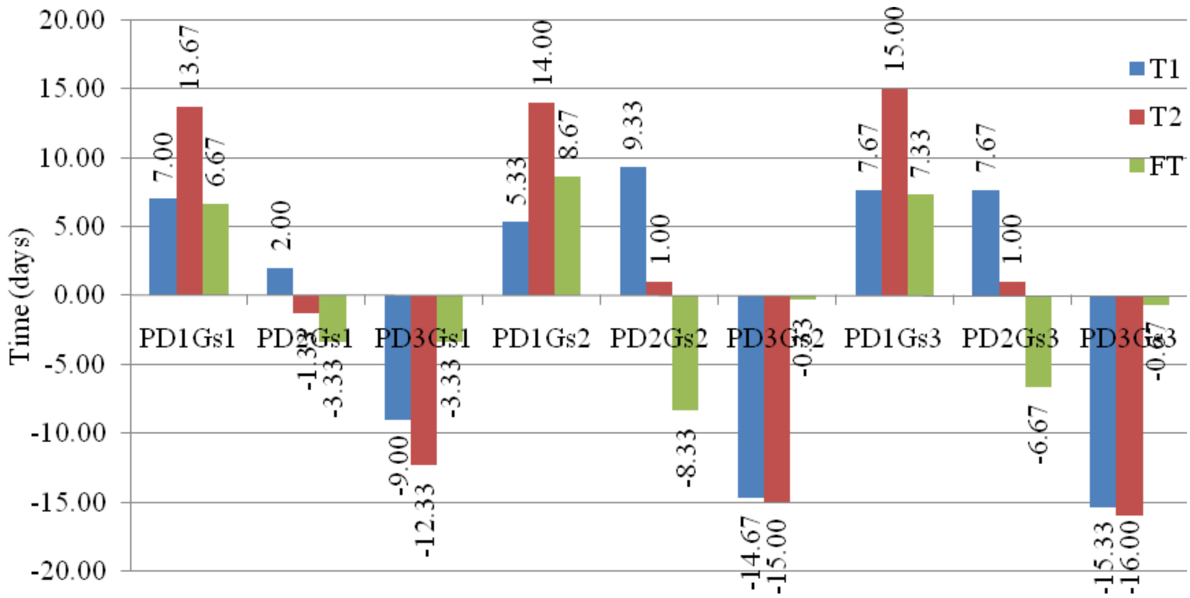

Fig. 8. Graphical representation of the differences (days) generated by growth substrates (Gs) in relation to planting date (PD), crocus 'Queen of the Blues'
Source: Original graph generated based on calculated values.

CONCLUSIONS

The flowering time (FT) of the 'Queen of the Blues' crocus recorded a specific variation in relation to the date of planting (PD) and the growing substrate used (Gs).
The PD1 planting date associated with Gs2 provided the longest flowering time under the study conditions, and the short flowering time was recorded in PD2 with all 3 substrates, respectively in PD3 and Gs1.
The mathematical and statistical methods and tools used highlighted the differences between the variants, in relation to the evaluated floral attribute (FT), so that the choice of variants given by PD and Gs is safe in relation to the purpose for a certain ornamental area, open space.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SOCIO-ECONOMIC CHALLENGES FOR REGIONS AND AGRICULTURE IN THE NEW MEMBER-STATES

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Abstract

The regional inequalities in the EU are an essential part of policy agenda and public discussions. The new Member-States remain in the group of "lagging regions" that includes low-income areas facing a number of challenges. Agriculture is a crucial sector in most of these regions, and it is seen as a major source of local employment and income. The survey aims to present the characteristics and the implication of regional disparities and outline recommendations for more balanced development. The study shows that diverge is growing at a national, regional and local level. Regions are experiencing low growth, high unemployment rate, social exclusion and poverty. However, it can be concluded that many of the regions have unexplored potential. In order to address the disparities, then policymakers should focus on the regions` specific features. The regional programs should be directed to their unique characteristics and challenges. In this regard, the implementation of targeted support should be associated with coordination and cooperation between different stakeholders.

Key words*: *inequality, poverty reduction, regional development

INTRODUCTION

Regional disparities are an essential part of the policy agenda and object of discussion at the EU level. Although there are a number of instruments directed to balanced regional development, various reports show rising inequality among Member-states and a growing divergence at the local level [5, 14, 18, 21].
The new Member-states regions are considered "lagging regions" with low-income and market participation alongside incomplete structural transformation [14]. In addition, these inequalities in the regions impact the welfare of the households leading to poverty, social exclusion and emigration.
On the other hand, agriculture plays a vital role in the region of the new Member-states. Although there is a decreasing share of this sector in GDP due to economic progress [4, 27] the sector is an important part of the rural economy and source of income for rural areas population.
The survey aims to present the characteristics and implications of regional disparities and recommendations for more balanced regions development.

MATERIALS AND METHODS

In order to observe the socio-economic challenges at a national and regional level, the methodology proposed by Pilati and Hunter [21] is applied. While traditionally, GDP per capita is a widely used measure for assessing regional convergence and economic growth, indicators such as risk at poverty and social exclusion are also applied [7].
The disparities in the income distribution are analysed based on the S80/S20 ratio. The indicator is the most commonly used index in this context. This measure "as a ratio of total income received by the 20% of the highest income population to that received by the 20 % of the population with the lowest income"[18].
The survey focuses on social-economic development at the NUTS2 level and is based on Eurostat data from 2009-2020.

RESULTS AND DISCUSSIONS

Gross domestic product per inhabitant is a key indicator of economic development and growth [27]. Figure 1 presents GDP per capita in Bulgaria, Romania and Croatia. The

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

regions with the highest and lowest indicator level in the countries are outlined. In the 2014-2020 programming period, almost one-third of the total EU budget was oriented towards Cohesion and convergence policy [8]. The EU goal is to overcome disparities in regional economic growth.

According to the EU definition, [21] Bulgaria and Romania are identified as countries with low-income regions because their GDP per capita in PPS is lower than 50% of the EU average. During the observed period in some Romanian regions, GDP per inhabitant is increased above 50% (Nord-Vest, Sud-Est and Sud-Muntenia). Some regions have a GDP per capita below 50% of the EU average; however, they have had economic growth higher than the EU average since 2009. Only one region in Bulgaria: Yugozapaden, has GDP per capita above 50% of the EU average (89%).

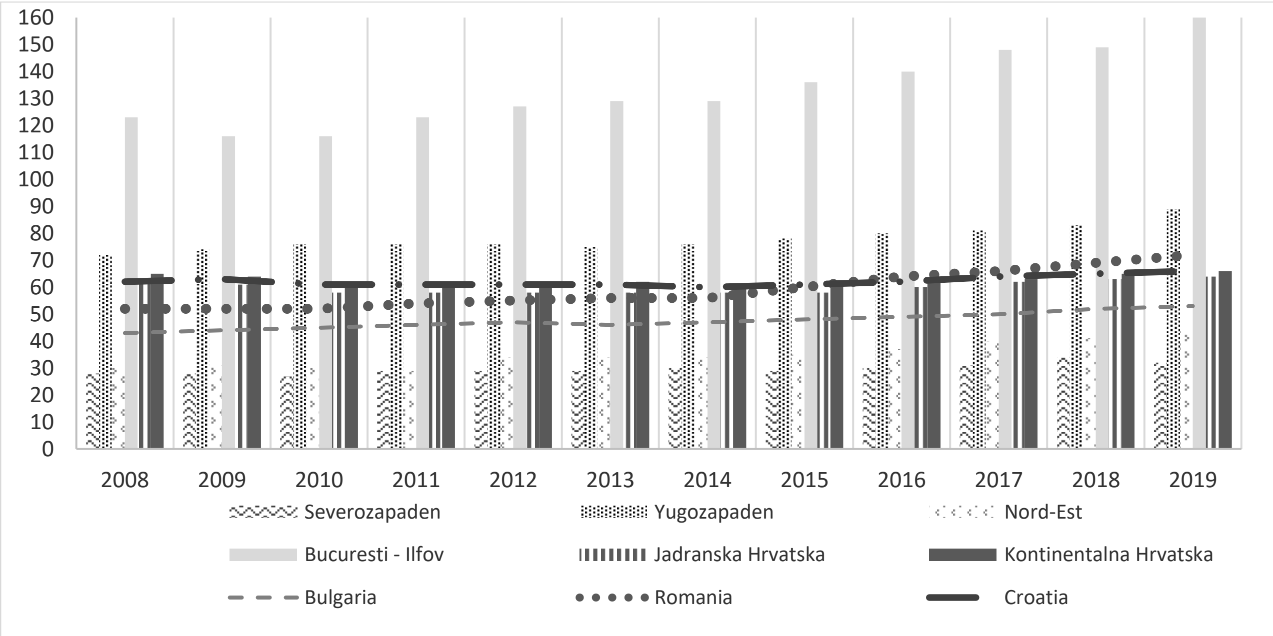

Fig. 1. GDP (PPS) per inhabitant in percentage of the EU-27 average
Source: [10, 20].

The indicator is approximately three times higher than the region with the lowest level of GDP in the country. In 2019, the other five Bulgarian regions are still among the poorest in the EU, with a GDP per inhabitant between 31% and 41% of the EU average. Although the income levels in Bulgarian regions are still low, they are more than double their 2000 levels [21].

Romanian regions have higher growth performance compared to Bulgaria. In 2019, only one region is still below the 50% of EU average – Nord-Est (44%). The region of Bucuresti is far above the national and EU average. It has a GDP approximately four times higher than the other regions. These trends outlined a large concentration of production and capital in the Bucharest region.

Croatia is the newest Member-state that accessed the EU in 2013. In the 2002-2008 period, Croatian GDP per capita increased by around 4%, reaching 63% of the EU-28 average [21]. These levels are similar to that in other Central and Eastern European countries. The 2008 financial crisis led to a six-year recession, slowing the convergence process. In 2015, the Croatian economy recovered slowly from the crisis. After 2015 the annual economic growth was above the EU average. The GPD per capita is above 50% of the EU average; however, there is no significant growth, and the convergence process is lagging behind.

In contrast to Bulgaria and Romania, Croatian regions are not considered as low-income, and there are no serious imbalances in their economic growth.

Based on the analysis it can be concluded that Bulgaria and Romania could not take advantage of the proposed instrument despite the financial support under the EU funds. Significant issues have been identified in almost all regions in Bulgaria.

Resources and production capacity are concentrated mainly in Sofia and Bucharest districts. By contrast, the rest of the country lags behind and can hardly reach capital levels. In Croatia, the results are more balanced; however, the country is not making remarkable progress after the accession to the EU, and the convergence process is slow. In addition to the observed regional differences, intra-regional disparities are formed. Therefore volatile results are observed in some of the regions in Romania and Bulgaria.

Low-income regions in Romania and Bulgaria are growing closer to the EU average GDP. Their economic development is catching up, and they receive already serious financial support from the Cohesion Policy. However, some of the poorest regions are not developing fast, which results in wider national differences. Therefore, a spatially targeted policy is needed to ensure that the more developed areas do not concentrate investment and growth opportunities away from the other areas in the selected countries.

In addition to GDP per inhabitant, another indicator of social challenges in regional development is the income quintile share ratio (Table 1).

Table 1. Income quintile share ratio (S80/S20)

Countries/NUTS2 regions	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Bulgaria	6.5	6.1	6.6	6.8	7.1	7.7	8.2	7.7	8.1	8
Severozapaden	6.7	6.3	5.4	6	6.5	7.3	7.1	7.6	7.6	8.5
Severen tsentralen	6.5	5.3	4.6	5.4	4.8	5.1	6	6.8	6.5	5.9
Severoiztochen	6.4	6.1	5.8	6.4	7.3	8.2	7.5	6.2	6.7	6
Yugoiztochen	6.7	7.4	7.3	7.3	6.5	7.4	9.4	6.2	7.7	8.1
Yugozapaden	5.6	5.4	6.1	6.1	6.8	7.2	8.2	8.5	9.1	8.5
Yuzhen tsentralen	5.4	5.5	7	6.9	7	7.9	7.7	6.7	6.9	6.5
Croatia	5.6	5.4	5.3	5.1	5.2	5	5	5	4.8	
Jadranska Hrvatska			4.8	4.7	4.6	4.6	5.1	4.9	4.4	
Kontinentalna Hrvatska			5.6	5.3	5.4	5.2	5	5.1	5	
Romania	6.2	6.6	6.8	7.2	8.3	7.2	6.5	7.2	7.1	6.6
Nord-Vest	5.5	5.5	5.2	5.1	6	5.3	5.5	5.8	5.2	5.2
Centru	5.2	5.7	5.8	6.9	11	6.4	5.2	6.2	6.3	6
Nord-Est	7.2	7.7	9.1	9.8	10.2	8.7	8.4	9.2	9.5	8.9
Sud-Est	6.3	7.1	7.9	9.5	7.9	7.1	7	7.4	7.2	7.1
Sud - Muntenia	5.3	5.3	5.1	5.7	7.1	5.8	6	6.8	7.1	5.6
Bucuresti - Ilfov	4.5	4	5	4.4	4.4	6.6	4.1	5	4.1	4
Sud-Vest Oltenia	7.5	9	6.8	7.3	8.3	10.3	8.9	9.8	7.3	7.7
Vest	6	7.5	6.9	7.7	5.8	5.5	5	5	4.8	6.4
EU average	5.03	4.98	5	5.2	5.22	5.16	5.08	5.12	5.09	5.24

Source: [11].

Based on the data, several conclusions can be drawn. First, in the EU and Croatia, there is a lack of dynamics, while in Romania and Bulgaria, significant variations are registered. Bulgaria has recorded the highest level of the ratio. There is an increase in income inequality in the country. Despite the macroeconomic stability, negative convergence trends are observed. In Bulgaria, the increase in income is more distorted to the upper quintiles of the population than in the Romania, Croatia and EU average.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In Romania, the highest ratio levels are registered in the region with the lowest GDP per capita. The income equality is much lower than the EU average in the Bucuresti region.

The results show a decrease in income disparities and positive trends in Croatia.

Secondly, there are severe interregional differences. Inequality is also deepening at the regional level, with the most significant differences in Yugozapaden and Severozapaden regions. Therefore, despite the higher GDP per capita in the Yugozapaden region, the income is unevenly distributed and concentrated mainly in the capital city Sofia.

The analysis results clearly outline the significant challenges related to income inequality in Bulgaria and Romania, which could not be resolved after the countries acceded to the EU.

The high levels of income inequality in Bulgaria seriously increase the risk of social exclusion, preventing balanced and sustainable growth.

In this regard, another important indicator related to regional development is the risk of poverty and social exclusion [23]. It is based on the sustainable development goals set by the United Nations [25].

The data shows that Bulgaria and Romania are observed the highest indicator levels. In Croatia, the results are close to the EU average levels.

In Romania and Bulgaria, serious regional disparities are registered. In Romania, people who face poverty risk in Nord-Est and Sud-West regions are four times more than the Bucuresti region. In Bulgaria, the indicator level is two times higher in Severozapaden than Yugozapaden region. According to the latest Eurostat data [9], the gap between cities and rural areas is the highest in Romania and Bulgaria. (30% in Romania and 24% in Bulgaria). By contrast, in Croatia, the indicator in rural areas is 23.6 % and close to the EU average (23.2%). Unemployment, low income and education, exclusion from the labour market are critical drivers for the observed trends.

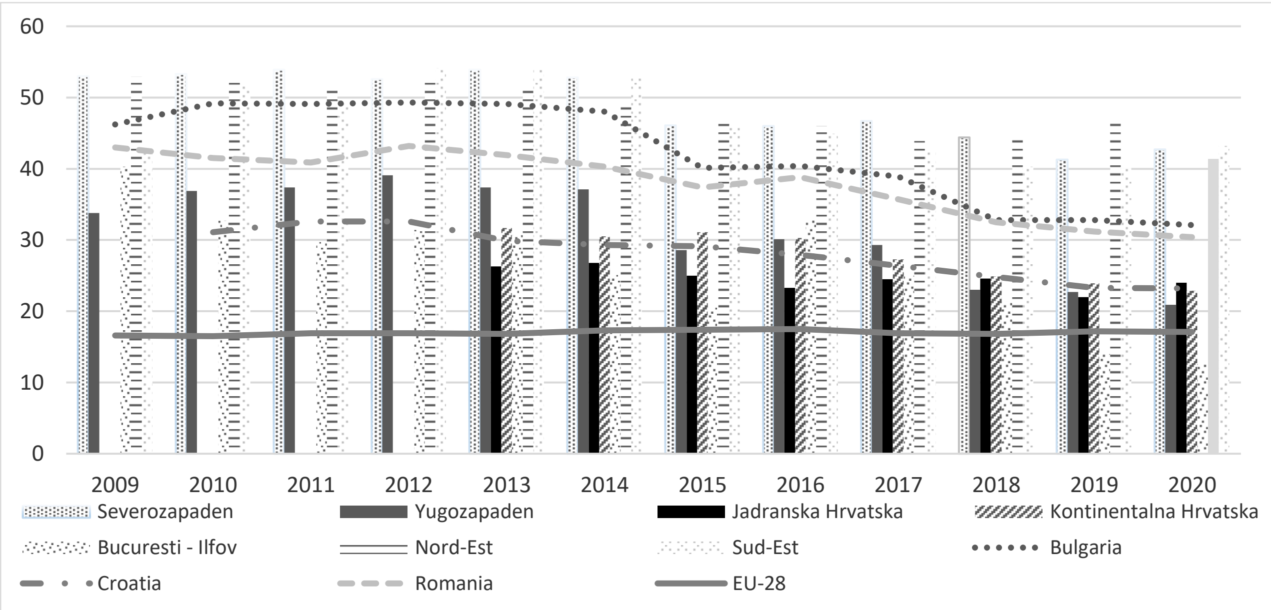

Fig. 2. Risk at poverty and social exclusion (% of the population)
Source: [12].

The results in Romania and Bulgaria emphasize the contrast between developing the capital city and the rural regions. The study results show that a significant part of the territory of Bulgaria and Romania could not boost their economic and production potential. In Croatia, the trends are positive, and the indicator is decreasing after the accession to the EU.

Disparities between regions and serious intra-regional disparities hold back the implementation of innovations and new technologies, the development of circular and bioeconomy models that could contribute to green and sustainable economic growth. In this context, it is necessary to consider the possibilities for overcoming serious imbalances in territorial development through the new approaches of regional development [1, 14, 15, 17, 21].

Agriculture remains a vital sector in the new Member-States economy.

The share of agriculture in the total gross value added shows the role of agriculture in the national economy (Figure 3).

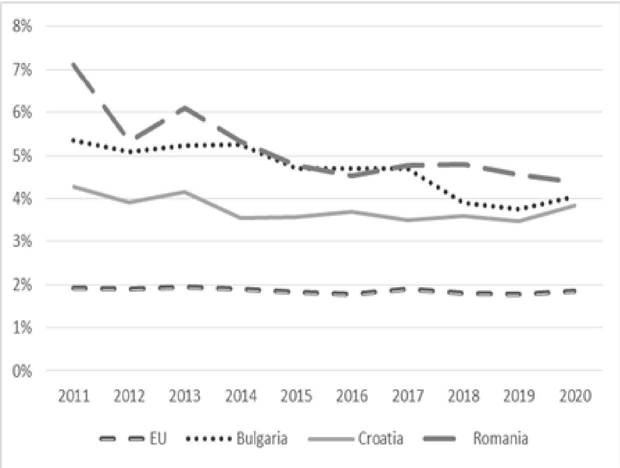

Fig. 3: Share of agriculture in Gross value added (%)
Source: Own calculation based on [13, 20].

Based on the data, it can be concluded that the share of agriculture in gross value added is declining in the selected countries. The highest decrease is observed in Romania. However, the sector's share remains higher than the EU average in these countries.

Although agriculture represents only around 4% of total GVA, the importance of them sector is higher than the results indicate. According to EU country factsheets [6], Romania and Croatia rural territory are 67.8% and 62.8%, respectively. In addition, the share of the rural population is over 60%.

In Bulgaria, the share is much lower (22.1%); however, the territory in the intermediate regions is more than 60%.It should be noted that agriculture is a vital sector in the Bulgarian regions with the lowest GDP per capita. According to the National Statistical Institute in 2012-2020, the agricultural sector has a higher share than countries average (Severozapaden- 12.3% and Severen Tzentralen - 9.8%)

According to EU country factsheets [6], the agricultural output is dominated by crop production in the selected countries. The share of the subsector is 70% in Romania, 67% in Bulgaria and 60% in Croatia. In Croatia, there is a more balanced agricultural structure. By contrast, cereals form 37% and 21% of agricultural output in Bulgaria and Romania.

In the selected countries, the farms under 5 hectares are 84% of total holding in Romania, 82.6% and 67% in Bulgaria and Croatia, respectively [6]. Although small farms dominate in rural regions, there are serious challenges related to the term "land grabbing" in Romania and Bulgaria. This process strongly impacts small farmers and agricultural workers [2, 24]. On the other hand, Croatian agriculture struggles with land ownership and outdated land registry books that affect the rural population's well-being [19].

After the accession to the EU, Croatian transformation led to an increase in GPD and a decrease of the population facing risk at poverty and social exclusion. On the other hand, the regional difference remains an issue and rise during the observed period. In Romania and Bulgaria, the monoculture agricultural structure with the domination of extensive production also leads to serious imbalances.

In scientific circles, different "paradigms" related to balanced regional and rural development are highlighted. Hodge and Midmore [17] outlined four models of rural development – a sectorial model, territorial approach and local or integrated model.

Despite the financial fund under the CAP and Cohesion policy, some studies pointed out that these policies do not prioritize the New Member States acceded after 2004 [3, 16, 22, 26].Therefore in the new programming period, changes in several areas are needed.

The local model with an orientation toward the specific features of the regions could be an option to expand regional potential. However, implementing such an approach requires capacity building at a regional and local level.

In Bulgaria and Romania, regional and even local imbalances are observed. In order to improve the regional performance of the lagging regions in the countries, adaptation toward the new policy and priorities at a local level is needed. The cooperation between different stakeholders would be essential for better implementing the new CAP. In addition, the Bulgarian and Romanian governments should support more the small and medium-sized producers in their application for different funds. Coordination and knowledge transfer is also vital in achieving more balanced regional development.

CONCLUSIONS

Based on the results, some conclusions and recommendations can be outlined:

(i)Key socio-economic indicators show serious differences between the new Member-States and EU average; between the different regions in Romania and Bulgaria, and more balanced development in Croatia.

(ii)Agriculture remains an important sector in the selected countries. However, land fragmentation and „land grabbing" remain a serious challenge in some regions.

(iii)There is unexplored potential in implementing various regional policies and instruments.

(iv)Boosting the potential of lagging regions should focus more on more well-target support to improve the business environment. The regional gaps related to skills and education should also be addressed

(v)Building greater coordination and improving administrative capacity is crucial for expanding the regional potential. In this regard, the implementation of regional and cohesion policies should be associated with better coordination between different stakeholders.

(vi)The regional imbalances could be overcome with financial support directed to small and medium-sized farms. The simplification of the procedures, a key priority in the new CAP, could help implement better policy measures.

(vii)Local models based on the specifics of the regional economy could boost regional development

ACKNOWLEDGEMENTS

This research work was carried out with the support of Centre of research, technology transfer and protection of intellectual property rights at the Agricultural University-Plovdiv.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AGRICULTURE 4.0 – CONCEPTS, TECHNOLOGIES AND PROSPECTS

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Abstract

Agriculture 4.0 is seen as a new possibility in overcoming the global challenges related to the scarcity of resources, climate change and food security. In this context, the aim of the paper is to outline the main definitions, concepts, technologies and trends in Agriculture 4.0 development and discuss the challenges, as well as opportunities and prospects. Based on the literature overview, it can be concluded that Agriculture 4.0 will play a crucial role in transforming the agri-food sector and shaping future agricultural production models. On the other hand, the new concepts should be linked to the Green Deal and sustainable development goals to ensure a fair and resilient agricultural system. Along with the benefits of Agriculture 4.0, there are challenges associated with farmers' perceptions and ability to change, the development of infrastructure, especially in rural areas and the lack of standards for implementing the new technologies. The government and policymakers' role is essential and should be directed in supporting the implementation of the concept Agriculture, 4.0.

Key words: *digitalization, innovation, sustainable development*

INTRODUCTION

Agriculture is considered a key sector providing food for the growing population and ensuring the viability and resilience of rural areas. On the other hand, agriculture is facing a number of global challenges related to the scarcity of resources, climate change and food security, combined with the COVID-19 pandemic.

In this context, the European Green Deal and Farm to Fork strategy focus on agricultural models oriented towards the transition to a clear circular economy [15].

Therefore Agriculture 4.0 is seen as a new possibility in overcoming these global issues. Agriculture 4.0 as a term is related to different concepts such as digital agriculture, smart, vertical and precision farming [4, 22, 26, 27, 43, 61]. In addition, it is expected that Agriculture 4.0 will impact the production systems and agricultural supply value chain. [5, 16, 50, 57]

Along with the number of benefits related to increased productivity and environmental protection [2, 41, 51], some authors outline challenges associated with the social effect of digitalization [19, 37, 48].

The paper aims to outline the main definitions, concepts, technologies, and trends in Agriculture 4.0 development and discuss the challenges as well opportunities and prospects.

The study is structured as follows: First, the applied materials and methods are presented. The second part shows the definitions, concepts and technologies related to Agriculture 4.0. The main challenges and barriers are also outlined. In the third part, some conclusions and recommendations are highlighted.

MATERIALS AND METHODS

The study is based on the theoretical framework presented by de Alcantara et.al [9]. The survey applied discourse analysis. The method is related to the institution's discourses that foster new technologies implementation [36].

In order to observe the challenges in Agriculture 4.0 implementation the study uses the proposed by European Commission Digital Economy and Society Index (DESI). The indicator monitors key digital policy areas and tracks country profiles. According to European Commission data DESI includes a three-level structure with four sub-dimensions: Human capital, Connectivity and Digital public service [14]. The data is based on the DESI key indicators dataset.

RESULTS AND DISCUSSIONS

Origin and drivers for Agriculture 4.0 development

Agriculture always has played an important role in humans' livehood. The new technologies that influence farm models have a long history of development. Zhai et al. [65] mark four stages of agricultural transformations. Agriculture 1.0 is labour intensive and related to animal forces use. Agriculture 2.0 is associated with different agricultural types of machinery. Various chemicals are also introduced. However, these trends increased productivity but also caused environmental harm and waste of resources [65].

Computer technologies led to the development of Agriculture 3.0 in the 20th century. The application of chemicals was reduced. The sustainable agricultural development concept was introduced [47]. However, the global challenges the world faces alongside the rapid development of digital technologies [5, 18] emerged Agriculture 4.0.

A number of global challenges influence the sustainability of the agricultural system. According to [10], four main drivers stressing agriculture and requiring new farming models and the implementation of Agriculture 4.0: growing population, climate change, food waste and resource scarcity.

United Nations World Population Prospect [58] indicates that the population will increase to 10 billion by 2050. This latter will lead to growth in food demand. Based on FAO data [17], agriculture will have to provide 70% more food by 2050. These trends require increased productivity and efficiency. By contrast, 33% to 50 % of produced food becomes a waste [17].

In this regard, food security remains a huge issue causing poverty and hunger. According to World Health Organization [62], 700 million people are extremely poor, and 800 million are chronically hungry. The clime change impacts agriculture and decreases yield due to the higher temperatures [20]. In addition, the Intergovernmental Panel on Climate Change (IPCC) concluded that greenhouse gas emissions from agriculture and forestry are doubled over the past 50 years [25]. In order to decline the environmental impact of agriculture and adapt to climate change, new farm models have to be proposed.

According to De Clercq et al. [10], Green Revolution and new technologies have increased agricultural production three times since 1960. However, overcoming the global challenges requires not only changes in agricultural practices but also new business models and new political agenda in rural areas.

Definitions and basic concepts

The term Agriculture 4.0 is closely linked to other concepts in scientific literature and is even used as a synonym of smart agriculture, digital and precision farming [7]. Agriculture 4.0 is introduced and explained based on different dimensions and perspectives.

Based on the literature review, Sponchioni et al. [54] outline six standpoints for Agriculture 4.0 definition: the first perspective defines Agriculture 4.0 as an evolution of precision farming. Klerkx et al. [27] consider that smart farm, precision agriculture, and agriculture 4.0 have the same meaning. In addition, Kong et al. [29] pointed out that agriculture 4.0 can improve precision agriculture.

Second perspective links Agriculture 4.0 to Industry 4.0 [3, 40, 64]. Liu et al. [31] observed the relations between Agriculture and Industry in the context of lessons learned from industrial revolutions.

The third dimension presents Agriculture 4.0 related to the digitalization of agriculture and digital technologies. Fielke et al. [19] outline the importance of interaction between digital technologies and farm management.

Forth perceptive defines Agriculture 4.0 as an opportunity for new farm models to integrate data and decision making. By Decision Support Systems implementation, Agriculture

4.0 is based on mathematics and less on beliefs and intuition [34, 39, 55].

The fifth concept is beyond the farm gate and links Agriculture 4.0 to the food value chain. The Agriculture 4.0 technologies are helping farmers to connect with the other actors in the food value chain [33, 60].

The sixth perceptive presents Agriculture 4.0 in context to its main objectives. Different authors highlight that Agriculture 4.0 increases profitability and ensures the sustainability of farming [11, 64].

The main definitions that reflect these six perspectives are presented on Table 1. Based on literature review some authors present own definition aiming to integrate all dimensions of Agriculture 4.0 [35, 54].

Table 1. Summary of Agriculture 4.0 definitions and perceptive

Authors	***Definition***	***Perspective***
Monteleone et. al. [45], p. 3	*„This concept appeared at the beginning of the 21st century, as an evolution of the PA concept through the diffusion of IoT"*	Agriculture 4.0 as a Precision Farming Evolution
Piwowar, [45], p. 170	*"Similarly to the concept of Industry 4.0, the transformation process in Agriculture 4.0, aimed at increasing competitiveness, is also implemented through the use of modern information technology"*	Links Agriculture 4.0 to Industry 4.0
Sott et.al.[53], p. 149855	*„ refers to the use of information and communication technologies such as Big Data and Analytics to explore the variability of data and use it to deal with changes in the agricultural scenario"*	Agriculture 4.0 and digital technologies
Kong et. al. [29], p. 2	*"Agriculture 4.0 also improve the agricultural system's responsive performance with accurate decision making in response to operational uncertainties and real time data updates. "*	Agriculture 4.0 and decision making
Kovács, Hust,[30], p. 38	*"It is broader and more comprehensive, as it seeks to integrate all actors in agri-food production through a technological value chain.*	Agriculture and food value chain
Huh and Kim, [24], p. 8	*"represents the use of emerging technologies to create a value chain to integrate organizations, farmers, customers, and all stakeholders in favour of economic, social, and environmental sustainability.*	Agriculture 4.0 and its main goals

Source: Own survey based on [8, 54].

There is not globally accepted definition of Agriculture 4.0 and the concept is transforming and shifting towards sustainability and inclusion. [48, 49, 65]. However, the term agriculture 4.0 is still developing and evolving [27, 64].

Agriculture 4.0 Technologies

Agricultural 4.0 technologies are important in implementing smart specialisation and innovation strategies. Different authors outline different core technologies and use various classifications. Ting et al. [56] and da Silveira et al. [8] divided agricultural production into subprocesses and defined the technologies as pre-field, in-field, post-field.

Pre-Field are directed to seeds and genetic development and include sensing technologies and the Internet of things [26].

In-Field technologies are related to planting and harvesting [56] and associated geoinformatics, new hardware and software. Wolfert et al. [59] point out that with the implementation of machinery and sensors on the farms, decision–making is guided by data. Ferrandez-Pastor et al. [18] consider that the Internet of Things could help farmers' management.

Post-Field technologies are linked to distribution, processing, and consumption [56]. This stage relates to AIoT, blockchain, cloud computing, and big data. Zhai et al. [65] highlight that the optimisation of the supply value chain is one of the most effective approaches to overcome issues with food waste.

Based on the literature review, Araújo et al. [1] define the core technologies in Agriculture 4.0. The authors show the data flow between the core technologies and users. On that base, five stages and types of technologies are identified: sensor and robotics; Internet of Things; cloud computing; data analysis and decision support system.

Based on the new technologies in the future, farms will be run very differently, allowing higher profitability and efficiency. On the other hand, the lack of globally accepted definition and policy challenges Agriculture 4.0 implementation.

Main challenges and barriers

Although Agriculture 4.0 is a widely discussed topic and the benefits of its implementation are identified in scientific literature, there are a number of challenges for developing the new concept.

Based on the literature review, da Silveira [8] divided the main barriers of Agriculture 4.0 implementation into five dimensions: technological, economic, political, social, and environmental. As technological barriers can be considered operational and technical problems [12, 18]. Other issues are associated with managing information and data [3, 59, 65]. The implementation of Agriculture 4.0 requires the development of infrastructure in rural areas, and the lack of it is seen as a significant challenge [3, 6, 64].

The main economic barriers are linked to the high investment costs [12, 18, 44]. The social and environmental implications may also lead to potential costs that is challenging agriculture 4.0 implementation and diffusion [21, 49]. Another essential economic factor is skilled labor costs [18].

Political barriers include differences in the politics created by developed and developing countries [42]. Another issue is the lack of policies that promote start-ups [64] and farmer-centred approaches [38]. Social barriers are related to a lack of highly qualified labour with technical knowledge and digital skills [18, 27]. Another critical factor is training and qualification [64].

Environmental barriers are linked to the capability of Agriculture 4.0 technologies to influence the climate and the behaviour of the system (Braun et al., 2018; Grieve et al., 2019). The limited acceptance of agricultural technologies are also a challenge [32, 50].

One of the main barriers to Agricultural 4.0 implementation is the infrastructure and digital skills. They are a significant issue for the development of the concept. In this regards Table 2 presents the DESI-total score as an indicator for Member States of the EU digital progress and the development of digital society.

Based on the data, several conclusions can be drawn. The indicator's highest level is registered in Denmark, followed by Finland, Sweden, and the Netherlands. By contrast, there are many Member-States, which are below the EU. The lowest score, however, is recorded in Bulgaria and Romania.

The 2030 target of the EU is at least 80% of people to have at least basic digital skills [13]. On the other hand, in 2021, only 56% possess basic digital skills [14].The increase in digital competence is low and lagging behind the EU goals for the analyzed period.

The observed trends explain the low level of Agriculture 4.0 implementation and serious challenges in rural areas in Bulgaria and Romania [63].

It should be outlined that having an Internet connection and using the Internet is insufficient. Implementing new concepts like Agriculture 4.0 requires appropriate skills and competencies.

Another barrier for Agricultural 4.0 development is associated with digital infrastructures. Denmark registers the highest score in connectivity, followed by the Netherlands and Spain. Greece and Bulgaria have the weakest score in the Digital infrastructure dimension [14]. In rural areas, digital infrastructure and digital competencies remain serious challenges.

Table 2. DESI-total (aggregate score, %)

Countries	2016	2017	2018	2019	2020	2021
Austria	38.9	42.6	45.2	47.7	50.2	56.9
Belgium	38.9	41.6	44.1	46.1	51.1	53.7
Bulgaria	26	28.1	30.9	32.7	34.4	36.8
Cyprus	29.4	32	34.6	37	39.3	43.5
Croatia	30.1	33.1	35.3	38.4	40.5	46
Czech Republic	33	34.9	38.4	41.1	43.7	47.4
Denmark	50.1	53.3	54.8	57.9	61.8	70.1
Estonia	44.4	46.5	49.5	52.1	54.7	59.4
Finland	49.5	52.1	55	58.1	62.8	67.1
France	35.3	38	40.7	44	47.2	50.6
Germany	38	39.9	42.2	45.1	49	54.1
Greece	23.5	26	27.8	30.1	32.9	37.3
Hungary	29	31.6	33.5	35.3	38.5	41.2
Ireland	40.3	43.3	46.8	49.1	54.1	60.3
Italy	29.8	32.8	35.3	38.5	40.8	45.5
Latvia	38.5	40.9	43.2	44.5	47.2	49.5
Lithuania	37.6	40.4	44.3	46.7	49.4	51.8
Luxembourg	44.1	47.3	49.3	51.5	55.5	59
Malta	43.1	45.2	48	52	56.5	59.6
Netherlands	45.9	49.1	52.1	54.5	58.9	65.1
Poland	26.2	28.8	31.5	33.9	37.6	41
Portugal	36.8	39.3	42.1	44.3	47.5	49.8
Romania	21.4	23.2	25.7	27.1	30	32.9
Slovakia	30.6	33.4	36.3	37.7	39.7	43.2
Slovenia	38.1	40.5	43	45.9	48.2	52.8
Spain	39.7	42.9	46.3	49.6	52.7	57.4
Sweden	48.3	50.9	55.3	58.4	61.6	66.1
EU	35.3	37.9	40.6	43.1	46.3	50.7

Source: European Commission [14].

Among the main advantages Agriculture 4.0 can be considered increased financial returns [24, 28], reducing costs [44].
On the other hand, there are environmental benefits such as reducing waste, water, and energy [21, 46, 65]. Social benefits are related to farmers' security [59] and jobs creation in the agricultural sector [46].
By contrast, as disadvantages of agriculture 4.0, some studies point out risks in implementing new technologies [44] and exclusion or discrimination against the not digitally skilled farmers [27].
In addition, Klerkx and Rose [26] also outline the difficulty in assessing the environmental, social, and economic impacts on Agriculture 4.0 diffusion.
In this regard, the main challenges should be analyzed and observed to stimulate and encourage the Agriculture 4.0 implementation.
Therefore, coordination between governments, investors and other stakeholders is needed [23, 52].

CONCLUSIONS

Agriculture 4.0 is considered a central pillar in shaping the future agri-food sectors. The concept is related to economic benefits such as optimising agricultural production, supply-chain and distribution. In addition, the term is linked to new opportunities in the labour market and new types of business models. Environmental benefits are associated with the rational use of resources and chemical products.

This study is directed to analysing the development of agriculture 4.0 - main definitions, technologies, barriers, challenges and opportunities. Based on the survey, it can be concluded that agriculture 4.0 is defined differently based on the researchers' perspective and agenda.

Alongside the emerging technologies and benefits, a number of challenges are outlined. The future of Agriculture 4.0 should be directed to establishing strategies to overcome the challenges and barriers and define the actors related to these barriers.

Agriculture 4.0 is changing governments, policymakers, and other stakeholders' perspectives on agriculture. Governments will play a key role in shaping the environment for Agriculture 4.0 development. In order to overcome the global challenges, agricultural production and distribution models should shift towards an innovation- and knowledge-based agenda.

ACKNOWLEDGEMENTS

This paper was supported by the Bulgarian Ministry of Education and Science under the National Research Program "Intelligent Plant-growing", approved by DCM# 866/26.11.2020.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

NDMI USE IN RECOGNITION OF WATER STRESS ISSUES, RELATED TO WINTER WHEAT YIELDS IN SOUTHERN ROMANIA

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Abstract

In the south part of Romania, during 2016-2021, research was conducted on the water stress of wheat crop, represented by 7 varieties of premium genetics wheat, i.e. high in protein and gluten. The analysis of NDMI (Normalized Difference Moisture Index) showed that, during the research period, the plants benefited from an average index of 0.21 units, placing the area in the category of those that offer a moderate size of vegetation and a medium stress for water. Under these conditions, the average wheat yield was 4,413 kg/ha, i.e. less than 50% of the varieties potential. The annual wheat variation of NDMI (170 days, spring-summer) ranged from -0.015 units in 2020, when yield was below 2,000 kg/ha, to 0.356 units in 2021, when due to phytosanitary stress, the average yield was of 5,512 kg/ha. Rest of the years had intermediate values, in each of them the water stress being present either in spring or in summer. The correlation between the water stress and the obtained yields was represented as a polynomial function, statistically assured. Average yields of 50% of the variety potential can be obtained at stresses of not less than 0.1-0.2 NDMI units. In this regard, it is necessary to rethink technologies, especially on recalculating the level of some inputs, which in conditions of pronounced water stress are only partially used by plants.

Key words: *NDMI, wheat, water stress, yield*

INTRODUCTION

The Southern part of Romanian Plain, an area of about 50-80 km along the Danube River, has been noted in the last 10 years by the modified parameters of climatic conditions, with an emphasis on increasing temperatures (especially in summer time), on reducing quantities of precipitation and on the appearance of an aggressive alternation between day and night temperatures, especially in April and early May [2]. Declared by the meteorological institutions of NASA as the hottest decade of the last 80 years [12], the period 2011-2020 also left its negative mark in the study area, 2015 being the warmest year, and the agricultural year 2019- 2020 being extremely dry.
Climate stress factors, and especially drought, due to the lack of water in the soil reserve, correlated with the precipitation volume reduction, require new studies, highlighting the risks of reducing wheat yield, the main agricultural crop of the area and the development of new agricultural techniques, to capitalize more efficiently the reduced water resource and deal with hot summers, especially during the flowering – filling the grain – maturity periods, when the wheat is very sensitive to temperatures above 30°C.
New technologies, offered by specific satellites, positioned outside the atmosphere and intended to monitor the state of vegetation [3, 6, 7], but also the agricultural crops [5, 13], are becoming more and more used for accurate and predictive knowledge of crop water stress [4, 8, 16], in order to resize the volume of inputs needed for crops to obtain the maximum possible yields, but with minimum costs [11] in the new conditions.
From the many techniques offered by satellites, we first approached the use of two monitoring indicators, that can be used for assessing the condition of agricultural soils, being non-invasive methods, without environmental impact [9], namely:
(1)NDVI (Normalized Difference Vegetation Index) – described in another paper [1];

(2)NDMI (Normalized Difference Moisture Index).

NDMI shows the water stress of crops and has values between –1 and +1, each obtained value corresponding to a certain agronomic situation [14], depending on the mapping of the studied area. The calculation formula for NDMI, when performing readings using Sentinel-2 satellite is:

$$NDMI = \frac{NIR - SWIR}{NIR + SWIR} = \frac{B8A - B11}{B8A + B12} \quad (1)$$

where:

NIR = near infrared;

SWIR = shortwave infrared.

NDMI has been used successfully in various aspects of vegetation assessment, as soil brightness is canceled [10]. Research has shown that a 30-40% land cover results in more accurate NDMI readings [15].

Based on what is already known, we will present the results obtained with NDMI in wheat crop, this being the index that provides us with information on the water content of plants (stems + leaves). The proposed objective is to demonstrate that NDMI can be used for measuring the water stress in which wheat plants have entered very frequently in recent years.

MATERIALS AND METHODS

The research area is located in the south of Romania and includes an area of 110 ha, cultivated with 7 premium wheat varieties, with different vegetation periods. According to our own hypothesis, in very different climatic conditions from one year to another, it is necessary to combine the varieties, so that they can substitute each other in the capitalization of vegetation factors, depending on their appearance in the system. From pedological point of view, the study was carried out on chernozemic soils, slightly carbonated, with about 25-26% clay and 3.1-3.2% humus, with good permeability and contact with groundwater only at rainfalls over 100 mm (up to a depth of 6-8 m).

The thermal regime, on average in the years 1961-1990, indicates a temperature of 11.68°C, as well as precipitations of 473.9 mm, i.e. 4,739 m^3/ha.

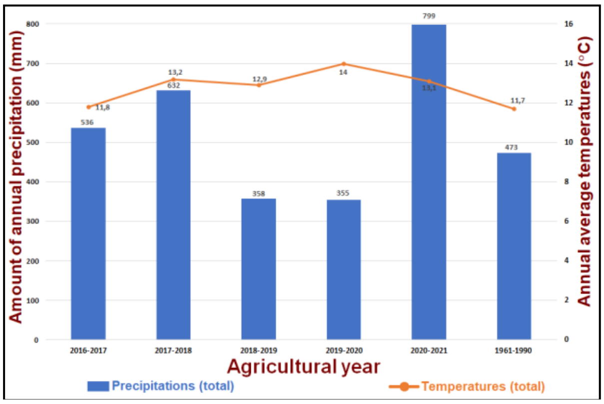

Fig. 1. Temperatures and precipitations from 2016-2021, compared to the average of 1961-1990
Source: Own determination.

Figure 1 shows the temperature and precipitation regime, which influenced the climate in the agricultural years of experimentation.

The average annual temperature during the experiment period was 13°C, with more than 1.3°C higher than the multiannual average (1961-1990). It is a high value, which speaks for itself about the stress suffered by plants in recent years. Also, the annual temperature variation is large, from 11.8°C in the agricultural year 2016-2017, to 14.0°C in the very warm and dry year 2019-2020. An amplitude of 2.2°C is observed only within the 5 analyzed years.

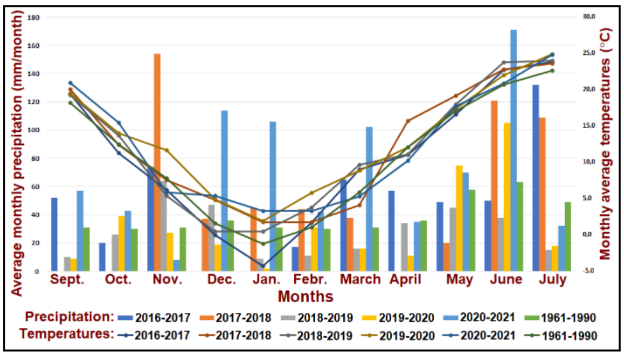

Fig. 2. Average monthly temperatures and precipitations from 2016-2021, compared to the average of 1961-1990
Source: Own determination.

The variation of precipitation in the studied period was also very large, from 355 mm in

the agricultural year 2019-2020 (with high water stress), to 799 mm in 2020-2021, i.e. over 2.25 times more. It should be noted that the most abundant rainfall fell outside the optimal range for plants, namely in June and July, during the harvest period (Figure 2).
On the other hand, in April and May, decisive for the formation of the wheat production elements, precipitations were reduced and often unsustainable by the water supply of the soil, so that the plants did not have the necessary water to achieve optimal yields, although the used technologies required yields of over 6 t/ha.
The role of the NDMI is to indicate exactly the water content in the plants, which correlates with the mapping of the phenological development of the varieties and, finally, with the level of harvests.
The NDMI calculation was performed in the following successive steps:
(1) Data for the 5 agricultural years (2016-2021) were collected from the satellite monitoring system (Sentinel-2).
(2) Data were analysed and the readings from the days with overcast skies were removed, since they gave non-compliant figures due to the lack of radiation reception by the evaluation bands.
The remaining data, confirmed with several observations made on the ground and/or with the personal drone (DJI Mavic 2 Pro) are then sorted in tables and subjected to calculations of correlative evolution over time.
For the five agricultural years (2016-2021), bifactorial (2D) functions were calculated between NDMI and time (170 days, on average, from February 1 to harvest time). We don't have similar data for the phenological evolution in autumn, so we excluded that period. The calculated functions are presented in five annual graphs. By summing up the data, the average NDMI for the period 2016-2021 was calculated, a parameter that shows us to what extent the studied area provides the water necessary for the phenological development and the achievement of the average wheat yield for the 7 varieties. The aim of this paper is to develop a model on the influence of climatic conditions on the water supply of plants, a model of water stress and to find out to what extent there is a correlation between the winter wheat yield and the NDMI results, thus verifying its correctness and usefulness for agriculture.

RESULTS AND DISCUSSIONS

To begin with, there is presented the scalar interpretation of NDMI. Assuming that NDMI varies between –1 and +1, the scale of interpretation in Table 1 is used.

Table 1. Interpretation of NDMI values – estimation

Crt. no.	NDMI value	Interpretation
1.	–1.0 → –0.8	Uncovered soil, without vegetation
2.	–0.8 → –0.6	Almost absent vegetation
3.	–0.6 → –0.4	Very reduced vegetation
4.	–0.4 → –0.2	Low and dry vegetation
5.	–0.2 → 0	Medium-low vegetation cover, high water stress
6.	0 → 0.2	Medium-low vegetation cover, low water stress
7.	0.2 → 0.4	Medium vegetation cover, low water stress
8.	0.4 → 0.6	High vegetation cover, no water stress
9.	0.6 → 0.8	Very high vegetation cover, no water stress
10.	0.8 → 1.0	Total vegetation cover, no water stress – optimized yields.

Source: Own determination.

Models of NDMI functions for the five agricultural years are shown in Figures 3-7.
The year 2017 starts on February 1 with a low to medium coverage of the plant sector (Figure 3). Plants come out of the winter already under water stress.

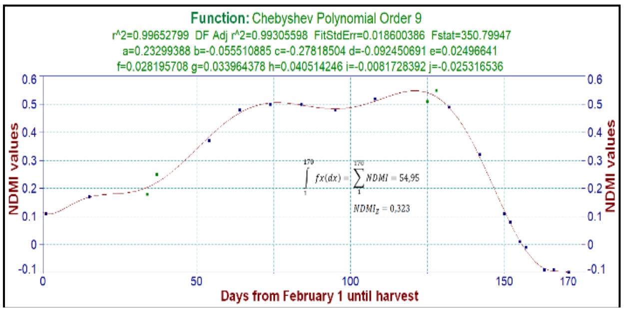

Fig. 3. The time dynamics of NDMI in wheat crop, spring-summer 2017
Source: Own determination.

The rains of April, May and June (first part) reduced the stress, the crop formed a high cover, in which the water stress was no longer felt until it entered in the maturation-harvest phase, at the end of June and beginning of July. The varieties had enough water during the formation of the reproductive organs. Overall, however, the integral under the curve, which gives us the sum of the daily values of NDMI during the vegetation period is relatively small (54.95) and leads us to a daily NDMI of 0.323 units, which can justify the yields of 5,139 kg/ha.

The year 2018 begins with high NDMI values (Figure 4), which remain high until the end of March due to high water reserves in the soil, as a result of the 160 mm of rainfall in November 2017, then supported by the 40 mm fallen in December 2017 – March 2018. The lack of precipitation in April and May led to the entry of vegetation under high water stress, with negative consequences on the formation of production. The tolerance to water stress of most varieties made the heavy rains that fell in early June led to improved production elements and helped them obtaining satisfactory yields.

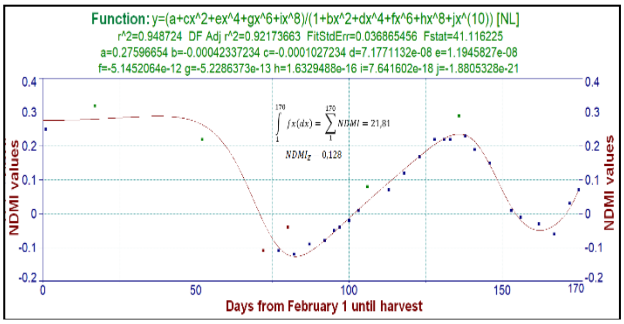

Fig. 4. The time dynamics of NDMI in wheat crop, spring-summer 2018
Source: Own determination.

This agricultural year (2017-2018) has shown that, if the crop has no hydric stress until the formation of fruiting, it better withstands the lack of rainfall in April, as long as the rains return in May-June to complete yields by improving its components. With the described parameters an average wheat yield of 5,512 kg/ha was obtained, even though the NDMI values were small (amount of 21,81 units, with a daily NDMI of 0,128 units).

The year 2019 falls between the first two years, without major stress in February and beginning of March and with a significant return of plant turgidity throughout the period from the beginning of stem formation to grain filling, but with stress before maturation. The amount of the daily NDMI values during the vegetation period is 41.69, which leads to a daily NDMI of 0.245 units (Figure 5), i.e. the stress exists, is low, but not sustainable. The yield obtained under these conditions was 5,915 kg/ha. We emphasize that although the precipitation in the vegetation was reduced, their distribution was very good.

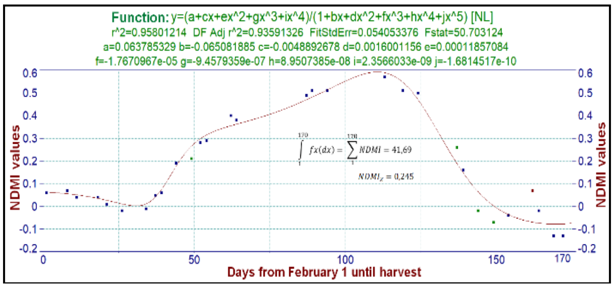

Fig. 5. The time dynamics of NDMI in wheat crop, spring-summer 2019
Source: Own determination.

The year 2020 was completely dry, the NDMI parameters being close to 0 at the beginning of the vegetation period and below 0, pronounced negatively for the entire vegetation period (the sum of the daily values was –2.62, and the daily NDMI was –0.015). The few rains that fell in May (towards the end of the month) couldn’t get the plants out of the permanent stress they were in, and those in June made it difficult to harvest and reduced the yields. The integral under the curve is negative (Figure 6), indicating the depth of stress in which the plants hardly withstood, manifested by low plant cover, low density and small ears. Average yield was 1,998 kg/ha, with low quality. An extreme year, so that only the late varieties reacted to the delayed humidity.

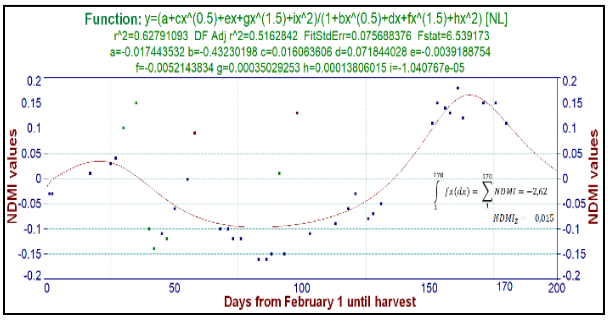

Fig. 6. The time dynamics of NDMI in wheat crop, spring-summer 2020
Source: Own determination.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The agricultural year 2020-2021 had a lot of rainfall, started in September 2020, continued in the spring of 2021, with excess even at harvest time, when they became restrictive on the final yield. Under these conditions, the dynamics of NDMI was extremely favorable to the wheat crop in spring, at the beginning of summer, in all the phenophases of its growth and development, with a smaller vegetal cover at the beginning and a well-developed one later, not being at all in water stress. However, there was a stress towards the end of the vegetation period, but it was caused by the degradation of the foliage due to the attack of diseases. Without water shortage, but with phytopathological stress, the crop suffers in the grain filling – maturation phase, reducing its yield and quality below the potential of the varieties. The amount of the daily values of NDMI during the vegetation period is 60.63, which leads to a daily NDMI of 0.356 units (Figure 7), the highest of the whole experimentation period, but the final result was influenced by the phytosanitary stress.

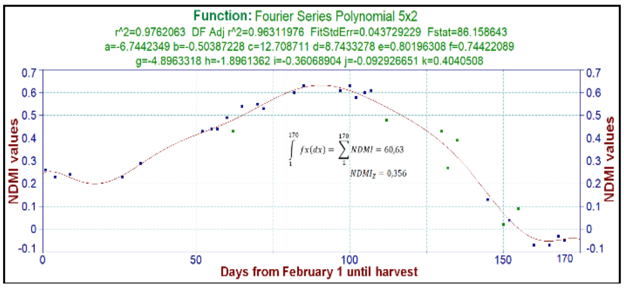

Fig. 7. The time dynamics of NDMI in wheat crop, spring-summer 2021
Source: Own determination.

From the NDMI evolution during the vegetation periods of the agricultural years 2016-2021 it can be seen a very large variability of the water stress intensity from one year to another. Only 2020-2021 wasn't under hydric stress, but the presence of water couldn't compensate for pest issues. Under these conditions, the yield reached only 5,512 kg/ha, less than in the years with lower NDMI values, but with a very good plant health, especially during the crop development stages. Having such a climate variability from one year to another, we tried to find a mathematical pattern for the entire period (2016-2021), which would describe the multiannual evolution of climate stress on wheat yield (Figure 8). A very complex function is observed and ensured by a correlation ratio r^2 = 0.255 and a determination of 25%. As the correlation coefficient for this very large number of determinations is $r = \sqrt{r^2} = \sqrt{0.255} =$ 0.505, we find that the model is statistically assured. It also shows us that the amount integral of NDMI over the period of wheat vegetation, which is 35.29 units, and the daily value of 0.207 places the southern part of Romania in a state of high stress for water in the case of a high cover (well-developed plants in spring) or in a lower state of water stress if the spring was drier and the crop had a low vegetative mass. In both cases, the yield will suffer, being greatly diminished below the potential of the varieties.

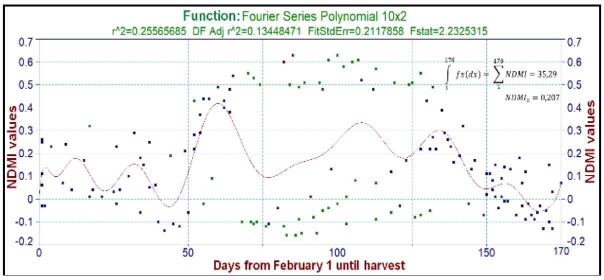

Fig. 8. The time dynamics of NDMI in wheat crop, spring-summer 2017-2021
Source: Own determination.

The mathematical pattern of the correlation between NDMI and the average wheat yield for the 7 varieties is presented in Figure 9, in the form of a polynomial function which is statistically ensured by a correlation ratio r^2 = 0.775 and a determination of 77.5%. It turns out that in 77.5% of cases the situation is the same as in this model.

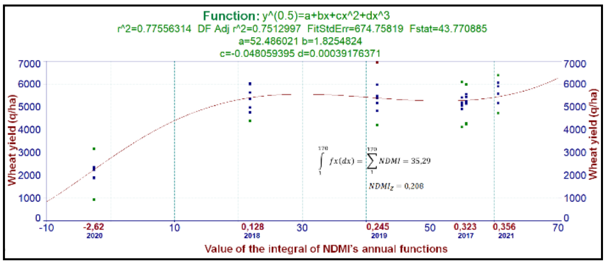

Fig. 9. Correlation between the total value of NDMI units and the wheat yields obtained, average for 7 varieties, in the agricultural years 2016-2021
Source: Own determination.

There are years when the average NDMI during the vegetation period was negative (–0.015), in which case the water stress of the crop is permanent, and the crop level is around 1,000 kg/ha for some varieties or around 2,000 kg/ha for the more tolerant ones. Once the indicator becomes positive (0.128) the stress continues to exist, but it's reduced, and the yield increases to 4,000-5,000 kg/ha and is maintained up to NDMI = 0.323. Reducing the stress by increasing the average daily indicator above this value makes the yield exceeding 6,000 kg/ha. Unfortunately, in the only year in which this situation was favorable for obtaining high yields (2020-2021), the phytosanitary stress appeared, preventing the studied varieties of reaching their maximum potential of, which is 9,000 kg/ha.

CONCLUSIONS

For the south of Romania, in the analyzed period (2016-2021) the climatic conditions were extremely variable, as a whole characterized by high temperatures and a precipitation regime that wasn't favorable for agricultural crops. Using the data obtained from the Sentinel-2 satellite, it was possible to calculate the moisture index (NDMI), which highlighted the fact that there is a correlation between the hydric stress, presented as NDMI units, and the wheat yields, as long as these measurements are correlated with the situation found in the field (direct visits or using drones), to identify the occurrence of other limiting factors (e.g., weeds, diseases or pests).

Average yields varied between 1,998 kg/ha (in the agricultural year 2019-2020, with an average daily NDMI of –0.015 units) and 5,915 kg/ha (in the agricultural year 2018-2019, with an average daily NDMI of 0.245 units).

Yields aren't significantly correlated with the level of rainfall in the area due to their random fall and often during harvesting time, causing damages instead of helping the crop. The efficiency of spring precipitation also depends a lot on the water supply of the soil. If it's missing, the rains are retained by the soil and enter into the hydration process of the plants only after the restoration of moisture above the wilting coefficient.

In these conditions, it is necessary to rethink the technologies, with emphasis on the tolerance of varieties to climatic stresses, but also on the recalculation of some inputs and on the way in which they are made available to plants.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

LABOUR COST IN RELATION TO FARM SIZE, MOTIVATION AND EMPLOYEE PROFILE

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Abstract

Current and future demographic, geopolitical and environmental challenges have led to research focused on analysing the cost of labour in agriculture in relation to farm size, motivation and employee profile. TwoStep Cluster analysis formed: Cluster 1 - average emotional motivation of 1.1 points and financial motivation of 3.6 points formed by employees with work experience between 0 – 20 years (frq. – frequency 69.8%), farms under 500,000 SO (frq. 72.3%). Cluster 2 (24.4%) average emotional motivation of 2.8 points and financial motivation of 2.1 points: employees with experience over 40 years (frq. 97.2%), women (frq. 44.2%) and SE Development Region (frq. 58.1%). Cluster 3 (33.9%) average emotional motivation of 3.6 points and financial motivation of 1.2 points: with experience between 3 – 40 years (frq. 63.2%), financial benefits 2 – 4 euro/hour (frq. 94.3%), farms over 750,000 SO (frq. 43.4%), male (frq. 51.1). The average level of net financial benefits is 4.8 euro/hour from 2.0 euro/hour for unqualified employees to 10.3 euro/hour for highly qualified employees; from 4.7euro/hour in farms of sizes between 100,000 SO – 250,000 SO to 6.5 euro/hour in farms under 100,000 SO. Gender shows a difference of 9.1%. The average level of emotional motivation is 1.9 points and increases from 1.5 points for 0 – 10 years of experience to 2.7 points for experience over 40 years; from 1.9 points in farms between 100,000 SO – 250,000 SO to 2.4 points in farms over 750,000 SO. Gender differentiates women from men by 7.0%. Pearson analysis of motivations – employee characteristics indicates a strong and significant inverse correlation between emotional motivations and financial benefits. The inflection point is at 28 years of experience and 4.9 euro/hour. The results suggest the need for managers to recognize employees emotional motivations and manage them dynamically and individually.

Key words**:** *labour cost, employee motivations, financial motivations, emotional motivations, employee profile*

INTRODUCTION

With unprecedented climate change, meeting future food demand will have to be achieved through sustainable intensification of agriculture: improved resistance to pathogens and reduced use of water, fertilisers, labour and fuels [10]. Shiferaw B. and other contributors consider that the size of the labour cost resulting in many of the research studies suggests a low level of technology, especially on small farms, which reduces the possibility of applying science-based management. As farm size increases, labour costs decrease and the incidence of science-based management increases [6]. Research among rural households in China shows that a 1% increase in farm size is associated with an almost 1% increase in agricultural labour productivity [13]. In response to rising labour costs, some farmers outsource some energy-intensive farm work such as harvesting. These are taken over by specialised agricultural service providers who travel around the country. Through such measures, small farmers can remain viable in agricultural production [15]. Labour productivity is one of the partial indicators of agricultural productivity, but it is still at the forefront in theory and practice. Labour output seems to be the most important driver of economic performance growth in agriculture even though information, technology and scientific research are the current economic trends [2].

Work productivity can be improved by introducing a reliable system for evaluating and motivating employees [14]. According to the value of production and gross value added of agriculture in Romania in the period 2011 – 2020 was lower than in other EU member states. The key factors of its growth are: farm structure and size, labour force, technical equipment and investments [9]. Emotionally and intellectually motivated employees feel a strong commitment to the employing organization. The problem of motivation is today a challenge for modern managers as a continuous and variable process that requires an individualized approach [4]. Practices to improve employee motivation and opportunities are linked to financial results both directly and indirectly by influencing human capital [5]. The results of research conducted by Ouakuak, M.L. shows that motivations with ethical and emotional character affect performance at the workplace and intentions to quit [7].

The aim of the research presented in this article was to analyse the cost of labour in agriculture in relation to farm size, motivation and employee profile.

MATERIALS AND METHODS

The research objectives involved conducting an online survey using a questionnaire with 9 questions. The questions in the questionnaire are targeted at: age, work experience, gender, region of development, skill level, name of employing farm, financial benefits, financial motivations and emotional motivations. The questions had fill-in-the-blank item responses, one-item text response selection items, and multiple responses. Likert scales with 1 - 5 points (1 - min., 5 - max.) were used to determine the intensity with which motivations are perceived. The order of the questions was determined according to progressive difficulty. The platform used to develop and distribute the questionnaires was Google Forms (https://www.google.com). The collection of responses was conducted in the last quarter of 2021, online, from subjects in the North-East Development Region of Romania. 254 questionnaires were obtained at a response rate of 72%. Sampling of the population in the NE and SE development regions was carried out using the Neyman method, 5% deviation criterion and 95% confidence level. Computer applications such as Microsoft Office, IBM SPSS Statistics 23 (Kolmogorov-Smirnov test, t-test) were used to process the data. Validation of the questionnaire results was carried out with Exploratory Factor Analysis (EFA) in SPSS to explain the covariation in the set of measured variables and to identify common factors that determine the structure and order of these variables [11, 12]. TwoStep Cluster Analysis in SPSS was used for preliminary data analysis. It performs natural clustering from a data set that is not otherwise highlighted. This clustering was based on categorical variables: age, work experience, gender, region of development, size of employing farm, skill level and financial benefits and continuous variables: financial motivations and emotional motivations. The size of the employing farm was determined by correlating the response on the name of the employing farm with the values in the sample farm dataset by size. In order to make it possible to analyse these employee characteristics, the variables age (0 - 20 years; 21 - 40 years; 41 - 60 years; over 60 years), work experience (0 - 10 years; 11 - 20 years; 21 - 30 years; 31 - 40 years; over 40 years), size of employing farm (under 100,000 SO; 100,000 SO - 250,000 SO; 250,000 SO - 500,000 SO; 500,000 SO - 750,000 SO; over 750,000 SO) and financial benefits (0 - 2.0 euro/hour; 2.1 - 4.0 euro/hour; 4.1 - 6.0 euro/hour; 6.1 - 8.0 euro/hour; over 8.0 euro/hour). The number of clusters was determined automatically and the database produced from the questionnaire was analysed. The application used a probability distance measure which is based on the assumption that the variables in the modelled clusters are independent [1]. The results obtained made it possible to establish criteria according to which the statistical analysis of the initial variables could be carried out.

RESULTS AND DISCUSSIONS

In the preliminary phase of the research, the use of TwoStep Cluster analysis tools on the characteristics resulting from the questionnaire (Fig. 1) led to the construction of three clusters with good form quality (0.62) and with the main predictors of importance: work experience, financial benefits, size of employing farms, gender and region of development.

Cluster 1 (41.7%) had an average emotional motivation of 1.1 points and financial motivation of 3.6 points. It consisted of employees with work experience between 0 - 20 years (frq. - frequency 69.8%), financial benefits 0 - 2.0 euro/hour (frq. 13.9%), size of employing farms below 500,000 SO (frq. 72.3%), gender male (frq. 45.3%) and development region South-East (frq. 69.7%).

Cluster 2 (24.4%) had an average emotional motivation of 2.8 points and financial motivation of 2.1 points. It consisted of employees with work experience over 40 years (frq. 97.2%), financial benefits 4 - 6 euro/hour (frq. 19.3%), size of employing farms 500,000 – 750,000 SO (frq. 38.7%), gender female (frq. 44.2%) and development region SE (frq. 58.1%).

Fig.1. Clustering of employees by main characteristics - results Cluster
Source Analysis: Own calculation.

Cluster 3 (33.9%) had an average emotional motivation of 3.6 points and financial motivation of 1.2 points. It consisted of employees with 3 - 40 years of work experience (frq. 63.2%), financial benefits 2 - 4 euro/hour (frq. 94.3%), size of employing farms over 750,000 SO (frq. 43.4%), gender male (frq. 51.1) and development region SE (frq. 60.4%).

The average level of net financial benefits by agricultural work experience (Fig. 2) is 4.8 euro/hour and increases from 4.3 euro/hour for employees with 0 - 10 years experience to 11.7 euro/hour for employees with more than 40 years experience.

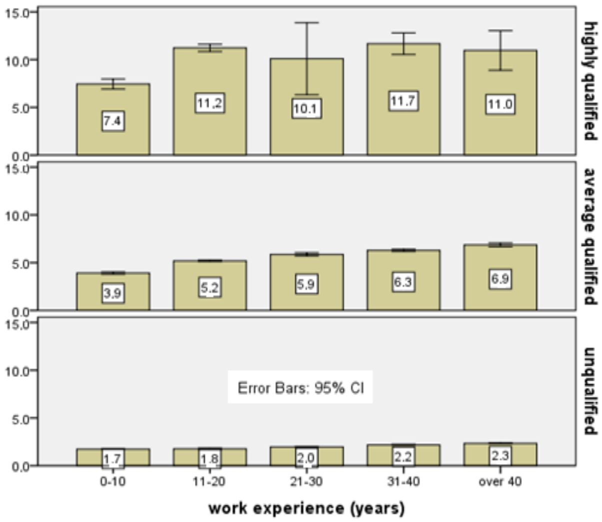

Fig. 2. Level of net financial benefits - average values (euro/hour) according to agricultural professional experience (years) and qualification level
Source: Own calculation.

Employees with experience of 0 - 10 years earn financial benefits that are 9.7% lower than the sample average and employees with experience over 31 years earn financial benefits that are 40.3% higher than the sample average. The average level of net financial benefits by skill level ranges from 2.0 euro/hour for unqualified employees to 10.3 euro/hour for highly qualified employees. In practice, highly qualified employees earn 114.2% more than the sample average and unqualified employees 58.3% less than the sample average. It is notable that there is some capping of financial benefits in two stages, from 11 - 20 years experience to 21 - 30 years experience and from 31 - 40 years experience to over 40 years experience. This phenomenon can also be put down to the decreasing marginal utility perceived by employees in the evolution of benefits but also to the insufficient capacity of management to capitalise on the marginal competence and experience of employees.

Employees can offer productivity gains that are not sufficiently used by farm management unless they are very obvious: the two thresholds of 11 and 31 years of experience.

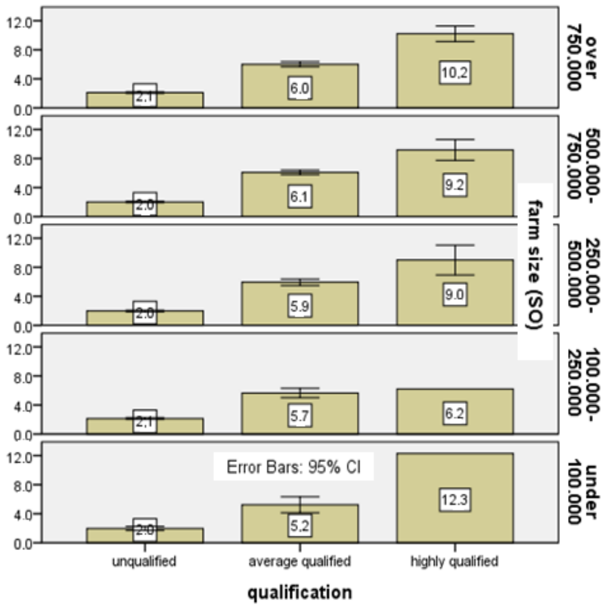

Fig. 3. Level of net financial benefits - average values (euro/hour) by economic size of the employing farm (SO) and skill level
Source: Own calculation.

All this against the background that labour migration is stimulated by the level of agricultural wages in Romania which are the lowest in the EU. The labour market is unbalanced, emigration to Western and Central Europe continues to be very high and poverty is a widespread phenomenon in many parts of the country [8].

Net financial benefits by economic size of the employing farm (Fig. 3) range from 4.7 euro/hour recorded in farms between 100,000 SO - 250,000 SO to 6.5 euro/hour benefit obtained in farms under 100,000 SO. These results are surprising as small farms are found to provide higher financial benefits than all other size categories. This phenomenon can be attributed to the additional benefits provided to highly qualified employees who also play an important role in farm management. Basically, employees with higher qualifications can perform several fractions of functions and receive cumulative benefits. Net financial benefits by skill level range from 2.0 euro/hour for unqualified employees to 9.4 euro/hour for highly qualified employees. Unqualified employees obtain significantly similar financial benefits regardless of farm size. In contrast, in the other categories financial benefits increase with farm size with the exception shown above: medium qualified employees on farms over 750,000 SO receive benefits with 15.4% higher than those on farms under 100,000 SO and highly qualified employees on farms over 750,000 SO receive 64.5% higher net benefits than on farms between 100,000 SO - 250,000 SO.

The development region has an average impact on financial benefits of 9.2% in favour of the SE development region (Fig. 4).

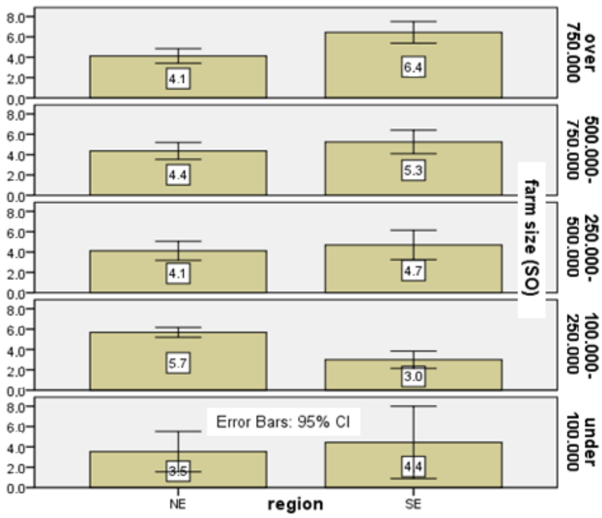

Fig. 4. Level of net financial benefits - average values (euro/hour) by economic size of the employing farm (SO) and development region
Source: Own calculation.

However, the lowest values are recorded by employees on farms in the same region with a size of 100,000 SO - 250,000 SO (31.0% lower than the average for farms in this size category).

There is also a significant gap in the financial benefits obtained by employees on farms over 750,000 SO in the SE, which are 56.1% higher than in the NE region. We believe that these are influenced by the labour pressure in the area which has higher incomes than in the northern half of the country.

The gender of employees shows a 9.1% difference between women and men (Fig. 5). Females on farms over 750,000 SO obtain benefits of 29.2% higher than the sample average and males on farms between 100,000

SO - 250,000 SO obtain financial benefits of 33.3% lower than the sample average. We believe that these differences are due to the fact that men reach the financial motivation plateau at lower values.

The intensity with which emotional motivations are perceived was determined in correlation with financial motivations. The average level of emotional motivations by work experience in agriculture (Fig. 6) is 1.9 points and increases from 1.5 points for employees with 0 - 10 years experience to 2.7 points for employees with more than 40 years experience. Employees with more than 40 years of experience perceive emotional motivations 43.9% more acutely than the sample average and employees with less than 10 years of experience are determined by emotional motivations 22.8% less than the sample average.

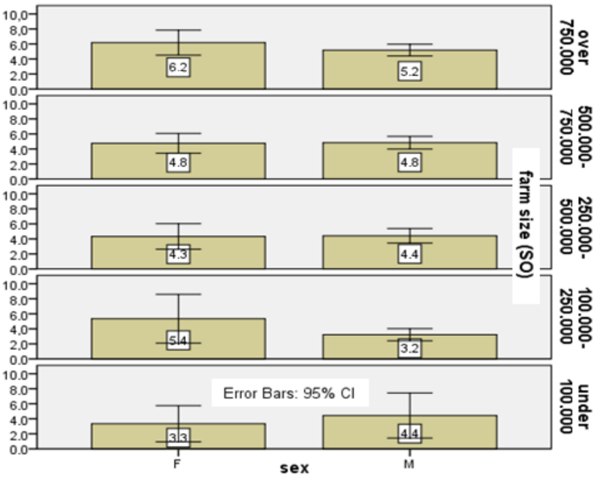

Fig. 5. Level of net financial benefits - average values (euro/hour) by gender of subjects and economic size of employing farm (SO)
Source: Own calculation.

The weakest emotional motivations are found in unqualified employees with less than 10 years of experience (68.4% more) and the strongest emotional motivations are found in highly qualified employees with more than 31 years of experience (105.3% more). The high variability in the perception of this type of motivation is justified by the complementarity with financial motivations. Emotional motivations are more intense the more financial motivations are attenuated by the satisfaction given by financial benefits.

The average level of emotional motivation by skill level ranges from 0.9 points for unqualified employees to 3.4 points for highly qualified employees. Basically, highly qualified employees perceive emotional motivation 78.9% more strongly than the sample average and unqualified employees 50.5% less than the sample average.

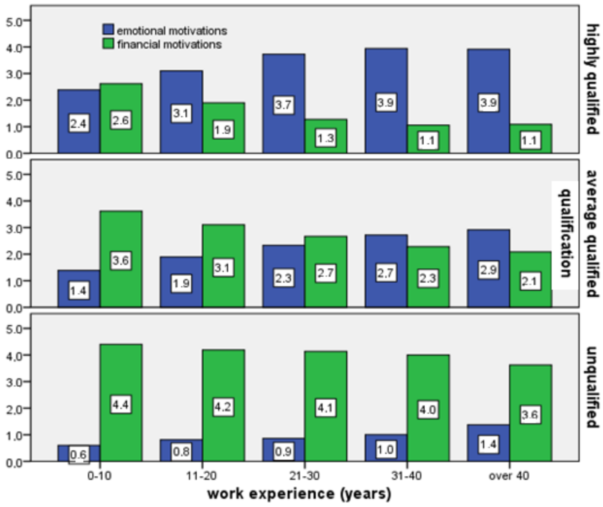

Fig. 6. Level of motivation - average values (points: 1-min., 5 max.) according to professional experience and qualification level
Source: Own calculation.

The level of emotional motivations according to the economic size of the employing farm (Fig. 7) varies from 1.9 points recorded in farms of 100,000 SO - 250,000 SO to 2.4 points value obtained in farms of over 750,000 SO.

The intensity of emotional motivation by qualification level ranges from 0.9 points for unqualified employees to 3.4 points for highly qualified employees.

A maximum level of 136.8% higher than the sample average is observed for highly qualified employees in farms under 100,000 SO, which can be attributed to the more personal relationships in small economic entities. Also, the lowest values of emotional motivations are found for unqualified employees in farms between 100,000 SO - 250,000 SO and 250,000 SO - 500,000 SO where the intensity with which these motivations are felt is 57.9% respectively 52.6% lower than the sample average. We justify these values by the dissatisfaction offered by financial benefits.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

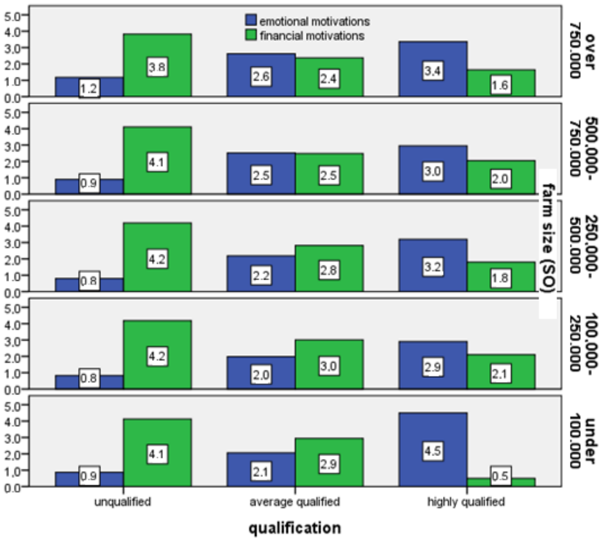

Fig. 7. Level of motivation - average values (points: 1-min., 5 max.) by size of employing farm (SO) and level of qualification
Source: Own calculation.

It shows a maximum level of 136.8% higher than the sample average for highly qualified employees in farms under 100,000 SO due to more personal relationships in small economic entities. Also, the lowest values of emotional motivations are found for unqualified employees in farms between 100,000 SO - 250,000 SO and 250,000 SO - 500,000 SO where the intensity with which these motivations are felt is 57.9% respectively 52.6% lower than the sample average. We justify these values by the dissatisfaction offered by financial benefits.

This segment of the population provides low productivity, inconsistent financial rewards and no room for other motivations. These considerations are also reflected in the results of other research which shows that the population employed in agriculture is ageing and has a low level of education. Also, 96.4% of people employed in agriculture have only practical experience [3].

The development region has a medium impact on emotional motivation with 7.5% in favour of the NE development region (Fig. 8). The lowest values are recorded by employees in farms of size 100,000 SO - 250,000 SO in the SE region.

There is also a significant gap in the perceived emotional motivations of employees in farms of size 100,000 SO - 250,000 SO in the NE, which are 140.0% higher than those in the SE region.

We consider that some of these farms are family businesses employing relatives and their attachment to the farm is higher than others.

Medium and large farms in the NE region have mostly been consolidated through joint ventures, with performance-based hiring and financial motivations taking precedence over emotional ones.

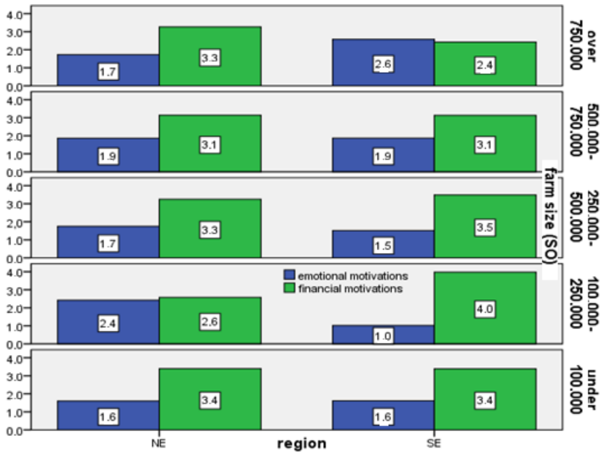

Fig. 8. Level of motivation - average values (points: 1-min., 5 max.) by size of employing farm (SO) and development region
Source: Own calculation.

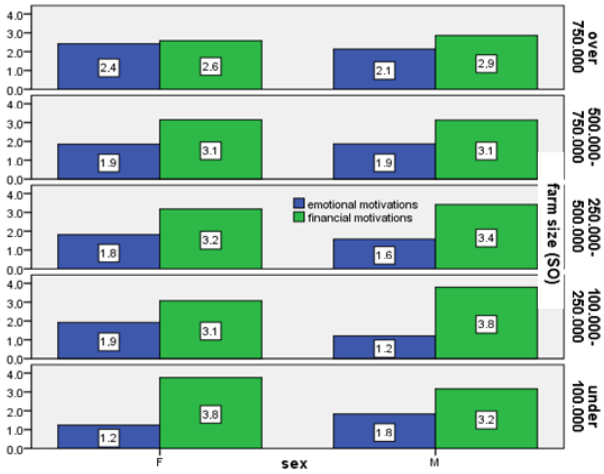

Fig. 9. Level of motivation - mean values (points: 1-min., 5 max.) by size of the employing farm (SO) and gender of the subjects
Source: Own calculation.

Gender of employees shows a 7.0% gender gap in favour of women.

Women on farms over 750,000 SO feel emotional motivations 26.3% more strongly than the sample average and men on farms between 100,000 SO - 250,000 SO feel these motivations 36.8% less than the sample average.

The same lower level is recorded for women in farms under 100,000 SO justified by the lower level of financial benefits they obtain in these farms.

Pearson correlation analysis between motivations and employee characteristics (Table 1) indicates a weak non-significant relationship between employee age and financial motivations but a statistically significant one for emotional motivations.

Table 1. Employee motivations and characteristics - mean values, standard deviations and multiple correlations

	Mean	Std Dev	Financial motivations	Emotional motivations
1. Age (years)	45.1	0.94	-0.16	.34**
2. work experience (years)	27.1	0.94	0.42	.82**
3. Net benefits (euro / hour)	4.8	0.92	-.78**	.64**
4. Firm size (SO)	228,451	0.96	0.27	0.31
5. Financial motivations	3.1	0.97	-.68**	-
6. Emotional motivations	1.9	0.92	-	-.68**

Financial motivations and emotional motivations 1-5, **Correlation is significant at the .01 level (2-tailed). N=254,
Source: Own calculation.

In contrast, work experience shows strong and significant correlations for emotional motivations but not statistically significant for financial benefits. The increase in net financial benefits leads to a strong reduction in financial motivations and, to a lesser extent, an increase in emotional motivations (by 21.9%). The inflection point at which the significant reduction in average financial motivations occurs is at 34 years of experience and 5.3 euro/hour (2.4 euro/hour for unqualified employees, 3.4 euro/hour for medium qualified employees and 5.8 euro/hour for highly qualified employees). For emotional motivations, the inflection point is at 28 years of experience and 4.9 euro/hour (2.8 euro/hour for unqualified employees, 3.7 euro/hour for medium qualified employees and 5.2 euro/hour for highly qualified employees).

Farm size does not provide statistically assured information on the relationship with the two types of motivation. The relationship between financial and emotional motivations are perceived by the subjects as strongly complementary, are statistically assured but also suggest the presence of other types of motivations that they did not find in the questionnaires. Consequently, the limitations of the research lie in the too cumulative nature of the two types of motivations which does not ensure a complete relevance of the employees motivation system. Future research could use a more detailed motivation system that would allow subjects to quantify their own perceptions more rigorously.

However, the results obtained are useful for farm management in agriculture because they provide benchmarks of importance and content of motivations. Managers can use these benchmarks to increase work productivity and employee quality of life.

CONCLUSIONS

The capping of financial benefits is probably driven by the phenomenon of diminishing marginal utility perceived by employees and the insufficient ability of management to leverage the marginal competence and experience of employees. In practice, productivity gains are missed and not sufficiently used by farm management. The gap in financial benefits obtained by employees in the SE and NE Development Regions is driven by labour pressure and higher average income levels in the South than in the North. The high variability in the perception of emotional motivations is partly explained by the complementarity with financial motivations. Unskilled employees on small and inexperienced farms perceive the dominance of financial motivations and are less sensitive to emotional motivations due to dissatisfaction induced by financial benefits.

The gap in the intensity of emotional motivations perceived by employees in the NE Development Region compared to those in the SE Region is due to the type of entrepreneurship, employees attachment to the farm, the mode of capital formation and the priority recruitment criteria for employers. Employees with above-average work experience, qualifications and net financial benefits perceive emotional motivations more acutely due to higher levels of satisfaction with other motivations and different perspectives on the relationship between personal fulfilment and professional fulfilment.

ACKNOWLEDGEMENTS

This research is a partial part of the subsidiary contract no. 1.D.119611/ 30.06.2020, entitled "Research on the formation of costs in agricultural crops and the development of a digital application for their monitoring, in order to improve operational management at farm level", signed between Iași University of Life Sciences and YXS Avalana LTD, as research partners.
The study is part of the Type D collaboration activities - Industrial research and/or experimental development activities carried out by the research organization in effective collaboration with the enterprise, Sub-activity D.1 Industrial research activities.
This research is co-financed by the European Fund for Regional Development through the Competitiveness Operational Program 2014 – 2020, project “Establishment and implementation of partnerships for the transfer of knowledge between the Iasi Research Institute for Agriculture and Environment and the agricultural business environment”, acronym “AGRIECOTEC”, SMIS code 119611.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPLEMENTATION OF DIGITAL DECISION SUPPORT SYSTEMS IN AGRICULTURAL FARMS - LIMITATIONS AND DETERMINING FACTORS

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Abstract

The aim of the research is to identify the factors that determine the adoption of Decision Support Systems (DSS) on Romanian crop farms. Qualitative research shows that the majority of farmers interviewed believe that the decision to implement DSS is based on: acquisition-use costs; time consumption; complexity; overall usefulness; intuitive interface; technical and economic support; solution provision. The relative importance of DSS application features recorded a minimum 2.8 pct. (on a scale of 1-7) for technical features and a maximum of 6.1 pct. for time consumption. The relevance of the applications was rated by farmers at 1.8 points, minimum 1.1 points - general relevance and maximum 2.1 points - cost. The Pearson correlation analysis between age and overall relevance rating was -0.59. Farmers with above average age consider too complex (-0.42). Education completed makes DSS applications seem less complex (0.56) and their economic functions more interesting (0.47). The economic dimension is related to acquisition cost (0.33); time consumption (-0.38) and economic functions (0.84). Relevance to farmers' interests with farm size relates moderately to strongly (0.72). Certified digital skills and quality of internet connection do not influence application quality dimensions probably due to the developed mobile network system in Romania.

Key words*: *agrarian economy, farm management information systems, smart farming, enterprise resource planning

INTRODUCTION

Current smart farming solutions apply information systems and technologies with the aim of increasing economic yields and optimizing input consumption [10; 16; 24]. Recently, more and more digital technologies are available for agricultural producers. Advanced Decision Support Systems (DSS) are increasingly appreciated because they enable farmers to make decisions based on technically, managerially and economically consistent information [7; 8]. In agriculture, DSS have been developed for several types of tactical and strategic decisions: increasing productivity, efficient resource allocation, adaptation to climate change and avoiding food waste [5; 9; 18; 30].

Web-based Enterprise Resource Planning (ERP) systems are also flexible, adaptable to user profiles [15] and capable of connecting for integrated use of multiple applications [28]. However, they also need some improvements. The development and implementation of DSS and ERP is also hampered by some technical features such as data standards, integration of autonomous systems and software intelligibility [8; 27]. There is a need for DSS applications that compare the economic implications of alternative technology systems and investments, determining their returns and cost-effectiveness [1; 4; 6]. Inwood S.E.E. et al. Believe that ERP systems can be more useful if they can provide a simple user interface with dynamic intelligent forms required for user data entry as well as customizable data visualization [11]. The process of implementing digital solutions requires resources and skills that not all entrepreneurs have [21]. Farm size and financial availability are internal resources that can be significant barriers to the use of digital technology [3; 14]. Necessary external resources are internet connectivity, data transfer and privacy regulations are other factors considered as barriers to DSS and ERP implementation [13; 20]. In contrast, farmers with internet access face information overload and have to consume significant time resources to manage it [22; 23]. Moreover, entrepreneurs also need to have specific digital skills - referred to as 'dynamic' [25] - to be able to adequately achieve a digital transformation of their business [2; 29]. Added to these are language barriers [27]. The firm's ability to reconfigure, build and integrate internal and external skills is also required to enable dynamic development in this regard [25]. All these conditions, barriers and factors can lead to specific disparities in the process of implementing digital technologies.

The latter, in turn, can lead to worsening the unequal distribution of value that exists between small and medium-sized entrepreneurs (especially in upstream supply chains) on the one hand and large players (downstream supply chains such as distribution and retail) on the other [8; 12]. To overcome these problems, it is appropriate to design and further develop DSS in correlation with demand (end-users). These processes should be carried out through iterative participatory learning. It provides several means by which producers and users of DSS, through such a dialogue, can learn and choose to implement, the technology knowledge and skills acquired [1]. National development strategies and specific competition between producers of smart agriculture solutions can be vectors to align the interests of suppliers and demand for such products [17].

The purpose of the research is to identify the factors that determine the adoption of digital technologies in vegetable farms in Romania with the objectives: (1) to establish the general perception of farmers regarding DSS applications, (2) to determine the relative importance of the characteristics of DSS applications, (3) to quantify the relevance of DSS for users and (4) to determine the barriers, inhibiting or stimulating factors for the use of these applications on farms. This research did not aim to provide a rating of existing DSS applications on the market but to provide information on directions in which these can be developed to increase the degree of implementation of these solutions by farmers.

MATERIALS AND METHODS

The field research was conducted on a representative sample by size categories of 60 farms in the NE and SE development regions, 30 from each region and 5 from each county. The 5 farms were selected by economic size (below 100 thousand SO; 100 thousand SO - 250 thousand SO; 250 thousand SO - 500 thousand SO; 500 thousand SO - 750 thousand SO; above 750 thousand SO). The economic size of the farms was pre-determined in the research project using this sample to determine costs in agriculture for the development of a proprietary DSS application.

1. To establish farmers' general perceptions of DSS applications, qualitative research was conducted in the form of a telephone interview with sampled farm managers. The objectives of the interview were to determine the appetite for the use of DSS applications and to identify the main issues leading to the use or rejection of these applications. Basically, this stage was the pre-launch on which the design of the other stages was based. Subjects were informed that they would subsequently receive a questionnaire based on their interview responses. This questionnaire will have included questions about the most important features of the DSS applications and their quality.

2. The relative importance of DSS application features was determined by quantitative research, as in the following steps. Eight graded questions on the Linkert scale (1-7) were developed. These questions were developed according to the subjects' opinions (questions 6-13). Subjects were advised to give the extreme values (1 and 7), minimum and maximum respectively at the beginning of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

completing the importance values and then to rate the other characteristics.

3. Quantification of the relevance of the DSS to users was determined by 8 questions also graded on the Linkert scale (1-7). The questions asked for an overall assessment of the quality of the applications they were offered by the providers or the ones they use (questions 14-2). Respondents were also advised to give the minimum and maximum values at the beginning of the completion of the quality values and then to rate the other characteristics. Data on the importance of each characteristic were transformed into subunit values and corrected the scores given to the quality of the applications. The results give a more accurate picture of the extent to which farmers value DSS applications.

4. The determination of barriers, inhibiting or stimulating factors to the use of these applications on farms was done by determining statistically assured correlations between farmer profiles and responses on the perceived importance or quality of DSS application [27].

Table 1. Questionnaire for surveyed farmers - content and form

Nr. crt.	Objective of the question	Form of the question	Answer options / content
Farmers profile			
1	use/knowledge of DSS applications		yes / no
2	age	completion item	text (age)
3	graduated studies	selection items	text (age)
4	digital skills developed	selection items	Linkert scale 1-7 where 1 represents avoidance of using software applications and 7 represents fluent use of software applications available
5	quality of internet connection		Linkert scale 1-7 where 1 is no internet connection 7 is excellent internet connection
Relative importance of DSS application features attributed by farmers			
6	costs of acquisition and use	selection items	Linkert scale 1-7 where 1 represents the minimum importance and 7 represents the maximum importance attributed to that characteristic Subjects were advised to give the extreme values (1 and 7), minimum and maximum respectively, at the beginning of completing the importance values and then rate the other characteristics.
7	the time required to use		
8	complexity		
9	relevance to farmers' interests		
10	intuitive interface		
11	technical functions		
12	economic functions		
13	algorithms for building recommended solutions		
Assessing the relevance of DSS application features from a farmer perspective			
14	costs of acquisition and use	selection items	Linkert scale 1-7 where 1 represents the minimum quality attributed to each characteristic and 7 represents the maximum quality attributed to each characteristic Respondents were advised to give the minimum and maximum values at the beginning of filling in the quality values and then assess the other characteristics.
15	the time required to use		
16	complexity		
17	relevance to farmers' interests		
18	intuitive interface		
19	technical functions		
20	economic functions		
21	algorithms for building recommended solutions		

Source: Own design.

The platform used to develop and administer the questionnaires was Google Forms (https://www.google.com). The collection of responses was carried out in the first quarter of 2022, online following the telephone interview carried out in the pre-launch phase which took place at the beginning of the year. Data processing and analysis of the results was carried out using IBM SPSS Statistics 23 and Microsoft Office applications for the creation of the main databases and for data validation and analysis respectively.

RESULTS AND DISCUSSIONS

In the interview phase, all farmers in the sample (n=60) were contacted by telephone and further information was obtained on the use, relevance, limitations of implementing DSS applications on their farm. 88.3% of the sampled farmers (n=53) responded to the questionnaire administration.

1. Establishing farmers' general perceptions of DSS applications led to the completion of the research design.

By the technique of triangulation of the subjects' opinions, the main issues to be considered in the decision to purchase and implement these applications on farms were identified: the level of the applications' prices and costs of use; the time required to use these applications for data entry; their complexity in terms of form and content; the extent to which they serve farmers' interests; the extent to which they have an intuitive interface; the extent to which they provide support for technical decisions; the extent to which they provide support for economic decisions; the ability to provide recommended solutions.

2. The relative importance of DSS application features scored an average of 4.0 importance points (on a scale of 1-7) with the lowest value (2.8 pct.) for the existence of technical features within the applications.

The maximum value was attributed to time consumption (6.1 pct.).

This was given by the high share of farms above 250 thousand SO which rated the average importance of this characteristic at 6.4 pct. (Fig. 1).

The responses of farms under 100 thousand SO who rated the complexity with 6.1 and farms over 500 thousand SO who consider that the economic functions and the functions through which solutions are recommended are particularly important.

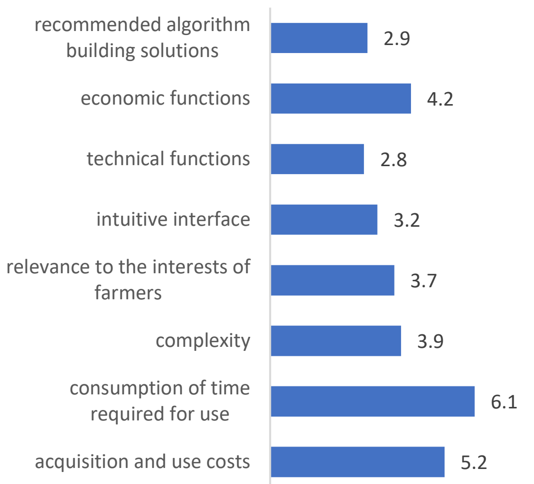

Fig.1. Level of importance of DSS application features in farmers' perceptions (1-7)
Source: Own calculation.

3. The quantification in nominal values of the relevance of the DSS to users resulted in an average of 3.2 pct. of importance (on a scale of 1-7) with a minimum value (2.1 pct.) for relevance to farmers' interests and a maximum value of 4.4 pct. for the technical component of the applications (Fig. 2). This component is highly valued by farmers because it allows to reduce diesel consumption and facilitates the organisation of farm work.

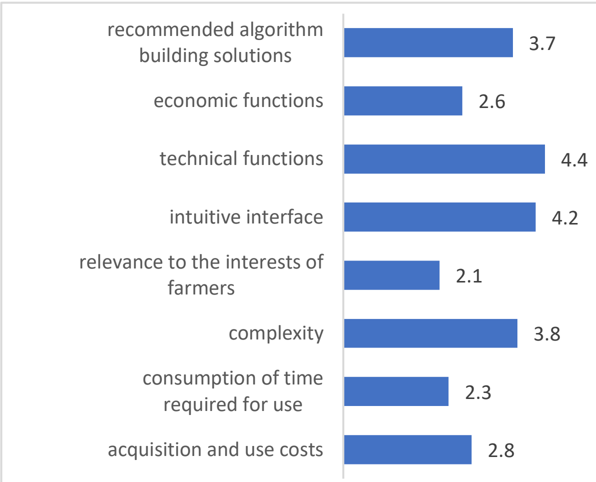

Fig. 2. Quality of DSS applications perceived by farmers with regard to application features (nominal values 1-7)
Source: Own calculation.

The highest average values were obtained for farmers with a farm size between 250 thousand SO - 500 thousand SO (4.1 pct.) probably due to the fact that they have a smaller crop structure and consequently do not consume a large amount of time to enter data into the application. This was also the feature they rated the highest (6.2 pct.).

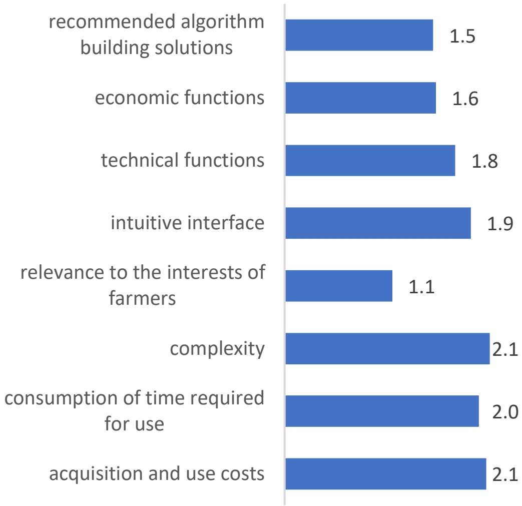

Fig. 3. Quality of DSS applications corrected for perceived importance by farmers (calculated values 1-7)
Source: Own calculation.

The relevance of applications in importance-adjusted values was rated by farmers at an average level of 1.8 pct. (on a scale of 1-7) (Fig. 3). These results are important for agriculture and DSS application providers as they do not express a positive perception of the usefulness and quality of these products. Of course, it is possible that some judgements were made by farmers from memory. Some farmers do not have such applications but only remember the reasons why they refused them when they were presented by suppliers. However, this information presents new challenges for DSS developers and bodies who understand that the digitisation of agriculture is a vector for the sustainable development of this economic sector. The minimum value of this indicator was 1.1 points for relevance to farmers' interest and the maximum value was 2.1 points for cost of acquisition. These values were obtained mainly from farmers who own such software. They do not consider the costs of purchasing and using them to be burdensome, but consider that they may be more relevant to farm activity. Our results confirm some results of previous research [19; 26; 27, 31] which state that in particular the technical characteristics of digital products play an important role in on-farm implementation. These relate to the low interoperability between devices. On the other hand some researches appreciate the high costs that limit the full potential of a certain technology of this kind [8]. Our research does not confirm such results. On the contrary, the costs most highly appreciated.

4. The determination of barriers, inhibiting or stimulating factors to the use of these applications on farms were determined by making multiple correlations between farmer profiles and the evaluation of DDS application components.

Table 2. Pearson multiple correlations between farmer profile and evaluation of DDS application components

Components of DSS quality as perceived by farmers	Mean	Std Dev	age	graduated studies	the economic size of the farm	digital competences	quality of internet connection
acquisition and use costs	2.8	1.73	0.12	0.33**	0.28**	0.04	0.13
consumption of time required for use	2.3	1.65	0.06	-0.05	0.38**	0.09	0.03
complexity	3.8	1.62	-0.42	0.56**	0.14	-0.16	0.07
intuitive interface	4.2	1.78	-0.21**	0.08	-0.02	-0.15	-0.12
technical functions	4.4	1.73	-0.16	0.23	0.22	0.09	0.09
economic functions	2.6	1.75	-0.12	0.47**	0.84**	0.07	0.06
recommended algorithm building solutions	3.7	1.61	-0.26	0.17	0.51	0.22**	0.19
relevance to the interests of farmers	**2.1**	**1.98**	**-0.59****	**0.79****	**0.72****	**0.41**	**0.11**

Financial motivations and emotional motivations 1-5, **Correlation is significant at the .01 level (2-tailed). N=53,
Source: Own calculation.

Pearson correlation analysis between age and the components by which DSS applications were rated indicates a weak relationship with the complexity rating but this is not statistically assured. On the other hand, the overall relevance rating shows a moderate negative correlation (Pearson coefficient -0.59) (Table 2).

We can assume that older farmers find these applications too complex and therefore not useful. The education completed relates to the grades given to several components of the applications. The weak relationship between acquisition cost and use (0.33) indicates a higher tolerance of larger farms to investment in general and in this direction in particular. Also, with increasing years of education, farmers consider DSS applications less complex (0.56) and are more interested in their economic functions (0.47). Consequently, studies are strongly related to relevance to farmers' interests (0.79). The economic dimension has a weak direct relationship with the cost of acquisition (0.33) and a weak indirect relationship with time consumption (-0.38). Small farmers are particularly dissatisfied with the costs involved in DSS applications and with increasing farm size the time consumption they require is more important. But the strong relationship between farm size and economic functions (0.84) justifies the obvious need for them. Given this, relevance to farmers' interests is implicit and the relationship with farm size is moderate to strong (0.72). These results are consistent with previous findings by other researchers that the implementation of decision systems is influenced by farmers' individual perceptions of innovation. These are in turn determined by the user profile and farm characteristics. Age, education level and farm size are recurring factors [8; 32]. Certified digital skills are weakly related to relevance to farmers' interests but this is not statistically assured. Moreover, the quality of internet connection does not correlate with either component and does not condition farmers' appetite for DSS use. We justify this by the high quality and good coverage of mobile internet networks nationwide.

The limitations of the research are given by the structure of the sample which is not representative for agriculture in the Eastern regions of Romania but for the size categories presented above. Very small farms are not sufficiently represented. This decision was taken in line with the economic impact of these farms on the sector.

CONCLUSIONS

The qualitative research revealed that the majority of the farmers interviewed consider that the main issues to be considered when deciding on the purchase and implementation of DSS applications on farms are: application prices and costs of use; time required for use and data entry; complexity; usefulness or general relevance; intuitive interface; support for technical decisions; support for economic decisions; provision of solutions. The relative importance of DSS application features was rated with maximum values for time consumption followed by acquisition and usage costs. The relevance of applications in importance-adjusted values was poorly appreciated by farmers, which expresses a negative perception of the usefulness and quality of DSS. Given that the highest score was obtained for acquisition and use costs, we believe that farmers feel the costs of acquisition and use are burdensome. In contrast, overall relevance was rated least highly. In agriculture there are not enough general decision tools that are used in all economic units. DSS products need to be developed in collaboration with farmers and agricultural specialists to ensure the specificity that this type of activity implies. Pearson correlation analysis between age and general relevance assessment shows a moderate negative correlation. Farmers above average age consider these applications too complex and therefore unnecessary. The education completed makes the DSS applications seem less complex and their economic functions more interesting. The economic dimension has a weak direct relationship with purchase cost and a weak indirect relationship with time consumption. The strong relationship between farm size and economic functions justifies the obvious need for them.

Relevance to farmers' interests is moderately to strongly related to farm size. Certified digital skills do not correlate statistically with any of the application quality dimensions. Neither does the quality of internet connection influence any of the components and does not condition farmers' appetite for using DSS probably due to the developed mobile network system in Romania.

ACKNOWLEDGEMENTS

This research is a partial part of the subsidiary contract no. 1.D.119611/ 30.06.2020, entitled "Research on the formation of costs in agricultural crops and the development of a digital application for their monitoring, in order to improve operational management at farm level", signed between Iași University of Life Sciences and YXS Avalana LTD, as research partners.

The study is part of the Type D collaboration activities - Industrial research and/or experimental development activities carried out by the research organization in effective collaboration with the enterprise, Sub-activity D.1 Industrial research activities.

This research is co-financed by the European Fund for Regional Development through the Competitiveness Operational Program 2014 – 2020, project “Establishment and implementation of partnerships for the transfer of knowledge between the Iasi Research Institute for Agriculture and Environment and the agricultural business environment”, acronym “AGRIECOTEC”, SMIS code 119611.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

METHODOLOGICAL APPROACHES TO OPTIMIZING THE STRUCTURE OF OWNED AND LOAN CAPITAL OF AGRICULTURAL ENTERPRISES

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Abstract

The success of the functioning of agricultural business entities largely depends on the ratio of all types of owned and loan financial resources used to finance their assets. Currently, there is no single approach to choosing the optimal ratio of equity and debt capital. And this applies not only to various economic enterprises engaged in the same type of activity, but also to a single participant in the agricultural business in a changing commodity and financial market environment. Therefore, optimization of the capital structure of an economic entity is a continuous process that requires adaptation to a constantly changing market situation and justification of methodological approaches to choosing the best ratio of its components. The urgency of the identified problem justified the need to analyze the composition and movement of equity and land capital of individual participants in the agricultural business of the Penza region. In the current research: an assessment of the main factors that determine the structure of capital is discussed, and the influence of sectorial agricultural specifics on the formation of the share of owned and loan capital in asset financing and in determining the level of financial leverage was observed. Based on the results of the research, a methodology for determining the optimal structure of the capital of a subject of agricultural business was proposed. The ratio of maximizing profitability and minimizing financial risk was chosen as an optimality criterion, which would ensure the success of the implementation of the financial strategy of an economic enterprise.

Key words: *owned capital, loan capital, capital structure, return on equity, financial risk*

INTRODUCTION

In the current economic conditions in Russia, agricultural activity is seen not only as the primary need for food production for the country's population, but also as a source of income. Agricultural business is successfully developing in all agricultural sectors. Making a profit does not depend on the chosen direction of activity, the main condition is the rational organization of the business. The viability of the agricultural business is ensured by solving many economic problems, including the optimization of the capital structure. The ratio of owned and loan sources of asset formation is one of the basic criteria for the financial stability of a business participant. The issues of capital structure management are widely discussed in economic researches [6, 7, 8, 9, 11, 14], however, the problem of determining methodological approaches to optimizing the structure of equity and debt capital requires further development.

The optimal capital structure is such a ratio of owned and loan funds, which provides the best value of the optimality criteria for a given level of financial stability of the organization. The most important optimization criteria are: the maximum level of projected return on equity and the minimum level of financial risks [1, 13].

MATERIALS AND METHODS

The methodological basis of the study was the fundamental provisions of the scientific theory of the essence of capital, modern research by domestic and foreign scientists. The study is based on the methods used in economic science: general scientific (dialectical, analysis and synthesis, comparison and analogy), special (systemic, comparative analysis). The information base of the study was official statistics; normative legal acts of the federal and regional levels; data from the Ministry of Agriculture of the Penza Region; financial statements of individual subjects of the agricultural business of the region, materials of their own research; data from Internet resources (scientific articles and works of practitioners, industry portals, economic reviews).

RESULTS AND DISCUSSIONS

For the majority of participants in the agricultural business of the Penza region (Russia), the priority is to maintain a sustainable production process and a stable financial condition. The choice of a scheme for financing activities is inextricably linked with taking into account the peculiarities of using both owned and loan capital. Organizations that use only their own capital have the highest financial stability, but limit the pace of their development, as they could not ensure the formation of the necessary additional volume of assets during periods of favorable market conditions and do not realize the financial opportunities for increasing return on invested capital, which gives the use of loan capital [3, 10]. The study of the methodological foundations for optimizing the structure of equity and loan capital was carried out according to the accounting data and financial statements of three participants in the agricultural business of the region (Materials of the Federal State Statistics Service, 2022) [12], who have different areas of activity: dairy - Uchhoz Ramsay PGSHA JSC - (I); grain and milk - AK Rodina Radishcheva - (II); grain – Kameshkir Feed Mill LLC - (III). As an example, Table 1 shows the dynamics of the components and the structure of owned and loan capital according to participant (I).

Table 1. Structure of owned and loan capital of an agricultural company, rubles

Source of funds	2018	2019	2020	Absolute deviation 2020 from, (+;-)		Growth rate 2020, %	
				2018	2019	2018	2019
Owned							
Authorized capital	72,380	72,380	72,380	-	-	100.00	100.00
Reserve capital	449	545	583	134	38	129.84	106.97
Undestributed profits	7,893	9,123	8,541	648	-582	108.21	93.62
Total	80,722	82,048	81,504	782	-544	100.97	99.34
Loan capital							
long term duties	4,166	4,552	11,012	6,846	6,460	264.33	241.92
short-term obligations including: loans	474	-	-	-474	-	-	-
Accounts payable	27,868	28,454	17,203	-10,665	-11,251	61.73	60.46
Other current liabilities	4 839	3 116	-	-4,839	-3,116	-	-
Total	37,347	36122	28,215	-9,132	-7,907	75.55	78.11
Total	118,069	118170	109,719	-8,350	-8,451	92.93	92.85

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

The decrease in the total value of the organization's sources in the reporting year is due to a decrease both in owned and loan funds.

Factors affecting the profitability of the participant's own funds (I) are presented in Table 2.

Among them, we may notice that the most important ones are: return on equity based on net profit, the share of net profit in profit before taxation, profit and profit from sales, profitability from sales in terms of profit from sales, turnover ratio on owned equity.

Table 2. Factors influencing the return on equity, rubles

Indicator	2018	2019	2020	Absolute deviation 2020 from (+;-)		Growth rate 2020, %	
				2018	2019	2018	2019
Return on equity based on net profit, *Y*	0.017	0.023	0.009	-0.008	-0.014	54.40	39.53
Share of pure profit in profit before taxation, *Y1*	0.762	0.873	0.711	-0.051	-0.162	93.30	81.40
Balance sheet ratio profit and profit from sales, *Y2*	1.249	0.474	0.342	-0.907	-0.132	27.39	72.22
Profitability of sales by profit from sales, *Y3*	0.016	0.042	0.032	0.016	-0.0103	-200.41	75.41
Turnover ratio of owned capital, *Y4*	1.128	1.344	1.198	0.070	-0.145	106.22	89.18

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

The decrease in return on equity compared to 2019 amounted to 0.014 points, which is justified by the influence of each factor:

$$\Delta Y(Y_1) = (Y_{1_1} - Y_{1_0}) \times Y_{2_0} \times Y_{3_0} \times Y_{4_0}$$
= -0.162 x 0.474 x 0.042 x 1.344 = - 0.00434

The share of net profit in profit before tax decreased by 1.62 rub, which indicates a decrease in the effectiveness of the tax policy of the organization, due to this, for each ruble of owned funds, less net profit was received by 0.00434 rubles.

$\Delta Y(Y_2) = Y_{1_1} \times (Y_{2_1} - Y_{2_0}) \times Y_{3_0} \times Y_{4_0}$=
= 0.711 x -0.132 x0.042 x1.344 = -0.00528

The efficiency of investment and financial activities in the reporting period decreased by 27.78%. For each ruble of profit from sales, there was less profit before tax by 0.00528 rubles.

$\Delta Y(Y_3) = Y_{1_1} \times Y_{2_1} \times (Y_{3_1} - Y_{3_0}) \times Y_{4_0}$=
= 0.711 x 0.342 x -0.010 x 1.344 = - 0.00337

Due to the factor (*Y*3) in the reporting period, each ruble of owned funds accounted for less net profit by 0.00337 rubles.

$$\Delta Y(Y_4) = Y_{1_1} \times Y_{2_1} \times Y_{3_1} \times (Y_{4_1} - Y_{4_0}) =$$
= 0.711 x 0.342 x 0.032 x - 0.145 = - 0.00112

As a result of a decrease in the level of use of owned funds in ordinary activities by 10.82%, each ruble of owned funds accounts for less net profit by 0.00112 rubles.
The total influence of factors was:

-0.00434-0.00528-0.00337-0.00112= -0.014

Considering that all factors had a negative impact on the final result, it could be concluded that the participant (I) in the reporting year used its owned capital inefficiently.
Factor analysis of indicators of profitability of loan capital is presented in Table 3.

Table 3. Factors affecting the profitability of loan funds, rubles

Indicator	2018	2019	2020	Absolute deviation 2020 from (+;-)		Growth rate 2020, %	
				2018	2019	2018	2019
Return on loan capital by pure profit, *Y*	0.037	0.053	0.027	-0.010	-0.026	72.71	50.27
Return on sales, *Y1*	0.015	0.017	0.008	-0.007	-0.010	51.22	44.33
Total capital turnover ratio, *Y2*	0.771	0.933	0.890	0.119	-0.043	115.41	95.41
Total and loan capital ratio, *Y3*	3.161	3.271	3.889	0.727	0.617	-123.00	118.87

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

Return on loan capital, calculated on the net profit of the organization, decreased by -0.026 points. Such indicators as return on sales (-0.010) and total capital turnover ratio (-0.043) had a negative impact.

To optimize the structure of equity and debt capital of the participant (I), as well as two other subjects under study, a methodology is proposed for determining the best capital structure, the optimality criterion in which is the ratio of maximizing profitability and minimizing financial risks.

However, practice shows that high profitability is most often achieved at the cost of risky financial decisions focused on raising loan funds [5].

Therefore, when determining the most optimal capital structure of an organization, depending on its specialization, it is advisable to use the following recommendations below to minimize the level of financial risks.

There are three principal approaches to financing various groups of assets of an organization:

(1) an aggressive approach - up to 40% of fixed capital, up to 50% of the fixed part of current assets and all variable working capital is usually financed by raising loan funds on a long-term and short-term basis;

(2) a moderate approach - up to 30% of the fixed capital and up to 20% of the permanent part of current assets is usually formed from long-term bank loans, the variable part of current assets - from short-term loan capital, the rest of the assets is formed from equity;

(3) a conservative approach - up to 20% of the fixed capital is financed by long-term bank loans and up to 50% of the variable part of current assets - by short-term bank loans. The rest of the assets is created from equity [4].

The constant part of current assets is their minimum, which is necessary for the implementation of the current activities of an economic entity. Its value does not depend on seasonal fluctuations in the volume of production and sales of products.

As a rule, current assets are fully financed by equity and long-term borrowings. Accounts receivable and cash are accepted as a permanent part of current assets.

The variable part of current assets, on the contrary, is subject to fluctuations depending on seasonal changes in the volume of activities.

They are usually financed at the expense of short-term loan capital, and with a conservative approach - partially at the expense of equity capital (for example, reserves) [2].

A significant share of loan funds in the capital structure of business entities is due to the effect of financial leverage (financial leverage). Its effect is manifested in the fact that an enterprise that rationally uses loan funds, despite their payment, has a higher profitability of its own funds [3].

Further, the level of financial leverage of the studied subjects of the agricultural business of the Penza region was calculated based on the three indicated approaches to asset financing. The initial data for calculations are presented in Table 4.

Table 4. Initial data for determination the level of financial leverage

Indicator	Agricultural business enterprises		
	I	II	III
Average annual cost of fixed capital, thousand rubles	52,115.5	34,112.5	37,481.0
Permanent part of current assets, thousand rubles.	1,919.0	1,640.5	11,684.0
Variable part of current assets, thousand rubles.	59,910.0	54,750.5	36,061.0
Total	113,944.5	90,503.5	67,226.0

Source: Own calculation.

The calculation of the share of loan capital, with three different approaches to asset financing, is presented in Table 5.

The result of determining the normative value of the financial risk ratio is shown in Table 6.

Table 5. Calculation of the share of loan capital

Method of financing	Agricultural business entities		
	I	II	III
Aggressive	52,115.5 × 0.4 + 1,919 × 0.5 + + 59,910 = 81,715.7 81,715.7/113,944.5 = 71.7%	34,112.5 × 0.4 + 1,640.5 × × 0.5 + 54,750.5 = 69,215.7 69,215.7/90,503.5 = 76.5%	37,481 × 0.4 + 11,684 × 0.5 + + 36,061 = 54,895.4 54,895.4/67,226 = 84.6%
Moderate	52,115.5 × 0.3 + 1,919 × 0.2 + + 59,910 = 75,928.5 75,928.5/113,944.5 = = 66.6%	34,112.5 × 0.3 + 1,640.5 × × 0.2 + 54,750.5 = 65,312.3 65,312.3/90,503.5 = 72.2%	37,481 × 0.3 + 11,684 × 0.2 + + 36,061 = 49,642.1 49,642.1/67,226 = 73.8%
Conservative	52,115.5 x 0.2 + 1,919 x 0.5 = =11,382.6 11,382.6/113,944.5 = 10%	34,112.5 × 0.2 + 1,640.5 × × 0.5 = 7,642.7 7,642.7/90,503.5 = 8.4%	37,481 × 0.2 + 11,684 × 0.5 = 13,338.2 13,338.2/67,226 = 19.8%

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

Table 6. Calculation of the normative value of the financial risk ratio

Method of financing	Agricultural business entities		
	I	II	III
Aggressive	71.7/(100 - 71.7) = 2.5	76.5/(100 - 76.5) = 3.2	84.6/(100 - 84.6) = 5.5
Moderate	66.6/(100 - 66.6) = 2.0	72.2/(100 - 72.2) = 2.6	73.8/(100 - 73.8) = 2.8
Conservative	10/(100 - 10) = 0.1	8.4/(100 - 8.4) = 0.09	19.8/(100 - 19.8) = 0.2

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

Based on the coefficients of financial autonomy and financial dependence, calculated according to the data of business entities and based on three different approaches to their financing, the normative values of equity and loan capital were determined (Table 7).

Table 7. Calculation of the normative value of equity and debt capital

Method of financing	Agricultural business enterprises		
	I	II	III
Coefficient of financial enterprise autonomy	0.743	0.871	0.953
Coefficient of financial dependencies	0.257	0.129	0.047
Aggressive:			
share of loan capital	0.743 x 0.4 + 0.257 x 0.5 = 0.43	0.871 x 0.4 + 0.129 x 0.5 = 0.41	0.953 x 0.4 + 0.047 x 0.5 = 0.40
owned share	0.709 x 0.6 + 0.291 x 0.5 = 0.57	0.871 x 0.6 + 0.129 x 0.5 = 0.59	0.953 x 0.6 + 0.047 x 0.5 = 0.60
Moderate:			
share of loan capital	0.743 x 0.3 + 0.257 x 0.5 = 0.35	0.871 x 0.3 + 0.129 x 0.5 = 0.33	0.953 x 0.3 + 0.047 x 0.5 = 0.31
owned share	0.743 x 0.7 + 0.257 x 0.5 = 0.65	0.871 x 0.7 + 0.129 x 0.5 = 0.67	0.953 x 0.7 +0.047 x 0.5 = 0.69
Conservative:			
share of loan capital	0.743 x 0.2 + 0.257 x 0.5 = 0.28	0.871 x 0.2 + 0.129 x 0.5 = 0.24	0.953 x 0.2 + 0.047 x 0.5 = 0.21
owned share	0.743 x 0.8 + 0.257 x 0.5 = 0.72	0.871 × 0.8 +0.129 × 0.5 = 0.76	0.953 x 0.8 +0.047 x 0.5 = 0.79

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

The level of the financial leverage ratio is measured by the ratio of the growth rate of net profit (rn, %) to the growth rate of gross profit (*n*, %):

$$У_{ф.л.} = \frac{\Delta rn\ \%}{\Delta n\ \%}. \qquad ....(1)$$

It shows how many times the growth rate of gross profit has increased. This excess is ensured by the effect of financial leverage, one of the components of which is its leverage (the ratio of loan capital to equity). Increasing and decreasing the leverage depending on the

prevailing conditions, it could be possible to influence the profit and return on equity.
An increase in financial leverage is accompanied by an increase in the degree of financial risk associated with a possible shortage of funds to pay interest on loans and borrowings. A slight change in gross profit and return on invested capital in conditions of high financial leverage could lead to a significant change in net profit, which is dangerous during a decline in production.

Table 8. Calculation of the normative value of the financial leverage ratio

Method of financing	Agricultural business enterprises		
	I	II	III
Aggressive	0.43/0.57 = 0.75	0.41/0.59 = 0.69	0.40/0.60 = 0.67
Moderate	0.35/0.65 = 0.54	0.33/0.67 = 0.49	0.31/0.69 = 0.45
Conservative	0.28/0.72 = 0.39	0.24/0.76 = 0.32	0.21/0.79 = 0.27

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

Comparison of the actual value of the financial leverage ratio (0.346), calculated according to the participant (I), with the obtained standard value (0.39) for 2020, allows us to conclude that in the reporting period he used a conservative approach to financing groups of his assets. Participant (II) acted in a similar way. The leverage ratio was 0.148. Both business enterprises finance from short-term loan capital only half of the variable part of current assets, and everything else is financed from their owned and long-term loan funds. The degree of financial risk when choosing a conservative approach is low, which could characterize it as the most optimal when determining the capital structure. Participant (III) uses a moderate approach to asset financing in its practice (financial leverage ratio was 0.491, and the resulting normative value was 0.45). This is a riskier financing approach given the current economic conditions. However, the priority in choosing a strategy for attracting loan funds is predetermined by the prospects for the further development of the organization and largely depends on the specialization of the activity of the economic entity.

CONCLUSIONS

Management of the capital structure of agricultural business entities should become an important component of their financial policy. The best ratio of owned and loan sources of financing of activities is achieved subject to the maximum increase in net return on equity and an acceptable level of financial risks, which ensures the maximum market value of the business. The success of the financial strategy of the organization as a whole depends on how effectively the capital structure is optimized.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

INFLUENCE OF HYBRID AND WEATHER CONDITIONS ON YIELD, PROTEIN AND OIL CONTENTS IN GRAIN OF MAIZE

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Abstract

Considering the role of maize in both animal feed and human consumption, improving the quality of maize grain should be investigated with the same perseverance as the grain yield. The main objectives proposed in this research were to evaluate the influence of the hybrid, weather conditions and their interaction on the yield, protein and oil contents in grain maize, and to investigate the relationships between these traits. Field experiments were performed for two consecutive years at ARDS Șimnic. The results obtained showed that the weather conditions during the study years were the determinant factor of variability in grain yield (88%), and the hybrid was the determinant factor of variability in protein and oil contents (84% and 83%, respectively). In average, in 2018, a significantly higher grain yield (9.05 t/ha) and a significantly lower oil content (4.2%) were registered compared to 2019 (6.08 t/ha and 4.5%, respectively), while the protein content was almost similar in both years (12.5% and 12.3%, respectively). The hybrids P 9903 (7.88 t/ha) and DK 5068 (7.79 t/ha) obtained the highest average grain yields. The hybrid F 376 had the lowest average grain yield (7.03 t/ha) but the highest average protein content (13.4%) and oil content (5.3%). Negative correlations between traits suggested that an increase in the grain yield meant a decrease in the grain quality traits (protein and oil contents).

Key words: *grain protein content, grain oil content, maize yield, weather conditions*

INTRODUCTION

Maize (*Zea mays* L.) is an annual cereal of the family Poaceae (Gramineae) and due to its multiple uses is considered of great importance in ensuring global food security.
Cereals are widely used as feed for animals (feeding chickens, dairy cows, etc.) providing more than 80% of the total concentrated feed [7, 8]. Also, this cereal is an important source of profit for agricultural units with export potential [19, 22, 24].
Romania produces about 10.9 million tons of maize per year in approximately 2.6 million hectares [13].
According to [17], the grain of maize typically contain 73% starch, 10% protein, 4% oil and 10% other constituents.
Protein and oil contents are the most important traits of interest in the maize market [20]. Maize oil is included in the human diet because it has positive health effects, being characterized by high levels of poly-unsaturated fatty acids, especially linoleic acid (24%). It is a good source of vitamin E (21.11 mg ATE/100 g) and tocopherol (14.3 mg/100 g) [28]. Also, the oil content is an important trait of the maize grain when the harvest is used for animal feeding because it has bigger calorific power than starch [1].
Protein is a primary structural and functional component of the living cell. Maize protein can be used in various forms to ensure the protein requirements of different sections of society (infants, the elderly and the disabled, etc.) to prevent malnutrition [18].
Current climate change is adversely affecting crop yields and quality in many parts of the world, and long-term implications of these traits reduction are significant for food security. Evaluations of the impact of global climate changes in Romania emphasize that aridity would increase in the south-western parts of Romania, especially during the crop growing season [23].
The Oltenia region located in the south-western part of Romania is one of the most important agricultural regions but one of the

most affected by drought and heat. These phenomena are considered to be some of the major causes of the decline of many crops in the affected areas [5, 9, 10, 11] and therefore of food insecurity.

The rainfalls from sowing to anthesis period and the average temperatures during grain-filling period are dominant climatic factors that explain inter-annual variability of maize yield in this region [6].

The weather conditions of the year are an important factor participating in the yields formation of all crops. Without water, the soil hardens, the roots do not grow sufficiently, and the plants remain underdeveloped affecting production [26].

Therefore, the a proper choice and cultivation of high yielding maize hybrids, that are of good nutritional quality and tolerant to drought stress is a pre-requisite to solving food insecurity. The objectives of this paper were to evaluate the influence of hybrid and weather conditions of the year on grain yield and the quality of maize hybrids and to indentify degree of correlation of these traits.

MATERIALS AND METHODS

Experimental design and plant material

In this experiment, three commercial maize hybrids with a good adaptability to the pedo-climatic conditions in south-western Romania were used, namely: F 376 (NARDI Romania, FAO 500), P 9903 (Pioneer Hi-Bred Services GmbH Austria, FAO 300) and DK 5068 (Monsanto SAS France, FAO 460).

The field trials were conducted in order to investigate the influence of biological material (hybrid/genotype) and weather conditions of the year on yield, protein and oil content in maize grains. The experiments were performed during 2018 and 2019 at the research fields of the Agricultural Research and Development Station (ARDS) Șimnic, Craiova. The site is located on the south-western Romania, in the central part of Oltenia at $44^0$19' N, $23^0$48' E and 182 m altitude. The experiments were established by randomized block method in three repetitions, on a reddish preluvosoil.

Morphologically, the soil presents an Ap 0-29 cm horizon characterized by: pH=5.08, 2.68% humus, 0.072 mg/kg nitrogen, 52.2 mg/kg phosphorus; 125 mg/kg potassium [25].

The principles of conventional technology of maize cultivation were applied (autumn deep ploughing, 55,000 plants/ha). Every year, wheat was the pre-crop. Seeds were sown on April 23 in 2018 and on April 18 in 2019, respectively.

During experiments, nitrogenous fertilizer was utilized within two times of vegetation period: 250 kg/ha N and P_2O_5 kg/ha (20-20-0) before sowing and with 250 kg N/ha (ammonium nitrate) at V8 growth stage. Weeds were controlled by hand weeding and by the use DUAL GOLD 960 1.5 l/ha applied immediately after sowing, and with EQUIP 1.5 l/ha + BUCTRIL 1.0 l/ha in the V6 stage.

Harvesting was carried out in the second decade of September each year.

Grain yield per plot was adjusted to 15.5% grain moisture and was converted to tones/ha. Chemical composition in maize hybrids, protein and oil contents in grain were determined by infrared spectroscopy technique on the apparatus PERTEN *Inframatic 9140*.

The local weather conditions

The local weather conditions data (precipitations and temperature) were collected from the Weather Station Craiova (Table 1). The year 2018 was considered moderately favourable for maize crop, the precipitation surplus being of +20.7 mm compared to the multiannual average. This year there was a surplus of precipitation in June and July, the rest of the months being dry. The air temperature was higher than the multiannual average, with the exception of July (-1.2°C).

Compared to the multiannual average, 2019 was very dry, the precipitation deficit being of -111.4 mm. All the months of this growing season have been dry, with the exception of June when there was a surplus of precipitation (+62.4 mm). The air temperature was higher, with the exception of July (-1.2°C).

Statistical analysis

Statistical analyses were conducted using analysis of variance (two-factor ANOVA) and means were compared by Fisher's least significant difference (LSD) test at P≤0.05. The relative dependence between the studied traits was defined by correlation analysis (Pearson's correlation coefficients) and linear regression. All these analyses were carried out using the option Data Analysis in the Microsoft Office Excel program.

Table 1. Monthly precipitation and temperature for ARDS Simnic

Month	Multiannual average		Deviation from multiannual average (±)			
			2018		2019	
	P	T	P	T	P	T
April	53.1	12.2	-42.0	+4.4	-11.1	-0.3
May	71.7	17.5	-20.7	+1.7	-39.7	-1.3
June	73.6	21.5	+67.4	+0.1	+62.4	-1.2
July	82.2	23.8	+52.8	-1.2	-23.2	-0.9
August	47.0	22.5	-19.0	+1.2	-38.0	+2.6
September	61.8	17.8	-17.8	+1.4	-61.8	+2.4
Growing season (April – September)	389.4		+20.7		-111.4	

P = Precipitation in mm; T = temperature in °C
Source: Own processing based on data from Weather Station Craiova.

RESULTS AND DISCUSSIONS

Grain yield

Grain yield is the most important character for the maize breeding program. It is a polygenic character that largely depends on both genotypic and agro-ecological factors.

The analysis of variance (ANOVA) for grain yield showed a significant influence of the hybrid, the year and their interaction (P≤0.05) (Table 2). Most of the overall variation, respectively 88%, was due to the year (Figure 1).

Many researchers reported that the genotype and environment fluctuations have a high impact on the maize yield [3, 4, 30].

In this study, we observed that the average grain yield for two years of study was 7.57 t/ha. In 2018, on average for all hybrids tested, a statistically significantly yield was recorded (9.05 t/ha) compared with 2019 (6.08 t/ha) (Table 3). The 32.8% decrease of yield is the result of rainfall deficiency and its rather unfavourable distribution during the growing season.

The highest average yield in the research period was achieved by hybrids P 9903 (7.88 t/ha) and DK 5068 (7.79 t/ha), while hybrid F 376 (7.03 t/ha) achieved the lowest grain yield. The hybrid F 376 had a significantly lower yield in 2018 compared to all tested hybrids, and in 2019 a significantly lower yield compared to only the P 9903 hybrid. In both years, the P 9903 hybrid had a significantly higher yields compared to all hybrids tested (Table 3).

Table 2. ANOVA for grain yield, protein and oil contents

Source of variation	**Sum of squares**	**df**	**Mean squares**	**F-value**
Grain yield (t/ha)				
Hybrid (A)	2.649	2	1.324	70.423*
Year (B)	39.457	1	39.457	2,098.146*
Interaction (AxB)	2.636	2	1.318	70.082*
Error	0.236	12	0.019	
Protein content (%)				
Hybrid (A)	9.310	2	4.655	45.048*
Year (B)	0.125	1	0.125	1.210^{ns}
Interaction (AxB)	0.370	2	0.185	1.790^{ns}
Error	1.240	12	0.103	
Oil content (%)				
Hybrid (A)	7.320	2	3.660	66.545*
Year (B)	0.605	1	0.605	11.000*
Interaction (AxB)	0.280	2	0.140	2.545^{ns}
Error	0.660	12	0.055	

*and ^{ns} - significant and non-significant at P≤0.05
Source: Own calculation.

The DK 5068 hybrid had in 2018 a significantly higher yield compared to all tested hybrids but in 2019 this hybrid had a significantly lower yield compared to only the P 9903 hybrid (Table 3).

[16] noted that water stress during the grain-filling stage reduced grain yield by 60%, and [14] also reported a greater reduction in yield under drought stress in the reproductive stage than in the vegetative and grain-filling stage.

Table 3. The average grain yield, protein and oil content of the studied hybrids

Traits	Hybrid (A)	Year (B)		Average per hybrid
		2018	2019	
Grain yield (t/ha)	F 376	8.27	5.78	7.03
	P 9903	9.05	6.71	7.88
	DK 5068	9.81	5.77	7.79
	Average per year	9.05	6.08	7.57
Protein content (%)	F 376	13.5	13.3	13.4
	P 9903	11.8	12.0	11.9
	DK 5068	12.1	11.6	11.9
	Average per year	12.5	12.3	12.4
Oil content (%)	F 376	5.1	5.4	5.3
	P 9903	3.8	3.9	3.9
	DK 5068	3.6	4.3	4.0
	Average per year	4.2	4.5	4.4

Indicator	LSD test	A	B	AxB
Grain yield	5%	0.05	0.06	0.11
Protein content	5%	0.11	0.21	0.28
Oil content	5%	0.08	0.10	0.19

Source: Own calculation.

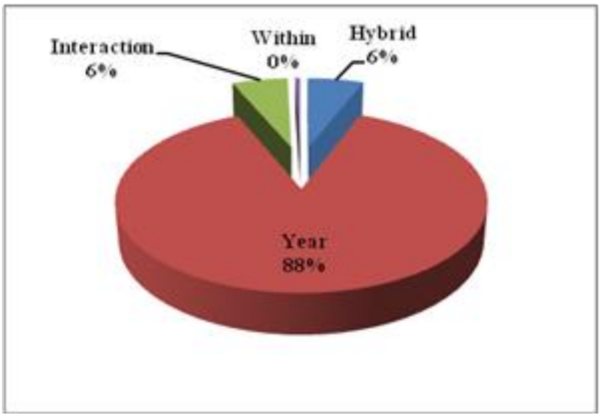

Fig. 1. Share of hybrid, year and their interaction in the variation of grain yield
Source: Own calculation and processing.

Protein content

The ANOVA results for the protein content showed the presence of significant differences in the case of the hybrid (P≤0.05) but non-significant differences in the case of the year and also in the case of the hybrid x year interaction (Table 2).

For protein content, most of the overall variation, respectively 84%, was due to the hybrid (genotype) (Figure 2).

[12] also reported a non-significant effect of the climatic conditions of year on the protein content of maize hybrids, while other authors [4, 27] reported that the protein content was significantly influenced by the genotype and climatic conditions of the year.

[17] found that the grain of maize contain 10% protein. In this study, the average protein content for all hybrids tested was higher (12.4%) compared to this value and almost similar in both years (12.5% and 12.3%, respectively).

The hybrid F376 had, on average, significantly higher protein content (13.4%) compared to the hybrids P 9903 (11.9%) and DK 5068 (11.9%) (Table 3).

Many authors [4, 27, 29] reported that the protein content in maize grain ranged between 8.0-14.0%; 8.05-11.43% and 13.63-15.07%, respectively. These variations were due to genotype and pedo-climatic conditions of study.

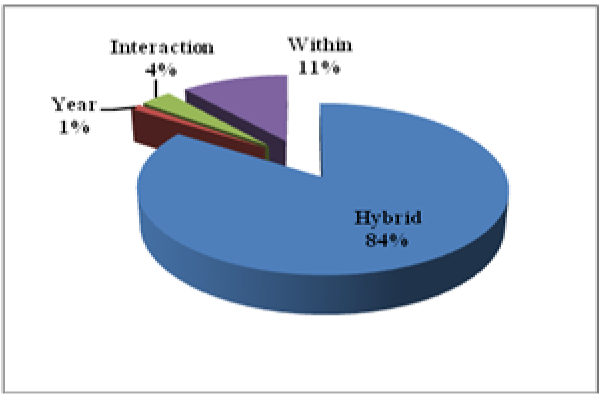

Fig. 2. Share of hybrid, year and their interaction in the variation of protein content
Source: Own calculation and processing.

Oil content

The results of ANOVA indicated that the oil content was significantly different in the case of the hybrids and years, but non-significant in the case of the hybrid x year interaction (Table 2).

The hybrid (genotype) explained most of the overall variation of this trait, respectively 83% (Figure 3).

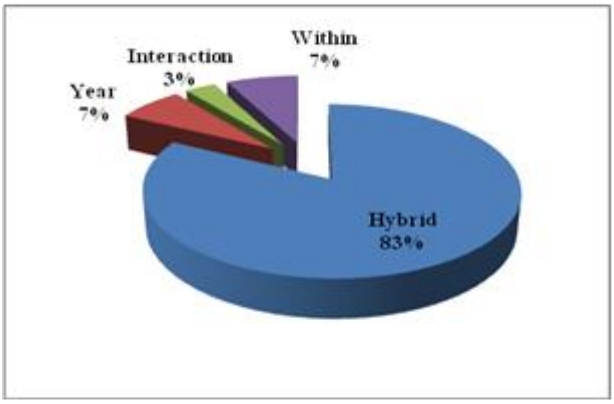

Fig. 3. Share of hybrid, year and their interaction in the variation of oil content
Source: Own calculation and processing.

Similar results for the influence of genotypes and years on oil content were reported by [15].

[17] found that the grain of maize contain 4% oil. In our study, the average oil content for the studied period was 4.4% (Table 3). The results are agreement with findings of [2, 4, 27] which shows that the oil content varied between 2.56-5.57%, 3.72-5.02% and 4.70-5.53%, respectively, depending on the genotype and the pedo-climatic conditions.

For the synthesis of grain oil, the most favourable year was 2019 when significant oil content was reached (4.5%) compared to 2018 (4.2%). These results showed that higher temperatures and lower rainfall during grain-filling stage favoured the oil content.

The highest average oil content in the research period was achieved by the hybrid F376 (5.3%) compared to the hybrids P 9903 (3.9%) and DK 5068 (4%).

Correlations between traits

The estimate of phenotypic correlations between grain yield and the two grain quality traits for 2018 and 2019 are presented in Figures 4, 5, 6 and 7.

In 2018 significant negative correlation was observed between grain yield and protein content ($r=-0.746^*$; $p\leq0.05$), also between grain yield and oil content ($r=-0.910^{**}$; $p\leq0.01$)

The coefficients of determination showed that about 56 % of the variation in the protein content and about 83% of the variation in the oil content are explained by the variation in grain yield of maize (Figures 4 and 5).

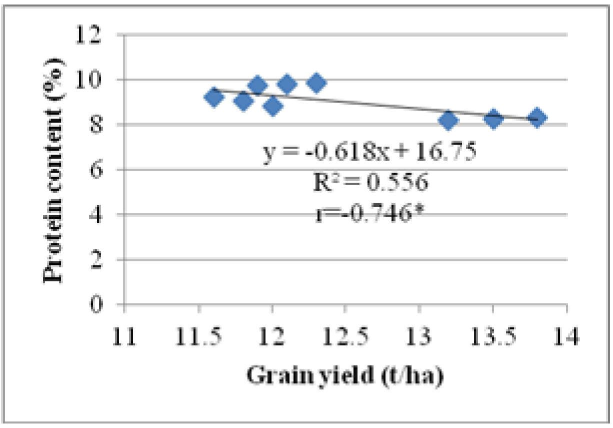

Fig. 4. Regression line and correlation coefficient between grain yield and protein content in 2018
Source: Own calculation and processing.

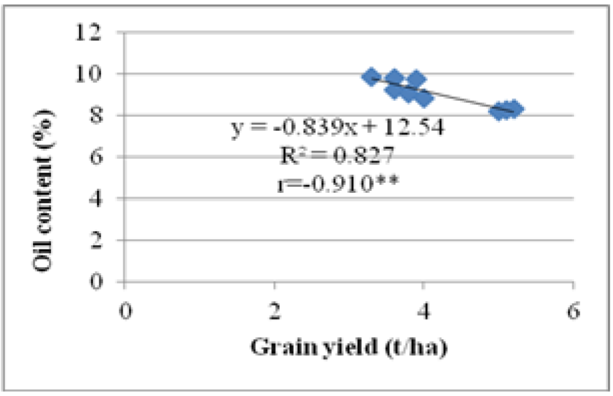

Fig. 5. Regression line and correlation coefficient between grain yield and oil content in 2018
Source: Own calculation and processing.

In 2019 the relations between grain yield and protein content and also between grain yield and oil content were negative but weak ($r=-0.222^{ns}$ and $r=-0.628^{ns}$, respectively).

Only 4.9 % of the variation in the protein content is explained by the variation in the grain yield, also 39.4% of the variation in the oil content is caused by the variation in the grain yield (Figures 6 and 7).

Our results revealed that an increase in yield leads to a decrease in the protein content and oil content in grain of maize. Contrary to these results, [21] reported low relations between yield and both quality traits.

On the other hand, [2] observed a weak negative relation between yield and protein content, but a weak positive relation between yield and oil content.

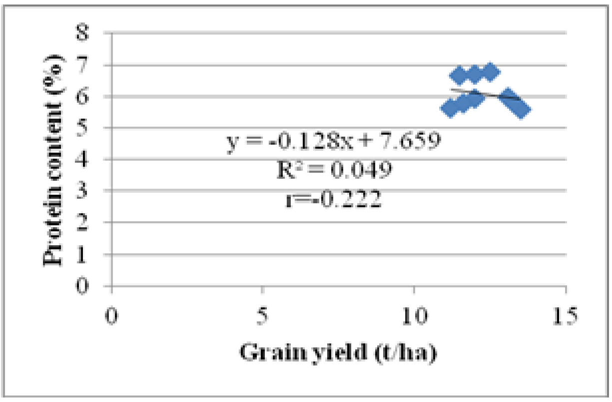

Fig. 6. Regression line and correlation coefficient between grain yield and protein content in 2019
Source: Own calculation and processing.

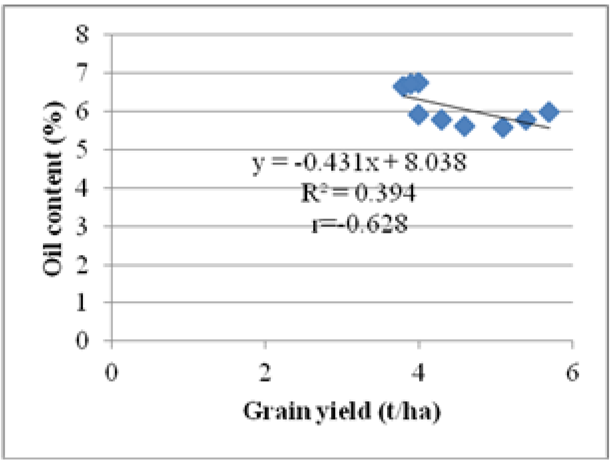

Fig. 7. Regression line and correlation coefficient between grain yield and oil content in 2019
Source: Own calculation and processing.

CONCLUSIONS

The results showed that grain yield was more influenced by the weather conditions of the year.
In the case of grain quality traits viz. protein and oil contents, the determining factor was the hybrid.
The highest grain yield and the lowest oil content in grain of maize were registered in 2018, while protein content was almost similar in both years.
The highest average grain yields were obtained by P 9903 and DK 5068 hybrids, and the highest protein and oil contents were obtained by F376.
The correlations between grain yield and quality traits have been negative in both years, thus breeding for high quality maize hybrids require moderate balance between these traits.

ACKNOWLEDGEMENTS

This research work was financed from the Project ADER 1.1.3"*Creation of productive maize hybrids, tolerant of drought, heat, disease and pests in order to reduce the impact of global warming on agroecosystems in Romania"*.

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MEASURES AND TOOLS TO STREAMLINE THE TRANSITION TO GREEN ECONOMY IN ROMANIA

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Abstract

The green economy is currently a hotly debated global pillar as it has a significant impact on sustainable development. The implementation of this concept aims to identify viable solutions for the development, conservation and protection of the environment as a result of economic and social aggression. At the same time, international organizations are generating alternatives to combat the long-term negative factors that may affect the well-being of the population. In order to reach the proposed objective, that of implementing a sustainable economy, a coalition is needed between the private sector and the legislative power in Romania. The private and public spheres must reach a common point through which they can reduce the wear and tear of economic growth with the aim of reducing environmental risks, enhancing the use of resources and increasing the quality of life. This paper aims to identify the tools needed to adopt a Green Economy by analysing current opportunities for economic development based on sustainable policies and investments. In the context of those presented, the paper proposes some measures and tools to streamline the transition to a green economy in Romania. To reach the result of this descriptive analysis, research methods were used based on reports, studies, papers and specialized publications both online and offline. As a main result of this paper we can mention the identification of some changes at the level of demographic indicators but also the identification of some notable results in terms of share of renewable energy in gross final energy consumption and recycling rate, important factors for the analysis of the green economy at national level.

Key words: *green economy, recycling rate, sustainable tools, investments*

INTRODUCTION

The green economy is currently a topic of interest, presenting a very complex reality, an accumulation of activities that are found in all economic sectors and that have in common the direct reporting to the environment in an effort to protect quality and stop degradation. to preserve or restore natural balances, to protect and safeguard non-renewable resources, including by identifying and promoting innovative alternatives.

A milestone in this area was the publication of the "Growth Limits" Report by the Rome Club in 1972. At the moment, the field of green economy has become one of the fashionable topics on the agenda of global discussions. The current trends, which imply the need to change the models of economic development, are indicated by the increasing emphasis on issues related to environmental degradation. The green economy was one of the topics of discussion at the United Nations Conference on Sustainable Development Rio + 20 (Rio de Janeiro, June 2012) [15].

and at the Conference of Environment Ministers "An Environment for Europe" (Batumi, June 2016) [16, 17].

Ideally, this type of economy is a set of activities that do not produce pollution, do not produce waste or can implement technologies that have the ability to recycle them to reintroduce them into the natural circuit without unbalancing the ecosystem, activities or systems that not to produce elements harmful to humans or the environment and to use natural resources rationally without affecting their quality or regenerative capacity [2].

In fact, such an economy does not exist. The Community cannot suddenly abandon the traditional production procedures that consume non-renewable, polluting, aggressive resources in relation to the natural environment.

The technological development of classical production systems over time cannot be stopped until they are replaced by new or innovative systems that ensure similar comfort and are also efficient. At the same time, no substitutes have been identified for all non-renewable sources that have a similar quality and exist in quantities above the current need.

All this hat developed around the green economy is just a contemporary model of transition from the classic model, which focused strictly on environmental protection and was perceived as an economic burden, to an innovative model, focused on tools that use protection environment as a resource in ensuring the sustainability of economic growth.

In the near future, we must all treat the green economy as one of the main pillars of sustainable development, poverty reduction and resource conservation in an innovative way. This is just a tool that can bring to light technologies based on low carbon, lower energy consumption, reducing waste. All this with a single purpose: the eradication of risk factors on the environment [10].

The solution to avoid or mitigate these risks is to consolidate and develop the green economy. This cannot be done in the short term. It takes a long transition period to resolve the many and complex issues involved in such a process. Scientific research must contribute to the success of the transition and to shortening its duration, in order to provide solutions to technical problems. Entrepreneurs are also motivated to invest in new sectors of economic activity and consumers of products/ services that, through their options and demand, will support the growth and proliferation of the green economy. Last but not least, governments that, aware of the scale of the risks and the need to act to avoid or mitigate their consequences, will act, with the means at their disposal, to encourage and support all activities that make up the green economy [11].

The transition to a green economy will generate major economic opportunities. Replacing the traditional economy with the green one is a new growth process, a generator of decent jobs and a sustainable strategy to eradicate poverty. This green mechanism can turn many challenges into economic opportunities and can avoid the negative impact on the environment. The green economy will also stimulate economic growth and the number of jobs in the environmental sector, which require specific environmental skills [17].

In this context, the purpose of the paper is to provide an analysis of a number of considerations regarding the challenges and opportunities facing Romania in the transition and implementation of the principles and objectives of the green economy, as well as the impact on society in general.

MATERIALS AND METHODS

To achieve the objective of the paper, specific research methods and mechanisms used in the field of the green economy have been applied to analyze the impact at national level. Also, we used a descriptive analysis based on a series of reports, studies, works, statistics and publications.

The analyzed data were collected from specialized literature in the green economy field.

The research methodology used is based on three phases of analysis. The first phase of collecting information and research documentation, the second phase provides a detailed descriptive transposition of the analyzed data, while the third phase summarizes the information collected and concretizes through conclusions.

RESULTS AND DISCUSSIONS

Making an analysis at national level, Romania has launched since 2008, the National Strategy for Sustainable Development of Romania Horizons 2013–2020–2030 [12]. We find in this document some aspects related to the objective of promoting the habits of consumption and sustainable production. The national objective proposed to be implemented by 2020 was to dissociate

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

economic growth from environmental damage by highlighting performance indicators regarding the sustainability of consumption and production. Analyzing this aspect, we find that no measures have been imposed to achieve this goal and from a technical point of view, we are at point 0.

Also for 2020, as a national goal for sustainable development, it aims to reach the current average level of EU countries at the main parameters of responsible management of natural resources. Some of the measures aimed at sustainable development and the transition to a green economy aimed at:

-adoption of ecological technologies;

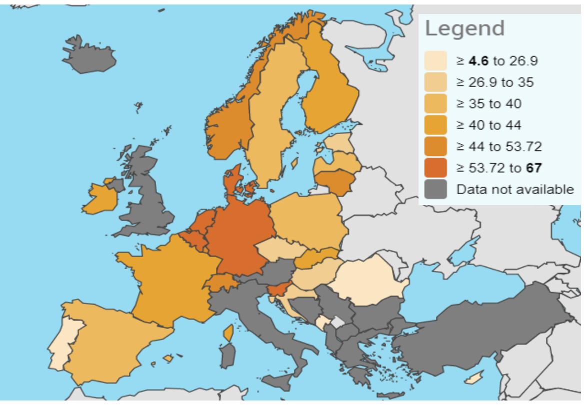
-stimulating eco-innovation;

-green public procurement.

As a target for 2030, the Strategy proposed: bringing the EU member states closer to the average level of sustainable production and consumption at that time.

With regard to integrated waste management, the aim is to move from waste disposal to selective collection and recovery of a greater proportion of recyclable waste, including the conversion of organic waste into compost, and its exclusive use in urban areas. of ecological landfills.

In terms of waste, Romania separately collects 13.7% of waste in 2022 (Map 1). The goal we need to achieve is 55% by 2030, and the European average is 45%.



Map 1. Recycling rate of municipal waste
Source: Eurostat [7].

However, Romania ranks 32nd in the top of the world's greenest economies, in a ranking led by Denmark, Luxembourg and Switzerland. Yale's Top Composite Environmental Performance Index (EPI) [18]. looks at dozens of indicators, including waste management, air quality and biodiversity (Table 1). The analysis took into account only those countries considered by the World Bank to have high incomes. Romania is far from the top of the ranking, obtaining a total score of 64.7 points, compared to over 80 points in the top five. It is interesting to note first of all that in the ranking there are mainly European countries, only 12th being Japan, and 13th Australia, followed by New Zealand 19th. At the same time, it is noted that at the top are some of the richest countries in the world, states whose agenda has been on environmental protection for many years.

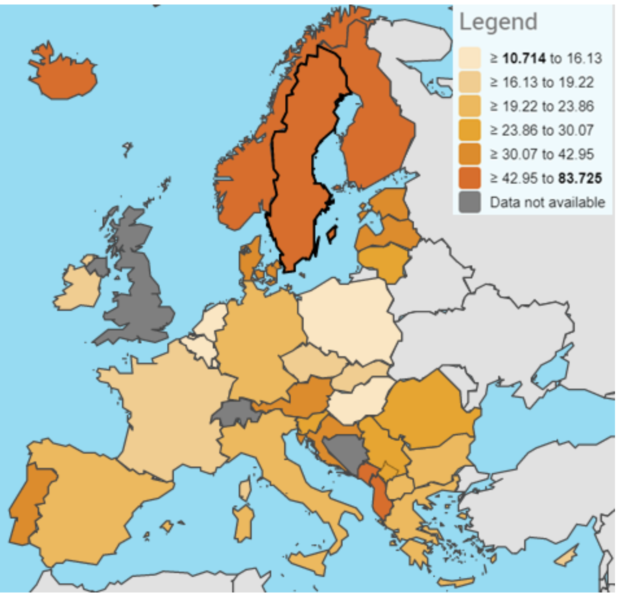
Table 1. Top countries with the greenest economies

Position	Country	Score
1	**Denmark**	**82.5**
2	**Luxembourg**	**82.3**
3	**Switzerland**	**81.5**
4	**Great Britain**	**81.3**
5	**France**	**80.0**
6	**Austria**	**79.6**
7	**Finland**	**78.9**
8	**Sweden**	**78.7**
9	**Norway**	**77.7**
10	**Germany**	**77.2**
…	**...**	**…**
32	**Romania**	**64.7**
33	**Hungary**	**63.7**

Source: Yale's composite Environmental Performance Index (EPI), https://epi.yale.edu/, [18].

If we talk about resources, at the moment we do not use them at all rationally and sustainably and this puts more and more pressure on our planet. The population should favor the use of mechanisms to facilitate the transition to a green economy, moving beyond the scope of policies that focus exclusively on waste and based on green design, innovation and investment. Research can sustain innovation not only in production but also in business models and funding mechanisms.

Speaking of the rational use of resources, we took into account for the analysis and the situation of renewable sources as a share in the gross domestic energy consumption of Romania. With the growing interest in the green economy, the amount of renewable energy produced has suddenly increased in Europe. We are talking about an increase from 16.6% in 2016 to 20.9% in 2020 in the share of renewable energy in gross final energy consumption. This is not accidental but is related to the mandatory legal aspects of Directive 2009/28/EC on the promotion of the use of energy from renewable sources. At the level of our country, the situation is favorable. Romania is slightly ahead in terms of the share of energy from renewable sources compared to the European Union average. In 2020, the target of 24% of total energy consumption from renewable sources has been reached (Map 2). For 2030, the new target set by the Romanian government is 30.7%. Thus, Romania is on the 10th place in the EU and above the average level of the European Union. In 2020, the production of electricity in Romania came in proportion of 12.4% from wind energy, 3.4% from photovoltaic solar panels and 27.6% from hydropower. In total, the production of renewable energy (wind, photovoltaic and biomass) accounted for 16% of the total.



Map 2. Share of renewable energy in gross final energy consumption
Source: Eurostat [8].

Eco-innovation and research that promotes innovative solutions are essential for the transition to a green economy (Fig. 1). Innovation is not limited to production processes, but could also encourage and support new business models. There are already many examples of innovative solutions that focus on providing services instead of marketing products: for example, you don't have to own a car to meet your transportation needs [4].

Such collaborative business models, which focus on service delivery, could benefit from the new financing mechanisms, given that, over time, investment and profit follow different patterns of evolution [3].

Analyzing the Eco-Innovation Index we can see that our country has no high performance results and ranks 25th with a score of 57. This score places us below the average performance of many countries in Europe and we do not perform on any analysis indicator of this index. We can talk about results when we analyze the efficiency of resources or socio-economic indicators, but this performance is in a continuous decrease compared to the last analyzed report. Taking into account all the eco-innovative factors of analysis, the results of our country place us at half the average level of the EU [6].

The green economy can be applied to all sectors of activity with the capacity to achieve synergies that can provide new development opportunities with major impact. Achieving notable results requires active involvement not only at the level of public policy but also at the level of enforcement in the territory of the measures through the instruments proposed at regional level.

In this sense, local public authorities have an important role in the design and implementation of innovative systems:

-for efficient collection, for all the types of wastes;

- production of energy from renewable sources and ensuring local consumption;

- "pay as you throw" schemes that allow the implementation of the "polluter pays" principle in practice.

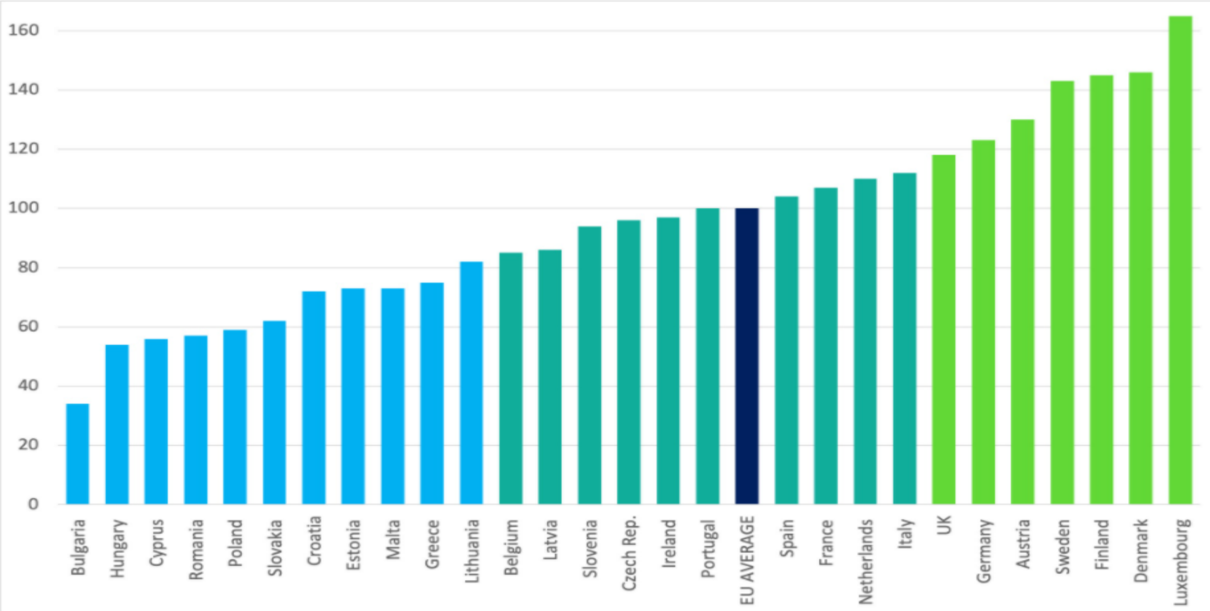


Fig. 1. Eco-innovation Scoreboard ranking and eco-innovation index composites for Romania
Source: Ecoap, Romania [5].

For the construction of the Romanian model of the green economy, the existing good practices at international and European level have an important role. At the moment we do not have a significant start but progress can be made by implementing projects financed from the structural and cohesion funds that need to be actively supported. Funding of this kind is essential to recover the long periods in which no development projects in the green sphere have been implemented at all [9].

Education plays an important role in the transition to a green economy and this is where the factors that educate consumers about the role and importance of resource efficiency, prevention and combating food waste come into play. Raising consumer awareness of the marketing of new waste products has a key role to play in promoting sustainable business models that contribute to the rapid development of advanced concepts and ideologies. In this sense, the transition from the theoretical approach of the green economy to its implementation requires facilitating the transfer of waste from one company to another company, respectively supporting the implementation of industrial symbiosis processes, both physically and electronically.

Another measure to facilitate this transition is to encourage the development of new skills and jobs for the reconversion of the unemployed and young people.

The green economy and its ability to generate new resources, to create new opportunities and sustainable business models, has attracted special attention, being found in the strategies and action plans of public authorities, business environment, research institutes and non-governmental organizations.

Identifying solutions and technologies for the reuse of secondary resources as a raw material in as many production circles as possible is an objective included in the policies and strategic plans of the private and public environment.

At present, Romania is beginning to take small but important steps towards promoting the green economy, namely a national model of good practice, which will contribute considerably to the promotion of new sustainable business models and encourage both the public sector to efficiently manage energy resources. which disposes. We believe that a more careful approach is needed at the national level to competitive advantages from a circular economy perspective, namely the ability of sectors to recycle resources and generate new resources for other industries [13].

Economic growth can be influenced by the protection and conservation of the environment, the moderate use of natural resources or their replacement with innovative solutions that can represent the challenges underlying the transition from the traditional economy to the green economy. For Romania, the green economy is an opportunity in itself to develop and stimulate competitiveness in new sectors of economic growth (eco-business, eco-innovation, eco-design, etc.) but also to stimulate an efficient management of resources for traditional economic sectors. There is clearly a strong economic logic behind this transformation: for example, European calculations show that the circular economy could create a net profit of almost one trillion euros, ie a GDP gain of 7% [1].

Encouraging and developing new sustainable business models that promote the efficient use of resources is the main way to make the transition to a green economy in Romania. In this sense, it is necessary to develop digital tools that promote an industrial symbiosis, which facilitates trade relations and direct transactions of residues and waste from production on all types of waste so as to become cost-effective and economically sustainable.

CONCLUSIONS

The transition to a green economy involves shaping a policy and investment-based economy that links economic development, the ecosystem, biodiversity, climate change, health and well-being of the population in the medium and long term. Thus, a favorable economic growth can be achieved only after the creation of synergy relations between all these factors in order to implement the identified mechanisms and tools [14].

The concept analyzed in this paper can be presented through different approaches that bring to the fore the obligation to analyze all the factors that can bring changes to the traditional model of economic growth. The activities through which it is desired to make the transition to the green economy, must also respect the aspects related to the economic, social or environmental impact. The whole process can lead to legislative damage that can have repercussions on civil society. The application of this concept aims to involve all stakeholders in all sectors of activity, not just waste management or green energy.

Transforming this type of economy into a sustainable one that will add value to the national economy, involves the transition to new business models, oriented towards innovation and not quantity. Also, the application and use of eco-efficient technologies, which actively contribute to the reduction of GHG emissions, represent challenges for developers and create opportunities for civil society.

In order for Romania to reach a stable green economy in the future, it is necessary to assume public policies from both the Government and the line ministries, as well as the involvement of all public authorities, but also of the private environment and NGOs.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPLICATIONS OF LEADERSHIP IN ORGANIZATIONAL AND MANAGERIAL CULTURE IN ROMANIAN ORGANISATIONS. PRELIMINARY STUDY

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Abstract

The study aimed to approach the leadership style practiced in various organizations in Romania operating in the private sector, because in the current context of the globalization of the markets and activities, of rapid growth of competition at an unprecedented level, the role of managers/leaders becomes more and more important. The term manager does not overlap with the term leader, but it is desirable that this should happen in practice. If the manager has a position and influence that come from his formal place in the hierarchy of the the organization, the leader gains sympathy and support through the qualities he possesses and uses in relationships with the others. A questionnaire of 10 questions was applied during this study. 80 people, working in management positions within various private organizations, including the field of agriculture, from the western part of the country were interviewed. The correctness of the results obtained largely depended on the objectivity of the answers of the interviewees. There is a temptation to give ideal answers while avoiding the real ones. This observation is characteristic of most empirical research on leadership in organizations.

Key words: *leadership, manager, organizational culture*

INTRODUCTION

In the current context of globalization of markets and activities, the rapid growth of competition at a level never reached before, the role of managers,leaders is becoming increasingly important.

The term manager does not overlap with the term leader, but it is desirable that this should happen in practice. If the manager has a position and influence that come from his formal place in the hierarchy of the organization, the leader gains sympathy and support through the qualities he possesses and uses in relationship with others. Leaders must thus ensure an adequate organizational framework for the company's employees to show their skills and initiative, to capitalize on their knowledge at the highest possible levels, without the need for rigid or sophisticated control system. In Marian Năstase's vision, leadership is the process bz which a person, a leader determines , through the use of interpersonal relationships, one or two people to act in order to achieve well+established goals, based on a strong and attractive vision [10]. Leaders have two main roles. First they have to accomplish the task. Second, they must maintain effective relationships with the group as a whole and with each member of the group. The relationships must be effective so that they lead to the completion of the task.

[1] emphasized that in fulfilling their role, leaders must meet the following needs:

1. Task needs. The group exists to achieve a goal or to accomplish a common activity. The role of the leader is to ensure that this goal is met. If the goal is not fulfilled, the leaders will lose the trust of the group and this will result in frustration, criticism and eventually dissolution of the group.
2. The need to maintain the group. In order to achieve their goals, the group must be kept together. The leader's job is to build and maintain the team spirit.
3. The needs of the individual. Individuals have their own needs, which are expected to be met in the work place. The leader's task is to be aware of these needs, so that when

necessary, he can take measures to harmonize them with the needs of the task and the group.
These three needs are interdependent.

Over time, attempts have been made to define those traits that define a successful leader, these characteristics have been placed at different levels:physical, intellectual (such as intelligence index) or personality (such as perseverance) traits. Even if in some cases relationships with managerial efficency can be achieved, it is practically impossible to identify the ”type” set of characteristics that build the ideal leader [4].

The American professor John P. Kotter (1992) proposes a very simple model and, at the same time, very strong in its essence, based on the duality of competences exercised by a person in the role (position) of manager and, respectively, leader. Management/leadership duality is described by managing two distinct contexts: complexity respectively change. According to this model, a person plays the role of a manager when his activity has as a characteristic landmark the management of complexity, and respectively the role of leader when his effort is focused on promoting and implementing change. Literature connects leadership skills with behaviour and performance [8].

Mumford argues that leadership involves a complex form of social problem solving in which the leader's performance is associated with his or her ability to sense the need for change, identify goals, create pathways to viable solutions, and does so by understanding the complexity of the internal and external environment. Complex problem-solving skills, social judgment skills, and knowledge have been linked to efficiency [3]. Leaders often need to generate solutions to multiple problems, which go quickly and come up with the best alternative solution in the shortest amount of time. [2] affirmed that leaders need skills and abilities to develop and implement solutions together with those who follow them, colleagues or supervisors who operate in complex, dynamic contexts. To do this , leaders need social skills. [5, 12, 13]. Moreover, effective leaders must have the ability to persuade their followeers, often in complex social situations, and it is very difficult to accept and support the proposed solutions.

Leaders need some established knowledge to come up with, solutions to meet challenges and opportunities [8]. For example, Smonton (1984, 1990) that charismatic leaders had a unique set of career experiences that provided them with the experience and knowledge to solve the problems faced by their listeners. Ironically, although the acquisitions of knowledge and skills is clearly important for leadership effectiveness, this are has been left out in leadership literature; however there are some exceptions [6]. Leaders who have accumulated knowledge characterized by a a longer-term perspective expect to be more successful as they rise to higher hierarchical positions in organizations [7].

Similarly, tacit experience and knowledge have been shown to have significant, positive relationship effectiveness and performance. [11].

In this context, the purpose of the paper was to approach the leadership style practiced in various organizations in Romania operating in the private sector. The reason was that in the current context of the globalization of the markets and activities, of rapid growth of competition at an unprecedented level, the role of managers/leaders becomes more and more important.

MATERIALS AND METHODS

Through this approach, it was aimed to highlight the leadership style practiced within the various organizations in Romania that operate in the private sector. The interviewed people were asked to answer the 10 questions in the questionnaire.

A number of 80 people who work in management positions within private organizations in several counties of the country: Timiș, Arad, Caraș-Severin were interviwed. The accuracy of the results of this study largely depends on the objectivity with which the people answered the questions in the questionnaire. There is the tendency to offer ideal answers while avoiding the real ones. This observation is characteristic for most of the empiric researches dedicated to leadership in organizations.

RESULTS AND DISCUSSIONS

Next the answers to the questions will be analysed, specifying the purpose of questions.

Question 1: *Do you encourage team members you work with and try to heed their suggestions?* Through this question I wonted to highlight the extent to which the leader encourages subordinates to make decisions and how important the opinion of subordinates is.

Table 1. Frequency of answers to question 1

Answer options	Always	Very often	Sometimes	Total
Absolut frequency	20	25	35	80
Relative frequency %	25	31	44	100

Source: Field survey, 2022.

Analyzing the frequency of answers to the question from the previous table, we note that continuous adjustment of the people involved in management positions encourage the participation of subordinates in decision-making. From this point of view it can be said that the aim is to create a team which should be used as a first method to encourage participation in improving organizational performance by making the best decisions. People implied in agricultural management positions (especially animal husbandry) support the idea that the suggestion from the farm stuff are important, because animals are unpredictable. It is important that the farm stuff, especially in the field of growth of sports horses, to be very competent and prepared.

The team is a powerful tool through which the affiliation and the social needs of the staff are satisfied, the context for individual development is created; it is the participatory tool that encourages involvement and the primary method for establishing organizational learning. Thus the whole process related to the team (group process) underlines the basic values of the organizational development. Leaders who are more interested in intimidating and humiliating their employees than working in a team will give up any approach to organizational development.

Another subject, which derives directly from the chosen theme for this paper, is the one of innovation and creativity,

Question 2: *Do you encourage your subordinates to be creative in their work . If yes, why? If not, why?*

Most of the interviewees stated that they encourage their collaborators to be creative in what they do, because they consider that innovation and creativity are both means of implementing change and results in this process. On the other hand, specialists in the agricultural field claim the following: on a livestock farm all processes are preset (starting with the feeding schedule, movement, grooming, cleaning etc) as well as on the vegetable farms, so creativity at work is not necessary. The work schedule is fix and has to be followed as such.

The origin of change was defined as a notion by

David Nadler and Michael Tushman [9], in their book „Strategic organization design**”** and presents the emergence of change in an organization. This may occur because of the environment in which the organization operates or through the intent of the organization. Thus the changes can be unintentional and happen independently of the will of the organization or can be intentional or deliberate, concrete actions calculated by the organization. To identify the needs and problems of an organization, to find the most appropriate solutions and the best way to apply them in organizational development, you need an open creative spirit that generates new innovative ideas that allow the continuous adjustment of the life of the organizations to the external conditions of the operating environment, in parallel with an increase in internal stability [9].

Question 3: *Do you consider it necessary to monitor the program to ensure that a specific task of project will be completed on time?* From this question results the importance that the leader attaches to the planning of the activity and the timely employment. The interest for monitoring is 100% and those from the agricultural field consider it necessary, too. Which is an integral part of managerial activity (monitoring as a managerial function is essential). the problems that will inevitably appear refer to the way of monitoring (the capacity of the organization to implement an objective monitoring evaluation system) and the use of results (how we will use results obtained from the monitoring). this issue is related to the following question, which refers to how to relate to subordinates in case of identifying personal mistakes.

Question 4: *When you have to correct certain mistakes of colleagues, do you worry about endangering interpersonal relationships?* Over 85% of respondents do not worry that interpersonal relationships could be damaged, because they claim that these mistakes can be corrected collegially, respecting human dignity and pedagogical norms, which highlights the importance of human resources in the context of organizational development. Based on this idea, it is related to to the leadership skills of the leader of the organization to provide constructive feedback, in the sense of those mentioned above.

Question 5: *How do you feel about performing multiple complex tasks simultaneously?* One of the typical problems faced by the private sector manager, and not only, refers to the lack of a linear activity to another) and the need to face different tasks at the same time. The majority of respondents (90%) said that it depends on the type of objectives proposed and the deadlines for their achievement, a very small number (10%) reported major problems in the field; overburdening leaders (are not necessarily burdensome for the organization) poses a major risk to the functioning of the organization and initiating the process of organizational development. Many Romanian managers tend to focus on secondary operational issues at the expense of strategic issues essential to the organization (due to the desire to provide the image of the leader ”omnipresent” and ”skilled at everything”).

Question 6: *When you have a complex project to do, do you explain to your subordinates what the hard parts of this project are, do you try to give them details?* In this way an analysis of the leader”s ability to transform the general tasks and objectives of the organization into clear and well-structured objectives at the individual level is attempted. This effort refers to the personal abilities of the leader and the features of the subordinate team. In this regard, we noticed some reluctance on the part of the respondents, because 61% of those who surveyed provide a these details only if requested.

Question 7: *Do you read articles about the act of leadership (leadership, psychology) and try to apply in practice what you read?* According to the data in Table 2, we notice that 43% of the subjects do it rarely or not at all (those from the agricultural field DO NOT read such articles as they work according a fix work schedule and a set programme.)read materials related to their work, 27.5% read frequently and 18%always and 25% read very often. We can say that respondents are open to learning and consider it important in the process of personal and group development. This is an essential element of organizational development because we cannot talk about changing and improving organizational performance without learning.

Table 2. Frequency of answers to question 7

Answer options	Always	Very often	Sometimes	Total
Absolute frequency	15	20	45	80
Relative frequency %	18	25	57	100

Source: Field Survey, 2022.

Organizational development means giving up the status quo and opening up to creativity. It would have been interesting to see what kind of of materials respondents refer to when they say they read specialized materials, on one hand; and on the other hand the ability to select the best sources which is a variable. Another issue concerns the ability to implement theoretical knowledge at a practical level.

Question 8: *Do you advise your collegues on their own behaviour and performance?* This seeks to observe the leader's interest in the well-being and professional development of subordinates.

The leader advises subordinates on their behaviour at work and how they could improve their performance. This seeks to observe the leader's interest in the well-being and professional development of subordinates.

The leader advises subordinates behaviour at work and how they could improve their performance. The majority of respondents (90%) do this only if asked, which iss a shortcoming in my view, as many collegues are unaware that they would need counseling. Counseling is important for all those who are oriented towards healthy performance. They will learn to build teams based on correctly motivated human resources, towards self-improvement, not on excessive super-competitiveness between employees.

Question 9: *Do you the limits imposed by other collegues?* This question tries to observe the extent to which the leader respects the limits imposed by subordinates.

All respondents claim that they respect the limits imposed by subordinates, but before approaching a person the leaders must have a clear idea of the limit they want to impose both for them and for their subordinates. For this reason, leaders need to think about the people they want to approach, taking into account the personality, the relationship that exists between them, the level of comfort in which the person they want to approach is and everything else that can be relevant for them. It could be a person who does not accept constructive criticism, in which case care must be taken with the tone used in the conversation. Even in this aspect I have noticed a deficiency in terms of answers, too. Everybody answered ”yes”, although the question was open, which means that the investigated people should have given detailed answers, not just a simple ”yes”. People acting in the agricultural field are very trenchant and argue that limits have to be set from the very beginning (when submitting the CV) by the employer.

Question 10: *Do you enjoy analyzing the problems of the institution/organization you work for?* This question tries to observe the interest shown by the leader towards the problems of the organization/institution in which he works and to find solutions to these problems. To this question the respondents unanimously answered that they are involved in solving the problems , but 30 of them said that in order to solve complex problems they need special skills, which they still have to work on.

CONCLUSIONS

The conclusions that can be drawn from this study and the recommendations that allow me to make them are the following:

The team is a powerful tool through which the affiliation and social needs of the staff are met and the context for individual development is created: it is the participatory tool that encourages involvement and the primary method for establishing organizational learning: it is the means to identify the needs and problems of an organization and find the most appropriate solutions and the best way to apply them in organizational development. There is a need for an open, creative spirit, which generates new, innovative ideas that allow the continuous adjustment of the life of the organizations to the external conditions of the operating environment , in parallel with an increase of internal stability.

The interest for monitoring is 100%, which is an integral part of the managerial activity. (monitoring as a managerial function is essential).

The issues that will inevitably arise here are how to monitor.

This problem is related to the following, to the way of relating to subordinates in case of identifying personal mistakes.

When individual feedback is provided, it is recommended to be done in a confidential, personal manner, to each individual employee. First of all, the habbit of giving feedback by comparing one person with others has more disadvantages than advantages. Despite appearances, it is not an effective way to boost an employee. The feedback provided by comparing people with each other has the effect of damaging the relationships between employees, negatively affecting the cooperation between them and creating an unconstructive pressure for the team.

Managers who are oriented towards healthy performance will learn to build teams based on correctly motivated human resources, towards self-overcoming, not on excessive super-competitiveness between employees.

One of the typical problems faced by the private sector managers and not only refers to the lack of a linear activity (rapid transition from one type of activity to another) and the need to face different tasks at the same time.

Many Romanian managers tend to focus on secondary operational issuesat the expense of strategic issues essential to the organization (due to the desire to provide the image of the ”ubiquitous” and ”skilled at all” boss.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MANAGERIAL IMPLICATIONS OF THE NEW CAP VISION - FROM COMPLIANCE TO PERFORMANCE

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Abstract

The new Common Agricultural Policy radically changes the way the Union views agriculture and rural development. If until now the focus was on compliance, written documents and records, the new vision of the EC is focused on results and performance. The new CAP highlights the diversity that exists in the agriculture of the Member States and on rules built as close as possible to everyday reality, geared to local needs and conditions. By moving from the uniformity of most CAP instruments to the ability of states to plan their agriculture strategy and needs, it will radically change the way national strategic management handles issues. First of all, it is expected that the bureaucracy will decrease significantly once the rules, the norms will be reduced, both in number and in terms of complexity. The managerial implications are obvious, the focus on impact and achievements leading to another type of management characterized by advice, assistance, focused on achievements, cost-effective tools and sustainable development. The purpose of the paper is to analyze the managerial implications of the new CAP vision from compliance to performance.

***Key words*:** *Common Agricultural Policy, compliance, performance, National Strategic Plan, vision*

INTRODUCTION

One of the most complex European projects, with direct consequences on the well-being and sustainable development of the European space, began in 1957, with the signing of the Treaty of Rome on the creation of the European Economic Community by six states, France, Germany, Italy, Belgium, The Netherlands, Luxembourg [7]. The agricultural policy regulations were contained in Articles 38 to 46 of the Treaty of Rome and Articles 32 to 38, respectively, following the amendments made by the Treaty of Amsterdam.

Article 38/32 established that the common market will extend to the agricultural sector as well as to the agri-food trade by creating a common agricultural policy, and in art. 39/33, the objectives of the Common Agricultural Policy (CAP) were set [13]. Their simple enumeration, after 65 years, shows us the importance that was given then to the agricultural sector: the increase of the agricultural productivity by promoting the technological progress, the rational development of the agricultural production, especially of the labour force; ensuring a fair standard of living for the agricultural community, in particular by increasing the individual incomes of agricultural workers; market stabilization; ensuring security of supply and ensuring reasonable prices for consumers. These goals remain viable even today, even though the situation in the Union has been constantly changing. After 65 years, the EU considers this pillar one of the most important, over 28.5% of the Union budget, for the period 2021-2027 returned to agriculture. The principles governing the CAP date back to 1958, when the agriculture ministers of the six signatory states of the Treaty met in Stresa (Italy) [8]:

• The principle of the single market: within the European Union, agricultural products circulate without restrictions;

• The principle of Community preference: the consumption of products originating in the European Union is favoured, by imposing higher prices on imported products than on domestic production;

• The principle of financial solidarity: common measures are financed from a common budget

The fact that it has since been decided that the agricultural sector should benefit from a common policy of Member States giving up individual decisions for 90% of agricultural products in favour of Community decisions has been a major factor in what has become the CAP today.

Without minimizing the 1992 reform, known as the MacSharry reform [12, 13], after the then agriculture commissioner Ray MacSharry, where overproduction was brought under control by compensatory payments to farmers, per hectare for arable crops, and per animal head for cattle, the 1999 reform, based on the Commission's reform proposals in the Agenda 2000 document [9], fundamentally redirects the CAP.

There is a structural shift through the grouping of measures aimed at product quality and production process, care for the environment, multilateral development of rural areas - under a common umbrella, that of rural development policy, which has thus become the second pylon to PAC. It was the reform that strengthened the over 20-year philosophy of the CAP, focused on compliance [1], on the authority of the Commission, translated into clear, common steps that Member States had to follow.

This reform is about to be overcome today by the new vision of the CAP, based on National Strategic Plans (NSP), focused on performance indicators, performance management and performance quality [6].

With the new common policy, paradoxically, it seems that the Union is returning to the national contexts of the states, to their concrete development, to highlighting the diversity that exists in EU agriculture and to cost-effective instruments.

In particular, the states are encouraged to develop National Strategic Plans, in compliance with very clearly stipulated environmental and climate conditions. Strengthening the focus on performance/ results, defined rules much closer to everyday reality and directing efforts in relation to local needs and conditions will make NSP tools that will ensure sustainable development in the future.

It has gone from a uniform approach in the design of most CAP instruments, specific to compliance, to the possibility for states to make interventions that can contribute to the objectives of the new CAP.

There are several aspects that are worth highlighting: the complementarity between the interventions of the 2 pillars of the CAP, the fact that the commission's audits will focus on general principles and systems, the simplification of reporting requirements for national administrations, the obligatory national agricultural advice, reducing the number and complexity of rules that will be reflected in simple and pragmatically applicable rules.

All this will have, of course, deep managerial implications, so that the agricultural business management will move towards the result, towards the output, will develop tools and indicators through which to anticipate the results, to invest their efforts and logistics in SMART objectives, so that planning should be appropriate to the results obtained

MATERIALS AND METHODS

The research is based on a large scale of information sources regarding the evolution of Common Agricultural Policy from the foundation of the European Union till present.

The rich information was selected and exposed in a logical way in a very comprehensive manner in order to reflect the positive vision from a stage to another destined to sustain the development of agriculture in all the member states and to emphasize the dynamics from compliance to performance and quality.

RESULTS AND DISCUSSIONS

The size of the CAP focused on compliance and its managerial implications

The 1999 reform and the Agenda 2000 analysis document were an important step in the development of the CAP. For a qualitative study that I am trying to carry out, through which I will analyse the basic indicators that identified the idea of compliance with the common agricultural policy of the last 2 decades, with reference to the managerial implications and the new paradigm shift starting with the new CAP 2023 - 2027 [2], implicitly the indicators by which we identify the transition to performance and results, as well as the new managerial implications, I will analyse the CAP 2014-2020 and the new National Strategic Plan 2023 - 2027. I will not consider the period 2021-2022, respectively the transition mechanism in the sector (EAFRD and EAGF), as described in the Transitional Regulation.

In order to understand the managerial implications specific to the period 2014-2020 included in the CAP, I will point out some structural aspects of the CAP 2014-2020[3, 4, 5], which I consider relevant for the present study.

Firstly, the common agricultural policy had gained and had to consolidate several important aspects at that time:

• Additional payment in the first Pillar for farmers in areas with natural constraints;

• Coupled support for sectors and areas with a specific risk of production abandonment;

• Payments for areas with natural constraints in the 2nd Pillar, with an increased ceiling and a stable definition for the mountain doubled by targeted and more integrated actions possible for the mountain areas in the thematic sub-programs for the mountain;

• Diversification of rural development measures that allowed to cover not only the compensation of production and investment overheads, but also the capacity of mountain communities to develop revenues from sales-supply chains of quality and diversification.

These opportunities, cultivated after the 1999 reform, were continued by the 2014-2020 CAP. EC monitoring, control and inspections required states to provide information to Brussels on an ongoing basis. In doing so, the Union shall ensure that States comply with bureaucratic formalities and comply with the requirements of the Commission.

During the analysed period, 3 major directions were pursued and the entire common agricultural policy closely followed them.

First, the reorganization of direct payments. Specifically, the following were pursued: convergence at national level and between Member States; payment for sustainable agricultural practices; support for small farmers; support for young farmers; direct payments only to active farmers; capping direct payments; support for disadvantaged areas naturally; transfer of funds between the two pillars of the CAP (Direct Payments and Rural Development), simplification of cross-compliance criteria.

Secondly, market management mechanisms: making existing public intervention and private storage aid systems more flexible and efficient, but also introducing a new safeguard clause for all agricultural sectors; better sectoral organization, and the existing rules for the recognition of Producer Organizations and inter-sectoral organizations will be extended to all sectors and funded by the rural development program.

Third, rural development, in 6 important directions. Rural development is becoming an important issue for former communist countries, which use this tool to bridge the gap between urban and rural areas: encouraging the transfer of expertise and innovation, increasing competitiveness; strengthening agri-food supply chains and risk management in agriculture; restoring, conserving and strengthening ecosystems, promoting resource efficiency and the transition to a low-carbon economy; promoting social inclusion, reducing poverty; economic development in rural areas.

For the period under review, the philosophy of the CAP was to set common European targets and to oblige all states to meet these targets within the parameters required by the Commission. Any deviation was analysed and the necessary financial corrections were made. Compliance management certainly had a positive aspect - strengthening an organizational culture of agricultural entrepreneurship, using two-axis monitoring and control tools. Predictably, the intervals in which the Commission requested documents or statistical analysis to track targets were known and unpredictable / spontaneous, in the sense that the Commission could at any time request an audit or move specialists to Member States. In such a way that the key points pursued in Brussels are reached, which is what happened. These were: better targeting of income support to accelerate growth and employment; better adapted crisis management tools with increased response capacity to meet new economic challenges; payments to protect long-term productivity and ecosystems; a more competitive and balanced food chain (the European strategy from farm to fork is meant to make the transition to a new agri-food system that ensures quality food); encouraging Agri-environmental measures; facilitating the setting up of young farmers (one of the most ambitious measures in the light of European demographic trends); stimulating employment in rural areas and entrepreneurship.

The size of the CAP focused on performance and results and its managerial implications

The 1999 reform managed to solve much of Europe's agricultural problems, to strengthen the two pillars of the EAFRD and the EAGF, but at the same time it could not prevent the structural differences that exist in Europe between Western developed countries and former communist states developed [10, 11].

In this context, in addition to the Union's ambitious Agri-environment, climate and bio-agriculture projects, on the one hand, and the destructive effects of the Covid 19 pandemic, on the other hand, the Commission has determined the to be able to make a fair transition to the years to come.

Without compromising on the commitments made by the European Green Pact and the Farm to Fork Strategy for Sustainable and Sustainable Agriculture, the Commission has changed the way the Common Agricultural Policy is implemented, which I believe is a new reform for the following period. The new reform is based on the National Strategic Plans and on performance and results. This change will have an impact on agricultural entrepreneurial management, both at national and farm level.

Several elements are visible at the moment: simplification and modernization of agricultural policy; rebalancing responsibilities between Brussels and the Member States (subsidiarity principle); better targeted, results-based and performance-based support; more equitable distribution of direct payments; higher environmental and climate standards.

In the period 2014-2020, all the member states, including Romania benefited of the provision of the CAP with a deep impact on agricultural production and farmers income [14, 16, 17, 18, 19.]

By abandoning the way in which Member States comply with the commitments and responsibilities set by the Commission, the new Agricultural Policy is beginning to consider the particularities of the states and create tools for these particularities to be accepted and promoted. In this way, each state plans its own priorities, chooses its own goals, and ensures that they are met as planned. Beyond an absolutely justified margin of error, states must fall within what they alone plan.

Member States have the right to devise a National Strategic Plan in which to pass the main objectives of the development of their sector of activity. The Commission reserves the right to announce common targets in which states fall, noting that these targets are no longer so strict. The rules and regulations are becoming more general, leaving great freedom of movement to the Member States.

In this way, the Commission provides much more direct, focused support for the needs of each state. There will be further discussions as states have their own interests and levels of development, but the new focus on performance and outcome is more effective.

For the EAFRD [10, 11], the constraints are as follows:

• at least 5% of the total EAFRD - LEADER;
• at least 30% interventions addressed to specific environmental and climate objectives (except for payments addressed to areas with natural and other specific constraints);
• maximum 4% of the total EAFRD - financing the technical assistance actions necessary for the efficient management and implementation of the CAP Strategic Plan.

The new document, as set out in the proposed regulation, will cover the minimum content, targets and financial planning, how to be approved by the Commission and how to amend. Member States will present their proposed interventions to achieve specific objectives at EU level and which bring together EAFRD and EAGF interventions, including sectoral interventions. Once a year there will be a performance evaluation, based on context, result and performance indicators. Each Member State shall draw up a single NSP for the period from 1 January 2023 to 31 December 2027 [10, 11].

In this way we can talk about important managerial implications in the new NSP.

First of all, the organizational diagnosis will be much more focused on the particular aspects of agriculture. Identifying weaknesses and threats will be more important than opportunities and strengths, in the sense that the correct identification of needs will lead to the establishment of concrete and pragmatic objectives/targets. Transforming needs into challenges and making them fruitful is an interesting option in the new agricultural management. The National Strategic Plan, as a tool, can be built through an understanding of future trends, which will happen on the market in the next 5 years. From this point of view, trend analysis, risk management, implicitly a dynamic risk management will be developed in the future [15].

The managerial implications will not only focus on effective planning, but will focus on intervention management, pursuing common goals for an intervention or so-called "cascade interventions". Such an intervention has the ability to solve other problems by rolling once implemented.

I believe that the technique of focused improvement inserts will influence the performance management focused on results. The lack of sufficient funds will determine the management to look for those interventions that will bring the most efficient and effective improvements. In this way, the available funds will be used in the most efficient way possible. The management of the trend analysis will be doubled by a management of the stakeholder analysis, of those interested in the agricultural policy. Consultations with them become a priority, the management of constant communication and coordination of decisions will be important.

Performance management will have to consider the mission and values it has in society. Rebalancing the trade balance of national agri-food products is an important goal for the state. The national strategic plans will aim to develop the agricultural sector so that it becomes sustainable and resilient. Or performance management automatically becomes a quality management, I am talking about a high-performance quality that will face the free market, to create market leaders capable of exporting anywhere in the world. At this point, the managerial implications also concern an investment management, of the entrepreneurial culture that it must propose. It becomes a transformative management, able to achieve successful objectives but, at the same time, to perfect the interested human resource, to create an entrepreneurial organizational culture for stakeholders.

CONCLUSIONS

The Commission's proposal, through the new CAP, envisages a move towards a performance-oriented agricultural policy that requires a solid performance framework based on a set of common indicators that will allow the Commission to assess and monitor Member State performance. The agricultural entrepreneurial management will also wear these values. Strategic planning, trend management and risk management, financial planning doubled by cost management, management of improvement interventions, supportive communication and counselling are some elements of a new management. Not necessarily the competitive advantage as the transformation of needs into challenges and their fruition through effective understanding of trends will mark the new management in agriculture. And most importantly, the ability of management to fit in, both in its own proposed targets and in the new European strategy that is difficult to achieve. The new management will be based on control and monitoring, on meeting the criteria, but these will no longer be a priority in the dynamics of management.

The aim is to shift responsibility and opportunities in a common Community framework, clearly defined and implemented, in order to achieve several key objectives at the same time - simplification, results-oriented (rather than compliance) and the effectiveness of agricultural policy. Managerial philosophy goes from doing the right thing to doing the right thing.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

COMPARATIVE ANALYSIS OF ECONOMIC EFFORTS AND EFFECTS IN MILK PRODUCTION AT RUMINANTS

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Abstract

In milk production, as in any economic activity, in order to obtain favourable economic results, it is necessary to allocate a certain level of resources, of different types. The present research is based on 157 case studies carried out on ruminant farms of various species, as follows: 54 on dairy farms, 47 on sheep farms, 33 on goat farms and 23 on buffalo farms, and aim at the comparative analysis of the economic results, in relation to the allocations of resources, in the direction of milk production. For this, a series of indicators are analysed such as average milk production, different categories of expenses, unit cost, profit/loss, taxable income rate, etc., highlighting the minimum, maximum and average levels of indicators calculated by species. The results of the analysis indicate, among others, that species such as goats and buffaloes, whose notoriety on the market is below that of cow's or sheep's milk, can obtain superior economic results compared to them.

Key words: *milk, cows, sheep, goats, buffaloes*

INTRODUCTION

In Romania milk is produced by cows, with the highest share in production and also by buffalos, ewes and goats. Milk yield differs from a species to another and depends on breed, farm size and farming system [1, 3,13].
The activity of milk production in livestock farms, regardless of the species of economic interest, involves the development of flows of activities both inside the system and outside it, in order to sell the production.
These activities involve the allocation of resources of various kinds, which, from an economic point of view, are reflected in financial efforts, and their result must be aimed at maximizing the economic effects.
Therefore, a major challenge for the dairy sector is to improve profitability [14].
In different contexts, external factors, regardless of the internal allocation of resources, can play a decisive role in conditioning the profitability of farms [7].
The analysis of the resources used in the milk production sector must take place at the farm level, in order to achieve the best use of the resources.
When the farm produces at the optimum level of production, it is considered efficient, through the efficiency of transforming the input into output [8].
Different research results indicate that higher milk production requires higher production costs, but higher production results in better economic results [11, 12].
In this context, the purpose of the paper was to make a comparative analysis of the economic results in relationship with the resource allocation in milk production in Romania using a sample of 157 ruminant farms raising dairy cows, ewes, goats and buffalo in order to identify which is the hierarchy of the farm species producing milk based on their economic results.

MATERIALS AND METHODS

The present study is based on the results of research carried out between 2017 – 2020 in 157 case studies on dairy farms of different species, as follows: 54 on dairy farms, 47 on sheep farms, 33 on goat farms and 23 on buffalo farms.
The farms are located in different regions of Romania, with different forms of relief and have different sizes.
Thus, the average size of cow farms was 73.4 heads, between 5 - 568.3 heads; for sheep the

average was 516.7 heads, between 31.7 - 3,983.3 heads; at goats the farm average size of 159.7 heads, between 15 - 476.7 heads; and for buffaloes an average of 44.3 heads, between 2 - 300 heads.

For each species, different technical-economic indicators of economic efforts and effects were calculated, such as average production of milk, total expenses, variable expenses, material expenses, fixed expenses, labour expenses, unit cost, profit/loss per unit, taxable income rate, by their average, minimum and maximum.

RESULTS AND DISCUSSIONS

The average milk production for ruminant species under study is very different, but in order to compare the efforts and the effects and find differences or similarities, the indicators calculated refer to the unit of product, meaning 1 litre of milk. Thus, the average milk production for cows was 4,554.9 litres, with a minimum of 2,600 litres/head and a maximum of 9,633.3 litres/head (Figure 1).

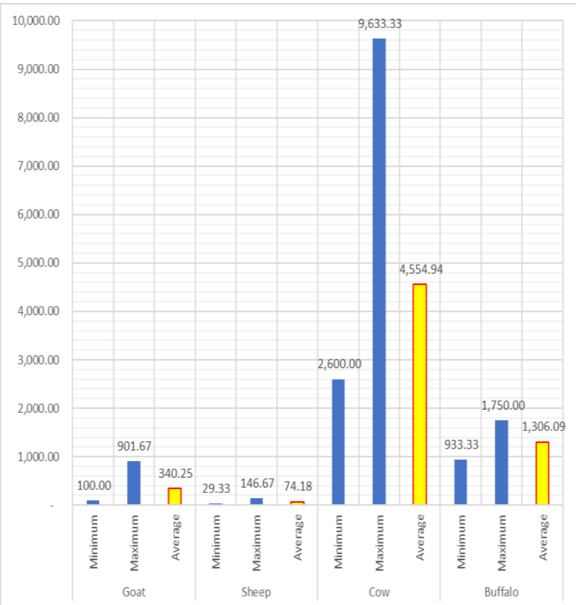

Fig. 1. Milk productions, by species (l/head)
Source: Own results.

For buffaloes, the average milk production was 1,306.09 l, ranging between the minimum of 933.33 litres and maximum of 1,750.0 litres. For goats, the average milk production accounted for 340.25 l, varying between 100.0 litres, the minimum level and – 901.67 litres, the highest one. The lowest milk production was for sheep, with an average of 74.18l, a minimum of 29.33 l and a maximum of 146.67 l.

In terms of total expenses, the highest values were for sheep, with an average of 6.74 RON/ litre. Of these, the expenses related to the main production (milk) were 3.39 RON / litre, representing 50%, the rest being covered by the value of the secondary production (lambs, young sheep fattening).

The next species in terms of total expenditure are buffaloes, with 3.79 RON/l, of which 3.42 RON/l are related to the main production.

For goats, the total expenses are 3.02 RON / l, of which 2.35 RON are related to the main production, and the lowest costs are for cow's milk, 1.71 RON/l, respectively related to the main production, of 1.55 RON/l (Figure 2).

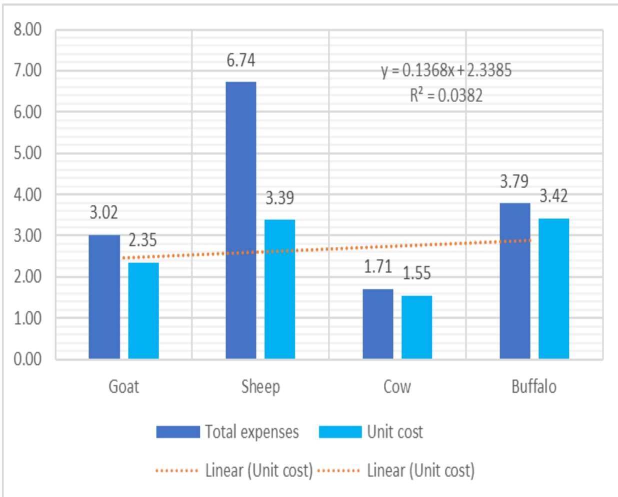

Fig. 2. Total expenses and unit costs (RON/litre)
Source: Own results.

The biggest difference between total expenses and expenses for milk production (unit cost) is for sheep, of 3.35 RON (almost 50%), indicating that secondary production for this species occupies an important or even decisive place for obtaining favourable economic results.

In the absence of selling the secondary production at sheep, which is represented by lambs and young sheep, the milk production alone would bring negative financial results.

For the other species, there are smaller differences between total costs and those for the main production (unit cost): 10% for cows and buffaloes and 22% for goats (and for this species, the sale of kids can bring a significant increase to cover farm expenses).

Variable expenses represent the large majority of total expenses. These include expenditures with forages, biological material, medicines and medical supplies, other material expenditures, supply quota and animal insurances.

The highest variable expenditures were for sheep, on average of 5.13 RON/litre, representing 76.1% of the total expenditures.

On the second place are buffaloes, with 2.84 RON/l (75% of total expenses), followed by goats with 2.06 RON/l (68.2% of total expenses), and we find the most advantageous variable expenses for cows, with 1.3 RON/l (76% of total expenses) (Figure 3).

Of the various categories of variable expenditures, the largest share are feed expenditures. In fact, it can be said that these are the most important, being the object of optimization calculations, both for technical, productive and economic purposes.

With a proper management of the feed system for animals, the forages expenditures will be reduced. Beside to lower feeding costs, also production efficiency and profitability will be improved [4].

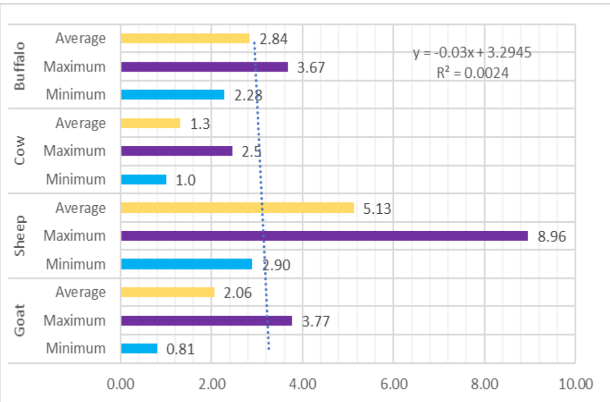

Fig. 3. Variable expenses, by species (RON/litre)
Source: Own results.

Material costs are part of the variable costs and include forages, biological material, medicines and veterinary materials, as well as other material costs.

On average, by species, these expenses were: 1.2 RON/l milk for cows, 1.98 RON/l for goats, 2.73 RON/l for buffaloes and 4.91 RON/l for milk (Figure 4).

Fixed expenses include labour costs, general expenses, interest on loans and amortization.

For dairy cows, they were, on average, 0.4 RON/l, for buffaloes 0.95 RON/l, for goats 0.96 RON/l, and for sheep 1.6 RON/l (Figure 5).

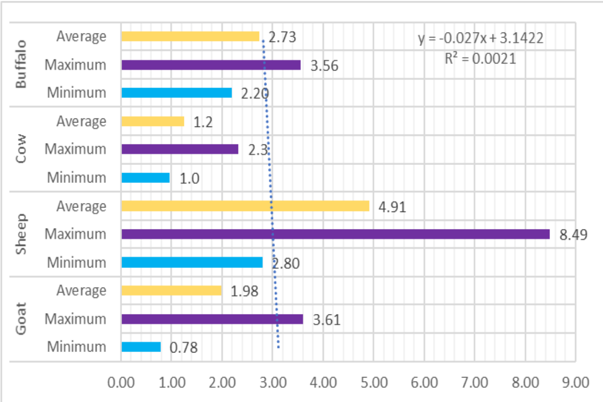

Fig. 4. Material expenses, by species (RON/litre)
Source: Own results.

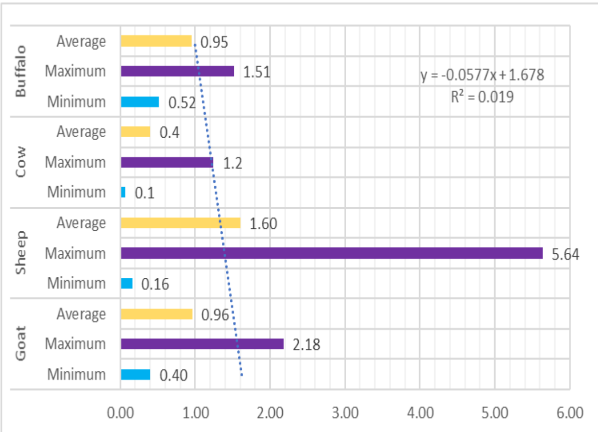

Fig. 5. Fixed expenses, by species (RON/litre)
Source: Own results.

Even the value of fixed expenses is lower than variable expenses, they are important in determining the value of the breakeven point.

Labour costs represent the most part of fixed expenditures. Making them more efficient means optimizing working standards, depending on the category of animals and production.

For cows, they were 0.4 RON/l, for buffaloes 0.87 RON/l, for goats 0.90 RON/l, and for sheep 1.60 RON/l (Figure 6).

The selling prices of milk varied from one species to another. The highest average price was for buffaloes, 4.15 RON/litre, and the lowest price was for cows, 1.56 RON/litre.

Buffalo milk is appreciated as having special nutritional qualities and is sold at a much better price than cow's milk, being present on the market in lower quantities. This price compensates for the low level of production compared to cows.

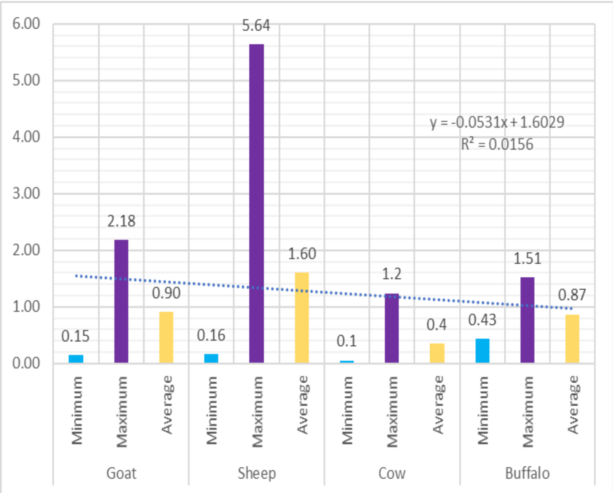

Fig. 6. Labour expenses, by species (RON/litre)
Source: Own results.

For cows, the minimum selling price of milk was 1.10 RON/l, and the maximum was 3.67 RON/litre (Figure 7). Prices vary greatly depending on how the milk is sold. The lowest values are found at farmers who sell milk to processors, and higher price levels are obtained where milk is sold through vending machines, or directly on the local markets, or as different categories of cheese [6]. This shows how important a minimum primary milk processing is on the farm.

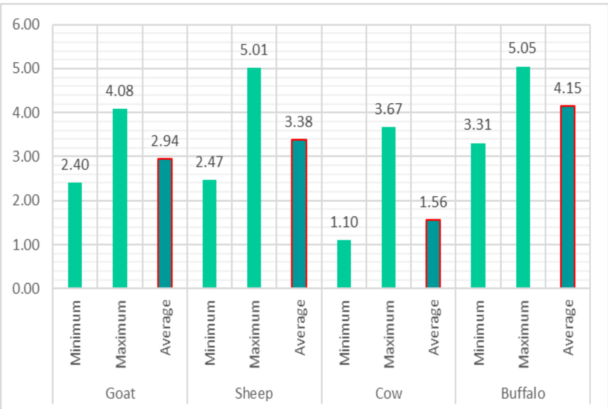

Fig. 7. Milk prices, by species (RON/litre)
Source: Own results.

For goats, the price of milk was, on average, 2.94 RON/l, and for sheep 3.38 RON/l. It should be noted that the average price of milk is a price calculated and converted according to the form of delivery of milk (drinking milk, or cheeses). For sheep, the price is fully converted, as milk is sold as cheese.

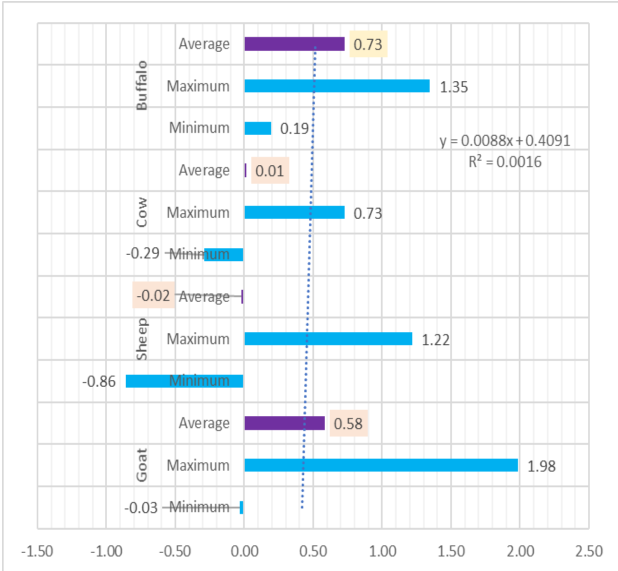

Fig. 8. Profit / loss, by species (RON/litre)
Source: Own results.

The financial results (economic effects) of the milk production activity for the 4 species of ruminants, and here we refer to profit / loss, indicate that, for cows and sheep, whose products are the most common on the market, the situation differs from one farm to another, but the average results show a critical level, in the sense that it is in the immediate vicinity of zero (close to the break-even point); specifically, for cows a profit of 0.01 RON/l (with a minimum of -0.29 RON/l and a maximum of 0.73 RON/l), and for sheep, a loss: -0.02 RON/l (with a minimum of -0.86 RON/l and a maximum of 1.22 RON/l) (Figure 8).

The encouraging situation for farmers is in the case of goats and buffaloes, where the highest levels of profit are: on average 0.58 RON/l for goats and 0.73 RON/l for buffaloes.

These two species of ruminants, whose milk is not bought by the large mass of consumers, are sold at slightly higher prices (due to the superior and even curative qualities of their products, as well as due to the fact that they are somehow niche products), and

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

economically, production efforts are accompanied by satisfactory effects for farmers. This is a solid reason for stimulating the spread of the exploitation for these two species.

Raising goats is mostly described as low-input systems across the world, no matter extensive or semi-intensive [9]. Also, according to other researches, the profitability of buffalo breeding in extensive farming system was higher than other species [10].

As a result, the rate of taxable income varies both from one species to another and between farms of the same species (Figure 9).

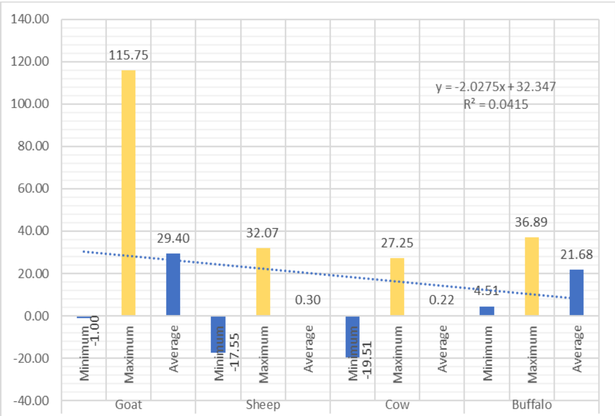

Fig. 9. Taxable income rate, by species (RON/litre)
Source: Own results.

For dairy cows, the average is 0.22% (minimum -19.51%, maximum 27.25%), the negative results being in farms with low milk production (around 3,000 l/head, or even less, with a very low price obtained).

The rate of taxable income for buffaloes is much higher than for cows, on average 21.68% and only positive (minimum 4.51%, maximum 36.89%).

For goats, the average is the highest of the ruminant species, of 29.40%, and also in this species we find the highest level of maximum value, of 115.75% (in the case of an elite farm of 60 heads, with milk productions of 586.6 l/head).

In sheep, the taxable income rate is similar to that of cows, on average 0.30% (minimum -17.55%, maximum 32.07%), the minimum values being in the case of small farms (below 200 heads) and with reduced milk production (less than 100 l/head).

The results pointed out that a large range of factors have a deep influence on milk production besides the species [2].

Technical aspects have a deep impact on milk production efficiency and competitiveness [5].

CONCLUSIONS

The analysis of the different indicators of effort and, respectively, of the effect of the milk production activity highlighted the fact that there are a multitude of factors that contribute to obtaining favourable economic results, namely farm size, average and total milk production, level of different categories of expenses, market context for the sale of milk production, the degree of production processing (primary processing on the farm, or creation of added value by delivering different varieties of cheese), the general management of the farm, etc.

It is necessary that the farms from the milk sector to reappraise the coordinates of the systems of milk production at farm level with specific focus on enhancing technical efficiency and competitiveness of the sector.

It should also be noted that the positive economic results obtained in raising goats and buffaloes may be an incentive for dairy farmers to address these species and expand their use in production, along with a certain level of primary processing of milk on the farm.

The analysis of the indicators in the case studies shows that smaller farms, with lower levels of milk production per animal, generally have the highest unit costs and the lowest profit levels. They fail to adapt quickly to fluctuations in the economic sphere.

In the case of larger farms, even if the average milk production per animal is not high, this is compensated by the higher number of animals, which will create the conditions for positive financial results.

The objectives of the activities carried out must be defined in such a way as to specify the desired results, to guide the design of strategies for their implementation and to serve as performance standards.

These objectives fall into various priority areas, such as increasing the profitability of the farm, its position on the market, launching new products, providing financial resources, improving human resources, increasing labour productivity, etc.

ACKNOWLEDGEMENTS

This paper is part of the research carried out under the ADER Project 24.1.2 ”Research on the economic efficiency of raising sheep, goats, dairy cows, cattle and buffalos” - Phase 4 ”Economic efficiency analysis program for sheep, goats, cattle, buffaloes”, funded by the Ministry of Agriculture and Rural Development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FERTILISATION MANAGEMENT OF WHEAT CONTAMINATED WITH *FUSARIUM GRAMINEARUM* AT ALBOTA AGRICULTURAL DEVELOPMENT AND RESEARCH STATION, ARGES COUNTY, ROMANIA

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Abstract

As it is well known, Romania is an important cultivator and producer of wheat in the European Union. Due to the pedo-climatic conditions that our country has, wheat is found in all development regions, and especially in the South-Muntenia Region. Here, in 2020, 602,794 ha were cultivated, representing 28% of Romania's total area cultivated with wheat. The production obtained was 1,753,248 tons, and accounted for 27% of Romania's total wheat production. Unfortunately, this crop faces diseases and pests that can affect plant nutrition and development, and ultimately influences indicators such as the average production and total production. Contamination of cereals with toxic fungal metabolites is one of the main problems of contemporary agriculture. Fusarium species are the most dangerous pathogens of cereals and have a high level of toxicity. These metabolites are the main cause of the development of cereal fusarium (FHB). Under the existing natural conditions at Albota-Pitesti Agricultural Research and Development Station (ARDS), Arges County the paper presents several studies on the mineral nutrition of winter wheat subject to the risk of contamination with Fusarium toxins. It should be noted that the types of soil on which the experiments were performed were Vertic Luvisols. Five winter wheat varieties were selected for testing: Delabrad, Dropia, Faur, Glosa and Gruia. The phenophases in which the mineral nutrition of the plants was characterized with macro and micronutrients, were those of the ear emergence-flowering.

Key words: *fertilisation, Fusarium toxins, Romania, wheat area and production*

INTRODUCTION

The main metabolites of microscopic fungi are mycotoxins. Cereals, cereal products, and food are contaminated by them [3], [4], [5].

In global agriculture, one of the current problems is the contamination of cereals with toxic fungal metabolites (pathogens and saprotrophs) [11].

The pathogens of cereals, which have a high level of toxicity and a high degree of danger are the species of *Fusarium*. Fumonisin B1 and deoxynivalenol, secondary metabolites of these fungi, are the most widespread mycotoxins in Europe and worldwide. The presence of these metabolites in grains is the main cause of development of Fusarium head blight [7], [10], [12], [13] [17], [18], [19].

Named in the interwar period "grânarul Europei/the granary of Europe", Romania was also in 2020 a popular wheat grower. Thus, according to Eurostat, Romania ranked 4th in terms of the area cultivated with this cereal and 6th in the category of total wheat production. Unfortunately, the average production placed our country towards the end of the ranking [8]. It is known that this indicator, mentioned above, is directly influenced by the applied cultivation technologies, by the pedo-climatic conditions and by the presence of diseases or pests, among which *Fusarium graminearum* stands out. This pathogen causes the appearance of the well-known and destructive disease called ear fusarium wilt, which is manifested by: inducing the sterility of the inflorescences, which means reducing the number of grins in the wheat ear, poor filling and thus reducing the size of the grains [1] (Fig. 1).

Photo 1. Attack of *Fusarium graminearum*
Source: [1].

Of course, all this leads to a decrease in production and crop quality [6].
The experiments presented in this paper were made at ADRS Pitesti-Albota (Agricultural Development Research Station Pitesti-Albota). Among the research areas of this institution we mention: integrated management of field crops protection, study of biology and damage caused by diseases and pests to field crops, new methods of control and prevention for them [20].
ADRS Pitești-Albota is located in the South-Muntenia Region, in Argeș County (Map 1). Although the South-Muntenia Region was the main wheat grower and producer in the country, Argeș County did not stand out by obtaining significant quantities of cereals.

Map 1. The position of ARDS Pitești, Albota in Romania
Source: [14].

Thus, at the level of 2020 it owned only 8% of the total wheat production obtained in the Region.

MATERIALS AND METHODS

In the experimental plots from ADRS Pitești, Albota, five varieties of wheat susceptible to the attack of *Fusarium graminearum* were tested. Varieties were tested on fertilized plots with the next doses (kg active ingredients / ha): $N_0P_0K_0$ and $N_{90}P_{80}K_0$. The wheat varieties were: Delabrad, Dropia, Faur, Glosa and Gruia.
From the arable layer of these experimental plots, soil samples were collected and analyzed and at the same time samples were extracted from the plants in the stages of the ear emergence-flowering.
The following analyzes were performed from the soil samples: total nitrogen (Nt), available phosphorus (P_{AL}), available potassium (K_{AL}), soil reaction (pH) and total humus (Ht). The soil type in the experiment was Vertic Luvisols.
The dry matter of the aerial parts of the plants was subjected to the following analyzes: determination of the content of micronutrients (Mn, Fe, Zn, Cu) and macronutrients (Mg, N, P, K). All analyzes were performed according to the RISSA methodology and the results obtained were interpreted in comparison with

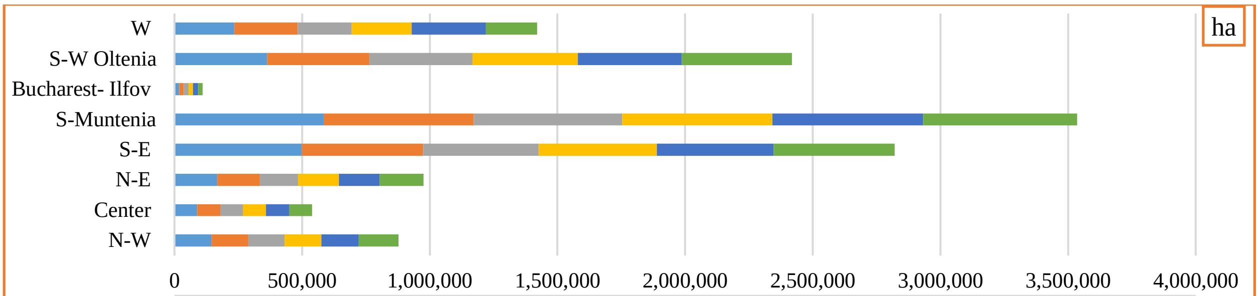
some optimal limits in the literature [2], [15], [16].

For the statistical analysis presented in the paper, the data extracted from the Eurostat and NIS sites were used and the analyzed indicators were the following: the total cultivated area and the total wheat production in Romania, for the 8 Regions and for the South-Muntenia Region, in the period 2015-2020.

RESULTS AND DISCUSSIONS

The data provided by Eurostat shows that in 2020 Romania was ranked on the fourth place in the top wheat-growing countries in the European Union, after France, Germany and Poland. Also in the same year, it ranked sixth in total wheat production, after countries such as: France, Germany, Poland, Spain and Italy. Thus, Romania owned 10.97% of the cultivated area with wheat and 5.1% of the total wheat production achieved in the European Union [8].

Figure 1 shows the areas cultivated with wheat, in Romania, by Development Regions. It is observed that in the South-Muntenia Region were found the largest areas in each year of the analyzed period, 2015-2020. Other important cultivating regions were: South-East and South-West Oltenia.



	N-W	Center	N-E	S-E	S-Muntenia	Bucharest- Ilfov	S-W Oltenia	W
2015	146,036	89,490	167,735	498,777	584,951	18,531	363,758	234,537
2016	143,778	90,619	167,152	475,350	587,677	18,374	399,471	248,290
2017	141,990	88,208	149,149	452,569	581,410	18,220	404,633	211,955
2018	143,963	90,874	160,104	463,262	588,180	17,978	411,839	234,321
2019	146,294	90,322	159,722	457,554	590,924	19,067	407,824	290,937
2020	155,504	89,673	171,015	473,458	602,794	18,171	431,044	199,889

Fig. 1. Dynamics of wheat cultivated areas in Romania, in the period 2015-2020
Source: [9].

Analyzing the situation in the main wheat-growing regions, we can conclude that the areas destined for this crop increased for South-Muntenia by 103.05% and for South-West Oltenia by 118.50%, and for the South-East Region decreased by 5.08%.

In 2020, the percentage of the most important wheat-growing regions was as follows: South-Muntenia Region - 28%, South-East Region - 22% and South-West Oltenia Region - 20% (Figure 2). The other Regions together accounted for 30% of the total area sown with wheat in our country.

In the South-Muntenia Region, the main cultivator, the counties that made the biggest contribution to obtaining the first place in the ranking were Teleorman - 28% and Călărași - 21%. The percentage obtained by Argeș County, where the lands of ADRS Pitești-Albota are located, was among the lowest in the Region, of 8%.

The total wheat production harvested in the 8 Development Regions, in the period 2015-2020, is presented in Figure 3. In first place was the South Muntenia Region, followed by South-West Oltenia, South-East and West It can be seen that the total wheat production increased in the analyzed period in the South-West Oltenia Region by 136.36% and decreased in the South-Muntenia Region by 25.82%, in the South-East Region by 36.02% and by 18.38% in the West Region.

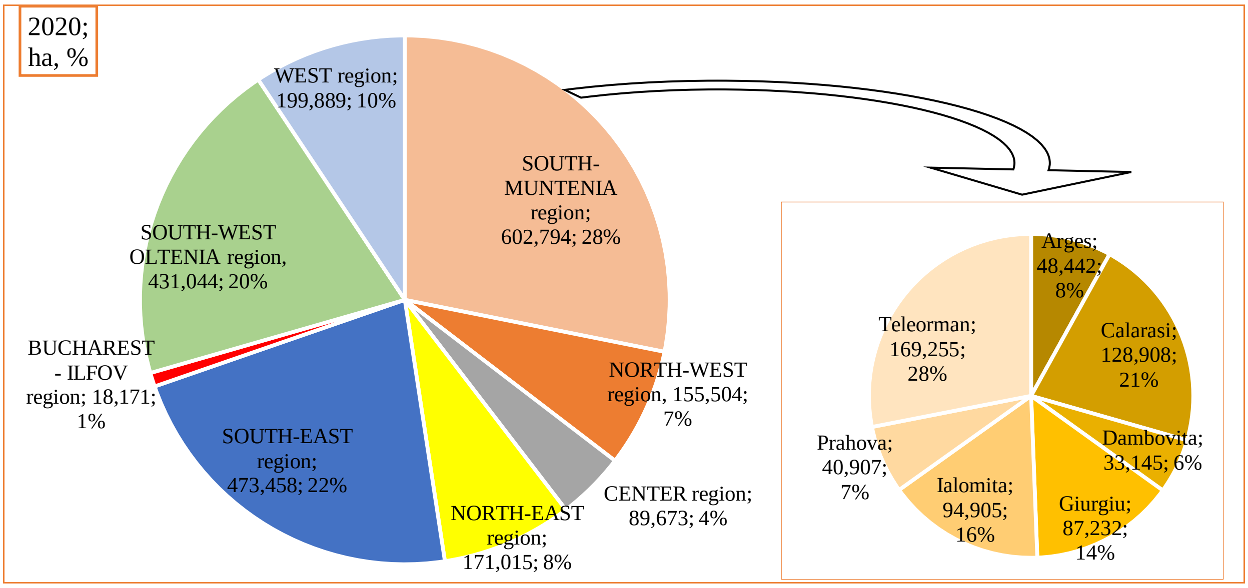
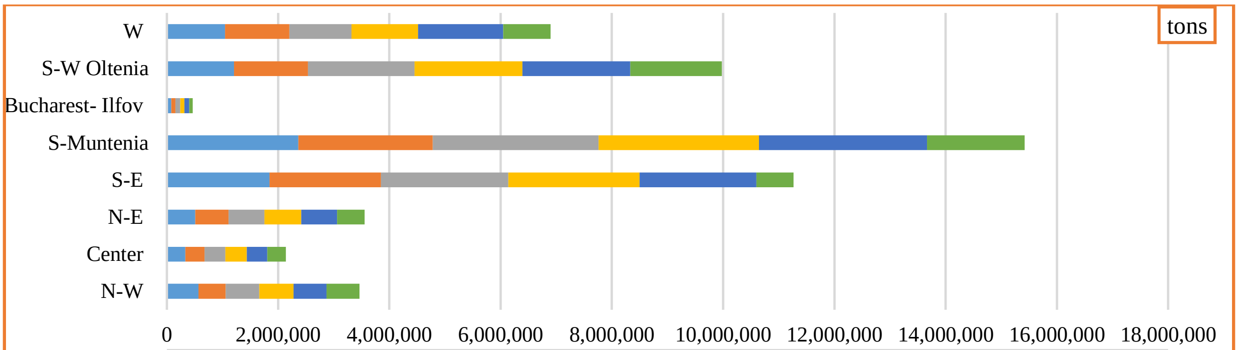


Fig. 2. Areas cultivated with wheat in Romania, by Regions and component counties, in 2020
Source: [9].



	N-W	Center	N-E	S-E	S-Muntenia	Bucharest-Ilfov	S-W Oltenia	W
2015	568,840	334,399	508,014	1,847,471	2,363,365	78,412	1,209,834	1,044,178
2016	486,149	343,937	602,385	2,001,020	2,415,738	76,387	1,324,194	1,156,667
2017	605,625	376,094	643,443	2,290,042	2,980,976	83,430	1,916,249	1,118,516
2018	616,426	382,881	661,136	2,361,871	2,884,626	76,811	1,943,001	1,196,160
2019	591,702	370,627	643,813	2,098,415	3,023,395	87,701	1,936,385	1,528,540
2020	591,858	329,144	497,233	665,372	1,753,248	60,943	1,649,780	852,288

Fig. 3. The dynamics of the total wheat production obtained in Romania, in the period 2015-2020
Source: [9].

In 2020, the percentage of the largest wheat-producing regions was the following: South-Muntenia Region - 27% and South-West Oltenia Region - 26% (Figure 4). The other Regions together accounted for 47% of the total wheat production obtained in our country.

In the South-Muntenia Region, the main producer, the counties that made the biggest contribution to obtaining the first place in the top were Teleorman - 41% and Giurgiu - 19%. The percentage obtained by Argeş County, was among the lowest in the Region, of 8%.

Regarding the average wheat production / ha, Romania does not register special yields. Thus, in 2020, our country ranked last in the European Union, with 2.96 tons / ha of wheat [8]. One of the important factors influencing yield is *Fusarium graminearum*, the pathogen that causes fusariosis.

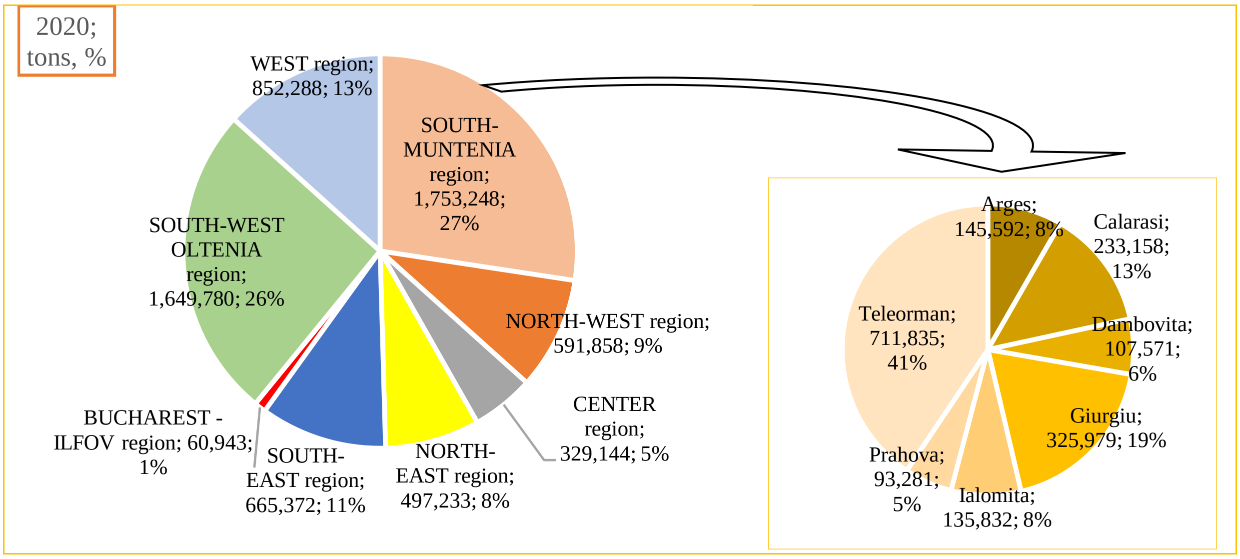


Fig. 4. The total wheat production obtained in Romania, by component Regions and counties, in 2020
Source: [9].

The following are aspects related to soil characterization from ARDS Pitești, Albota and characterization of the mineral nutrition status of wheat plants from the five varieties sensitive to the attack of *Fusarium graminearum*, in order to determine the factors that favor its appearance:

Characterization of the soil in the experiment

The characterization of the soil from ADRS Albota is presented in Table 1.

Table 1. The main agrochemical properties of soil from ADRS Albota

Soil fertilisation	Humus, %	Nt, %	pH $_{H2O}$	P_{AL}	K_{AL}
$N_0P_0K_0$	2.24	0.26	4.89	33.18	166.66
$N_{90}P_{80}K_0$	2.17	0.39	4.73	44.97	120.00

Source: own determinations.

The level of humus supply is low and the nitrogen supply is medium.

The mobile phosphorus content was high and the mobile potassium content was moderately-low.

The state of mineral nutrition of the plants in the experiment

The content of N (Figure 5) was within the limits of the optimal range.

Higher values of this nutrient has recorded on the parcel fertilised with $N_{90}P_{80}K_0$, as the effect of the high nitrogen rates applied in the soil.

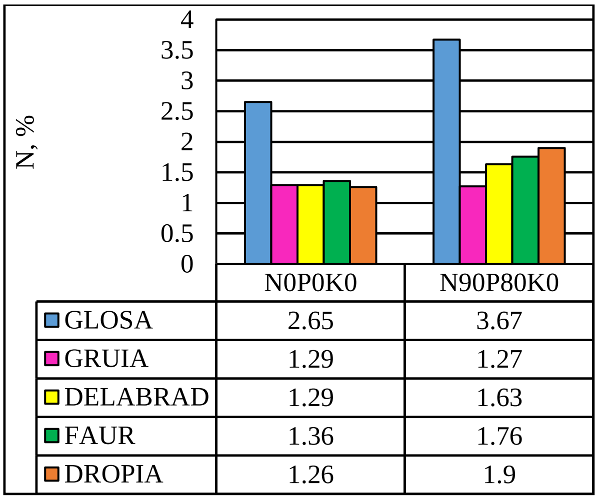
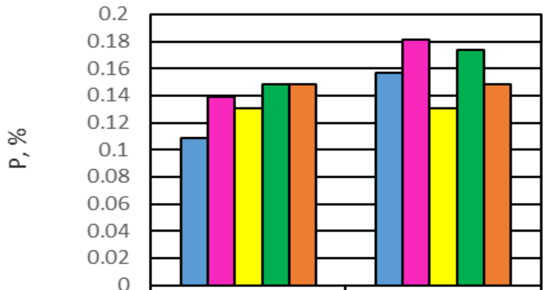


Fig. 5. The content of nitrogen in the aerial parts of winter wheat (ear emergence-flowering stage), ARDS Pitești, Albota
Source: own determinations.

Of the five wheat varieties analyzed, the highest percentage of N in the aerial parts of the plants was recorded in the Glosa variety - 3.67%.

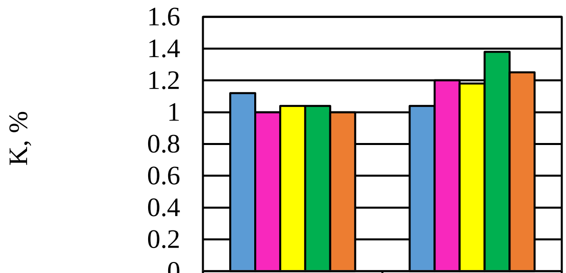
The contents of phosphorus, potassium and magnesium (Figures 6, 7 and 8) were below the limit of the optimal range, their accessibility to plants were reduced by low pH conditions, the acid reaction being one of the factors that favor the attack of *Fusarium graminearum* on wheat.



	N0P0K0	N90P80K0
GLOSA	0.109	0.157
GRUIA	0.139	0.181
DELABRAD	0.131	0.131
FAUR	0.148	0.174
DROPIA	0.148	0.148

Fig. 6. The content of phosphorus in the aerial parts of winter wheat (ear emergence-flowering stage), ARDS Pitești, Albota
Source: own determinations.

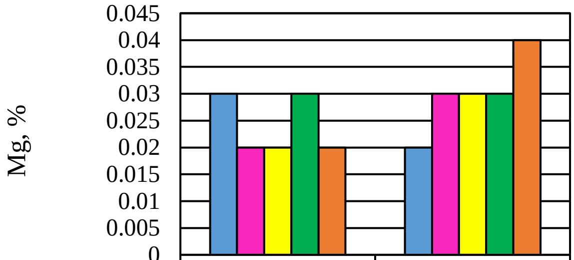
In general, the five varieties in the experiments responded well to fertilization with $N_{90}P_{80}K_0$.
The highest content in P was noted in Gruia - 0.181% (Figure 7).
In Delabrad and Dropia varieties no difference was observed between the 2 fertilization variants.
With the exception of the Glosa variety, the other varieties recorded higher values of K content also in the 2nd fertilization variant. At Faur we recorded the highest percentage of K - 1.38% (Figure 8).



	N0P0K0	N90P80K0
GLOSA	1.12	1.04
GRUIA	1	1.2
DELABRAD	1.04	1.18
FAUR	1.04	1.38
DROPIA	1	1.25

Fig. 7. The content of potassium in the aerial parts of winter wheat (ear emergence-flowering stage), ADRS Pitești, Albota
Source: own determinations.

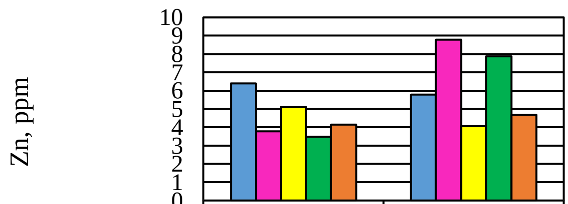
The Mg content did not differ much between the 2 fertilization variants (Figure 10).



	N0P0K0	N90P80K0
GLOSA	0.03	0.02
GRUIA	0.02	0.03
DELABRAD	0.02	0.03
FAUR	0.03	0.03
DROPIA	0.02	0.04

Fig. 8. The content of magnesium in the aerial parts of winter wheat (ear emergence-flowering stage), ARDS Pitești, Albota
Source: own determinations.

However, with the exception of Glosa and Faur varieties, the other varieties recorded slightly higher values of Mg content in the fertilization variant with $N_{90}P_{80}K_0$. In Dropia we recorded the highest percentage of Mg - 0.04%.
The Zn content (Figure 9) was below the optimum limit, which shows that the absorption of Zn in the plant is largely genetically controlled.
Supplementing plant nutrition with zinc is an important agricultural means to reduce the incidence of *Fusarium graminearum* attack on winter wheat crops.



	N0P0K0	N90P80K0
GLOSA	6.4	5.78
GRUIA	3.78	8.78
DELABRAD	5.1	4.05
FAUR	3.48	7.88
DROPIA	4.15	4.68

Fig. 9. The content of zinc in the aerial parts of winter wheat (ear emergence-flowering stage), ARDS Pitești, Albota
Source: own determinations.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Glosa and Delabrad had more Zn (in the aerial parts of the plants) in the variant with $N_0P_0K_0$, and the other 3 varieties in the 2nd variant fertilization. The highest concentration of Zn was observed in Gruia - 8.78 ppm (Figure 9).

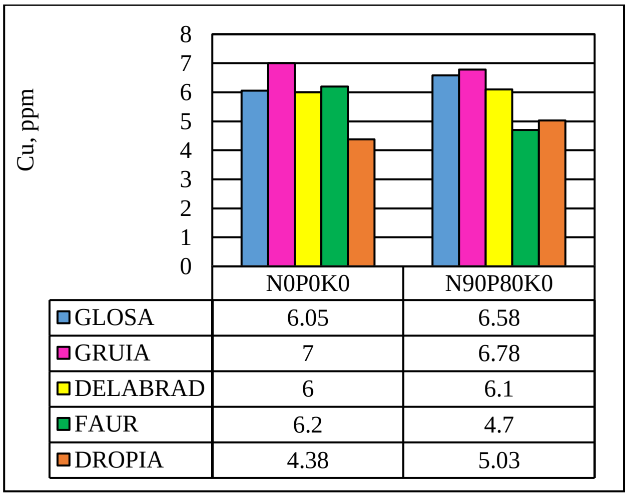
The contents of Cu, Fe and Mn (Figures 10, 11 and 12) were within the limits of the optimal range.

High values of these nutrients to the upper optimum limit have recorded, especially due to the acid reaction of the soil.

The Cu content accumulated after the 2 fertilization variants is shown in Figure 10.

It is observed that Gruia and Faur varieties reacted better to the variant with $N_0P_0K_0$, because they concentrated higher amounts of Cu, and the other varieties registered higher values for the fertilization variant with $N_{90}P_{80}K_0$.

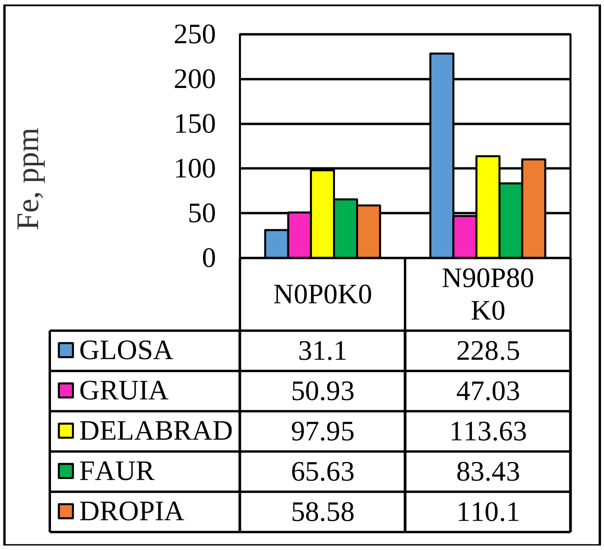
The Glosa variety recorded the highest concentration of Cu - 6.58 ppm after fertilization with $N_{90}P_{80}K_0$.



	N0P0K0	N90P80K0
GLOSA	6.05	6.58
GRUIA	7	6.78
DELABRAD	6	6.1
FAUR	6.2	4.7
DROPIA	4.38	5.03

Fig. 10. Copper content determined in winter wheat - the aerial parts (emergence-flowering of the ear stage), ADRS Pitești, Albota
Source: own determinations.

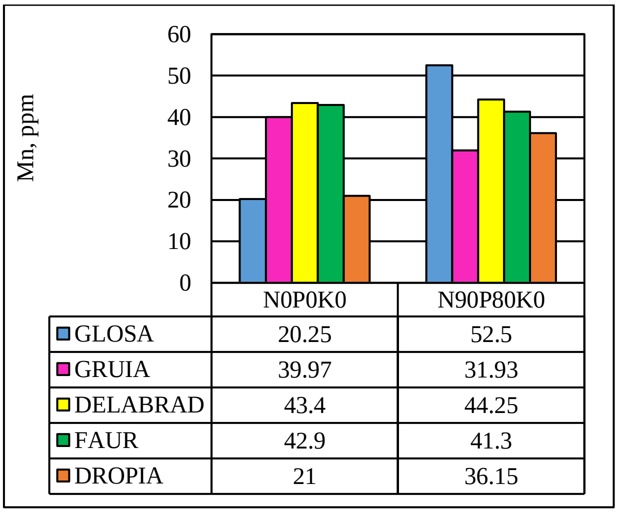
Figure 11 shows the iron content of winter wheat plants. With the exception of the Gruia variety, the five experimental varieties responded well to fertilization with $N_{90}P_{80}K_0$. The highest concentration of Fe was found in the Delabrad variety - 113.63 ppm.



	N0P0K0	N90P80 K0
GLOSA	31.1	228.5
GRUIA	50.93	47.03
DELABRAD	97.95	113.63
FAUR	65.63	83.43
DROPIA	58.58	110.1

Fig. 11. Iron content determined in winter wheat - the aerial parts (ear emergence-flowering stage), ADRS Pitești, Albota
Source: own determinations.

The Mn content accumulated after the 2 fertilization variants is shown in Figure 12. From this it is observed that the Delabrad and Faur varieties concentrated higher amounts of Mn in the variant with $N_0P_0K_0$, and the other varieties registered higher values in the variant with $N_{90}P_{80}K_0$. At Glosa we recorded the highest concentration of Mn - 52.5 ppm.



	N0P0K0	N90P80K0
GLOSA	20.25	52.5
GRUIA	39.97	31.93
DELABRAD	43.4	44.25
FAUR	42.9	41.3
DROPIA	21	36.15

Fig. 12. Manganese content determined in winter wheat - the aerial parts (emergence-flowering of the ear stage), ADRS Pitești, Albota
Source: own determinations.

Figures 13, 14 and 15 show the correlations created between the content of N and those of P, K, Mn, Fe, Zn and Cu, existing in the dry matter of plants.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Figure 13 shows that the potassium content of the plants increases with the growth of the nitrogen content, up to the optimum limit of 2.8% N, in the dry matter of the plants.

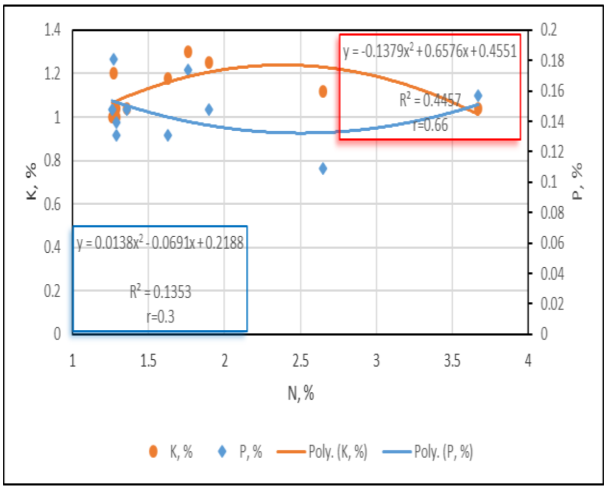


Fig. 13. Correlation between the N content and those of P and K, in winter wheat - aerial parts (ear emergence-flowering stage), ARDS Pitești, Albota
Source: own determinations.

When the optimum value is reached, the potassium content decreases as the nitrogen content increases.
The iron and manganese content of the plants increases as the nitrogen content increases (Figure 14).
The data obtained shows that unilateral fertilisation, with high rates of nitrogen, through changes induced in plant mineral nutrition, could increase the incidence of *Fusarium graminearum* attack on wheat on soil with acid reaction.

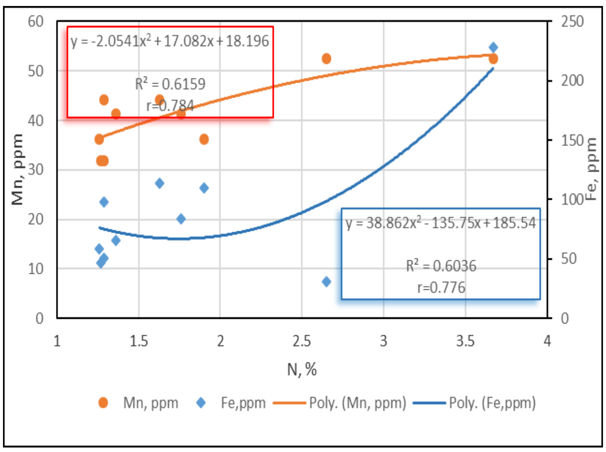


Fig. 14. Correlation between the N content and those of Mn and Fe, in winter wheat - aerial parts (emergence-flowering of the ear stage), ARDS Pitești, Albota
Source: own determinations.

Analyzing Figure 15 we find that the zinc content of plant dry matter increases with increasing nitrogen content to 2.5% N and is almost constant in the content range of 2.5 - 3.5% N.

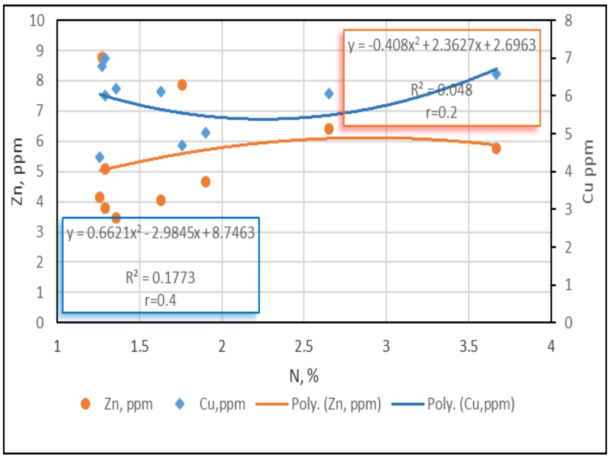


Fig. 15. Correlation between the N content and those of Zn and Cu, in winter wheat - aerial parts (ear emergence-flowering stage), ADRS Pitești, Albota
Source: own determinations.

The copper content of the dry matter of the plants decreases with the growth of the nitrogen content to 2.5% of N, and after this value, it shows an increasing trend with increasing N content of plants.
Excessive fertilization with high doses of nitrogen can cause imbalances in plant nutrition with P, K and Mg, which will lead to a low content of these macronutrients. All this will growth the attack of *Fusarium graminearum*.
By balancing plant nutrition and increasing plant resistance to disease, the application of potassium fertilizers is an agricultural measure designed to reduce the incidence of *Fusarium graminearum* attack in the study area.
Agrochemicals that improve plant nutrition can be important methods to prevent and control the attack of *Fusarium graminearum*, especially because they can reduce the genetic sensitivity of some winter wheat varieties to the attack of *Fusarium graminearum*.

CONCLUSIONS

The analyzes made on soil and wheat plants, at ADRS Pitești, Albota showed that:

- The soil shows an acid reaction with pH values between 4.73 - 4.89;
- The nutrient content in winter wheat plant were within the optimum range for N, Fe, Cu, Mn and were below the optimum range for P, K, Mg and Zn.

The experiments performed on the five wheat varieties sensitive to *Fusarium*, with 2 fertilization variants, under the conditions mentioned above, highlighted the following aspects:

- in certain situations, an element that can trigger the attack of *Fusarium graminearum* is the acid reaction of the soil;
- The appearance of *Fusarium graminearum* can be favored by the low content of P, K and Mg in plants, caused by excess nitrogen.
- in the case of wheat grown on acidic soil, unilateral fertilization with high doses of nitrogen could increase the incidence of *Fusarium graminearum* attack due to changes in plant mineral nutrition.

Consequently, in the studied area, the application of potassium fertilizers and the supplementation of plant nutrition with Mg and Zn are agricultural methods to reduce the incidence of *Fusarium graminearum* attack.

By better managing the problems caused by pathogens, a better average yield / ha can be achieved.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Ministry of Education and Research, within the project: PN-II-2007; 51040/2007 "Risk management of wheat contamination with fusariotoxins during vegetation - GRIFOX".

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASPECTS REGARDING THE ACTIVITY OF AGRI-FOOD COOPERATIVES IN GERMANY

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Abstract

In this paperwork a x-ray regarding the main aspects related to the activity of agro-food cooperatives in Germany was accomplished. A series of indicators related to cooperatives in Germany were analyzed and presented. Forms of associations, producer groups and horizontal and vertical cooperation have proven to be opportunities for small business development. This is underlined by agricultural cooperatives in Germany, a major EU grower, farmer and producer, at the forefront of agricultural excellence. Agricultural cooperatives are associations of farmers and family farms working together on the land. They are established by law to increase efficiency and strengthen market positions. At the same time, they take responsibility for all aspects of the environment, thereby preserving the landscape and preserving the biodiversity of plant and animal species. On the one hand, many cooperatives use the latest technologies in fields such as farming, fertilization, plant protection, and the introduction of digitalization in the production process promotes the development of environmentally friendly management. After German reunification, existing economic units were dissolved or converted. Those who continued their activities took the legal form of agricultural producers' cooperatives, sponsored and represented by the Cooperative Audit Association and the German Association of Raiffeisen. Statistical data used in this research was mainly taken from the International Cooperative Alliance (ICA) website, the rest being obtained from other sources.

Key words: *agri-food cooperatives, Germany, German Raiffeisen Association, turnover*

INTRODUCTION

Cooperatives are autonomous associations of persons, for economic, social and cultural purposes, which have a voluntary structure and which serve the needs of the members who contribute to their capital [9].

Legal forms traditionally used in agriculture, cooperatives are engaged in environmental protection and preservation of surrounding landscapes, through the following actions:

-the creation on their lands and the maintenance of some landscape features;

-the use of modern technologies for soil cultivation, fertilization and crop protection,

-rehabilitation of exploited areas;

-protection against floods, as it deals with the maintenance of ditches and dams,

-production of renewable energy (biogas, wind, sun) that supports the reduction of the use of fossil fuels.

Agricultural cooperatives also stand out in the area of charitable actions and at the same time it should be mentioned their important contribution to the development of rural areas, being the largest employers and taxpayers and offering several types of auxiliary services [6].

They constitute an important sector of the economy, as the EU has a total of 250,000 cooperatives, which have 163 million members (which represents a third of the EU population) and employ 5.4 million people [9].

Currently, agriculture in Europe is undergoing profound transformations, so that it is able to respond to the new challenges caused by pollution, but also by climate change. European agriculture, and not only, benefits from technological progress, contributing greatly to ensuring food security. Another aspect that needs to be specified is represented by the increasing industrialization of the agricultural sector. However, the role of small and medium-sized farms due to their multifunctionality should not be neglected. Both small and medium-sized farms and agricultural cooperatives can capitalize on the material and social potential, so as to contribute to sustainable development [15].

As for the agricultural cooperatives according to the specialists in the field, they are not so well known and appreciated at their true value.

Even if the aforementioned phenomenon happens, it is necessary to mention that, however, cooperatives hold a significant share in most of the European agricultural and agri-food sectors [10].

Within these cooperatives are distinguished agricultural cooperatives, which at union level are structured in Copa-Cogeca, "the united voice of farmers and agri-cooperatives in the EU".

According to the data available on the website, Copa-Cogeca "is the union of the two big agricultural umbrella organisations COPA and COGECA":

-"Copa (the Committee of Professional Agricultural Organisations) represents over 22 million European farmers and their family members in a combined effort with its members to promote the best interests of the agricultural sector among the EU institutions and other relevant stakeholders" [4].

-"Cogeca (the General Confederation of Agricultural Cooperatives) represents the general and specific interests of European agri-food, forestry, and fishery cooperatives among the EU Institutions and other socio-economic organisations contributing to European decision making"[4].

In the countries of the European Union, agricultural cooperatives are presented in various forms and types, but are based on the same principles of operation and organization according to the European Council Directive.

According to the data presented in Table 1, there were around 22,000 agricultural cooperatives in the EU, which had more than 6,000,000 members. The turnover of these cooperatives amounted to over EUR 300 billion.

Table 1. Agricultural Cooperatives in the EU

EU: Member States:	Total number of Cooperatives	Total number of Members*	Turnover (million Euro)
Italy	5,834	863,323	34,362
Spain	3,844	1,179,323	25,696
Germany	*2,400*	*1,440,660*	*67,502*
France	2,400	858,000	84,350
Hungary	1,116	31,544	1,058
Bulgaria	900	-	-
Portugal	735	-	2,437
Croatia	613	10,734	167
Slovakia	597	-	1,151
Greece	550	-	-
Czech Republic	548	524	1,327
Lithuania	402	12,900	714
Slovenia	368	16,539	705
Belgium	301	-	3,257
Austria	217	306,300	8,475
Netherlands	215	140,000	32,000
UK	200	138,021	6,207
Poland	136	-	15,311
Ireland	75	201,684	14,149
Romania	68	-	204
Luxembourg	55	-	-
Latvia	49	-	1,111
Finland	35	170,776	13,225
Sweden	30	160,350	7,438
Denmark	28	45,710	25,000
Estonia	21	2,036	512
Malta	18	1,815	204
Cyprus	14	24,917	62
Total	21,796	6,172,746	347,342

* multiple membership
- data not available
Source: [3], 2014.

In the European Union, the countries with the strongest network of agricultural cooperatives are: Italy; Spain, France and Germany. These agricultural cooperatives in the countries specified above have different economic powers [2].

In Germany, cooperatives were established in the 1840s in the form of credit unions, and towards the end of the XIX century the phenomenon became very popular. It is the merit of 2 visionaries, Franz Hermann Schulze-Delitzsch (1808-1883) and Friedrich Wilhelm Raiffeisen (1818-1888), who established the first forms of support. Thus, in 1847, Raiffeisen created an association that granted, under favorable repayment conditions, loans to small farmers in the municipality of Weyerbusch (Westerwald). Schulze-Delitzsch also founded, in 1847, the carpenters' and shoemakers' association, and

in 1850 the first loan and economics association, the current Volksbank.
Cooperation continued to expand, and in 1870 led to the formation of regional and national federations and entities [13].
Images showing fractions from the activity of agricultural cooperatives are presented in Photos 1 and 2.

Photo 1. From the activity of cooperatives in Germany
Source: [7].

During the communist period, the cooperatives in East Germany were transformed into "Landwirtschaftlichen Produktionsgenossenschaften"/ Agricultural production cooperatives, while in West Germany the cooperative phenomenon continued to develop. In 1972 Raiffeisen and Schulze-Delitzsch merged and formed the DGRV - Deutscher Genossenschafts und Raiffeisenverband/German Cooperative and Raiffeisen Confederation [5].
After the fall of the Berlin Wall the "Landwirtschaftlichen Produktionsgenossenschaften"/ Agricultural production cooperatives were reorganized and became part of the national organization Raiffeisen.
Cooperatives in Germany and German legislation of cooperatives, one of the oldest in the world, have been elements of inspiration for similar forms in other countries, especially from Europe and Asia [13].
In terms of legislation, in Germany, all cooperatives operate in accordance with the Cooperative Societies Act, which was promulgated in 1889. The law has undergone several changes over time, and in 2006 it was correlated with the specifications of Regulation (EC) No. 1435/2003 – Statute of the European Cooperative Society [8].
In 2015 Germany proposed to include the idea of cooperation in Unesco's Intangible Cultural Heritage of Humanity, a proposal officially accepted in 2016.
In this context, the paper aims to present the situation of the agricultural cooperatives that are part of the Deutscher Raiffeisenverband - DRV/German Raiffeisen Association, following their number, members and turnover.

Photo 2. From the activity of cooperatives in Germany
Source: [7].

MATERIALS AND METHODS

The work focused, on the one hand, on the presentation of agri-food cooperatives in Germany, and on the other hand, on the analysis of some indicators specific to their activity. From the indicators presented and analyzed in the work we mention: the number of Raiffeisen cooperatives existing in Germany in the main agricultural sectors; number of members of cooperatives in Germany; turnover achieved by Raiffeisen cooperatives in the main agricultural sectors. Some of the data presented in the paper was taken from the International Cooperative Alliance website, ICA. It should be noted that this data was obtained by the ICA by applying online questionnaires to the members of the cooperatives, as a result of the partnership signed with the European Commission, for the period 2016-2020, regarding the cooperative movement. The data analyzed in the work were presented in graphic form to reflect as well as possible the situation of cooperatives in Germany.

RESULTS AND DISCUSSIONS

According to data presented by BMEL, in Germany agriculture differs between regions. Thus, in the South of the country, small family farms predominate, in the north larger farms, and in the east large corporations and cooperatives of agricultural production [1]. Here, the approximately 800 cooperatives cover 23.2% of the total agricultural area in the area.

These cooperatives appeared after the reunification of Germany, as a kind of continuation of the former production cooperatives [14].

In eastern Germany, where the former Democratic Republic stretched before 1989, about 4,500 "Landwirtschaftlichen Produktionsgenossenschaften"/ Agricultural production cooperatives operated. Subsequently they were dissolved or transformed into modern entities. The transformation took place at the structural and staff level, with the loss of many jobs and the migration of young people to cities, and represented the transition from a planned economy to a market economy [11].

With all the problems, 1,500 former cooperatives continued their activity, and their number was reduced over time, mainly due to mergers, reaching 800. They were later incorporated by the Deutscher Raiffeisenverband - DRV/ German Raiffeisen Association [6].

A method used by some cooperatives to overcome the problems that arose due to competition and lack of skilled labor was the expansion of the fields of activity and services, thus also practicing non-agricultural activities.

Ranked 3rd in the EU in 2014 in terms of the number of agricultural cooperatives, but in first place in terms of number of members and 2nd in terms of turnover (Table 1), Germany had in 2017 a total of 7,319 cooperatives, and the sectors of activity in which most cooperatives operated are shown in Figure 1.

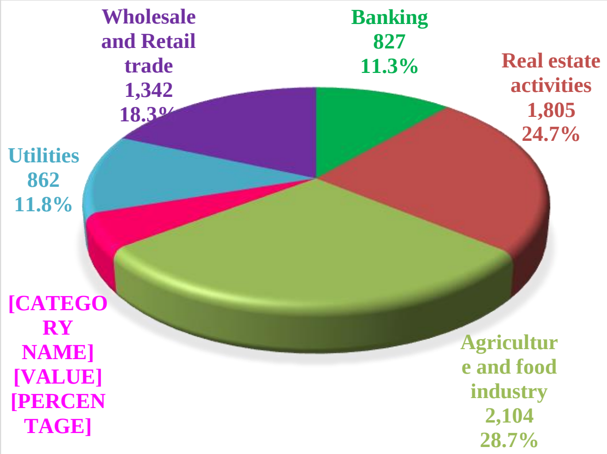


Fig. 1. Number and percentage of cooperatives from the main sectors in Germany, 2017
Source: [13].

It is noted that the largest share was held by cooperatives in the Agriculture and Food Industry sector (28.7%), followed by real estate activities sector (24.7%) and Wholesale and Retail trade (18.3%).

Other sectors in which cooperatives operate in the territory of Germany are:

-Information and Communication;
-Insurance;
-Construction;
-Professional Scientific and Technical Activities;
-Administrative and support service activities;
-Education;
-Human health and social work activities.

The members of the cooperatives from the main sectors of activity in Germany in 2017 are presented in Figure 2. Regarding the number of members related to cooperatives, in 2017, the Banking sector was detached (18,500,000 members), followed by Real estate activities (2,821,000 members) and Agriculture and Food Industry (1,300,000 members).

From the data presented in Fig. 2, it can be seen that the cooperatives in the Utilities sector recorded the lowest number of members in 2017 (180,000 members).

The turnover of cooperatives from the main sectors of activity in Germany in 2017 is presented in Figure 3.

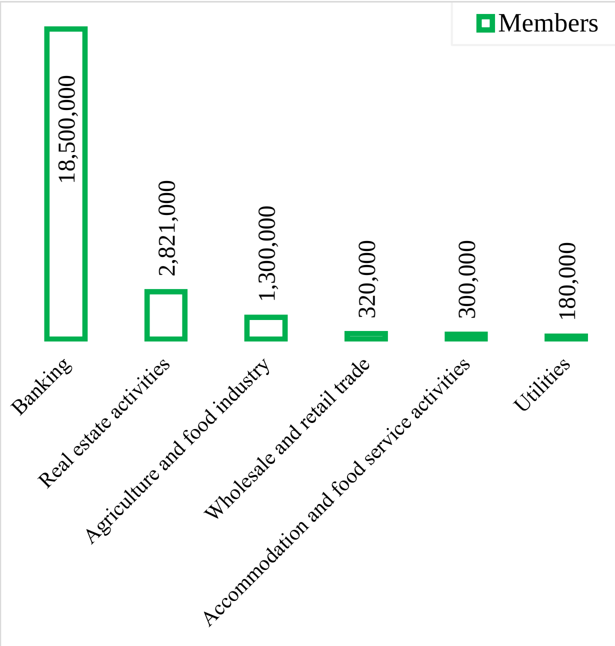


Fig. 2. Members of cooperatives from the main sectors in Germany, 2017
Source: [13].

The most significant turnover of the cooperatives was registered by the Wholesale and Retail sector (133 billion Euro). This was followed by Agriculture and Food (62 billion Euro) and Real estate activities (10.6 billion Euro). The lowest turnover related to cooperatives was achieved by the sector Utilities and Accommodation and food service activities (1 billion Euro per sector).

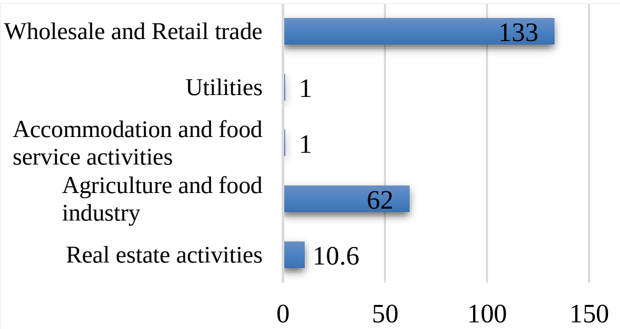


Fig. 3. Turnover of the cooperatives from the main sectors in Germany, 2017 (billion Euro)
Source: [13].

In Germany, three ICA member organizations operate:

-DGRV - *Deutscher Genossenschafts und Raiffeisenverband* (German Cooperative and Raiffeisen Confederation) - intersectoral national organization, full member;

-GdW - *Bundesverband deutscher Wohnungs und Immobilienunternehmen* (Federal association of German housing and real estate companies) - national organization, the housing sector, full member;

-ZdK - *Zentralverband deutscher Konsumgenossenschaften* (Central Association of German Consumer Cooperatives) - national organization, the consumer sector, associate member.

-Consumer Cooperatives) - national organization, the consumer sector, associate member.

DGRV - Deutscher Genossenschafts und Raiffeisenverband (German Cooperative and Raiffeisen Confederation) includes 4 associations of cooperatives, as it appears in Figure 4.

They are composed of:

- ✧ 4 regional associations;
- ✧ 5 trade associations;
- ✧ 6 Companies in the Volksbanken Raiffeisenbanken cooperative financial network;
- ✧ 39 Raiffeisen headquarters and subsidiaries;
- ✧ 13 Affiliates and other members;
- ✧ 28 Companies of the BÄKO Group;
- ✧ 24 Companies of the REWE Group [5].

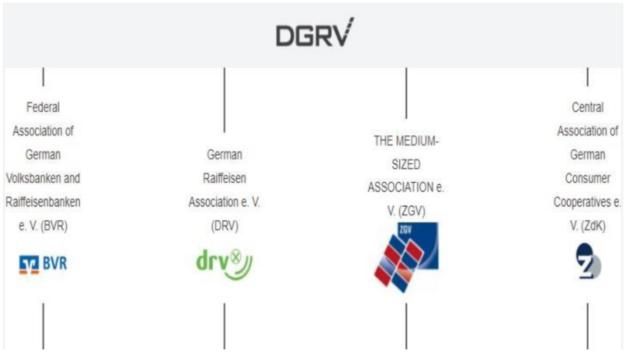


Fig. 4. Composition of DGRV - Deutscher Genossenschafts und Raiffeisenverband (German Cooperative and Raiffeisen Confederation)
Source: [5].

One of the most important associations that is part of the DGRV organization - Deutscher Genossenschafts und Raiffeisenverband/German Cooperative and Raiffeisen Confederation is Deutscher Raiffeisenverband - DRV/ German Raiffeisen Association. It deals with:

- ➢ 66% of German milk processing;
- ➢ 50% of German grain trade;

- 33% of German livestock trade;
- 33% of German wine harvest [6].

The evolution of the number of Raiffeisen cooperatives in Germany during 1950-2019 is shown in Figure 5. From the presented statistical data it can be seen that during this time the number of Raiffeisen cooperatives was framed by a decreasing trend. The largest number of Raiffeisen cooperatives was registered in 1950 (23,753 cooperatives), and the smallest number was registered in 2019 (1,984 cooperatives). Raiffeisen cooperatives in Germany in 2019 decreased by: 11.8%, compared to 2015 and by 61.8%, compared to 1990.

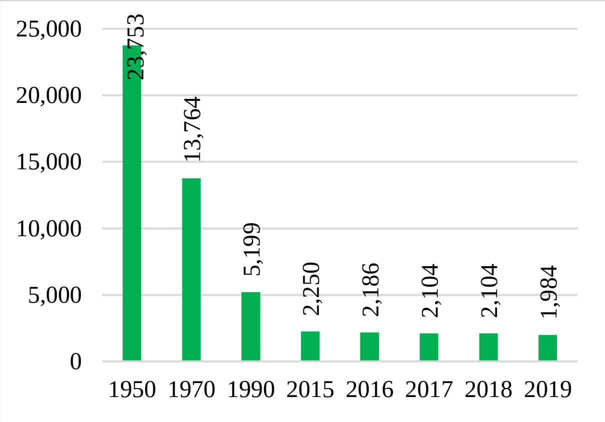


Fig. 5. The evolution of the number of Raiffeisen cooperatives in Germany, 1950-2019 (cooperatives)
Source: [6], 2020.

The number and percentage of Raiffeisen cooperatives in the main agricultural sectors in Germany in 2020 is presented in Figure 6. In 2020, in Germany there were 1,766 Raiffeisen cooperatives distributed as follows: Farming (542 cooperatives, respectively 30% of the total); Others (422 cooperatives, respectively 24% of the total); Purchasing and marketing (342 cooperatives, respectively 19% of the total); Dairy (168 cooperatives, respectively 10% of the total); Wine growers (148 cooperatives, respectively 8.0% of the total); Fruit, vegetables, horticulture (82 cooperatives, respectively 4.0% of the total) and Cattle and meat (75 cooperatives, respectively 4.0% of the total).

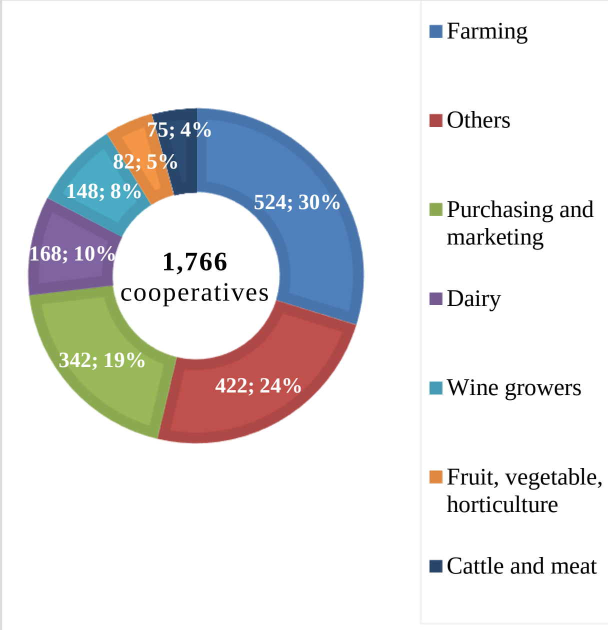
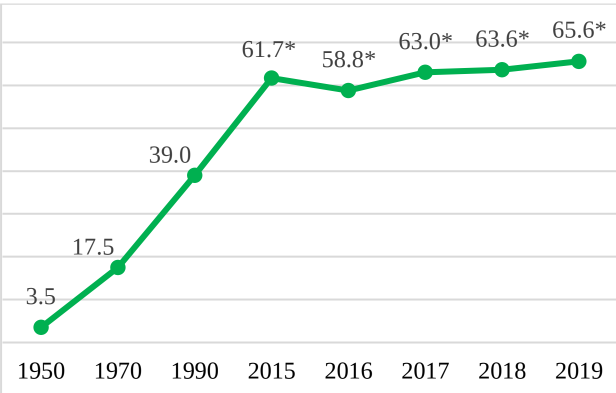


Fig. 6. Number and percentage of Raiffeisen cooperatives from the main agriculture sectors in Germany, 2020
Source: [6], 2020.

The evolution of turnover for Raiffeisen cooperatives from the main agriculture sectors in Germany, 1950-2019, (billion Euro) is presented in Figure 7. From the presented statistical data, it is found that in the period 1950-2015, the turnover attributed to Raiffeisen cooperatives in the main agricultural sectors in Germany was on an upward trend, from 3.5 billion Euro (1950) to 61.7 billion Euro (2015). In 2019, the turnover increased by 58.2 billion Euro, compared to 1950.



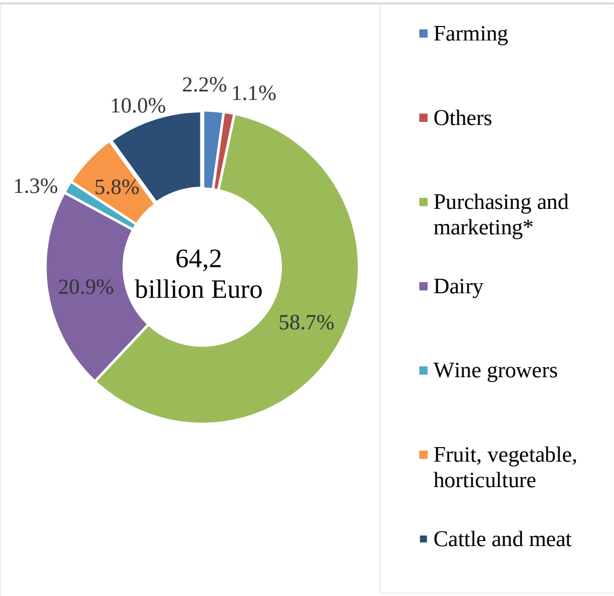
*including sales of the subsidiaries and holdings of the cooperative companies
Fig. 7. Evolution of turnover for Raiffeisen cooperatives from the main agriculture sectors in Germany, 1950-2019, (billion Euro)
Source: [6], 2020.

The substantial increase in turnover mentioned above demonstrates that agricultural cooperatives directly contribute to the realization of sustainable businesses of which their members benefit. During 2015 - 2019, the turnover of Raiffeisen cooperatives registered a series of changes [12].

The most representative turnover was recorded in 2019 (65.6 billion Euro), and the lowest was 58.8 billion Euro (2016). In 2019, the turnover increased by 6.3%, compared to 2015.

According to statistical data and studies conducted for the period 2010-2019, it was highlighted that the turnover of agricultural cooperatives in Germany has increased by approximately 53.0%. Another aspect that must be highlighted for 2010, is represented by the market share established in the report, the sectoral turnover, as follows: cooperatives afferent to the cereal sector (about 50% of the turnover); cooperatives in the vegetables and fruits sector (40% of the turnover); cooperatives in the field of pork (less than 20% of turnover) etc [16].

The turnover (including sales revenues related to subsidiaries and cooperatives' participations) of cooperatives in the main agricultural sectors in Germany in 2020 is shown in Figure 8.



*including sales proceeds of subsidiaries and holdings of the cooperatives

Fig. 8. Turnover of the cooperatives from the main agriculture sectors in Germany, 2020 (billion Euro)

Source: [6], 2020.

From the presented data, it is found that the turnover achieved by the cooperatives in 2020 was of 64.2 billion Euro.

The turnover was distributed as follows: Purchasing and marketing (37.7 billion Euro, respectively 58.7% of the total); Dairy (13.5 billion Euro, respectively 20.9% of the total), Fruit, vegetable, horticulture (3.7 billion Euro); Cattle and meat (6.4 billion, respectively 10.0% of the total); Farming (1.4 billion Euro); Farming (1.4 billion Euro and 2.2% of the total); Wine growers and Others (0.8 billion Euro).

ACKNOWLEDGEMENTS

This research work was carried out with the support of the Project ERASMUS+2019-1-RO01-KA203-063752 "Coo Performance Digital, state-of-the-art agribusiness education for farmer led enterprises in the agri-food value chain".

CONCLUSIONS

Agricultural cooperatives in Germany have developed over time both upstream and downstream of sectors. Following the presentation and analysis of the main indicators specific to the agri-food cooperatives in Germany, the following were found:

-In 1950, the largest number of Raiffeisen cooperatives was registered (23,753 cooperatives);

-In 2019, the lowest number of Raiffeisen cooperatives (1,984 cooperatives) was registered in Germany;

-In 2020, out of the 1,766 Raiffeisen cooperatives existing in Germany in the main agricultural sectors, 542 cooperatives belonged to the Farming sector;

-In 2017, the Agriculture and Food Industry sector registered 1,300,000 members;

-Between 1950 and 2015, the turnover achieved by Raiffeisen cooperatives in the main agricultural sectors was on an upward trend;

-In 2019, the highest turnover generated by Raiffeisen cooperatives in the main agricultural sectors was recorded, of 65.6 billion Euro;

-In 2020, the turnover of cooperatives in the main agricultural sectors in Germany was of 64.2 billion Euro. The sector that had the largest contribution to the turnover was "Purchasing and marketing" (37.7 billion Euro, respectively 58.7% of the total).

In the future, in the European Union, but also in Germany, the agri-food cooperatives will be able to meet the requirements in order to achieve a sustainable agriculture.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PRODUCTIVITY AND ECONOMIC EFFICIENCY IN THE PRODUCTION OF SEEDS OF BIRD'S FOOT TREFOIL CULTIVARS

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Abstract

During the period 2017-2019 in the experimental field of RIMSA-Troyan by the block method in four replications, were tested the following bird's foot trefoil cultivars: 'Targovishte 1' (Bulgaria), 'Alvena', 'Lotanova' and 'Frilo' (Italy), 'Polom' (Slovakia), 'Bonnie' (France), 'Bull' (Canada). The economic efficiency and the economic indicators were determined on the basis of reported seed yield. The obtained results show that 'Lotanova' achieved the highest seed productivity (0.39 t.ha-^{1}), with the lowest cost price (33.10 BGN/t) and the highest profitability rate (509.04%), which makes it suitable for growing in mountain conditions. The established strong correlation dependence between the yield with the gross income and the gross profit of 'Lotanova' determines the economic effect of the introduction of this cultivar for production in practice.

Key words**:** *bird's foot trefoil, cultivars, economic indicators, seed productivity*

INTRODUCTION

Bird's foot trefoil is a fodder legume suitable for haymaking, grazing and combined use [3]. The interest in it is because of its cultivation with low investment of production costs [6], which confirms its position as an economic species with low resource requirements. The high nutritional value of bird's foot trefoil [7, 13, 2] complements its advantages over many other legume species. Nitrogen-fixing ability of bird's foot trefoil [14] is important for reducing the costs of nitrogen fertilizers in the soil and improving environmental efficiency.

The production of bird's foot trefoil seeds is quite limited. This is due to the low yield, which is the result of easy cracking of pods and high seed loss [8, 4]. The lack of sufficient yields has prevented its spread.

The method of growing the crop and climatic factors [10, 5] are essential in the production of seeds of bird's foot trefoil.

Research determining the economic efficiency, which compares the income from the sale of seed production and the costs involved in its implementation are quite scarce and incomplete. This requires the determination of economic efficiency, which gives an idea of how a production system manages to generate the maximum desired volume of finished product with limited and predetermined quantities of production factors and technology used [11].

The aim of the present study is to analyze the economic indicators and determine the economic efficiency of seed production on the basis of the productivity obtained from bird's foot trefoil cultivars.

MATERIALS AND METHODS

The experiment was conducted in the period 2017-2019 in the experimental field of RIMSA-Troyan with the following bird's foot trefoil cultivars: 'Targovishte 1' (Bulgaria), 'Alvena', 'Lotanova' and 'Frilo' (Italy), 'Polom' (Slovakia), 'Bonnie' (France), 'Bull' (Canada). Sowing was carried out in 2016, and seed harvesting in the second experimental year for three calendar years.

The technology for creating grassland includes: plowing, double disking, cultivation, sowing, rolling, harvesting the first regrowth for fodder, and the second for seeds. Seed collection is related to technological events, such as harvesting, transporting of seeds, cleaning and storage. These manual and mechanized activities are described in the technological map for each cultivar and on the basis of the obtained seed yield the calculations concerning the economic indicators are made. From the obtained data the economic evaluation of the production of bird's foot trefoil seeds was performed, which included the following indicators: production costs (BGN/ha), cost price of 1 t of seed production, gross income and gross profit (BGN/ha), profitability (%). The prices of the used seeds, materials, fuel are indicated in BGN at market prices for each studied year separately.

The economic efficiency of costs in the seed production of bird's foot trefoil cultivars [1] actually is a ratio of the created effect to the costs. It gives an idea of which of the analyzed bird's foot trefoil cultivars is the most suitable for use from an economic point of view. The cost-effectiveness ratio used shows how much revenue is realized per unit cost [12].

Statistical data processing was performed by analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Table 1 shows the seed yield on the basis of which the analysis of economic indicators was made. In the first experimental year the seed productivity varied from 0.28 to 0.39 t ha^{-1}. ‘Lotanova’ stood out as the most productive, and ‘Alvena’ and ‘Frilo’ registered the same seed productivity, 0.35 t ha^{-1}, respectively. All tested cultivars are more productive than the standard variety ‘Targovishte 1’. In the second seed-producing year, higher yields were reported for more cultivars compared to the previous year, with a maximum value again for ‘Lotanova’ (0.48 t ha^{-1}). The third year also registered high levels of seed yield, with the highest values for ‘Lotanova’ (0.43 t ha^{-1}) and Frilo (0.39 t ha^{-1}). The variability of average seed yield values ranged from 0.30 to 0.43 t ha^{-1} for the study period. Maximum productivity was reported for ‘Lotanova’, followed by ‘Frilo’ both over the years and on average for the period. To a large extent, seed productivity is determined by the combined impact of climatic factors and structural elements of seed production.

Table 1. Seed yield (t ha^{-1}) year and per Mean for the period 2017-2019

Cultivars	2017	2018	2019	Average for the period
'Targovishte 1'	0.28	0.33	0.31	0.30
‘Alvena’	0.35	0.36	0.33	0.34
‘Lotanova’	0.39	0.48	0.43	0.43
‘Frilo’	0.35	0.36	0.39	0.36
‘Polom’	0.34	0.31	0.32	0.32
‘Bonnie’	0.33	0.33	0.31	0.32
‘Bull’	0.37	0.34	0.35	0.35

Source: Own calculations.

The economic analysis (Table 2) on the impact of production costs in the production of bird's foot trefoil from different cultivars shows that their size increases from 1,238.00 BGN/ha to 1,423.00 BGN/ha. The differences in the investments made for seed production between the different cultivars are determined mainly by the costs of transporting and cleaning of the seeds on the basis of the obtained yield. The main factors determining the amount of costs incurred are the price of fuel for mechanized equipment and the amount of increased number of working hours for cleaning. The lowest costs were made for ‘Targovishte 1’ (1,238.00 BGN/ha), and the highest in the production of seeds for ‘Lotanova’.

With the increase in production costs, a decrease in the cost price of 1 t of seeds of different cultivars is registered. Production cost price expressed by the relationship between production costs and yield obtained, ranged from 33.10 BGN/t to 41.30 BGN/t, with the lowest value reported for ‘Lotanova’.

Table 2. Economic analysis of seed production of bird's foot trefoil for the period 2017-2019

Cultivars	Production costs	Cost price	Gross revenue	Gross profit	Profitability
	BGN/ha	BGN/t	BGN/ha	BGN/ha	%
‘Targovishte 1’	1,238.00	41.30	6,133.30	4,895.30	395.42
‘Alvena’	1,312.00	38.60	6,933.30	5,621.30	428.45
‘Lotanova’	1,423.00	33.10	8,666.70	7,243.70	509.04
‘Frilo’	1,338.00	37.20	7,333.30	5,995.30	448.08
‘Polom’	1,301.00	40.60	6,466.70	5,165.70	397.06
‘Bonnie’	1,301.00	40.60	6,466.70	5,165.70	397.06
‘Bull’	1,323.00	37.80	7,066.70	5,743.70	434.14

Source: Own calculations.

This cultivar showed the highest production costs and the highest seed yield. ‘Targovishte 1’ had the highest cost price of the seed production.

Gross revenues ranged from BGN 6,133.30 to BGN 8,666.70 BGN/ha, with the highest value for ‘Lotanova’. This is explained by the highest seed yield of this cultivar (0.43 t/ha). It exceeded the control (‘Targovishte 1’) by 2,533.40 BGN/ha, which was directly related to the highest gross profit (7,243.70 BGN/ha) of ‘Lotanova’. Minimum gross profit was realized by the control cultivar (4,895.30 BGN/ha), followed by ‘Polom’ and ‘Bonnie’ (5,165.70 BGN/ha). Their value is the same due to the duplicate seed yield of these two cultivars. It is necessary to emphasize their equal value of cost price, gross revenue and profitability, which makes these two cultivars completely equal in the realization of economic benefits in their use.

As with the previous economic indicators, so with the most generalizing one - profitability, ‘Lotanova’ marked its superiority by 509.04%. For other cultivars, profitability rate varied from 395.42% (‘Targovishte 1’) to 448.08% (‘Frilo’).

Figure 1 shows the effectiveness of the application of different cultivars of bird's foot trefoil. Here it is considered not only as a ratio of the effect obtained and the costs incurred, but also as a criterion for evaluation (Bazitov et al., 2013).

In a given period of time, each farm has the need to perform a summary analysis of income and expenses to determine the direction of development of its activities, [9] defines economic efficiency as the amount of economic effect that is created with the participation of a unit of expenditure or unit of resources, or as the amount of costs or resources involved in creating a unit of economic effect.

In terms of the ratio of revenues to production costs, the highest coefficient of economic efficiency (6.09) is found in ‘Lotanova’. Of all the studied economic indicators, ‘Lotanova’ is the most recommended for the practice, because of its high seed yield, high revenues and respectively gross profit. Compared to the control cultivar, ‘Lotanova’ surpassed it by 22.93% in terms of economic efficiency.

The same trend was observed when calculating economic efficiency as a ratio of profit to production costs. The excess in ‘Lotanova’ compared to ‘Targovishte 1’ (control) is 29.34%. Immediately after it is ‘Frilo’, which exceeds the Bulgarian variety (var. 1) by 10.63% in terms of revenue and expenses and by 13.52% in terms of net income (profit) and expenses.

The lowest efficiency coefficient was registered for ‘Polom’ and ‘Bonnie’ - 4.97 and 3.93 in the ratio of the two studied economic effects on costs.

Their values are the same due to the obtained yield value, which in both variants is 0.32 t/ha.

This leads to the equal use of labor and payment for it, as well as the same amount of material resources spent on the output.

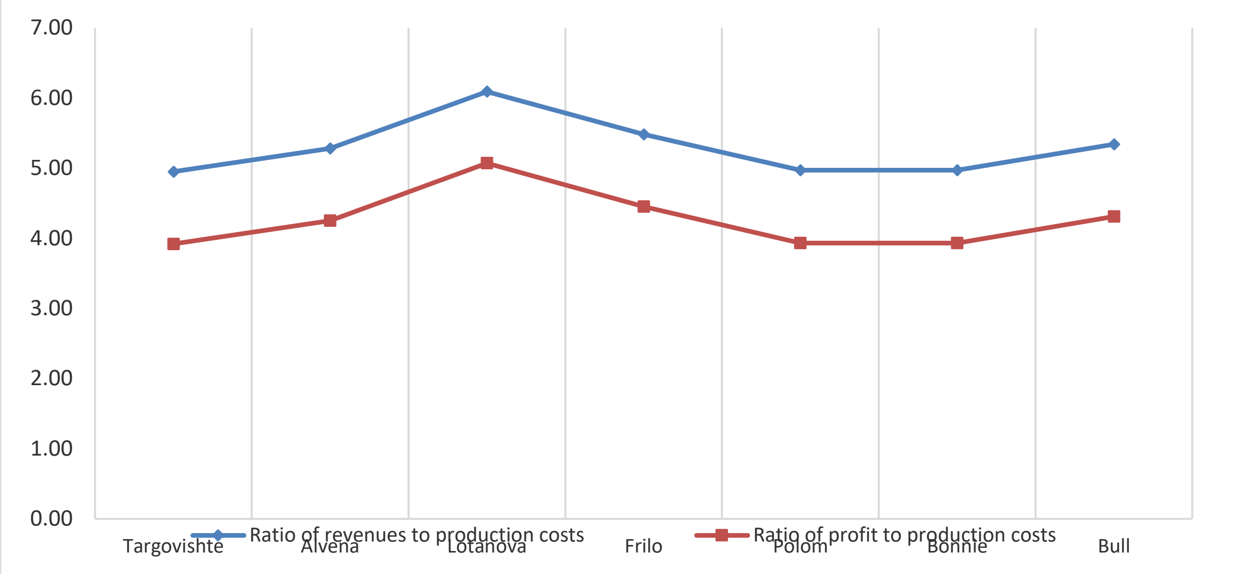

Fig. 1. Economic efficiency of costs in the seed production of bird's foot trefoil cultivars for the period 2017-2019
Source: Own calculations and design.

This shows that these two cultivars are the most unprofitable for farmers who have decided to invest in the sowing and production of bird's foot trefoil, as the value of additional seed production cannot offset the costs incurred.

CONCLUSIONS

Of the studied bird's foot trefoil cultivars, Lotanova is the most cost-effective for seed production, proving itself over the other cultivars with the highest yield (0.43 t/ha), highest gross revenue (8,666.70 BGN/ha) and profit (7,243.70 BGN/ha) and the lowest cost price (33.10 BGN/t). Despite the highest costs for the production with 1,423.00 BGN/ha, it is the most economically advantageous because it compensates the costs with the additional production.

'Polom' and 'Bonnie' are economically unprofitable in terms of seed production due to the low yield (0.32 t/ha) and the low value of the profitability rate (397.06%).

The economic efficiency of the production of seeds from different cultivars of bird's foot trefoil gives us reason to recommend 'Lotanova' for cultivation by farmers, due to its efficiency from a fodder and economic point of view.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STATISTICAL ANALYSIS AND ECONOMIC EFFICIENCY OF FODDER PRODUCTION FROM NATURAL GRASSLAND (TYPE *CHRYSOPOGON GRYLLUS* L.) FERTILIZED WITH HUMATE FERTILIZERS

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Abstract

During the period 2013-2015, a field experiment was conducted on a natural grassland of Chrysopogon gryllus L. type, fertilized with phosphorus humate, boron and molybdenum humate and their combination. On the basis of the obtained yield, on average for the study period, economic indicators were determined and correlation dependences, economic efficiency and regression equations were calculated. It was found that fertilizing with humate biofertilizers showed a high positive correlation dependence between dry matter yield and gross income (r = 1.0000); cost price and production costs (r = 0.9708); profitability with gross profit (r = 0.8241). The coefficient of determination $R^2 = 0.9675$ of the very good regression dependence between production costs and cost price is high enough to represent the regression dependence equation (y = 150.72x + 1.5118). The high coefficient of economic efficiency in fertilizing with boron humate (2.90) gives grounds for the application of fertilizer for practical purposes in mass production of fodder in a natural meadow of Chrysopogon gryllus L type.

Key words: *economic efficiency, natural grassland, statistical analysis*

INTRODUCTION

Natural grass associations are a huge natural resource that provides environmentally friendly and low-cost raising of ruminants. They are the subject of research by both economics and ecology. Environmental protection and restoration of natural resources [9] are important for the animal husbandry in a number of regions and an opportunity to increase farmers' incomes and produce traditional Bulgarian food to find markets in Bulgaria and the European Union [7].

The amount of hay obtained determines the unsatisfactory condition of natural meadows, which is below the biological potential of grass species and of low quality. Yields from natural meadow and pasture ecotypes are very low. Their use can be considered as a dependence on maintaining the biological balance in nature [8], as well as on the share of species in the grass composition [2, 4]. Therefore, the establishment of environmentally friendly organic fertilizers for foliar or soil application is particularly relevant. Bioproducts are an important component of the integrated nutritional treatment of organic farming. The trend of changing agricultural practices and prevention of harmful effects of chemical fertilizers has imposed biofertilizers in recent years [15].

In this way, the opportunities for environmental pollution of mountain areas will be reduced to a minimum [5].

An innovative technology in modern agriculture is the application of biohumus. Humin substances [12, 13] restore the organomineral balance and realize the production of ecological products [14]. This increases productivity by stimulating nutrient movement and improving the root system.

This necessitates studying the dependencies on climate and the impact of various natural factors, as well as human intervention on the botanical composition and yield of pastures and meadows, which will support the introduction of new environmentally and economically feasible systems for grassland and fodder management in the mountaine regions of Bulgaria.

The increase in economic efficiency is related to the methods of production, which in market conditions imply a rational combination and use of limited resources to ensure the greatest possible profit. Rationality in the utilization of resources is achieved by directing them to activities in which maximum effect is obtained [10]. It is affected by a variety of internal and external (economic, social, environmental, natural) factors.

The present study aims to present the statistical analysis and the result of the economic efficiency in the production of fodder from a natural grassland, fertilized with certain doses of humate fertilizers.

MATERIALS AND METHODS

Empirical data for dry matter yield of natural grassland, published by [1], were used to perform statistical analysis. They are for the period 2013-2015, when the research experiment was conducted in the experimental field of the Research Institute of Mountain Stockbreeding and Agriculture - Troyan with 5 different fertilizing variants on a natural grassland of *Chrysopogon gryllus* type.

The biological preparations included in the experiment were administered in the following doses:

1. Control (without fertilizing);
2. Phosphorus humate (300 ml/da);
3. Boron humate (160 ml/da);
4. Molybdenum humate (160 ml/da);
5. Phosphorus humate + Boron humate + Molybdenum humate (200 ml/da + 100 ml/da + 100 ml/da).

The methods of analysis can generally be grouped into: general (used by all sectors of the economy) and specialized (suitable for determining the subject and specific features of agriculture). The main statistical methods that are applied are correlation and regression analysis, tabular and graphical [3].

Correlation analysis is defined as the dependence between yield and key economic indicators (production costs, cost price, gross income, gross profit and profitability of production). In practice, correlation and regression analysis are often used together [6]. Each regression analysis or regression coefficient shows by how many units the (+/-) result (impact) changes when the i-th factor changes (+/-) with the same unit [16].

Of particular significance in the application of regression analysis is the size of the sample.

For the compilation of the statistical analysis technological maps have been developed by [11], who calculated the production costs, cost price, gross income, gross profit and profitability of dry matter yield from a natural grassland, and the prices are presented in BGN/da.

To establish economic efficiency, gross income and production costs were taken to determine how effective this experiment was.

RESULTS AND DISCUSSIONS

Correlation dependences and regression equations between yield and main economic indicators of fodder production from a natural grassland, fertilized with humate fertilizers

Fertilizing of a natural grassland of *Chrysopogon gryllus* type with humate fertilizers had the greatest impact on the change in average yields. Dry matter yield in fodder production registered the highest positive correlation (Table 1) in the gross income indicator ($r = 1.0000$) and in contrast a negative correlation dependence with production costs ($r = -0.0232$), cost price ($r = -0.2602$), and profitability ($r = -0.0164$).

The theoretical regression line and the equation of the regression dependence between dry matter yield and gross income from a grassland with bird's foot trefoil are shown in Figure 1, where $y = 0.0899x + 26.23$ at high coefficient of determination - $R^2 = 0.9006$.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 1. Correlation dependences between yield and main economic indicators of fodder production from natural grassland (*Chrysopogon gryllus* L.), fertilized with humate fertilizers

	Yield	Production costs	Cost price	Gross income	Gross profit	Profitability
Yield	1					
Production costs	-0.0232	1				
Cost price	-0.2602	0.9708	1			
Income	1.0000	-0.0229	-0.2598	1		
Profit	0.4722	-0.8922	-0.9735	0.4718	1	
Profitability	-0.0164	-0.9430	-0.9070	-0.0168	0.8241	1

Source: own calculations.

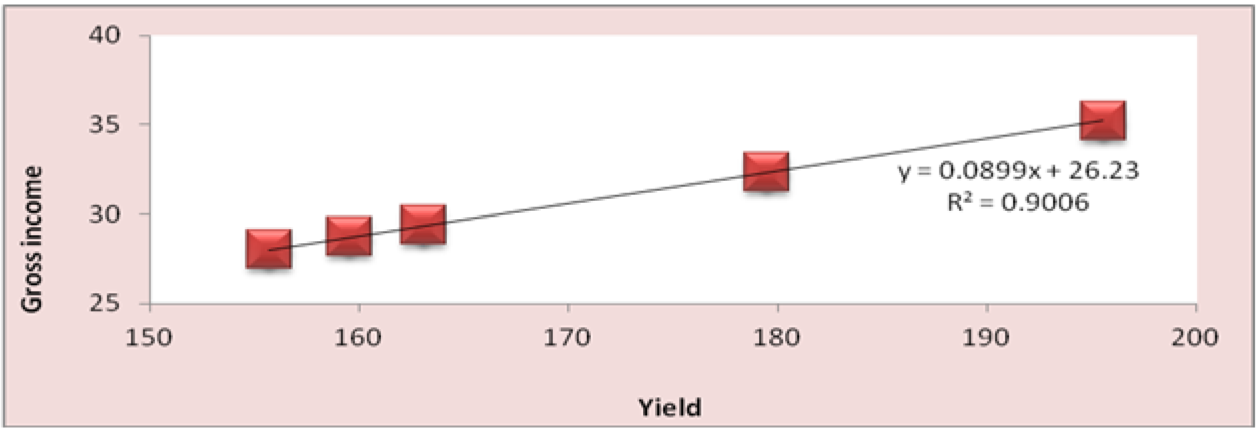

Fig. 1. Theoretical regression line and equation of the regression dependence between gross income and yield in dry matter production
Source: Own calculations and derived equation.

The obtained profit showed a positive but relatively weak correlation with the realized yield (r = 0.4722), which proved the interrelation between these two indicators.
The efficiency of the applied fertilizing is a numerical expression of the obtained high value of the correlation coefficient between the production costs and the cost price, which is respectively r = 0.9708. Figure 2 presents a very high coefficient of determination (R^2 = 0.9425) and the regression equation for predicting the cost price of the obtained fodder production by the average values of production costs (y = 150.72x + 1.5118).

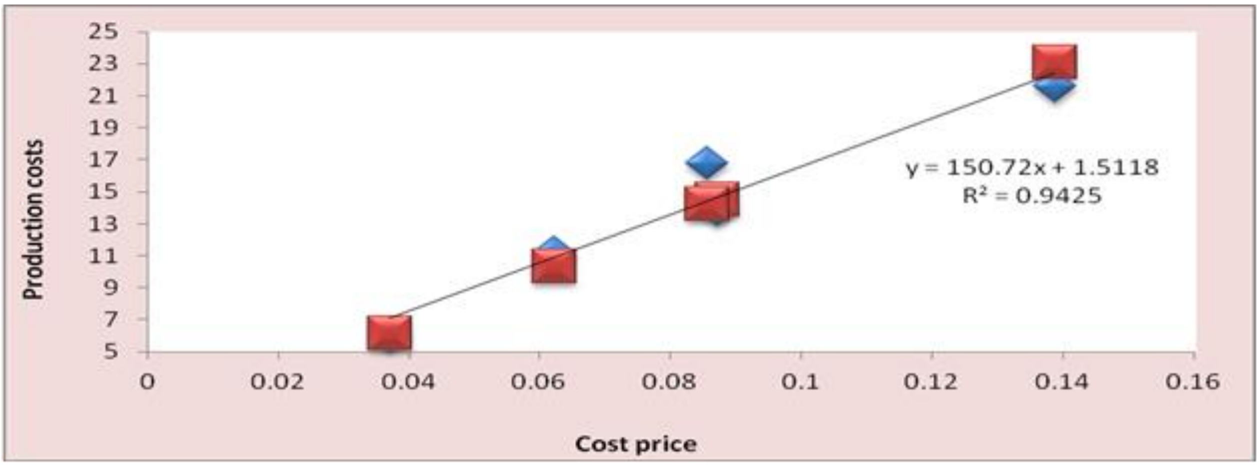

Fig. 2. Theoretical regression line and equation of the regression dependence between production costs and cost price of dry matter production
Source: Own calculations and derived equation.

The results of the analysis show a positive correlation (r = 0.8241) between the indicators gross profit and profitability. The high correlation dependence makes it possible to derive a regression equation (Figure 3), which is respectively y = 0.0401x + 10.235, with a coefficient of determination $R^2 = 0.6791$.

A negative correlation dependence is observed between cost price and gross income (r = -0.2598), profit (r = - 0.9735) and profitability (r = - 0.9070).

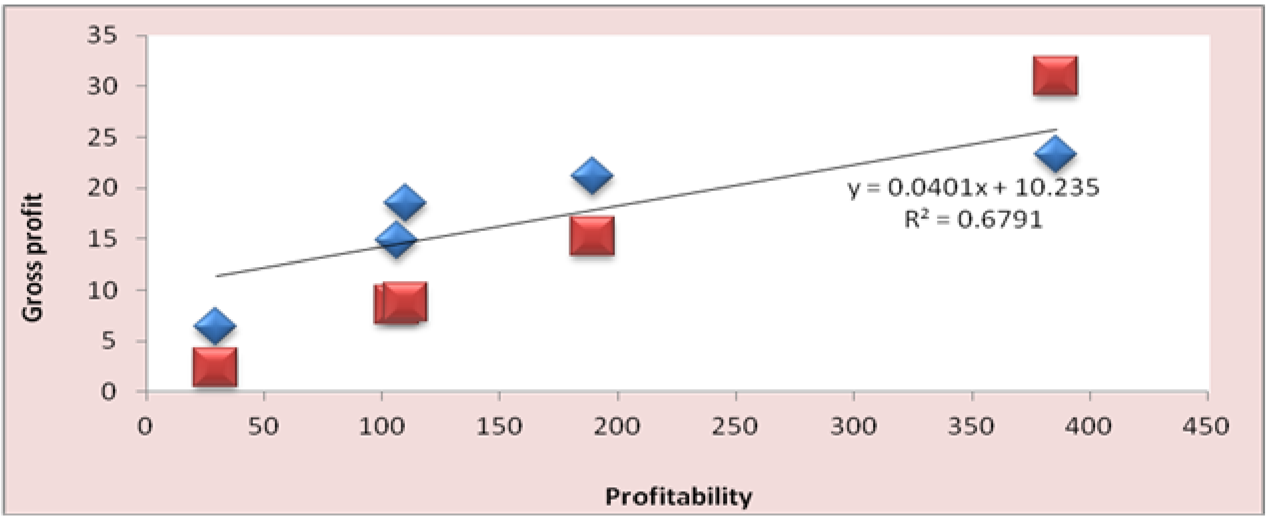

Fig. 3. Theoretical regression line and equation of the regression dependence between gross profit and profitability in dry matter production
Source: Own calculations and derived equation.

Economic efficiency of fodder production from natural grasslands, as a result of fertilizing with humate fertilizers

The indicator of economic efficiency aims to show its usefulness by comparing the income from the sale of production and the costs and even the investments in its implementation. It helps to form a clearer assessment of farmers in the analysis of income and expenditure at a later stage. Economic efficiency answers the question of how efficient a farm is.

The highest efficiency coefficient (Table 2), showing the ratio of income from the sale of fodder production to the production costs, is observed in the variant of fertilizing with Boron humate for all three studied years (252.82%; 230.20% and 396.80%). The trend is maintained at the coefficient with the lowest value, namely in fertilizing with the combination of the three types of fertilizers (125.20%; 121.01% and 143.74%). These numbers clearly show that fertilizing with Boron humate is the most suitable variant, which has the highest economic efficiency, while the variant with combined fertilizers is economically inefficient for producers.

Table 2. Economic efficiency and cost-effectiveness ratio (Cef) of fodder production from natural grasslands, as a result of fertilizing with humate fertilizers

Variants	2013		2014		2015		2013-2015	
	C_{ef}	%	C_{ef}	%	C_{ef}	%	C_{ef}	%
1. Control (without fertilizing)	4.08	408.30	4.33	433.50	6.43	642.72	4.86	485.93
2. Phosphorus humate 300 ml/da	1.95	195.22	2.21	221.48	2.03	202.98	2.06	206.47
3. Boron humate 160 ml/da	2.53	252.82	2.30	230.20	3.97	396.80	2.90	289.52
4. Molybdenum humate 160 ml/da	1.89	189.19	1.64	163.56	2.83	282.84	2.10	210.21
5. Phosphorus humate 250 ml/da + Boron humate 100 ml/da + Molybdenum humate 100 ml/da	1.25	125.20	1.21	121.01	1.44	143.74	1.30	129.72

Source: Own calculations.

The study on the economic efficiency in the variant of fertilizing with Phosphorus humate, has shown the following change: In the first and in the second analyzed years the fertilizing with Phosphorus humate ranked second in efficiency after the variant with the highest efficiency (with Boron humate). In 2015, however, fertilizing with Phosphorus humate was practically ineffective (C_{ef} = 2.03) compared to fertilizing with Molybdenum humate (C_{ef} = 2.83). This change in the last year of the study is reflected in the ranking of fertilizing variants according to their average efficiency coefficient for the period. Overall, the study period (2013-2015) has indicated that the most effective fertilizing variant was with Boron humate (C_{ef} = 2.90), followed by the second most effective one with Molybdenum humate (C_{ef} = 2.10 or 210.21%). Phosphorus humate fertilizing has an efficiency coefficient of 2.06 or 206.47%.

CONCLUSIONS

It was found that fertilizing with humate biofertilizers showed a high positive correlation dependence between dry matter yield and gross income; cost price and production costs; profitability with gross profit.

There is a very good regression dependence between dry matter yield and gross income, which allows the development of a regression equation. The coefficient of determination R^2 = 0.9006 is high enough to represent the equation of the regression dependence between these two indicators (y = 0.0899x + 26.23). The strong relationship between production costs and cost price, expressed by the coefficient of determination R^2 = 0.9425, determines the representation of the regression dependence equation in the form y = 150.72x + 1.5118.

Fertilizing with Boron humate on natural grassland showed the highest economic efficiency and proved to be the most suitable and efficient for the production of fodder.

All analyzed fertilizing variants are suitable for organic production, but the relationship between yield and economic indicators and the applied statistical data processing define bioproducts as economically and environmentally efficient.

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FORMATION OF A PROJECT ACTIVITY MANAGEMENT SYSTEM IN THE AGRO-INDUSTRIAL COMPLEX OF THE REGION

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Abstract

Modern challenges, limitations and risks of the socio-economic development of the region's agro-industrial complex require concentration of efforts, finances, managerial competencies in strategically important areas and tasks. The basis for the effective functioning of the agro-industrial complex of the Penza region is the application of the principles of project management in the activities of agribusiness entities. Project management is a tool both for managing the creation of new products and services, and for implementing targeted changes within individual organizations, as well as entire socio-economic systems. In the Penza region, project management is widely used by agribusiness entities in the implementation of both large and local projects in various fields of activity. The paper presents the results of the analysis of project management in the agro-industrial sector of the region, which indicates both positive and negative trends. The identified problems indicate a low level of quality of the processes of initiation and planning in the project management of business entities. In the current research the system of project management of agribusiness is considered taking into account state support. As a result of the analysis of the relevant projects, the main directions for improving the elements of project management were identified. In the frame of the current research the following research methods were used: the analogy method, the abstract-logical and analytical methods, the method of comparative legal assessment.

Key words: *project management, agribusiness entities, project activities, promising areas of project management, government support*

INTRODUCTION

The basis for effective production management and sustainable development of agribusiness entities is the application of innovative management theories and methodologies. One of the promising technologies of modern management is project management. The use of project management tools by agricultural producers makes it possible to increase the effectiveness of activities through the mobilization and structuring of resources, organization and control of activities at all stages of project activities in accordance with the strategic goals of agribusiness [5, 9].

At present, there is no formed integrated system for managing projects of the regional agro-industrial complex, the modern model of project activity is represented by the use of individual methods and tools of project management [4]. The use of project management methodology allows you to more effectively respond to any changes in the internal and external environment, in contrast to traditional functional management [1].

In the Penza region (Russia), elements of project management are widely used by agribusiness entities in the implementation of both large and local projects in various fields of activity.

The development strategy of the Penza region (Russia) provides for the implementation of priority projects in the field of agro-industrial complex and appropriate state support for the project activities of agribusiness, which significantly increases the business activity of economic entities in the field of project management [8].

In this context, the paper aims to identify trends in the development of project activities in the agro-industrial complex of the Penza region and to determine the main directions for improving the elements of project management in the region.

MATERIALS AND METHODS

The object of the current research is the project activities of agribusiness entities of the Penza region for 2019-2021.

The authors used the primary data of the Ministry of Agriculture in the Penza region (Russia) on the results of competitive selection for obtaining grant support, legal information of regional legislation, open information on the websites of agribusiness entities.

The obtained results are based on the use of the analogy method, abstract-logical and analytical methods, the method of comparative legal assessment.

The method of analogies and the analytical method were used while carrying out a comparative assessment of the development of elements of project management of agribusiness entities in the region. The use of the abstract-logical method made it possible to study the essence of project management and determine the possibility of applying the relevant results in the practical activities of project initiators. With the help of the comparative legal method, an analysis of the legal framework for the development of project activities in the agro-industrial complex was carried out as part of the socio-economic development in the Penza region, and an assessment was made of the legal regulation of state support for project activities of agribusiness entities.

The results of the study were obtained based on the use of methods of analogy, abstract-logical, analytical and comparative legal assessment. The object of the study was the project activity of agribusiness entities in the Penza region (Russia).

RESULTS AND DISCUSSIONS

The development of the regional agro-industrial complex is the basis for ensuring the food security of the country, under any internal and external conditions, therefore, increasing the efficiency of the functioning of agribusiness entities is a strategic task of the regional agricultural areas [16].

The basis for achieving the goals of increasing the efficiency of business entities, reducing risks, increasing the level of competitiveness is the use of modern business management methods. The use of tools that make up the complex of project management allows not only to use the available resources of agribusiness entities, but also to actively attract additional investments [2].

In accordance with the Law of the Penza Region dated May 15, 2019 No. 3323-ZPO “On the Strategy for the Social and Economic Development of the Penza Region for the period until 2035” [11], investment projects in the agricultural and industrial areas are being implemented in the region, initiated by large industry companies: Damate LLC, Rusmolco LLC, Cherkizovo Group PJSC, Aviagen Torkeys LLC, MAYAK Group of Companies, FomLine Group and others [11]. The total investment capacity of investment projects is more than 50 billion rubles, it is planned to create more than 1,800 additional jobs.

The leading initiator of projects for the production and processing of turkey meat in the region is Damate LLC. The specificity of the project activity of Damate LLC is the implementation of multi-projects, which consist of several mono-projects and require the use of a number of special project management methods associated with "end-to-end" control over the implementation of interrelated projects.

In the Penza region, Damate LLC operates at sites located in six districts of the region. Since 2019, Damate LLC has been building sites for the production of turkey meat in the Vadinsky, Spassky and Mokshansky districts of the Penza region (Russia). The investment capacity of the projects is 15.5 billion rubles, 700 jobs would be created, and the budgetary efficiency in the form of tax payments would amount to 3.8 billion rubles.

A project for the modernization of an elevator in the Kolyshleysky district is at the completion stage, and a project for the construction of a new feed mill is being implemented at the same site. The investment capacity of the projects is 3.5 billion rubles.

The launch of new facilities would increase the total feed production capacity of Damate LLC up to 886 thousand tons per year, increase the production of turkey meat up to 207 thousand tons per year. As a result, the implementation of investment projects could create more than 220 new opportunities for employment [6].

The project activity of Damate LLC is characterized by a multi-level life cycle of projects, they are implemented simultaneously and are at different stages of the cycle from initiation to completion.

Rusmolco LLC is the initiator of projects in the dairy industry of the country and the Penza region. In 2007, the project management methodology of Rusmolco LLC was tested on mono-projects, which, in terms of the volume of attracted resources (size), were classified as small projects (criteria for the scale of the project).

The subject area of the projects was the restoration and reconstruction of old dairy farms in the farms that are part of the company, located in Bashmakovskiy, Pachelmskiy, Penza, Kuznetskiy, Narovchatskiy, Kamenskiy and Nizhnelomovsky districts of the Penza region (Russia).

Modern technologies were introduced in all farms, new equipment was purchased and installed, the old livestock was replaced with highly productive cattle. The next stage of the design activity of Rusmolco LLC is industrial investment design, which is based on innovative processes in the industry. The innovative approach of Rusmolco LLC to the implementation of projects could significantly increase the effectiveness of process project management, in particular, the process of managing the cost and quality of the designed products.

Investment project for the construction of a dairy complex in the Serdobsky district implemented Rusmolco LLC with full capacity in 2022. At the end of 2019, the first phase of the complex for 5,200 heads was put into operation, at the beginning of 2021, the expansion of the complex to 7,200 head of dairy herd began. The construction of a modern large dairy complex could create more than 400 jobs, the growth in the production of premium milk would be over 100 thousand tons per year [14].

The basis of successful project activity Rusmolco LLC are modern approaches to the formation of a project team, as a purposeful construction of a special way of interaction between participants, which allows them to effectively realize their professional, intellectual and creative potential in accordance with the strategic goals of the company.

PJSC Cherkizovo Group carries out project activities in the field of pork production and processing. The investment project for the creation of a pig-breeding complex for 440 thousand heads provides for the construction of 11 feedlots with an annual content of 40 thousand heads each. The investment capacity of the project would be 6 billion rubles.

The multi-project orientation of the project management of PJSC Cherkizovo Group involves the implementation of projects in various fields of activity in order to ensure vertical integration that connects all links of the production chain from grain cultivation to the production of finished products. PJSC "Cherkizovo Group" acts as the initiator and investor of the project, the volume of investment in the development of the region amounted to 12 billion rubles. A feature of the design activities of Cherkizovo Group PJSC is the use of elements of high-tech scientific design, in particular, the development of breeding production (raising gilts and using Topigs Norsvin genetic materials) [3].

The cumulative implementation of all investment projects in the Penza region allowed the region to take a leading position in the Volga Federal District in the production of turkey, milk and pork.

The key factor determining the business activity of the project activity of small agribusiness entities is state support at all levels within the framework of the current State programs for the development of small and medium-sized businesses in agriculture, which determine access to investment resources and subsidies [10].

Within the framework of the national projects “Small and medium-sized businesses and support for individual entrepreneurial initiatives" and "Development of the agro-industrial complex", such regional projects, such as "Acceleration of small and medium-sized businesses" (grants "Agrostartup"), "Creating conditions for an easy start and comfortable business, and others.

The total amount of budget allocations for the implementation of the State program "Development of the agro-industrial complex of the Penza region" for 2014-2024 is 42,421.8 million rubles (Decree of the Government of the Penza Region, 2013) [7].

2,639.5 million rubles are provided for the implementation of the subprogram "Support for small business forms", including federal budget funds (72.9%), Penza region budget funds (6.5%), extra-budgetary funds (20.6%).

For 2019 - 2021 more than 200 small businesses implemented projects for the creation and development of their farms with the help of state support, of which novice farmers - 74.3%, family livestock farms and agricultural consumer cooperatives - 15.8 and 9.9%, respectively.

The sub-program "Support for small businesses" provides support for projects in the field of agro-industrial complex and includes the following areas:

- Agrostartup grants for the realization of projects for the creation and development of farms on the terms of co-financing from the state budget;
- Grants for the development of family farms on the terms of co-financing from the federal budget for stimulation
development of small forms of management;
- Grants "Agroprogress" on the terms of co-financing from the federal budget to stimulate the development of small businesses;
- Grants for the development of the material and technical base of agricultural consumer cooperatives on the terms of co-financing from the federal budget to stimulate the development of small business forms.

The amount of grant support for 2021 - 2024 presented in Table 1.

Table 1. Amount of financial support (subprogram "Support for small businesses"), thousand rubles

Indicator	2021	2022	2023	2024	2024 in % to 2021
Grants "Agrostartup" for implementation creation and development projects peasant (farm) households	27,585.6	42,261.0	46,226.4	48,214.2	174.8
Grants for the development of the material and technical base of agricultural consumer cooperatives	89,311.6	63,405.8	54,347.8	56,684.8	63.5
Grant support for development family farms and Agroprogress grants	85,240.3	102,974.8	114,430.7	119,351.2	140.0

Source: Compiled by the authors based on data from http://publication.pravo.gov.ru/SignatoryAuthority/region58 (Accessed on 12.12.2021) [13].

For a more detailed analysis of state support participants, the results of competitive events to support novice farmers, development of family farms of peasant (farm) households within the framework of the state program of the Penza region "Development of the agro-industrial complex of the Penza region". For 2019 - 2021 in these events, more than 180 participants were applicants (Table 2).

62 peasant (farm) enterprises and 10 family farms were recognized as recipients of state support, the amount of funding amounted to 289.41 million rubles. The following types of activities were identified as the subject area of projects within the framework of competitive events: dairy and beef cattle breeding, horse breeding, sheep breeding, poultry farming, beekeeping, horticulture, potato growing, vegetable growing of closed and open ground by the data from the Ministry of Agriculture in the Penza Region.

The development of project activities of small agribusiness is carried out using standard elements of project management, however, it has a number of features [15].

In the field of small agribusiness, it is more often planned not to implement a project, but to organize a production system.

Table 2. The directions of activity for which farm beginners and family farms received financial support

Direction of activity	2019	2020	2021	On average for 2019 - 2021
Support for beginning farmers, million rubles				
Beef cattle breeding	17.94	24.15	4.30	15.46
Dairy farming	29.85	30.96	4.50	21.77
Horse breeding	-	3.0	-	1.00
Beekeeping	2.92	-	4.82	2.58
Vegetable growing	7.28	2.29	6.93	5.48
Potato growing	5.67	2.7	-	2.79
Gardening	6.99	12.99	-	6.66
Amount of allocated grants – total	70.65	76.09	20.55	55.76
Support for family farms, million rubles				
Beef cattle breeding	8.81	17.16	40.45	22.14
Dairy farming	-	9.63	-	3.21
Horse breeding	-	5.82	-	1.94
Sheep breeding	-	-	10.32	3.44
Poultry farming	-	-	29.93	9.98
Amount of allocated grants – total	8.81	32.61	80.70	40.71

Source: Compiled by the authors based on data from the Ministry of Agriculture in the Penza Region [12].

Production cycles in their pure form are not projects, however, in recent years, the project approach has been increasingly applied to processes focused on continuous production. For example, projects to increase production to a sufficient level within a certain period, based on a given budget, or the fulfillment of certain orders that have contractual delivery dates [5].

Features of project activities in the field of agribusiness affect the effectiveness of relevant management processes, in particular the management of functional areas within the planning and execution processes. The lack of project management in the planning process in most cases is the reason for not granting subsidies.

The insufficient level of quality of initiation and planning processes in project management leads to the fact that the majority of entrepreneurs decide to start implementing an entrepreneurial idea, focusing mainly on the possibility of state support.

Often it leads to an underestimation of the state of the consumer market of manufactured goods (services rendered) and the characteristics of the selected types of activities. Therefore, mistakes made during the initiation process adversely affect the course of other project management processes.

CONCLUSIONS

The analysis of the development of project management in the agro-industrial complex of the region made it possible to determine various instrumental approaches to the implementation of project activities by agribusiness entities.

The main distinguishing characteristics of different approaches are the multi-project and single-project orientation of project initiators and stimulating factors for the development of project management.

The first option provides for the implementation of multi-projects, the initiators of which act simultaneously as an investor.

Within the framework of the second option, the initiators of the projects are small agribusiness entities that implement mainly mono-projects supported by state programs at the federal or regional levels.

The formation of a system for managing the project activities of the agro-industrial complex of the region could ensure the targeted, systematic development of the industry and move from individual projects and programs of business entities to a project-oriented business in the agro-industrial complex.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ACADEMIC PERFORMANCE OF TEACHING AND RESEARCH STAFF IN AGRICULTURAL HIGHER EDUCATION OF MOLDOVA

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Abstract

Moldova traditionally relies on the agricultural sector, rural population representing one third of labor force. The agricultural education and research system in Moldova is characterized by the aging of the teaching and research staff, the reduction of the number of students below the critical level, unattractiveness of science and education for the young generation, the weak connection between education, science and production, but also the inefficiency of the institutional activity. All these represent a major danger for the sustainable development of the rural areas. The aim of this paper is to analyze the major factors affecting the academic performance of research and teaching staff in agricultural higher education of Moldova. The study is based on field surveys of academic personnel of State Agricultural University, the only agricultural higher education institution in Moldova. The data set includes 120 respondents. Main analyzed indicators are related to academic performance as: professional motivation, research activity in projects, published research results and achievements, main problems and challenges within the institution related and other relevant factors. As result, income level remains an important factor for staff motivation in achieving higher performance.

Key words**:** *agriculture, academic performance, higher education, university, research*

INTRODUCTION

Management, measurement and assessment of performance related to public sector is a well-known tool used by most countries governments. Performance management is recommended as a way to develop employees. Aguinis [1] define performance management as "identifying, measuring and developing the performance at individuals or teams level integrated within the organization main aims" [1]. Thus, we can find a linkage between performance management and human resources development [2].

Performance management and performance measurements are closely related. In order to achieve performance management is important to select the main factors and the performance indicators for a quantitative assessment [3, 5].

The university sector was also affected by different changes related to the reduction of available financial resources, increased competition, change in the number of students [4]. Assessment of performance indicators in universities became particularly important for an efficient managerial system. It is believed that performance indicators have a major role in the management of higher education institutions [7]. Some authors examine the satisfaction level of staff with the existing performance indicators and provide recommendations towards improving its application [7], while others consider that the emphasis should be directed towards its effectiveness and efficiency [3]. In some cases, performance systems in higher education institutions do not measure the entire academic process: input, output and outcome [4].

To assess performance more quantitative performance measures are used, but they create different effects [8]. According to Taylor [7], performance indicators should be divided into three categories: internal, external, and operating.

The Republic of Moldova is the country with the highest share of the rural population in Eastern Europe. Despite this fact, the unemployment rate in villages is almost two thirds of the population. Due to the decrease of the employment possibilities in the rural environment, a massive process of depopulation of the villages takes place, especially by the young people and those with studies. On the other hand, the research-innovation system, which must be a pillar of support for agricultural producers, is also facing major problems and is not fulfilling its task. The precarious conditions in which the education-research system in agriculture faces with, characterized by the aging of the academic staff, the reduction of the number of students below the critical level, unattractiveness of science and education for the young generation, the weak connection between education, science, and production, but also the inefficiency of the institutional activity represents a major danger for the sustainable development of the rural areas.

The main areas to set priority objectives related to research, education and innovation in agricultural higher education institution of Moldova are: “physical and financial resources, performance management and development, performance attitude of teaching and research staff, innovation and social responsibility” [6].

The aim of this paper is to analyze the major factors affecting the academic and research performance of human resources in agricultural higher education of Moldova.

MATERIALS AND METHODS

The study is based on field surveys of academic personal in State Agricultural University of Moldova, the only agricultural higher education institution in Moldova. The data set includes 120 respondents. The survey was realized in May- June 2021. Main analyzed indicators are related to academic performance as: professional motivation, participation in research projects, published research results, collaboration with third organizations, main problems and challenges within the institution related and other relevant factors.

The data collected through questionnaires involved academic staff from State Agricultural University of Moldova. The surveyed staff included people from 29 to 80 years old (45 years on average), with an average work experience in education and research of 23 years (Table 1). The analyzed sample includes different target groups differentiated by age, work experience, scientific degree and position. In order, to determine which factors have a greater influence, regression analysis was used. Results analysis was made through SPSS Statistics software.

Table 1. Sample structure

Variable	Category	Number of respondents	Percentage
Age	<35	16	13.33
	36-45	54	45.00
	46-60	36	30.00
	>61	14	11.67
Work experience	>10	12	10.00
	11-20	38	31.67
	21-30	48	40.00
	31-40	8	6.67
	>40	14	11.67
Scientific degree	without scientific title	28	23.33
	Ph. D	74	61.67
	Ph. D habilitate	18	15.00
Job position	assistant	32	26.67
	lecturer	8	6.67
	associate professor	64	53.33
	professor	16	13.33

Source: author’s field research.

This research was realized within State Project 20.8009.0807.44 “Adaptation of the agricultural education-research system in the Republic of Moldova to the conditions of the contemporary society”.

RESULTS AND DISCUSSIONS

The number of employed people in agriculture has been diminishing considerably over the last two decades (from 50% in 2000 to 36% in 2018). Nowadays in agriculture are employed about 20 percent of active population. Also, the structure of employed people in agriculture according to education level had changed (Figure 1).

The number of employed persons in agriculture with a higher education degree increased with 5 percent in 2020 comparing to 2014 level (from 231.6 thousand persons to 236.1). At the same time increased insignificantly the number of secondary specialized persons employed in agriculture.

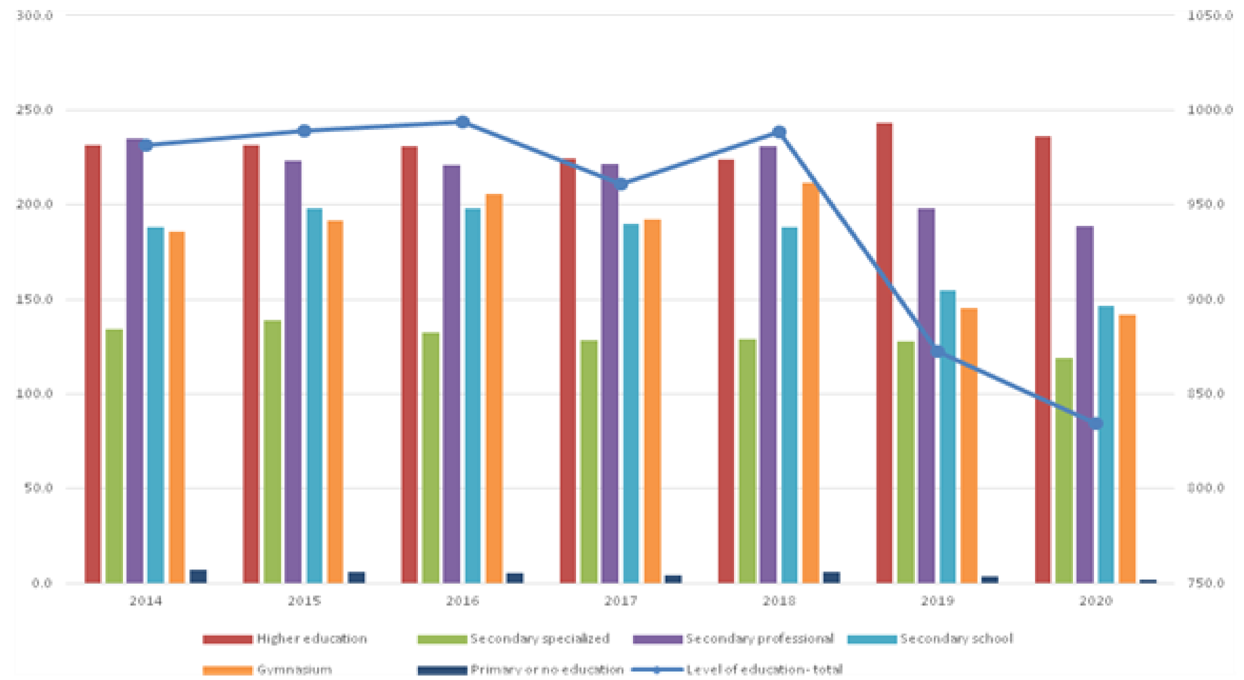

Fig. 1. Population employed in agriculture according to the level of education
Source: based on data from National Bureau of Statistics.

A reduction is noticed in relation to those that have a secondary professional, secondary school, gymnasium and primary or no education level (Figure 1).

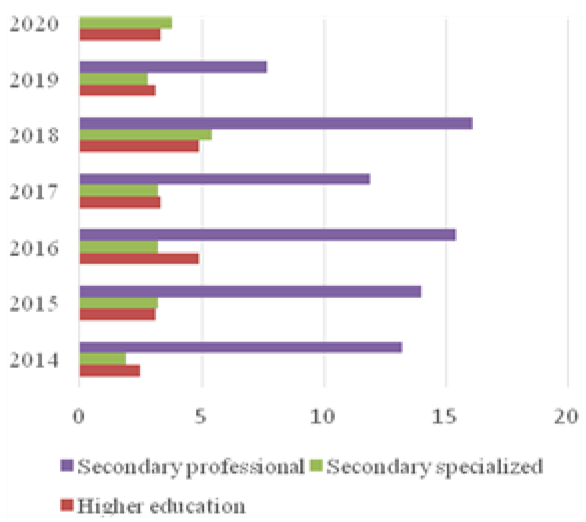

Fig. 2. Employed young population (until 35 years old) in agriculture according to the level of education
Source: based on data from National Bureau of Statistics.

If analyzing the employment in agriculture among young population until 35 years old, an opposite tendency is observed (Figure 2). Most persons have secondary professional level of education, followed by higher education or secondary specialized level.

The State Agricultural University if the only higher education institution and offers different degree programs at both bachelor and master level, as well as doctoral studies in the area of agricultural sciences in Moldova. The university includes six faculties with 3941 students and employs 296 teaching and research staff (according to 2019 data).

The university's academic staff includes 40 percent of people within 31- 45 y.o, 32 percent aged 46 – 62 and 29 precents of staff at retired age (>63 y.o.). Ageing staff is one of the main challenges for further development of the university and its performance management. Among the employed teaching and research staff, 70 percent have a Ph. D/Ph. D habilitate title, 44 percent are associate professors and 9 percent are professors (Table 2).

Table 2. The teaching and research staff in State Agricultural University, 2019

Faculties	staff number	Age, years			
		< 30	>=31< 45	>=46< 62	>63
Economy	78	1	47	23	9
Agronomy	56	2	20	17	19
Horticulture	39	0	11	19	11
Veterinary Medicine	40	2	11	13	14
Agricultural Engineering and Transport	44	0	16	11	17
Cadastre and Law	39	2	11	10	16
Total	296	7	116	93	86

Source: based on institutional data.

Staff performance is closely related to motivational factors that would allow academic staff to obtain better results. Among motivational factors we could refer to monetary and non-monetary factors. Among monetary factors, wage level represents an important incentive for all activities. Nevertheless, there are factors apart from financial ones, that can provide an equal or strong enough motivation for achieving high performance. These could be considered the following: recognition of scientific results, promotion possibilities, flexibility of working schedule, appreciation from colleagues.

From obtained data according to surveyed staff, recognition of scientific results, followed by career promotion possibilities and schedule flexibility are the factors that most motivates their activity (Figure 3).

Fewer surveyed academic stuff answered that wage size and appreciation are important factors that motivates their professional activity.

According to regression analysis data, there is a stronger correlation between respondents age (R=0.32) and work experience (R=0.37) with main factors that motivates the teaching and scientific activity. Results indicates that university's academic staff job position (R=0.29) and scientific degree (R=0.25) does not impact considerably the factors that determine academic staff to involve in teaching and research activity.

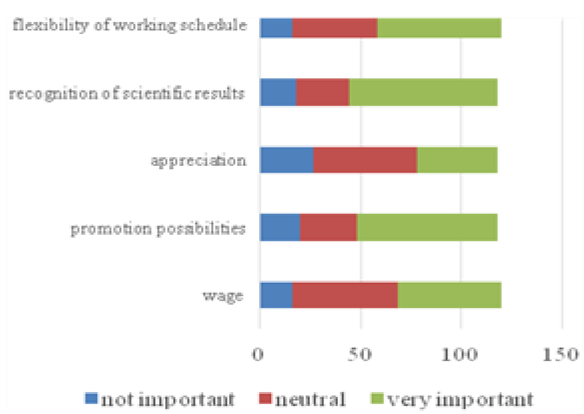

Fig. 3. Factors that motivate the teaching and scientific activity of academic staff
Source: based on survey data.

An important factor that affects the scientific performance of academic staff is related with the number of teaching hours per year. According to university's internal regulation (based on Ministry of Education, Culture and Research framework) yearly an associate professor teaching activity consists of 300-400 hours per academic year, for a professor 200-300 hours, while those that have a position of assistant or lecturer – between 400 and 600 academic hours. One third of surveyed teaching staff consider that teaching activity should consist of about 200-300 hours during an academic year in order to ensure quality in both teaching and research activities (Table 3).

Table 3. Desired number of teaching hours per academic year to allow ensuring quality

Number of hours per year	Number of respondents	Percentage
<100 hours	22	18.33
100-200 hours	32	26.67
201-300 hours	38	31.67
301-400 hours	26	21.67
>400 hours	2	1.67

Source: based on survey data.

At the same time, 34 percent would prefer to teach less than 100 hours or maximum 200 hours during an academic year in order to ensure high quality and to be able to carry on research activities. Only 21 percent believe that teaching 300-400 hours a year would allow them to accomplish all teaching and research tasks at a high level. The amount of teaching hours has an impact on research performance of academic staff. University staff that must teach more academic hours or a greater number of courses during a year have less time for scientific activities as working in research projects. According to multiple regression results, the number of teaching hours correlate with the activity in research projects (R=0.38) and number of scientific and methodical papers written (R=0.35). On average, the surveyed respondents taught 5.4 courses during the academic year 2020-2021. The range of courses varied from 2 to 14 courses. Job position influence the number of courses taught, thus a professor will have a lower number of courses, while an assistant professor or lecturer will have to take more courses to fulfill the minimum compulsory teaching hours per year. Multiple regression results reveals that there is an average correlation (R=0.47) between the number of courses taught during an academic year and the published scientific and teaching results (as research papers and various teaching/learning materials).

Table 4. Activity in research projects and other projects during 2016-2021

	Research projects	%	Other projects	%
Member of national project team	64	53.33	46	38.33
Member of international project team	38	31.67	34	28.33
Manager of national projects	14	11.67	12	10
Manager of international projects	14	11.67	2	1.67

Source: based on survey data.

More than half of surveyed academic staff worked within national research projects as a member, while one third were engaged in international research projects. Only 11 percent acted as managers of a research project (project manager/director) in the case of both national and international research projects (Table 4).

Meanwhile, university teaching and research staff participated also in other projects rather than scientific ones. A higher number of staff were involved as member of national project team (38 percent), and one forth of staff participated as team members of international projects. From regression data analysis the staff involvement in projects participation does not depend on personnel age, but there is a moderate association with work experience (R=0.44), scientific degree of researchers (R=0.45) and job position (R=0.43).

Most of university research staff participated in projects with the purpose to obtain academic experience (53%), make new contacts and enlarge the collaboration with peers from other countries (53%) or to obtain additional income (51%). Also, important reasons that determine university staff to participate in research projects are related to elaboration of research papers in peer reviewed and impact factor journals, conference participation, passion for research activity and the possibility to contribute to the development of the national agri-food sector (Table 5).

Among surveyed university staff, many answered that elaboration of doctoral thesis and support of Ph.D students were not important factors that determine their motivation to work in research projects. Such answers are related to the fact that most of surveyed staff already hold a Ph.D or Ph. D habilitate, thus this factor does not represent an incentive for their work in research projects. During the last five years, 16 of surveyed staff had confirmed the scientific degree of Ph.D/Ph.D habilitate, while 40 confirmed the title of associate professor/professor. However, only 25 percent of surveyed teaching and research staff have the right to supervise doctoral students, thus the reason to support Ph D students is not a relevant reason for project participation.

Regression analysis results demonstrate there is a strong correlation between the surveyed staff's scientific degree (R=0.71) and job

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
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PRINT ISSN 2284-7995, E-ISSN 2285-3952

position (R=0.67) with main determinant factors that influence participation in national and international projects. Meanwhile, researchers age and experience present an average correlation (R=0.48 and R=0.51).

An important part of research activity for all university's teaching and research staff is the elaboration of scientific papers and teaching materials.

Table 5. Determinant factors that influence university teaching and research staff participation in national and international projects, %

	not important	average	very important
Elaboration of Ph. D/ Ph. D. habilitate thesis	61.6	20.0	16.6
Willingness to get an additional income	21.6	26.6	51.6
PhD students' support	53.3	21.6	25.0
Elaboration and editing of scientific articles in journals with impact factor	30.0	26.6	43.3
Participation in scientific conferences abroad	31.6	31.6	40.0
Gaining academic experience	23.3	15.0	53.3
Obtaining new contacts and/or collaborating with researchers from abroad	21.6	25.0	53.3
Possibility to contribute to the development of the agri-food sector of the country	25.0	35.0	38.3
Visiting touristic objects in the country or abroad	43.3	26.6	26.6
Passion for research, science	26.7	25.0	48.3

Source: based on survey data.

During 2016-2021 were published scientific papers in national journals and conference proceedings 9 on average per surveyed person, followed by published scientific papers in international journals and conference proceedings – 4.43, university courses, including courses placed on educational platforms – 4.18 and methodical guidelines for taught courses - 3.6 (Figure 4).

There is a strong correlation between the job position and the number of published research papers and other teaching materials (R=0.63). Due to the fact that each university job position is for five years, in order to be eligible to apply for same or different teaching and/or research position a number of conditions should be met. Among these the number of published scientific research papers, textbooks are most important.

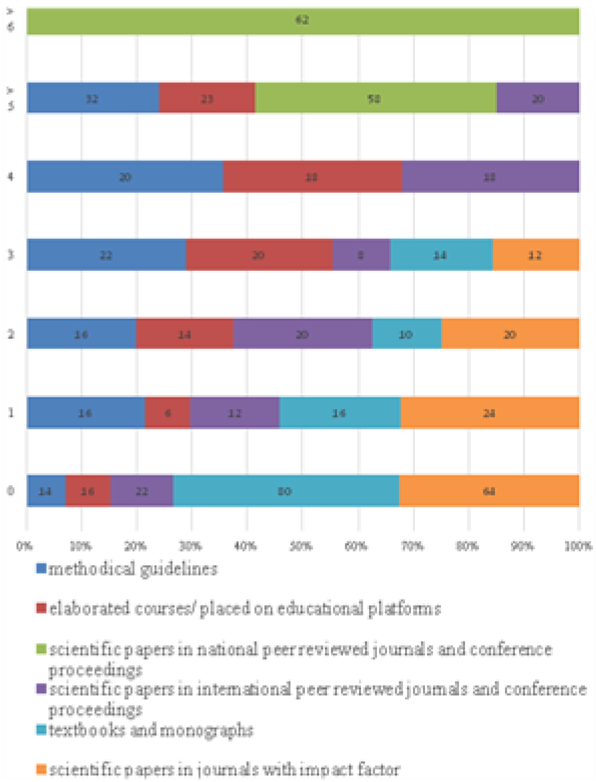

Fig. 4. Elaborated scientific papers and teaching materials by State Agricultural University staff during 2016-2021
Source: based on survey data.

Unfortunately, the yearly number of teaching hours per academic staff is quite high, thus most of surveyed staff would prefer fewer hours (until 300). Thus, in order to achieve the individual research objectives established for the academic year, some staff must work additional hours from home or during weekend (Figure 5).

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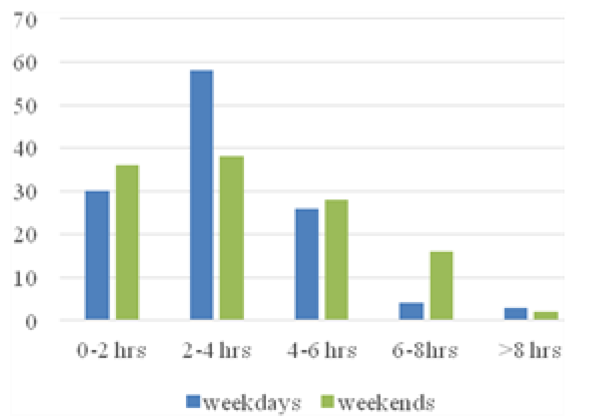

Fig. 5. Additional time spent on teaching and research activities
Source: based on survey data.

From received data, 25 percent dedicates between 0 and 2 hours within the working week to their scientific and teaching activity from home, while 48 percent allocate from 2 to 4 hours for these activities. At the same time, one third of surveyed staff allocated from 0-2 hours for the scientific and teaching activities during weekends, while another third spends from 2 to 4 hours (Figure 5).

Income is an important factor for staff motivation and a greater performance. Unfortunately, the monthly income received by surveyed teaching and research staff remains at a low level (7,906 MDL on average, with variations from 6,000 to 16,000 MDL), with an average family monthly income of 13,100 MDL. The survey suggests that most of respondents consider the monthly wage low that is not sufficient to cover expenses for a decent living. According to survey results, respondents consider that an minimum amount of 21,333 MDL per month (on average per surveyed staff) is necessary to insure normal living conditions for academic staff. The relevance of income factor is demonstrated by the average strong correlation with staff motivation for academic and scientific work (R=0.54), participation in research projects (R=0.52), publication of research papers and teaching materials (R=0.45).

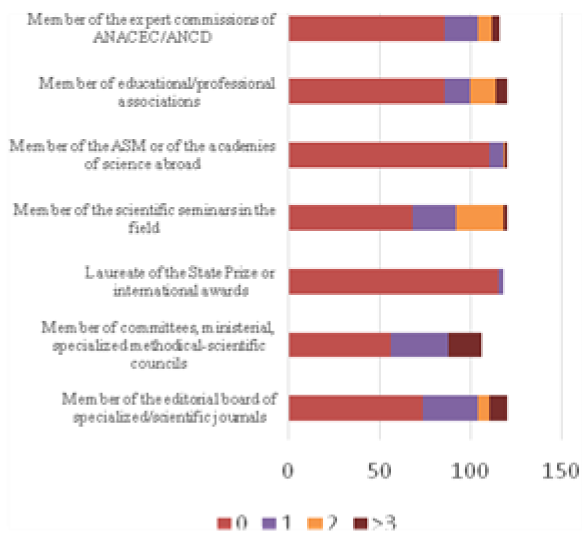

Fig. 6. Academic performance achievements 2016-2021
Source: based on survey data

Beside project participations and published papers, an important indicator of performance for teaching and research staff are different professional achievements. Among these professional achievements are included the following: member of expert commissions of National Agency for Quality Assurance in Education and Research and/or National Agency for Development and Research; Member of Science Academy of Moldova and/or other academies abroad; member of different educational/professional associations; member of scientific seminars in the field of research; laureate of the state prize and/or other international awards; member of committees, ministerial, specialized methodical-scientific councils; member of scientific journals editorial board (Figure 6).

The income size has a significant impact on the results of academic performance as member of scientific journals, editorial boards, participation in governmental, ministry commissions or scientific councils, member of scientific seminars and professional associations, member of expert commissions (R=0.5).

Satisfaction level from teaching and research conditions in the State Agricultural University reveals that only one quarter of employees are satisfied, while no one answered to be very satisfied (Figure 7).

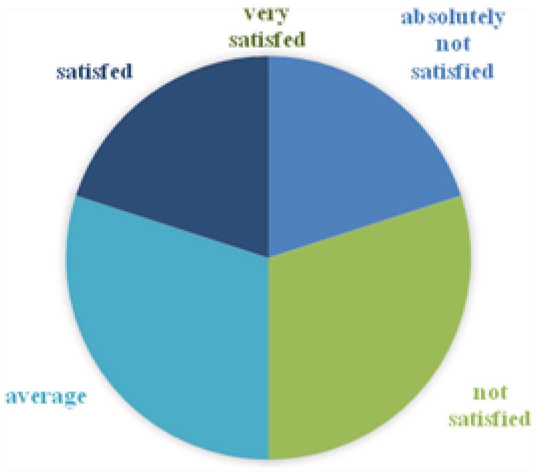

Fig. 7. Satisfaction level from educational and research conditions in the institution
Source: based on survey data

A direct factor which affects the satisfaction levels is the wage size. There is positive correlation between staff wage level and satisfaction (R=0.42, $p<0.05$). Moreover, half of surveyed staff affirm that the financial situation of their family over the last five years worsened, while one third consider the option to leave the country and move abroad. Most indicated the low wage as a main reason that determines to leave the country (R=0.41).

CONCLUSIONS

The performance of academic staff in State Agrarian University of Moldova depends on appreciation from peers and colleagues, wage level and flexibility of working hours. The number of teaching hours per year have a great impact on academic staff research activity. Most of surveyed staff participated in national or international research projects during the last five years. There is a moderate correlation between work experience, scientific degree and job position with the participation in research projects. Main motivation to engage in research projects is associated with obtaining academic experience, expanding collaboration with other colleagues from abroad, and obtaining additional income.

Income level remains an important factor for staff motivation in achieving higher performance. According to survey data its low level is not sufficient to cover monthly expenses of academic staff and determines the overall level of satisfaction. Moreover, low wage level is main factor that motivates academic staff to migrate abroad in the search of new opportunities.

ACKNOWLEDGEMENTS

This research work was financed from State Project 20.8009.0807.44 “Adaptation of the agricultural education-research system in the Republic of Moldova to the conditions of the contemporary society”.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

COMPARATIVE ANALYSIS OF THE MAIN TECHNICAL INDICATORS FOR RAPESEED CROP IN ROMANIA

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Abstract

The growing demand for rapeseed oil has led to an increase in cultivated areas and the improvement of rapeseed cultivation techniques. The article analyzed the main technical indicators related to area, total production and average production of rapeseed. A comparative analysis was also carried out for the mentioned indicators, in two distinct periods, delimiting the period before accession and after accession to the European Union. The averages of the two periods were compared, using the Student Test method, and the SPEC Forecast function estimated the area, production and average rapeseed production by 2030. The aim was to identify from a statistical point of view if the averages of the two periods are dependent, as well as to predict the evolution of the main technical indicators.

Key words**:** *rapeseed crop, agricultural potential, rapeseed production, Romania*

INTRODUCTION

In the search for renewable energy solutions, rapeseed has become increasingly important, given its use in the biodiesel industry [9]. However, rapeseed is not only a renewable energy source, it is also widely used in human consumption [10]. Rapeseed oil is the raw material needed to make margarine, mayonnaise, and frying oil. Being rich in fatty acids and having valuable nutritional properties, rapeseed oil is one of the main preferences of consumers in the European Union [1].

Rapeseed meal resulting from the process of manufacturing rapeseed oil is used successfully in animal husbandry, being an important source of protein in the diet of animals specializing in milk and meat production. Along with sunflowers, rapeseed is also important for beekeeping, being a honey plant that is used in honey production. [2, 3, 4].

Rapeseed began to occupy a significant share in the rotation of the Romanian farmer’s crops. If at the beginning this crop was not very successful, gradually farmers began to be attracted to such a crop, given the possibility of higher capitalization compared to the sale of cereals. However, the decision to cultivate rapeseed is an expression of the farmer's will and can be influenced by the cultivated area, knowledge of cultivation technology, but also examining the international trend regarding rapeseed areas cultivated in other states [5, 11, 6].

According to data provided by the Romanian Ministry of Agriculture and Rural Development, in 2019 the rapeseed crop occupied an area of 352.6 thousand hectares, with a total production of 798.2 thousand tons and an average production of 2.26 tons/ha. The average yields recorded for rapeseed cultivation had a significant evolution compared to 2010, when an average production per hectare of only 1.75 tons was recorded. This evolution of the average recorded productions can be attributed to the investments made in high-performance varieties and hybrids with increased resistance to diseases and pests.

Rapeseed is the dominant oil crop in the European community, being also the world's leading producer of rapeseed and rapeseed products. The largest producers in the EU are France and Germany, followed by Poland, the United Kingdom, the Czech Republic and Romania. Demand for rapeseed exceeds domestic supply, leading to imports of large quantities of rapeseed, mainly from Ukraine, Australia and Canada.

The area cultivated with rape in the European Union has decreased with the banning of neonicotinoids in the EU. Banning treatment with neonicotinoid substances for rapeseed makes production more difficult and expensive. Higher costs and lower yields make rapeseed less competitive compared to other crops. For the time being, farmers continue to grow rapeseed despite weaker economic results because there is no equally effective alternative to building crop rotation at farm level [7, 8].

Romania's agricultural potential in terms of rapeseed cultivation is extremely high and must be analyzed in terms of internal constraints and identifying the best strategies to manage climate change to achieve higher yields and to cultivate large areas of rapeseed [12].

Romania has a great potential to produce biofuels. Increasing the area occupied by oilseeds should not have a negative impact on the environment. The policy of reducing dependence on fossil fuel imports must be associated with a social and environmental policy [13].

The aim was to identify from a statistical point of view, if the averages of the two periods are dependent, as well as to predict the evolution of the main technical indicators.

MATERIALS AND METHODS

Data about area, total production, and average production for rapeseed crop come from the platform of the National Institute of Statistics and were analyzed quantitatively and qualitatively.

We must take into account the two periods of time when the agricultural product (oilseed rape), which is increasingly in demand, is being analyzed for bioethanol. Thus, the period 1994-2006 represents the transition period of agriculture, marked by a series of major changes that have affected the productivity of this sector, and the period 2007-2019 represents the period after accession to the European Union, when Romania, and therefore Romanian farmers, benefited from funds aimed at revitalizing the activity carried out.

The comparative analysis of data was also used for two distinct periods, before and after accession to the European Union. The tabular representation has been simplified by inserting the first and last year of the period analysed in order to facilitate the visualisation of the results obtained.

Also the estimation of area, total production and average production by 2030 was made using the Forecast function of the SPPS Statistical program.

To determine whether or not the two analysed periods are related, the Student Test was used, which is a decision method that helps us to validate or invalidate with a certain degree of certainty a statistical hypothesis, using the following formula:

$$\text{Tcal}=\frac{(M2-M1)}{\sqrt{\left(\frac{var1}{n1}\right)}+\sqrt{\left(\frac{var2}{n2}\right)}}$$

RESULTS AND DISCUSSIONS

At national level, in the period 1994-2006 the total area cultivated with rapeseed registered a positive trend. At the level of 2006, it is noted that a total area of 110.11 thousand hectares was established, while in 1994 the area occupied by rapeseed at national level was 342 hectares. Analyzing comparatively, it is observed that the area cultivated with rapeseed has increased exponentially being over 300 times larger than the area cultivated in 1994 (Table 1).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

At the level of development regions, the areas cultivated with rapeseed registered an ascending trend for all development regions of Romania. The most significant evolutions of the areas established with rapeseed are registered at the level of the Bucharest-Ilfov regions (an evolution of the areas of 1,677.8% of the surface in 2006, compared to 1994), the South-West Oltenia region where a cultivated area is registered with rapeseed 29 times higher in 2006 compared to 1994.

The Western development region also records a significant evolution of the areas occupied by rapeseed, being 33 times larger than the area cultivated in 1994 (Table 1.).

Table 1. Comparative analysis of the area cultivated with rapeseed in the periods 1994-2006, respectively 2007-2019 (thousand ha)

Region	1994	2006	%	2007	2019	%
Total	0.34	110.11	32,095.90	364.92	352.62	-3.40
Northwest	-	2.03	-	7.22	32.81	354.60
Center	-	0.28	-	2.05	9.20	349.10
North East	-	9.59	-	30.22	35.53	17.60
South East	-	35.74	-	127.17	64.94	-48.90
South-Muntenia	-	53.01	-	159.03	126.38	-20.50
Bucharest - Ilfov	0.07	1.28	1,677.80	4.25	7.53	77.30
Southwest Oltenia	0.23	6.69	2,874.20	27.27	32.68	19.90
West	0.05	1.49	3,208.90	7.73	43.55	463.70

Source: statistical data processing, Accessed on 17.01.2021.

In the period 2007-2019, the total area cultivated with rapeseed at national level registered significant oscillations during the analyzed period. At the level of 2007, an area of 364.92 thousand hectares was established, while in 2019 the area occupied by rapeseed crops decreased by 3.4%, being cultivated 352.62 thousand hectares, 12.30 thousand hectares less in 2019 compared to the area cultivated in 2007 (Table 1).

At the level of development regions, rapeseed crops have maintained their positive trend for most development regions, so that the most significant developments of the areas established with rapeseed are found in the Western regions (an evolution of over 460% of the area in 2019, compared to 2007), the Center region where there is an increase in areas established with rapeseed of 349.1% of the area in 2019 compared to 2007. A significant positive trend in terms of cultivated area with rapeseed is also noticeable in the development region Northwest, where the cultivated area with rapeseed increased by 354.6% in 2019 compared to the cultivated area in 2007 (Table 1).

In 2019, compared to 2007, the only 2 regions that register a decrease in the cultivated area with rapeseed are the South-Eastern development regions (with a reduction of the areas established with rapeseed of 48.9%) and the South-Muntenia region (which registers a reduction of areas established with rapeseed of 20.5%) (Table 1).

At national level, the total rapeseed production in the period 1994-2006 registered a significant evolution, being also influenced by the evolution of the cultivated area at national level. Thus, at the level of 1994 a total rapeseed production of 322 tons was registered, while in 2006 the registered production was 500 times higher than the one recorded at the level of 1994, being of 175.05 thousand tons (Table 2).

With regard to total rapeseed production in development regions, it should be noted that all developmental regions recorded much higher rapeseed production in 2006 compared to 1994, whereas no data are available for all development regions. To highlight the evolution of total rapeseed production in 2006 compared to 1994, it was analyzing the existing available data for 3 of the 8 development regions. Thus, the Bucharest-Ilfov development region recorded a rape production 48 times higher than the production recorded in 1994. Regarding the South-West Oltenia development region, the rapeseed production recorded in 2006 was 9.03 thousand tons higher than the rapeseed production registered at the level of 1994. The West Development Region obtained in 2006 a production by 2.14 thousand tons higher than the existing one at the level of 1994 (Table 2).

Table 2. Comparative analysis of total rapeseed production in the periods 1994-2006 and 2007-2019, respectively (thousand tons)

Region	1994	2006	%	2007	2019	%
Total	0.32	175.05	54,263.40	361.50	798.22	120.80
Northwest	-	2.97	-	8.72	76.60	778.30
Center	-	0.47	-	2.46	23.90	872.30
North East	-	13.08	-	34.13	63.71	86.60
South East	-	64.12	-	186.92	128.60	-31.20
South-Muntenia	-	81.32	-	96.94	298.66	208.10
Bucharest - Ilfov	0.03	1.64	4,717.60	3.08	15.70	409.10
Southwest Oltenia	0.23	9.26	3,873.80	18.29	70.37	284.70
West	0.06	2.20	3,898.20	10.94	120.68	1,002.70

Source: statistical data processing, Accessed on 17.01.2021.

At national level, the total rapeseed production in the period 2007-2019 registered significant evolutions. Thus, at the level of 2007 a total rapeseed production of 361.50 thousand tons was registered, while in 2019 the registered production was 2.2 times higher than in 2007, being 798.22 thousand tons (Table 2).

Regarding the total rapeseed production registered at the level of development regions, it is noted that 7 of the 8 regions registered higher rapeseed productions in 2019 compared to the productions registered in 2007. Thus, the regions with the most significant developments of the total rapeseed production obtained in 2019 compared to 2007, are: North-West with a production of 76.60 thousand tons, compared to 8.72 thousand tons that were harvested in 2007, being a production 8.7 times higher than in 2007. The Western Development Region recorded a significant evolution of rapeseed production in 2019 compared to 2007, registering a production of 120.68 thousand tons (increasing by 1002.7% compared to of production recorded in 2007). Also, the development region of Bucharest-Ilfov had a total rapeseed production of 15.70 thousand tons in 2019, while in 2007 the total rapeseed production in this region was 3.04 thousand tons, being approximately 5 times lower than the rapeseed production recorded in 2019 (Table 2).

The only development region with a decrease in total rapeseed production recorded in 2019 compared to 2007 was the Southeast region, where total rapeseed production decreased by 31.2% in 2019, compared to 2007 (Table 2).

At national level, the average rapeseed production in the period 1994-2006 registered an upward trend in the case of the regions for which there are data available necessary for comparison. Thus, at the level of 1994 there was an average yield per hectare in the case of rapeseed cultivation of 0.94 tons/ha, while in 2006 the average production per hectare was 68.8% higher than that since 1994, being 1.59 tons/ha (Table 3).

Analyzing the average yields obtained per hectare of rapeseed at the level of development regions, it is noted that, at the level of the 3 development regions for which there are data necessary to make the comparison, there were higher average yields per hectare in 2006 compared to 1994. Thus, the regions with the highest developments in terms of average rapeseed production per hectare obtained in 2006 compared to 1994 are the regions: Bucharest-Ilfov with an average production per hectare higher by 808 tons/ha in 2006 compared to the average production recorded in 1994 (an evolution of 171.2%), the South-West Oltenia region records an evolution of the average yield per hectare of rapeseed by 33.6% higher in 2006, compared 1994 and the western region show an evolution of the average production harvested per hectare of rapeseed, being by 20.9% higher than the average yield rat in 1994 (Table 3).

Table 3. Comparative analysis of average rapeseed production in the periods 1994-2006 and 2007-2019, respectively (tones / ha)

Region	1994	2006	%	2007	2019	%
Total	0.94	1.59	68.80	0.99	2.26	128.50
Northwest	-	1.46	-	1.21	2.34	93.10
Center	-	1.64	-	1.20	2.60	116.50
North East	-	1.37	-	1.13	1.79	58.70
South East	-	1.79	-	1.47	1.98	34.70
South-Muntenia	-	1.53	-	0.61	2.36	287.40
Bucharest - Ilfov	0.47	1.28	171.20	0.73	2.09	187.20
Southwest Oltenia	1.04	1.38	33.60	0.67	2.15	220.90
West	1.22	1.48	20.90	1.42	2.77	95.60

Source: statistical data processing, Accessed on 17.01.2021.

At national level, the average rapeseed production in the period 2007-2019 registered a significant evolution, being influenced by the specific weather conditions in the critical vegetation phases for the rapeseed culture, as well as by the investments made. Thus, at the level of 2007 there was an average yield per hectare in the case of rapeseed cultivation of 0.99 tons/ha, while in 2019 the average production per hectare was about 2 times higher than in 2007 (2.26 tons/ha average production in 2019) (Table 3).

Analysing the average yields per hectare cultivated with rapeseed in the development regions, it is noted that all development regions recorded higher average rapeseed production per hectare in 2019 compared to the productions recorded in 2007. Thus, the regions with the highest Significant developments in terms of average rapeseed production per hectare obtained in 2019 compared to 2007 are the regions: South-West Oltenia with an average production per hectare increasing by 1.48 tons/ha in 2019 compared to average production recorded in 2007 (an evolution of 220.9%), South-Muntenia where the average production harvested per hectare in 2019 was 287.4% higher than the production obtained in 2007 and the Bucharest-Ilfov development region where the average rapeseed production was 2.8 times higher than the average production per hectare recorded in 2007 (Table 3.).

Regarding the analysis of the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019), the conclusions can be drawn studying the results presented in Table 4.

Comparing the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant with the value of 9.1 (probability of 0.001 ***).

Regarding the analysis of the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019) the following conclusion can be drawn (Table 5): regarding the comparison of the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant with a value of 6.6 (probability of 0.001 ***).

Table 4. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the area cultivated with rapeseed

Region	N1	N2	A1	A2	DF	S1^2	S2^2	tcalc
Total	13	13	46.9	405.8	24	1,563.1	18,599.2	9.1
Northwest	11	13	1.1	13.0	22	0.6	102.8	4.2
Center	10	13	0.1	5.9	21	0.0	11.9	6.1
North East	12	13	4.1	33.5	23	13.0	131.3	8.8
South East	12	13	19.1	124.6	23	242.6	2,415.3	7.4
South-Muntenia	12	13	21.1	159.8	23	299.0	2,900.0	8.8
Bucharest - Ilfov	13	13	0.8	6.2	24	0.5	8.4	6.5
Southwest Oltenia	13	13	3.6	36.6	24	7.7	273.0	7.1
West	12	13	0.8	26.3	23	0.7	331.0	5.0
Critical values of the distribution of T	Probab. 0.05		2.1	*	significant			
	Probab. 0.01		2.8	**	distinctly significant			
	Probab. 0.001		3.8	***	very significant			

Source: statistical data processing, Accessed on 17.01.2021.

Table 5. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the total production obtained from rapeseed

Region	N1	N2	A1	A2	DF	S1^2	S2^2	tcalc
Total	13	13	61.1	881.8	24	3,650.4	197,824.5	6.6
Northwest	11	13	1.3	28.6	22	0.9	736.4	3.6
Center	10	13	0.1	14.5	21	0.0	117.2	4.8
North East	11	13	6.8	65.7	22	46.1	763.7	7.4
South East	12	13	25.3	249.7	23	588.9	10,830.5	7.6
South-Muntenia	12	13	27.7	368.0	23	705.8	43,413.4	5.8
Bucharest - Ilfov	12	13	1.1	12.6	23	2.1	72.0	4.8
Southwest Oltenia	12	13	3.8	72.8	23	8.3	2,097.7	5.4
West	12	13	0.7	70.0	23	0.7	3,485.4	4.2
Critical values of the distribution of T	Probab. 0.05		2.1	*	significant			
	Probab. 0.01		2.8	**	distinctly significant			
	Probab. 0.001		3.8	***	very significant			

Source: statistical data processing, Accessed on 17.01.2021.

Regarding the analysis of the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019) the following conclusion can be drawn (Table 6): regarding the comparison of the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant with a value of 4.4 (probability of 0.001 ***).

Table 6. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the average production obtained for rapeseed

Region	N 1	N 2	M 1	M2	G L	S1^ 2	S2^ 2	tcal c
Total	13	13	1.2	2.1	24	0.2	0.3	4.4
Northwest	11	13	1.1	2.0	22	0.4	0.3	3.6
Center	9	13	0.8	2.2	20	0.5	0.4	4.6
North East	11	13	1.4	1.9	22	0.3	0.2	2.9
South East	12	13	1.2	2.0	23	0.3	0.2	3.7
South-Muntenia	12	13	1.3	2.2	23	0.2	0.5	3.7
Bucharest - Ilfov	12	13	1.1	1.9	23	0.3	0.4	3.3
Southwest Oltenia	12	13	1.0	1.9	23	0.1	0.4	4.1
West	12	13	1.0	2.4	23	0.2	0.4	6.4
Critical values of the distribution of T	Probab. 0.05		2.1	*	significant			
	Probab. 0.01		2.8	**	distinctly significant			
	Probab. 0.001		3.8	***	very significant			

Source: statistical data processing, Accessed on 17.01.2021.

Regarding the estimation of the evolution of the area cultivated with rapeseed, it shows a linear trend in the estimated period, when the cultivated area is forecasted to be 352 thousand hectares. The optimistic variant also estimates an area of 1.1 million hectares cultivated with rapeseed (Figure 1).

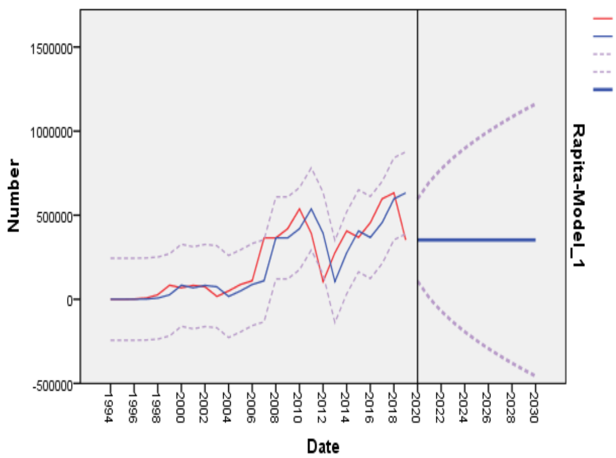

Fig. 1. Estimates of the evolution of the area cultivated with rapeseed by 2030
Source: statistical data processing, Accessed on 17.01.2021.

Regarding the estimation of the evolution of the production obtained from rapeseed, it shows a linear trend in the estimated period, when the production obtained is forecasted to be 798 tons, in a slight increase compared to 2019 (Figure 2).

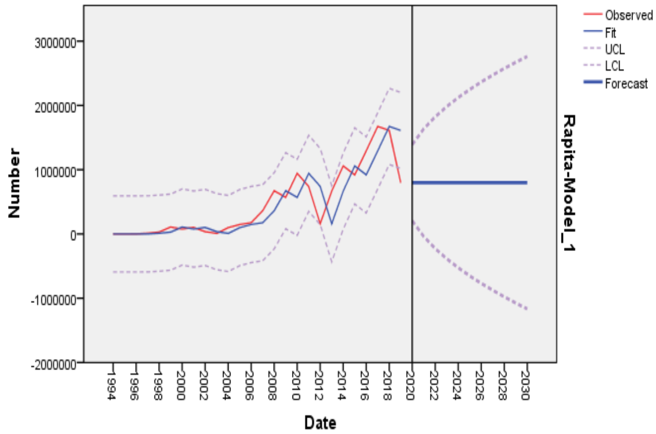

Fig. 2. Estimates on the evolution of rapeseed production by 2030
Source: statistical data processing, Accessed on17.01.2021.

CONCLUSIONS

Rapeseed cultivation has increased significantly in recent years, being cultivated over large areas, as a result of increasing demand for rapeseed oil. A significant increase in the area cultivated with rapeseed was noticed in 1999, when an area over 3 times larger than the previous year was cultivated.

After Romania's accession to the European Union, the area and total production obtained increased significantly, due to the opening of foreign markets in Western European countries and the good price obtained by farmers for this crop, which encouraged the cultivation of rapeseed.

Analyzing the averages of the two periods, in the case of the main technical indicators (area, total production, and average production) it was found from a statistical point of view, that there is a significant link between the averages of the two periods.

Considering the average yields recorded so far by farmers for rapeseed we can estimate that the average production for this crop could reach 3.3 tons/ha by 2030 by adapting cultivation techniques and technologies.

Regarding the area cultivated with rapeseed in the future, the estimates made indicate that the area cultivated with this technical plant remains at the same level from 2019, being 352 thousand hectares. The extension of the areas cultivated with rapeseed in Romania is limited by the favorable areas of cultivation for this crop, as well as by making the crop rotation at farm level.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the sectoral project ADER 23.1.1: “Technical-economic basis of production costs and estimates regarding the prices of capitalization of the main plant and animal products, obtained in conventional system and in organic farming” Subcontract no: 23.1.1./2-03.10.2019 contracted with the Ministry of Agriculture and Rural Development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE CLIMATE VARIABILITY OF THE YEAR 2019 AND THE IMPACT ON THE MAIZE PRODUCTION IN THE SOUTHERN-WESTERN DEVELOPMENT REGION OF OLTENIA, ROMANIA

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Abstract

In the current context of the global warming, knowing the impact on different economic sectors can be achieved by analyzing the climate variability in both short and long term. The agricultural production is closely linked to short-term climate variability at the year level. The main purpose of the study is to analyze the temperature and precipitation regime of the year 2019, for the Southern-Western Development Region of Oltenia, in relation to the bio-climatic requirements of the maize. The year 2019, in Romania, is the warmest year from 1900 to present, according to the National Meteorological Administration (NMA). The analysis of the thermic and precipitation resources will be performed based on the meteorological-climatic data from 15 meteorological stations belonging to the National Meteorological Administration. There will be used statistical methods and GIS techniques, complemented by using the Hellmann classification for establishing the types of the thermic and precipitation weather type of the year 2019. According to this classification, the year 2019 in the study area, was a warm and normally rainy year on average. Based on these variations of the temperature and precipitation regime, at the level of the study area, there was an average production per hectare of grain maize of 5,707 kg/ha, with 1,647 kg/ha less than in 2018, which was considered a record production year from 2000 to 2020.

Key words: *thermic regime, pluviometric regime, climate variability, maize, the Southern-Western Development Region of Oltenia*

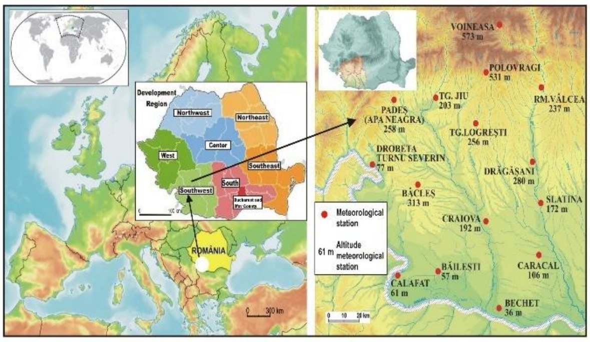
INTRODUCTION

The year 2019 has continued the series of the exceptional warm years, starting with 2015 [8], being the second warmest year after 2016, compared to the average of the pre-industrial period 1850-1900 at global level [12]. In Romania, 2019 ranked first in the top of the warmest years, for the period 1900-2021 [3]. In Oltenia, the recorded annual average temperature recorded was 12.4°C, with a positive deviation of 2.5°C compared to the period 1901-1990, confirming the characteristic of a warm year. All these thermic aspects confirm the continuation of the global warming and the need of sustainable measures for the socio-economic adaptation to the new climate context.

Knowing the impact of the climate variability on the growth, development and formation of the agricultural crops represents a compulsory condition for the implementation of a good agricultural management [7; 10].

The Southern-Western Development Region of Oltenia is characterized by a continental temperate climate, with altitudes between 18

m (at the South) and 2,519 m (at the North) and represents 12% of Romania's surface (Map 1) [5].
The main purpose of this study is to analyze the influence of the air temperature and precipitation variability on vegetation and maize yields in the Southern-Western Development Region of Oltenia, for the year 2019. Maize is one of the important spring crops of Romania, which has different requirements for air temperature and precipitation during the growing season. The maximum requirements for both air temperature and precipitation water consumption are the monthly interval of July-August [10].



Map 1. The location of the study area and of the meteorological stations.
Source: own processing from GIS open sources.

MATERIALS AND METHODS

The analysis of the temperature and precipitation resources will be performed, based on the meteorological-climatic data from 15 meteorological stations (MS), belonging to the National Meteorological Administration (NMA). These meteorological stations are representative for the study area, having altitudes between 36 m and 573 m (Map 1).
The monthly air temperature and precipitation data were compared with the values from 1901-1990 (reference period) in order to identify the thermic and precipitation weather types for the year 2019, according to the Hellmann criterion [6]. The analysis of the thermic resources is completed by the analysis of the maximum and minimum air temperature for each month. The characteristics of the thermic and precipitation regime of a year are reflected in the state of vegetation and in the yields of the crops [9]. In order to capture this aspect, the yields data and the cultivated areas with maize from the National Institute of Statistics (NIS) will be analyzed. These data are analyzed using statistical methods and GIS techniques.

RESULTS AND DISCUSSIONS

The analysis of the temperature regime

January has the lowest average temperature in the year, with values between -2.9°C at Voineasa and 0.9°C at Calafat, being a slightly warm month, according to the Hellmann criterion, in most part of the study area (Table 1).

Table 1. The matrix of the thermic time types recorded in the Southern-Western Development Region of Oltenia, in 2019, after Hellmann Criterion

MS	Months					
	I	II	III	IV	V	VI
Dr. Tr. Severin	W	W	W	SW	N	W
Calafat	W	W	W	N	N	W
Bechet	SW	W	W	N	N	SW
Băilești	SW	W	W	N	CO	SW
Caracal	W	W	W	N	N	W
Craiova	SW	W	W	N	N	SW
Slatina	SW	W	W	N	N	SW
Bâcleș	SW	W	W	N	N	W
Tg. Logrești	N	W	W	N	N	W
Drăgășani	SW	W	VW	N	N	W
Padeș (Apa Neagră)	N	SW	W	N	N	W
Tg. Jiu	SW	W	W	SW	N	W
Polovragi	SW	W	W	N	N	W
Rm. Vâlcea	SW	W	W	SW	N	W
Voineasa	SW	W	W	SW	N	W
Oltenia average	**SW**	**W**	**W**	**N**	**N**	**W**
MS	**Months**					
	VII	**VIII**	**IX**	**X**	**XI**	**XII**
Dr. Tr. Severin	SW	W	W	W	W	W
Calafat	SW	W	W	SW	W	W
Bechet	N	SW	SW	N	W	W
Băilești	N	W	W	W	W	W
Caracal	N	W	W	W	W	W
Craiova	N	W	W	W	W	W
Slatina	N	W	SW	W	W	W
Bâcleș	N	W	W	W	W	W
Tg. Logrești	N	SW	SW	N	W	W
Drăgășani	N	W	W	W	W	W
Padeș (Apa Neagră)	N	W	SW	N	W	W
Tg. Jiu	N	W	SW	SW	W	W
Polovragi	N	W	SW	W	W	W
Rm. Vâlcea	N	W	W	W	W	W
Voineasa	N	W	SW	SW	VW	W
Oltenia average	**N**	**W**	**SW**	**SW**	**W**	**W**

EC – excessively cold; VC – very cold; CL – cold; CO – cool; N – normal; SW – slightly warm; W – warm; VW – very warm; EW – excessively warm.

Source: NMA archive for temperature and precipitation values.

The average temperature in January, for the entire study area, was -1.0°C. Its thermic deviation from the reference period was 1.6°C, being a slightly warmer (SW) month, in average, according to the Hellmann criterion (Table 1). The monthly maximum air temperatures were registered between January 16th and January 18th and they were between 8.2°C at Padeș and 14.3°C at Calafat. The monthly minimum air temperature was recorded between January 5th and January 14th, being between -17.3°C at Padeș and -9.3°C at Dr. Tr. Severin.

February was characterized by a monthly average temperature between 0.1°C at Voineasa and 4.1°C at Drăgășani, being, according to Hellmann criterion, a warm month in the whole study area, except the Padeș MS area, where there was a slightly warm month (Table 1). The maximum values of the air temperature varied between 14.8°C at Voineasa and 18.5°C at Calafat and Drăgășani, in the interval between February 18th and February 20th. The monthly minimum temperatures were between -17.2°C at Padeș and -7.6°C at Caracal.

The spring months of 2019 were characterized by an alternation of normal days, in terms of temperature, with intervals in which the weather was warmer than usual [1]. The monthly average air temperature of March recorded values between 5.1°C at Voineasa and 10.4°C at Calafat, being a warm (W) month in most of the study area, except for Drăgășani MS where there was a very warm (VW) moth, according to Hellmann criterion (Table 1). April was characterized by a monthly average temperature ranging between 8.7°C at Voineasa and 13.1°C at Dr. Tr. Severin, and the average for the entire study area was 11.9°C, being a normal (N) thermic month, according to Hellmann criterion (Table 1). The highest values of the air temperature were recorded in the last five days of the month, being between 23.8°C at Polovragi and 27.7°C at Bechet. The lowest air temperature values were between -2.0°C at Voineasa and 3.0°C at Dr. Tr. Severin. May was a normal thermic month (Table 1) in most parts of the study area, with monthly averages of the air temperature between 12.6°C at Voineasa and 17.1°C at Bechet. The monthly average air temperature calculated for the entire study area was 15.8°C and its deviation from the reference period was -0.2°C, which confirms a normal thermic time, according to the Hellmann criterion (Table 1). The highest temperatures in May varied between 24.6°C at Polovragi and 31.0°C at Bechet and the minimum temperatures ranged between -0.4°C at Voineasa and 3.0°C at Dr. Tr. Severin.

The summer months of 2019 were characterized by warmer weather than usual [1]. June was characterized by average temperatures between 17.6°C at Voineasa and 23.5°C at Bechet, being a warm (W) month in most of Oltenia (Table 1). The maximum temperatures exceeded 30.0°C at Bâcleș meteorological stations (31.1°C) and Calafat (34.7°C), and the minimum temperatures recorded values between 8.0°C at Voineasa and 13.8°C at Calafat. July 2019 was a normal thermic month in most parts of the study area (Table 1). The monthly average temperatures varied between 17.2°C at Voineasa and 24.5°C at Calafat and the monthly average value for the entire study area was 22.1°C. The highest air temperature values were recorded at Polovragi (31.7°C) and Bechet (38.1°C). The minimum temperatures ranged between 5.5°C at Voineasa and 13.2°C at Calafat.

August 2019 was characterized by monthly average values between 18.5°C at Voineasa and 25.9°C at Dr. Tr. Severin, being a warm month for most parts of the study area (Table 1). The maximum temperatures ranged between 32.5°C at Polovragi and 38.2°C at Bechet and the minimum temperatures were between 6.9°C at Padeș and 14.2°C at Calafat.

In the autumn months, a higher than usual air temperature prevailed in most parts of the country [2]. As a result, in most of the study area, the fall of 2019 was slightly warm (Table 1). September was slightly warmer (SW) than most of the area, as evidenced by the values of the average air temperature that ranged between 13.9°C at Voineasa and 20.7°C at Dr. Tr. Severin. In the first days of the month, the maximum monthly values were recorded, which varied between 29.1°C at Voineasa and 34.6°C at Bechet. The minimum monthly air temperature was between -1.5°C at Padeș and 5.8°C at Dr. Tr. Severin. According to the Hellmann criterion, October was normal thermic on restricted areas at Padeș, Tg. Logrești and Bechet meteorological stations, slightly warm (SW) at Voineasa, Tg. Jiu and Calafat and warm (W) in the rest parts of the study area. The monthly average air temperature for the whole Oltenia region was 12.7°C, with a deviation from the reference period (1901-1990) of 1.9°C, which indicates a slightly warm (SW) month for the study area (Table 1). In terms of the maximum monthly air temperature values, there were recorded values between 25.1°C at Voineasa and 32.0°C at Bechet. The monthly minimum air temperature was between -2.7°C at Voineasa and 4.7°C at Dr. Tr. Severin.

November, according to Hellmann criterion, was a warm (W) month in most parts of the Oltenia region (Table 1). The monthly average air temperature values ranged between 7.3°C at Voineasa and 10.5°C at Dr. Tr. Severin. The maximum monthly values were between 18.0°C at Padeș and 25.5°C at Polovragi, and the minimum ones varied between -2.7°C at Padeș and 4.7°C at Dr. Tr. Severin.

The last month of the year was characterized by a warm (W) time for the whole study area, according to the Hellmann criterion (Table 1). The average air temperature for the entire Oltenia region was 3.1°C and its deviation from the reference period was 2.9°C, being the fourth largest deviation, since 2019, after November (4.1°C), March (4.0°C) and February (3.2°C). The maximum and minimum values of the air temperature recorded values between 9.8°C at Voineasa, 17.0°C at Polovragi, -10.4°C at Tg. Logrești and -3.4°C at Calafat.

The analysis of the precipitation regime

January 2019 was a very rainy (VR) and excessively rainy (ER) month in most of the study area. The monthly average precipitation in the entire study area was 83.1 mm. In January, the percentage deviation from the precipitation amount for the reference period 1901-1990 was 91.1%, which confirms that, on average, according to the Hellmann criterion, the month was excessively rainy (ER) for the entire study area (Table 2).

Table 2. The matrix of the pluviometric time types recorded in the Southern-Western Development Region of Oltenia, in 2019, after Hellmann Criterion

MS	Months					
	I	II	III	IV	V	VI
Dr. Tr. Severin	ER	VD	ED	ER	N	SR
Calafat	ER	ED	ED	N	ER	VR
Bechet	VD	ED	VD	N	VD	ER
Băilești	VR	ED	ED	N	VD	ER
Caracal	VR	ED	VD	SD	R	ER
Craiova	ER	VD	D	N	D	ER
Slatina	ER	ED	VD	VD	SD	ER
Bâcleș	-	ED	ED	VR	VD	ER
Tg. Logrești	ER	VD	ED	VR	N	ER
Drăgășani	ER	ED	VD	SR	D	ER
Padeș (Apa Neagră)	ER	ED	ED	VR	SD	ER
Tg. Jiu	ER	VD	ED	N	ER	ER
Polovragi	ER	ED	ED	N	R	SR
Rm. Vâlcea	ER	ED	ED	VD	N	ER
Voineasa	-	ED	ED	N	N	ER
Oltenia average	**ER**	**ED**	**ED**	**N**	**N**	**ER**

MS	Months					
	VII	VIII	IX	X	XI	XII
Dr. Tr. Severin	SD	ED	ED	ED	ER	ED
Calafat	VR	ED	ED	ED	ER	ED
Bechet	D	ED	ED	ED	ER	ED
Băilești	VR	ED	ED	ED	R	ED
Caracal	SD	ED	ED	ED	ER	ED
Craiova	R	ED	ED	D	ER	ED
Slatina	N	ED	ED	VD	VR	VD
Bâcleș	ER	ED	ED	ED	VR	ED
Tg. Logrești	D	ED	ED	VD	ER	D
Drăgășani	N	ED	ED	VD	ER	N
Padeș (Apa Neagră)	VD	ED	ED	ED	ER	D
Tg. Jiu	VD	N	ED	ED	ER	VD
Polovragi	ED	VD	ED	D	R	VD
Rm. Vâlcea	VD	VD	VD	SD	VR	VD
Voineasa	VD	R	ED	ED	N	ED
Oltenia average	**D**	**VD**	**ED**	**ED**	**ER**	**VD**

ED – excessively droughty; VD – very droughty; D – droughty; SD – slightly dry; N – normal; SR – slightly rainy; R – rainy; VR – very rainy; ER – excessively rainy.

Source: NMA archive for temperature and precipitation values.

February was an excessively (ED) droughty month in most of the study area (Table 2). The monthly average precipitation for the entire region was 16.9 mm, and according to Hellmann criterion, it was an excessively droughty month (Table 2).

The excessively droughty (ED) weather continued through March, with a monthly average precipitation of 15.1 mm for Oltenia. (Table 2).

The monthly interval February – March is part of the period of formation of water reserves in the soil for the field crops [2]. This interval for the year 2019, at the level of the Oltenia region is characterized by a deficient precipitation regime.

April has a monthly average precipitation of 62.6 mm for the whole area, being, according to the Hellmann criterion, a normal pluviometric month. In the spatial distribution of the precipitation amounts, it was found that at Dr. Tr. Severin MS, the month was excessively rainy (ER), very rainy (VR) at Bâcleș, Tg. Logrești and Padeș meteorological stations, slightly dry (SD) at Caracal, very droughty (VD) at Slatina and Rm. Vâlcea and at the rest of the meteorological stations, the month was normal pluviometric (Table 2).

May continued to be normal pluviometric throughout the study area, with a monthly average precipitation of 80.6 mm. In the spatial distribution of the precipitation amounts, there were identified areas from excessively rainy (Calafat and Tg. Jiu) to very droughty areas (Bechet, Băileşti and Bâcleș) (Table 2). On the general background, of normal thermic and rainy weather, according to the Hellmann criterion, Oltenia region is characterized by a uniformity and good and medium vigor of maize plants [1].

June was the rainiest month of the year 2019, with monthly precipitation averaging from 80.4 mm at Dr. Tr. Severin (slightly rainy) to 240.6 mm at Caracal (excessively rainy). In the Oltenia region, the monthly average precipitation was 156.1 mm, with a deviation from the reference period (1901-1990) of 85.4%, thus, being an excessively rainy month, according to Hellmann criterion (Table 2).

July is characterized by the predominance of a deficient precipitation weather (SD, D, VD, ED) at most of the analyzed meteorological stations. The study area is characterized by a monthly average amount of 50.3 mm, thus, being a droughty (D) month, according to Hellmann criterion (Table 2). As a result, drought begins in the second half of summer and the first part of autumn 2019. August was a very droughty (VD) month for the entire study area, with a monthly average precipitation of 28.3 mm. (Table 2).

July and August are considered to be the critical period for maize, both for temperature and precipitation regimes [10]. They were characterized by a normal thermic weather, warm and precipitation deficit at the level of Oltenia region.

In September, the precipitation deficit continues, so that the month was, on average, excessively droughty (ED) for the whole of Oltenia, the amount of precipitation recorded being 11.8 mm. Excessively droughty (ED) weather also characterizes October. The monthly average precipitation is 28.9 mm, for the study area (Table 2).

November is an excessively rainy (ER) month for most meteorological stations, so in Oltenia region there is an excess of precipitation (Table 2). In December 2019, the precipitation deficit is reinstated, the monthly average amount recorded for the entire study area being 26.8 mm. According to Hellmann criterion, December is a very droughty month (Table 2).

The yields of the maize crop are ensured by the distribution of the monthly amounts of precipitation during the vegetation period of the plants and not by the annual amount of precipitation [4].

Taking into account these variations in temperature and precipitation, from one month to another, in which the air temperatures were higher than usual and associated with water deficit from precipitation, especially in the critical period July-August, the vegetation rhythms for the maize crop were forced. As a result, the vegetation has deteriorated due to the drying of the leaves and the undersizing of the fruit elements. These aspects are reflected in the data of the cultivated areas, yields and the average yields per hectare (ha) obtained in the Southern-Western Development Region of Oltenia, in 2019 and shown in Table 3 [11].

Table 3. The cultivated area and the agricultural production of maize in the Southern-Western Development Region of Oltenia (2018-2020)

Culture	Year	Surface (ha)	Production (tone)	Average of production (kg/ha)
maize	2018	321,221	2,362,330	7,354
	2019	337,175	1,924,121	**5,707**
	2020	342,139	1,572,481	4,596

Source: processed data from NIS, 2022.

On a larger cultivated area in 2019, compared to 2018, the average production per hectare was lower by 1,647 kg / ha, due to the influence of the characteristics of the temperature and precipitation conditions of the analyzed year (Table 3).
The average production per hectare of 2018 is considered a record for the maize production for the period 2000-2020 [11].

CONCLUSIONS

The climatic variability, from the point of view of the air temperature and precipitation regime, in the Southern-Wester Development Region of Oltenia was high. The year 2019, at the level of the entire region, was a warm year as a whole. From temperature point of view, the main climatic alternation was between warm and normal thermic weather. In terms of precipitation, the year 2019, at regional level was, on average, normal pluviometric. But, there were large variations in the monthly precipitation, with precipitation deficit, prevailing over long periods of time. The main alternation of the types of precipitation time was between the deficit precipitation time and the excess time.
Depending on the variation of the thermic and precipitation resources and the non-fulfillment of the optimal requirements of the air temperature and precipitation amounts in the critical period July-August, the maize yields of the year 2019 decreased, compared to those recorded in the year 2018.

Author contributions: All authors have equal contribution to the preparation of this scientific paper.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIAN-MOLDAVIAN TOURISM ANALYSIS AND RECOMMENDATIONS

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Abstract

Romania and Moldova are committed to encouraging the mutual exchange of data and information in the field of tourism, as well as the exchange of experience in organizing and developing touristic activities. Specialized articles, open access from Clarivate Analytics and Research Gate were used for documentation. The data necessary for the research were collected from the information of the National Institute of Statistics of Romania, respectively of the National Bureau of Statistics of the Republic of Moldova. The research results showed that Romania is the third country as a tourist destination in the preferences of Moldovan tourists, while Romanian tourists are the main category of visitors to the neighboring country. Wine tourism and tourist attractions in the Lower Prut Meadow are the main attractions for Romanian visitors, while Moldovan tourists are attracted by the ski resorts and the Black Sea beach of Romania. The results of the study may be useful for tour operators, officials with responsibilities in this economic sector and for the development of more in-depth research in doctoral studies.

Key words: *tourism, Romania, Moldova, evolution, trends*

INTRODUCTION

Tourism was the most dynamic branch of world economy till the pandemic of Covid-19 which started in the year 2020. All the countries have been affected, including Romania and Republic of Moldova [10]. Tourism destinations can be enhanced by a combination of the factors of competitiveness and attractiveness. While competitiveness is given by the supply structure and service quality, the attractiveness derives from the demand side of tourism [13].

Romania is well known for its high attraction regarding the sea-shore and mountain resorts, and the historical and cultural heritage in Maramures, Bucovina, Transilvania and, of course, Bucharest, the capital [11, 12].

Republic of Moldova, despite that is a smaller country, has many interesting tourist attractions, some of them describing the common history between Moldova and Romania, which are "two sisters" countries.

such as: numerous natural reservations where biodiversity in terms of flora and fauna are amazing, the wines full of flavour which conquered the hearts of many Europeans and won golden medals at international fairs, especially by Cricova Vinery; Taul Park and Prommer Inn, Capriana Monastery situated at 40 km from Chisinau, Saharna Monastery well known as a site for pilgrimage, Soroca Fortress, Old Orhei, a locality full of history, Curchi Monastery, "Padurea Domneasca" Natural Rezervation [5, 15].

Chisinau, the capital, is a friendly and safe city, full of green spaces, and important buildings which tell us about its history and cultural heritage. The Cathedral of the Jesus, Birth, the Arch of Triumph, Puskin Park, with the Statue of the Steven the Great, National Museum of History, National Museum of Fine Arts, the Botanical Garden, the National Theater etc [5, 15].

Therefore, Republic of Moldova has a great tourism potential which deserves to be discovered, including a large variety of attractions: naturals areas, forests, hills, vineyards, orchards, natural reservations, medieval sites, fortresses, spa resorts, fests, being a well known country for ecotourism, spa tourism, historical and cultural tourism and health and recreation tourism [18].

Since 2014, the Moldovan Government has established the Strategy for Tourism Development till 2020 destined to valorise the tourism potential of the country [3].

Between Romania and Moldova are close economic, social and cultural relationship, and tourism is a part of these good relationships of collaboration for years. That is why the flow of tourists from the both sides has increased year by year.

In this context, the purpose of the paper was to analyze the dynamics of tourist arrivals, the most visited places preferred by tourists, the purposes of visits, in order that the results to enhance the activity of tourism agencies and tour operators in the both countries.

MATERIALS AND METHODS

To set up this paper there were used various information sources such as: published articles in well known international journals, press releases, articles published on internet etc.

Also, the data were collected for the period 2008-2020 from National Institute of Statistics of Romania [9] and National Bureau of Statistics of Republic of Moldova [8].

The studied aspects and indicators have been: tourim attractions, Romanian tourist arrivals in Republic of Moldova, Modovan tourist arrivals in Romania, inbound and out bound tourism in Republic of Moldova.

The research methods were represented by a deep documentation based on information sources, data structuralisation and representation in graphics, a corresponding interpretation of the evolution of the studied indicators.

RESULTS AND DISCUSSIONS

Romania - one of the favourite destination for the citizens of the Republic of Moldova

Romania is an important tourist attraction for the Moldavian visitors, but it is ranked the 3rd after Turkey and Bulgaria.

According to the statistical data, the number of Moldavian tourists who visited Romania in the interval 2000 - 2020 varied from the minimum of 857,000 in the year 2002 and the maximum of 2,330,000 in the year 2018.

In 2020, the year when the pandemic of Covid-19 started, Romania was visited by only 870,000 Moldavian citizens (Fig. 1).

In the period January-June 2008, Romania's touristic offer attracted more than 14,000 tourists from the Republic of Moldova, which represents an increase of 6.6% compared to the same time last year [7].

Through travel agencies and tour operators in January-June 2019, 121.2 thousand tourists and hikers went abroad from the Republic of Moldova,11.3% more than the same period last year.

Citizens of the Republic of Moldova preferred to travel mainly to Turkey (30.2% of the abroad travels), Bulgaria (22.2%) and Romania (17.1%). Most Moldovans visited other countries for recreation and leisure purposes [2].

In January-June 2019, travel agencies and tour operators provided tourist services to 151.6 thousand tourists and hikers, 12.2% more than in the corresponding period of 2018 [8].

The Federation of Romanian Tourism Employers [14] created in 2014 an online booking system where one can find 20% cheaper price offers for the Romanian sea coast.

"About 40 hotels, members of the Federation, have made special offers, so far for the year 2014, addressing the market in the Republic of Moldova.

Unfortunately, Republic of Moldova lost this market for the current Seaside season, due to the expiration of the visa liberalization period. In fact, the Federation has personalized offers for different markets, such as those for Israel or Germany" as mentioned The Federation of Romanian Tourism Employers [14].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

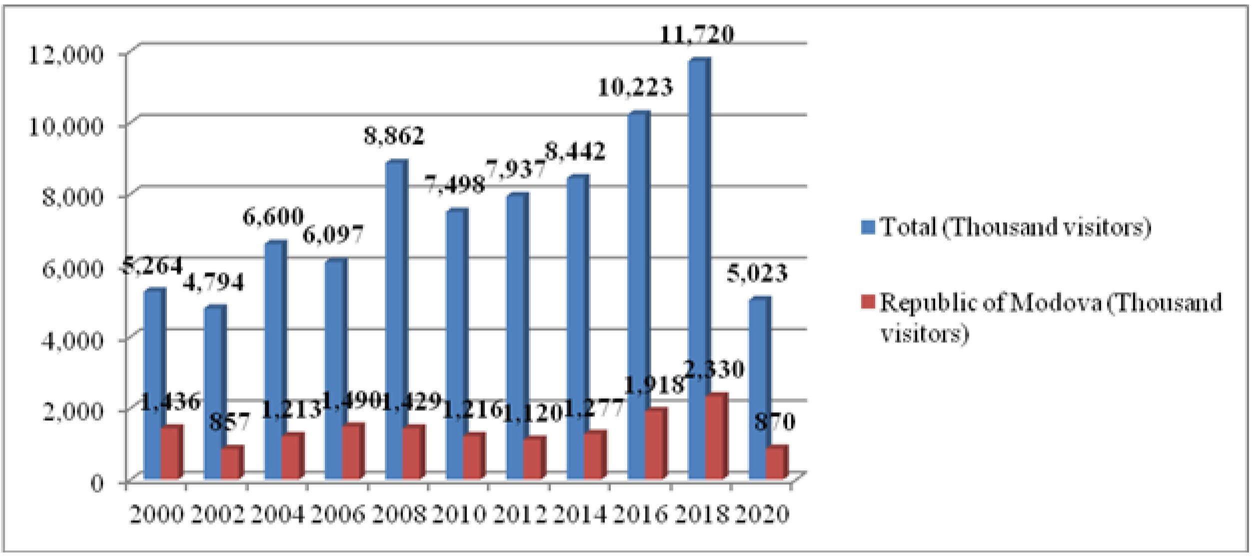

Fig. 1. Foreign visitors' arrivals in Romania by continent and country of origin, pointing out the arrivals of Moldavian tourists
Source: [8, 9].

Most tourists visiting the Republic of Moldova are from Romania

Most of the tourists who visited the Republic of Moldova during the analyzed period were from Romania. More precisely, 17.2% of the total people monitored were Romanian. Other significant shares in the total number of tourists arriving in the Republic of Moldova went to the citizens of Austria (13.8%), Germany and Ukraine (8.6% each) and the Russian Federation (6.4%), according to InfoPrut.

România, cooperation treaty with the Replublic of Moldova, in the field of tourism

The development of the relations between Romania and the Republic of Moldova, by encouraging the collaboration between the profile industries from the two states, is a priority for the Ministry of Tourism. Thus, the new agreement seeks to intensify the cooperation in key areas for the sustainable development of tourism in the two states [6].

"At the moment, the cooperation between the two governments is more intense than ever. The touristic potential of Moldova and Romania cannot be disputed by anyone. We share the same history and the same values. Therefore, this collaboration agreement was born from a belief that we can have a common future. Romania is willing to make every effort to support the Republic of Moldova in maintaining its European route, and tourism is an area that can accelerate the journey of this road with beneficial consequences on both sides of the Prut" [7].

Romania and Moldova are committed to encouraging the mutual exchange of data and information on tourism legislation and regulations, statistical data, as well as the exchange of experience in the field of tourism, organization and development of tourism activities.

At the same time, the Agreement provides for enhanced cooperation on investment projects of common interest in the field of tourism, through the development of projects eligible for financial support from the European Union, and through a sustained exchange of information on investments and facilities in the field.

In terms of promotion, the two countries agreed on the development of tourism promotion and information materials, the organization of documentary visits for journalists and experts in the field, as well as the participation in tourism events and fairs. In this sense, Romania has already developed a common cultural route with the Republic of Moldova, "Route of Voievod Stefan cel Mare". In Romania, the route includes the citadel of Suceava, Putna, the Palace of Culture in Iasi, the Neamt Fortress, the founders of the fortress of Vaslui and other places loaded with the history of Stefan.

The "Wine Road" is also a joint project aimed at developing tourism in the two countries. The new route includes several wineries in Romania and the Republic of Moldova and aims to promote the two countries through a unitary tourist product that will attract foreigners, especially from the Asian market [4].

The number of Romanian tourists participating in foreign tourist actions organized by travel agencies, by destination countries emphasizing the ones visiting the Republic of Moldova

The number of Romanian tourist who travelled abroad by means of the tourism agencies specialized in organization activities registered a high variation from a year to another in the period 2008-2020.

The lowest number of 257,235 recorded in the year 2010, and the peak was achieved in the year 2012 and accounted for 902,783. Then, the number of this type of agencies decreased to 355, 853 in the year 2014, but after that it was noticed a recover to 646,663 in the year 2018.

In 2020, due to the pandemic of Covid-19, the restrictions imposed by authorities affected very much tourism sector, and an important number of tourism agencies were closed. Therefore, in 2020, only 256,756 Romanian tourists used the services of the tourism agencies which remained open.

The number of Romanian tourists who prefer the services offered by the tourism agencies with an intermediary activity is much lower, representing about 16% of the total number of tourists who apply to tourism agencies. Its evolution was in general similar with the number of tourists who used the services of the agencies with organization activities in tourism in the period 2008-2020.

In the Republic of Moldova, the number of Romanian tourists who travelled to the Republic of Moldova using the services of the tourist agencies was very small and varied between 20 in 2009, the smallest number and 651 in the year 2010, the highest level. In 2020, only 127 tourists made use of the services of the agencies (Fig. 2).

Tourist activity of travel agencies and tour operators in the Republic of Moldova

The National Bureau of Statistics informs that, in January-June 2019, travel agencies and tour operators provided tourist services to 151.6 thousand tourists and hikers, 12.2% more than in the corresponding period of 2018.

Increasing the number of tourists and hikers was conditioned by the increase in the number of participants in domestic tourism (+ 23.0%), in sender tourism (+ 11.3%) and inbound tourism (+ 1.1%).

Number of tourists and hikers, participants in tourism organized by travel agencies and tour operators, by purpose of visits in the Republic of Moldova

Inbound tourism

Out of the 8.4 thousand foreign tourists and hikers who visited the Republic of Moldova in January-June 2019 and benefited from the services of travel agencies and tour operators, 83.1% arrived for recreation and leisure purposes, 14.2% - business and professional, and 2.7% for various treatments.

More significant shares in the total number of foreign tourists and hikers arriving in the Republic of Moldova belonged to the citizens of Romania (17.2%), Austria (13.8%), Germany and Ukraine (8.6% each), Russian Federation (6.4%), United Kingdom of Great Britain and Northern Ireland (5.4%), Poland (4.6%), China (3.9%), Italy (3.3%), States United States and France (2.0% each), Czech Republic (1.9%), Japan (1.8%), Bulgaria (1.7%), Turkey (1.6%), Israel (1%) 4%), Switzerland (1.2%), Lithuania (1.0%), Armenia and Sweden (0.9% each), Norway (0.8%).

Outbound tourism

The tourist who went abroad for various purposes, especially for relaxation leisure and entertainment are presented in Fig. 3.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

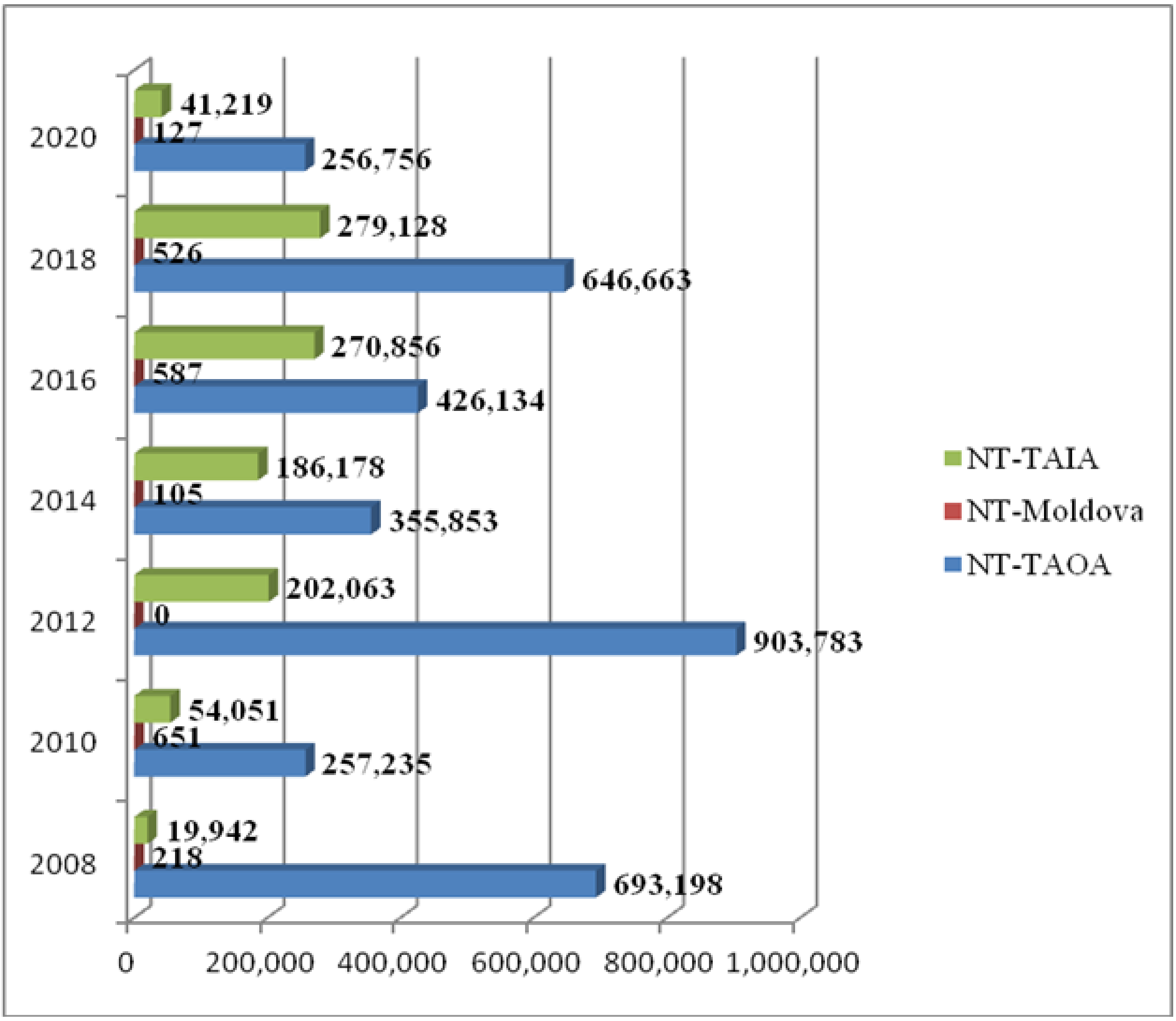

Fig. 2. The number of Romanian tourists participating in foreign tourist actions organized by travel agencies, by destination countries
Legend: NT-TAOA- No of tourists-Tourism Agencies with Organization Activity
NT- TAIA- No. of tourists- Tourism Agencies with Intermediary Activity
NT- Republic of Moldova- Total No. of Tourists -Tourism Agencies
Source: National Institute of Statistics, NIS, 2022 [9].

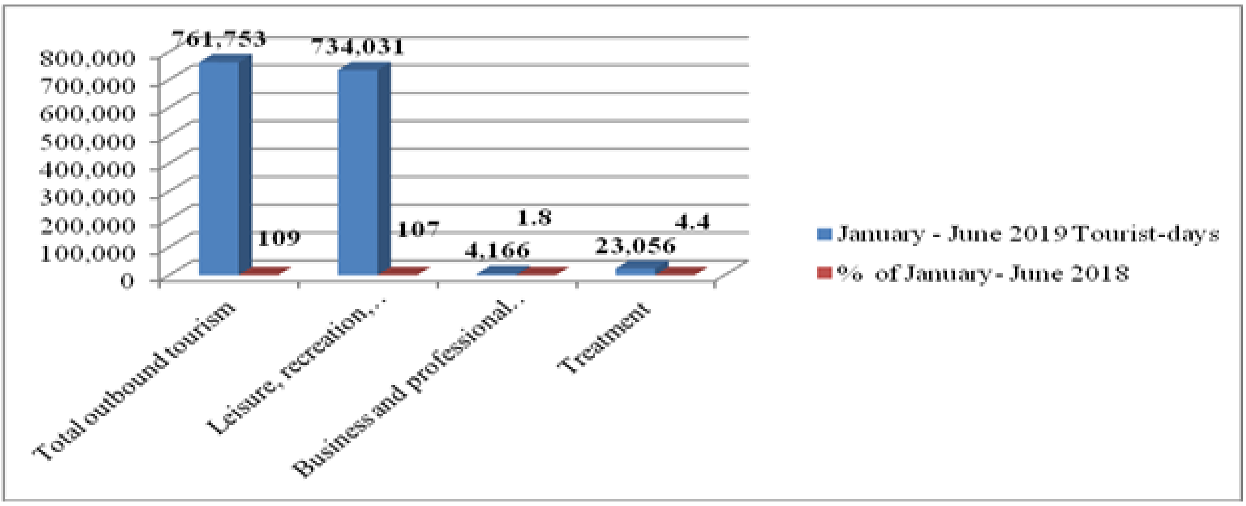

Fig. 3. Outbound tourism - Tourist -days, by purpose of the travel
Source: [8].

Tourist areas in the Republic of Moldova with hunting potential

The Lower Prut Scientific Reserve (Rezervatia stiintifica Lunca Prutului de Jos) is a protected area located in the lower reaches of the Prut River, including Lake Beleu and its surroundings, in the South- West of the Republic of Moldova. Between the villages of Văleni and Slobozia Mare in the Cahul district, Lake Beleu is the ideal place for nature lovers.

Photo 1. Lake Beleu.
Source: [16].

The lake is home to herds of Pelicans heading for the Danube, White Egrets, Gray Herons and other birds.

In May-July, white and yellow water lilies bloom on Lake Beleu. Due to the impressive diversity of habitats and life forms that it hosts in a relatively small space, "Prutul de Jos" is a true museum of biodiversity.

"Codrii" Natural Rezervation (Rezervația Naturală "Codrii") Within this reservation there is a rich "Museum of Nature", located in the hilly center of the Republic of Moldova, on the Plateau of Central Moldova (Straseni district), occupying approx. 40% of the surface of this high plateau.

Photo 2. "Codrii" Natural Rezervation
Source: [1].

The reserve is protected by about 1,000 species of plants, 43 species of mammals, 145 species of birds, 7 species of reptiles, 10 species of amphibians and more than 10,000 species of insects.

"Vadul lui Vodă" The picturesque valley of the Dniester River, the forest-park and the beaches on the bank of the Dniester contributed to the transformation of the area adjacent to Vadul lui Voda, located 23 km East from Chisinau.

Photo 3. "Vadul lui Voda"
Source: [17].

"Vadul lui Vodă" has become a beloved place of relaxation, not only for the inhabitants of the city but also for many guests who come from the Republic of Moldova and also from abroad.

Tourists are attracted by the spa-treatment and recreational objectives of this area.

Moldovan Wines- an important attraction for tourists

Republic of Moldova has a good wine production which is a testimony for its history, culture and agricultural performance.

Various winemaking vineries such as: Cricova, Milestii Mici, Branesti Cellars, Lion Gri are well known tourist destinations [4].

CONCLUSIONS

In conclusion, the research results showed that Romania is the third country as a tourist destination in the preferences of Moldovan tourists who are interested to spend their vacations in the Black Sea resorts and also in the ski resorts.

The Romanian people are attracted by the beauty of the landscapes, the capital Chisinau, Moldovan wines and gastronomy, cultural and historical places.

As a recommendation, in the recent years, the Republic of Moldova has become a famous destination due to cultural events and festivals and tourists could benefit of great fun during their vacations especially when the big festivals are organized, because there we'll find a lot of good cheer, beautiful people, tasty food and aromatic wines.

The "two sisters" countries have to intensify the promotion of their tourist destinations in order to increase the number of arrivals and overnight stays.

Special packages could be offered to tourist at a discounted price in extra season.

The development of common cultural and historical events could be another opportunity to strengthen the friendship and solidarity between the people and contribute to the development of tourism in the both countries.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

INCENTIVES FOR AGRICULTURAL HOLDINGS IN ACCESSING INVESTMENT FUNDS FOR THEIR MODERNISATION THROUGH CAP MEASURES

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Abstract

The investment support for the modernisation of agricultural holdings is an essential type of agricultural support in rural communities. This support could be accessed depending on many agronomic and socio-economic criteria. This article aims to observe whether the attractiveness in accessing the projects can be influenced by the size of the agricultural holdings and the level of direct payments received by development regions. It is also desired to see if access to these projects is sustained by the presence of agricultural income needs in the respective regions. By evaluating the data available on the Eurostat platform, we have assessed the number and average size of agricultural holdings in Romania at the level of NUTS 2 regions. In addition, with the help of the Farm Accountancy Data Network database, we have analysed the level of direct payment subsidies per farm. The results of this paper can provide relevant information on the current income needs of the analysed region. This can help us determine if, together with the number and size of the farms, it can influence the access to investment support projects through rural development measures.

Key words: *investment support, direct payments, Common Agricultural Policy, support measures*

INTRODUCTION

The potential of the development and modernisation of the agricultural holdings can be reflected by the income of those respective farms, the level of the income being among the most important economic categories in agriculture [1].

In European Union (EU) Member States (MS), the agricultural holdings, consequently their income, are supported by a wide range of agricultural interventions in order to ensure their sustainability, efficiency and development, as a condition for maintaining a competitive edge in the market [7]. And this is compulsory as EU agriculture is dominated by small farms which have an important economic role [11]. In the new programming period 2021-2027, according to the European Green Deal and Farm to Fork strategies, new objectives are added for the farms investments: ensuring food security and high-quality food, simultaneously with a significant reduction in inputs.

The investment support for the modernisation of agricultural holdings is one of those interventions mentioned above. This is an aid that could be accessed by the agricultural holdings voluntarily, being an essential type of agricultural support intervention, especially in countries where farms are affected by structural problems. [3] have clearly shown that high-performance agriculture can only be realised within modern agricultural holdings, endowed with modern and efficient equipment.

Due to its accession to the EU in 2007, Romania has experienced great opportunities to modernise its agriculture and agricultural holdings, as it has gained access to the vast range of instruments under the Common Agricultural Policy (CAP).

From data provided by the National Agency for Financing Rural Investments (AFIR), in the last two multiannual financial frameworks, Romania attracted EUR 745 million in 2007-2013, respectively EUR 967 million in 2014-2020 (data available only up to 2018) for the modernisation of its farms [9].

The region that accessed the largest volume of funding in both periods is the South-East Region [1]. The amounts attracted by this development region are the largest also in terms of the amount per hectare, being approximately EUR 80 in 2007-2013 and EUR 105 in 2014-2020. Those kinds of interventions could be accessed based on different agronomic and socio-economic criteria, and it could be influenced by the structure of a farm, its size and the level of aid received by Pillar I interventions, given that an increase in the volume of financial resources held by a farmer can improve his access to credits, and thus contributing to technological modernisation [6].

The investments made through rural development programs offered by the measure 121 Modernisation of agricultural holdings, was also analysed taking into account the type of investment and the structure of supported farms [10]. The author concluded that the support received could also be divided depending on the size of the farm in order to balance its distribution between farm groups.

This paper aims to observe whether the attractiveness of accessing the projects can be influenced by the size of the agricultural holdings, the level of direct payments received, as well as other indicators at the level of NUTS 2 regions of Romania.

MATERIALS AND METHODS

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

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This paper aims to observe whether the attractiveness of accessing the projects can be influenced by the size of the agricultural holdings, the level of direct payments received, as well as other indicators at the level of NUTS 2 regions of Romania.

RESULTS AND DISCUSSIONS

At the EU level, the number of agricultural holdings has decreased in recent years.
Thus, in the period 2005-2016, the number of farms in the EU was reduced by about 28%, whereas in Romania.
The country owns about 29% of the number of EU farms, the reduction is made at a slower pace, 19%, during the analysed period as shown in Fig.1.

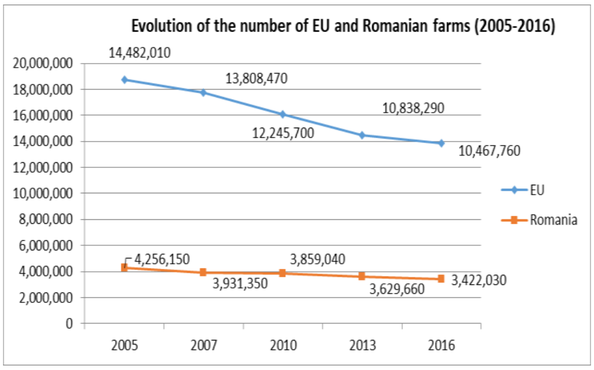

Fig.1. Number of farms in EU 2005-2016
Source: Eurostat [5].

There are large decreases in the number of agricultural holdings in MS such as Bulgaria, Slovakia (over 60%), and in countries such as Latvia, Poland, Hungary, Lithuania or the Czech Republic.
The only Member State with an increase in the number of agricultural holdings between 2005 and 2016 is Ireland, with the number increasing by 4% compared to the reference year (Table 1).

Table 1. The number of EU farms 2005-2016 (%)

Country	2005	2007	2010	2013	2016
Belgium	100%	93%	83%	73%	72%
Bulgaria	100%	92%	69%	48%	38%
Czechia	100%	93%	54%	62%	63%
Denmark	100%	86%	80%	74%	68%
Germany	100%	95%	77%	73%	71%
Estonia	100%	84%	71%	69%	60%
Ireland	100%	97%	105%	105%	104%
Greece	100%	103%	87%	85%	82%
Spain	100%	97%	92%	89%	88%
France	100%	93%	91%	83%	80%
Croatia	0%	100%	129%	87%	74%
Italy	100%	97%	94%	58%	66%
Cyprus	100%	89%	86%	78%	77%
Latvia	100%	84%	65%	64%	54%
Lithuania	100%	91%	79%	68%	59%
Luxembourg	100%	94%	90%	85%	80%
Hungary	100%	88%	81%	69%	60%
Malta	100%	100%	113%	85%	83%
Netherlands	100%	94%	88%	82%	68%
Austria	100%	97%	88%	82%	78%
Poland	100%	97%	61%	58%	57%
Portugal	100%	85%	94%	82%	80%
Romania	100%	92%	91%	85%	80%
Slovenia	100%	98%	97%	94%	91%
Slovakia	100%	101%	36%	34%	37%
Finland	100%	97%	90%	77%	70%
Sweden	100%	96%	94%	89%	83%
United Kingdom	100%	79%	65%	64%	65%
EU	**100%**	**95%**	**85%**	**75%**	**72%**

Source: Eurostat [5].

Table 2. Percentage evolution in the number of Romanian farms by micro-region 2005-2016

Region	2005	2007	2010	2013	2016
North West	100%	90%	89%	85%	81%
Center	100%	90%	90%	81%	75%
North East	100%	94%	93%	88%	84%
South East	100%	94%	87%	81%	77%
South Muntenia	100%	90%	94%	89%	82%
Bucharest-Ilfov	100%	98%	52%	40%	33%
South-West Oltenia	100%	95%	95%	92%	89%
West	100%	90%	86%	78%	72%
Romania	100%	92%	91%	85%	80%

Source: Eurostat [5].

As the number of agricultural holdings falls at a slower pace in Romania than the EU average, the share of Romanian agricultural holdings in the number of EU agricultural holdings increases in the period analysed, representing almost 32% of the total number of agricultural holdings in the EU in 2016.

Regarding the dimension of agricultural holdings by size class in 2016, the high number of small farms is noticeable:

-About 65% of their number is less than 5 ha.

-About 86% of the number of farms is less than 20 ha.

Nevertheless, at the level of the European Union, a share of small farms (less than 5ha) higher than the EU average is found, except Cyprus and Malta, which have specific agricultural features, in six Member States: Bulgaria, Greece, Hungary, Portugal, Croatia and Romania. From this, we can conclude that the large share of small farms is not an exclusive characteristic only for the new Member States, having a large number of small farms is also found in older MS such as Greece, Portugal, or even Italy. On the other hand, there are Member States that have a high share of farms larger than 100 ha, such as the Czech Republic, Germany, Denmark, France, Germany, Sweden, or Finland (Table 3).

After Malta, Romania ranks second in the EU, in terms of the percentage of farms smaller than 5 ha (91.78%).

The 2nd position in the EU is also maintained regarding the cumulative share of farms smaller than 20 ha.

Only 1.08% of the Romanian farmers own farms larger than 20 ha (Table 3).

And only 0.36% of the total number of agricultural holdings is above 100 ha. This large share of small farms in Romania requires a more detailed analysis beyond their cataloguing based on the physical size of the farms.

Assessing their role in the economic transformation, taking into account the multiple roles that small farmers play in the economy of local communities, is also necessary. Differentiated policy measures can either increase the dynamism of this sector or stimulate the integration of this sector with the rest of the economy [11].

Table 3. Size of farms in the EU 2016 (%)

Country	0 to 4.9 ha	5 to 19.9	20 to 49.9	50 to 99.9	> 100
Belgium	13.85%	30.63%	30.22%	18.62%	6.70%
Bulgaria	82.61%	8.46%	4.12%	1.81%	2.99%
Czechia	18.70%	36.37%	17.90%	9.23%	17.75%
Denmark	4.39%	39.29%	20.91%	13.44%	21.91%
Germany	8.56%	36.73%	24.06%	17.37%	13.28%
Estonia	31.56%	37.07%	13.71%	6.29%	11.38%
Ireland	7.39%	36.05%	38.55%	14.44%	3.58%
Greece	77.33%	18.37%	3.42%	0.72%	0.16%
Spain	51.57%	26.75%	10.83%	5.34%	5.50%
France	24.27%	18.16%	16.31%	19.36%	21.89%
Croatia	69.49%	21.98%	4.70%	2.63%	1.20%
Italy	61.93%	26.14%	7.84%	2.61%	1.47%
Cyprus	89.58%	7.70%	1.69%	0.69%	0.34%
Latvia	35.19%	43.53%	12.51%	4.13%	4.65%
Lithuania	50.03%	34.65%	8.15%	3.65%	3.52%
Luxembourg	16.24%	16.75%	15.74%	27.41%	24.37%
Hungary	81.42%	11.07%	3.77%	1.69%	2.04%
Malta	96.53%	3.47%	0.11%	:	:
Netherlands	20.15%	28.68%	29.69%	16.81%	4.72%
Austria	31.02%	37.37%	23.12%	6.43%	2.06%
Poland	54.33%	36.05%	7.17%	1.59%	0.85%
Portugal	71.48%	19.28%	5.02%	1.81%	2.40%
Romania	91.78%	7.14%	0.54%	0.18%	0.36%
Slovenia	59.47%	34.75%	4.91%	0.72%	0.17%
Slovakia	55.69%	23.81%	7.48%	3.66%	9.35%
Finland	4.02%	33.01%	32.99%	19.67%	10.30%
Sweden	10.50%	45.50%	19.29%	11.92%	12.81%
United Kingdom	10.18%	29.33%	21.87%	17.01%	21.60%
EU	**65.61%**	**20.36%**	**7.09%**	**3.64%**	**3.30%**

Source: Eurostat [5].

In terms of physical farm size, except the Bucharest Ilfov Region, given its particularities - the small size of the region and the typical structure of the farms given the proximity to the capital-, the South Muntenia Region has the largest shares of small and very small farms (96.4). On the other hand, with the same exception, the South Muntenia Region has the lowest percentages for farms in the categories between 5 and 99.9 ha (Table 4).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 4. Size of farms in the Romania 2016 (%)

Region	0 to 4.9 ha	5 to 19.9	20 to 49.9	50 to 99.9	> 100
North West	86.86	11.98	0.69	0.19	0.28
Center	84.70	13.31	1.19	0.37	0.43
North East	94.72	4.52	0.44	0.11	0.22
South East	92.78	5.64	0.61	0.27	0.69
South Muntenia	96.34	2.92	0.28	0.10	0.35
Bucharest-Ilfov	97.00	2.38	0.14	0.10	0.48
South-West Oltenia	93.89	5.55	0.25	0.09	0.22
West	81.91	16.15	0.99	0.34	0.61
Romania	91.78	7.14	0.54	0.18	0.36

Source: Eurostat [5].

In the trend of reducing by 19% the number of agricultural holdings in the period 2005-2016, we have at the end of the period a change in the size structure, in the sense of increasing by about 70 the number of farms > 100 ha but also an increase of very small farms, as such, the growth of large farms was done rather by reducing the of farms between 5-19.9, and not necessarily of very small farms (Table 5).

Table 5. The evolution of the Romanian farms dimension 2005-2016 (%)

Year	Total	0 to 4.9 ha	5 to 19.9	20 to 49.9	50 to 99.9	> 100
2005	100	90.94	8.35	0.38	0.12	0.21
2007	100	89.81	9.41	0.41	0.12	0.25
2010	100	93.13	5.86	0.46	0.19	0.36
2013	100	92.21	6.71	0.52	0.20	0.36
2016	100	91,78	7,14	0,54	0,18	0,36

Source: Eurostat [5].

In terms of average farm size at the EU level, there is a great diversity among the Member States, from 130 ha in the Czech Republic to average sizes below 5 ha in Romania, Cyprus and Malta. The average size of the farm increases during the period analysed in all Member States, but at different rates (Table 6).

Regarding the growth rates of the average size of agricultural holdings, we can discern three groups of countries: (1)countries where there is a growth significantly higher than the average growth rate at the EU level (39.5%), especially in the case of countries from Eastern Europe, such as Bulgaria (331.3%), Slovakia (168.6%), Latvia (109%), but also Estonia, Hungary, Poland, Lithuania; (2) countries with a growth rate comparable to the EU average: Denmark (42.3%), Germany (38.4%), Finland (37.7%), etc. (3) countries with an average growth rate below the EU average: Romania (12%) and Slovenia (11,1%). Austria and Spain recorded lower growth rates (5.2% and 6.9%, respectively).

Table 6. Average farm size in the EU (ha)

Country	2005	2007	2010	2013	2016
Belgium	26.9	28.6	31.7	34.6	36.7
Bulgaria	5.1	6.2	12.1	18.3	22.0
Czech Republic	84.2	89.3	152.4	133.0	130.2
Denmark	52.4	59.7	64.0	68.4	74.6
Germany	43.7	45.7	55.8	58.6	60.5
Estonia	29.9	38.9	48.0	49.9	59.6
Ireland	31.8	32.3	35.7	35.5	35.5
Greece	4.8	4.7	7.2	6.8	6.6
Spain	23.0	23.8	24.0	24.1	24.6
France	48.6	52.1	53.9	58.7	60.9
Croatia	:	5.4	5.8	10.0	11.6
Italy	7.4	7.6	7.9	12.0	11.0
Cyprus	3.4	3.6	3.0	3.1	3.2
Latvia	13.2	16.5	21.5	23.0	27.6
Lithuania	11.0	11.5	13.7	16.7	19.5
Luxembourg	52.7	56.9	59.6	63.0	66.3
Hungary	6.0	6.8	8.1	9.5	10.9
Malta	0.9	0.9	0.9	1.2	1.2
Netherlands	23.9	24.9	25.9	27.4	32.3
Austria	19.1	19.3	19.2	19.4	20.1
Poland	6.0	6.5	9.6	10.1	10.2
Portugal	11.4	12.6	12.0	13.8	14.1
Romania	3.3	3.5	3.4	3.6	3.7
Slovenia	6.3	6.5	6.5	6.7	7.0
Slovakia	27.4	28.1	77.5	80.7	73.6
Finland	32.6	34.2	35.9	42.0	44.9
Sweden	42.1	43.0	43.1	45.2	47.9
United Kingdom	55.6	72.1	91.2	94.7	90.1
UE	**11.9**	**12.6**	**14.4**	**16.1**	**16.6**

Source: Eurostat [5].

Regarding the development regions, there are differences in terms of the average size and growth rate during the analysed period. It should be noted that the West Region, wherein 2005, the largest average size of the farm was registered, also has the highest growth rate in the analysed period, almost

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

double compared to the national average (20.8%) (Table 7).

Table 7. Average farm size in Romania (ha)

Region	2005	2007	2010	2013	2016
North West	3.3	3.7	3.4	3.6	3.7
Center	4.0	4.4	4.1	4.7	4.6
North East	2.4	2.6	2.5	2.6	2.7
South East	4.0	4.4	4.8	4.8	5.0
South Muntenia	2.7	3.0	2.9	3.0	3.0
Bucharest-Ilfov	2.8	3.0	1.9	3.0	3.1
South-West Oltenia	2.9	2.8	2.8	2.8	2.7
West	5.5	5.9	6.3	6.7	6.9
Romania	3.3	3.5	3.4	3.6	3.7
UE	11.9	12.6	14.4	16.1	16.6

Source: Eurostat [5].

Romania has benefited from different types of European funds since its accession in 2007. This chapter intends to reflect the impact of different indicators, such as the level of subsidies per farm or farm income in the development regions of Romania.

Analysing the distribution of direct payments in the development regions of Romania, they register the highest value per farm in the South East and West regions, the lowest rate being in South-West Oltenia, registering almost 40% less direct payments per farm than the national average (Table 8).

Table 8. Direct payments in Romania 2019 (average by development regions)

Development Regions	UAA (ha/farm)	DP (€/farm)
North East	13.7	3,042
South Muntenia	21.94	4,383
South-West Oltenia	12.2	2,497
North West	13.22	3,265
Center	16.03	4,649
South East	27.89	6,110
West	25.14	6,109
Bucharest-Ilfov	23.68	4,329
Romania	17.7	4,058

Source: FADN [4].

Regarding the utilised agriculture area per farm (using the FADN database based samples), this had increased over the years. In some of the regions, the growth were over the average increase in the country (115.8%). There are higher rates of increase in West (159.4%), North East (151.8%) and South Muntenia (147%) (Fig. 2).

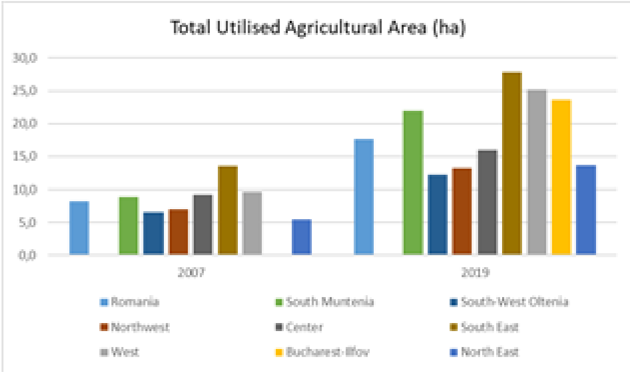

Fig. 2. The Utilised Agriculture Area of a holding (ha)
Source: FADN [4].

In terms of farm net value added, between 2007 and 2019, the average percentage increase in Romania was 141.6%. Similar or higher increases are in the North East region (230.5%), South Muntenia (295.7%), South East (334.7%) and West (196.2%) (Fig. 3).

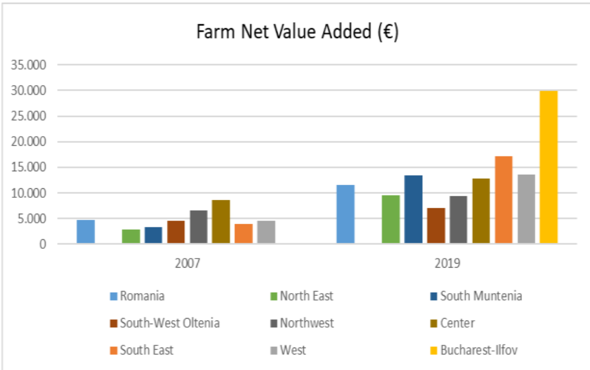

Fig. 3. Farm net value added (€)
Source: FADN [4].

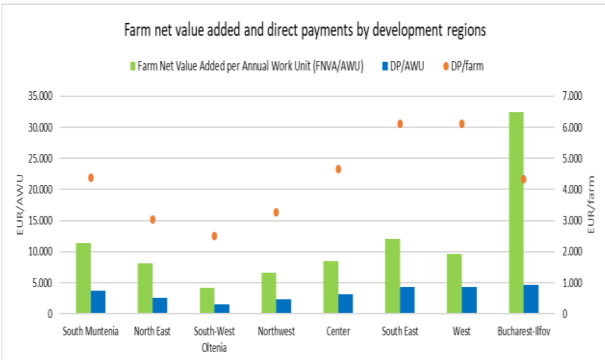

Fig. 4. Farm net value added and direct payments in Romania 2019
Source: FADN [4].

Analysing the farm net value added per annual work unit in relation to the level of direct payments per farm, it is noticeable that a higher level of income from direct payments have a relative importance in farm net value added [8] but it is not directly correlated to a higher level of the farm net value-added (Fig. 4).

Figure 5 indicates that entrepreneurial farm income (farm net income and wages paid) per annual work unit is not obviously influenced by the level of direct payment per farm. An outstanding example is the West development region, which receives considerably higher direct payments per farm than the South Muntenia region. Nevertheless, the farm income of the later development region is somewhat increased than the West.

Therefore, even though the direct payments are a component of the farm income, it does not substantially impact the farm entrepreneurial income. This indicator (entrepreneurial farm income) could help us overview the development regions that face possible agricultural income needs, despite the level of subsidies received.

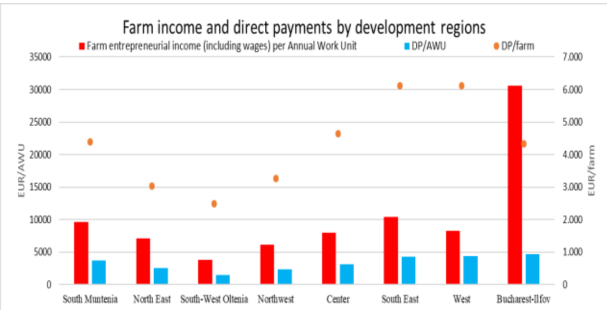

Fig. 5. Farm income and direct payments in Romania 2019
Source: FADN [5].

Regarding the indicators of total current assets, there is a peculiar shift in the position of the development regions. The most noticeable one is the significant decrease of the total current assets for the Central region by 56%. Three regions (South Muntenia, North East and South East) have undergone a significant spike, increasing their total current assets by 279.8%, 192.4% and 124.7%, respectively. Other regions recorded moderate levels of growth or moderate level of decrease (Fig. 6).

The total fixed assets cover the entire assets of an agricultural holding (land, fixed, etc.).

There are visible increases in all the regions, however, the most significant spike is in the South East region, with an increase of over four times in 2019 compared with the moment when Romania has joined the EU (Fig. 7).

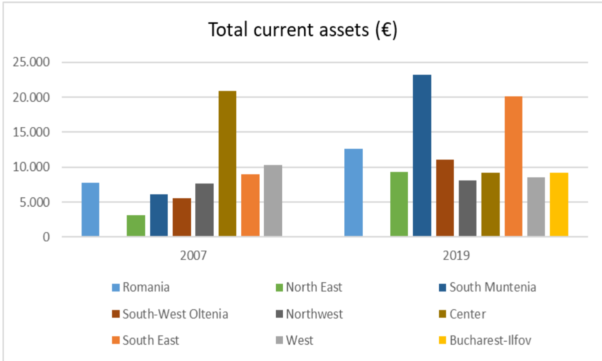

Fig. 6. Total current assets (€)
Source: FADN [4].

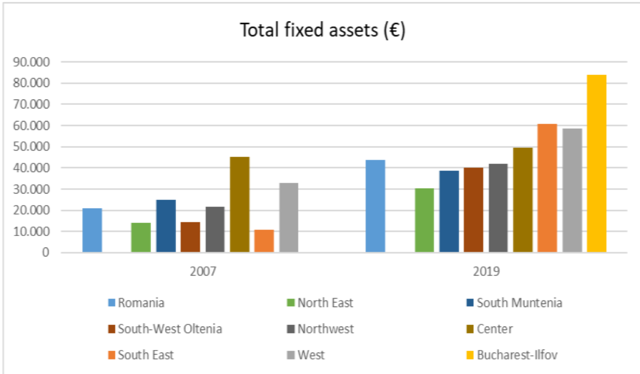

Fig. 7. Total fixed assets (€)
Source: FADN [4].

As analysed [1] the development regions attracted together over 1.7 billion euros between 2007 and 2020 for the modernisation of the agricultural holdings through Pillar II measures.

The top three regions that attracted the highest amounts during programming periods 2007-2013 and 2014-2020 are South East, South Muntenia and North West (Table 9).

Considering the average farm size, these three regions (South East, South Muntenia and North West) did not mark an ample growth (25% for the South East region and 10% for the others). On the other hand, when it comes to the utilised agricultural area of a holding, South East region has registered the highest growth. South Muntenia also registered a significant growth being in the top three of the regions that featured a high point. Whereas North West was also on the development path, it did not follow the spike of the other regions.

When looking at the net value-added and net value-added per annual work unit of the farms, from the three development regions in the discussion, only South Muntenia and South East noted a significant increase, while North West performed only moderate growth.

There is the same situation for the level of entrepreneurial farm income. South Muntenia and South East have a better income level, and North West seems to have higher agricultural income needs, despite a superior level of direct payments. The same path was indicated in the figure assessing the total current assets. Analysing the total fixed assets, a considerable growth could be seen only in the case of the South East region, the other two being relatively moderate.

Table 9. Contracted amount per NUTS 2 regions in Romania 2007-2020

Development regions	Contracted amount 2007-2013	Contracted amount 2014-2020	Total
Reg. N-E	80,716,422.60	61,289,271.01	142,005,693.61
Reg. S-E	173,328,189.88	227,018,001.78	400,346,191.66
Reg. S	133,708,303.99	154,518,819.88	288,227,123.87
Reg. S-W	47,871,475.96	137,260,528.04	185,132,004.00
Reg. West	90,103,652.14	107,059,035.29	197,162,687.43
Reg. N-W	78,668,093.11	169,128,376.22	247,796,469.33
Reg. Center	75,742,223.38	110,420,613.97	186,162,837.35
Reg. B-IF	65,651,633.20	890,816.53	66,542,449.73

Source: own calculations based on AFIR open data [9].

Going forward and linking the size of the big farms in the three regions with the total amount contracted during the programming periods under discussion, there is no data to indicate a direct link between these two indicators.

Indeed, South East regions have the most significant amount contracted and the highest number of big farms (2,850 farms over 100 ha), followed shortly by South Muntenia (2,450 farms over 100 ha).

However, on the contrary, the Northwest region has the second-lowest number of big farms (without considering the Bucharest-Ilfov region) but is still in top three regions of contracting amounts between 2007 and 2020.

Table 10. Analysis of the correlation coefficient

Indicators	Contracted amount 2007-2013	Contracted amount 2014-2020
Total number of farms 2007	0.248	
Total number of farms 2016		0.410
Average farm size 2007	0.241	
Average farm size 2016		0.267
Total Utilised Agricultural Area 2007	0.809	
Total Utilised Agricultural Area 2019		0.119
Direct payments/farm 2007	-0.235	
Direct payments/farm 2019		0.245
Farm Net Value Added 2007	-0.362	
Farm Net Value Added 2019		-0.476
Total current assets 2007	-0.056	
Total current assets 2019		0.567
Total fixed assets 2007	-0.255	
Total fixed assets 2019		-0.346

Source: own calculations based on Eurostat and FADN databases using Data Analysis of MS Excel [4].

Analysing the correlation coefficient between the contracted amounts for the modernization of the agricultural holdings (from 2007-2013 and 2014-2020) and the agronomic and socio-economic indicators, at the level of the development regions, a first assessment could be performed (Table 11).

As much as the correlation coefficient is closer to +1 or -1, it indicates a positive (+1) or negative (-1) correlation between the arrays.

A correlation coefficient that is closer to 0 indicates no or weak correlation. A mild correlation has been found between the amounts contracted and the total number of farms and between the average farm size and the total amounts for both 2007 and 2016.

By far, the strongest correlation of the amounts is with the utilised agricultural area per farm in 2007 (0.8, very close to 1), most probably due to the small size of the farms at the time of the accession.

For the economic indicators, a strong correlation could also be seen with the number of total current assets in 2019 (Table 11).

CONCLUSIONS

Over the last years, farm characteristics have been in constant change, both in the EU and Romania.

The investment support for the modernisation of agricultural holdings is an essential type of agricultural support in rural communities.

From accession, the Romanian agricultural holdings started modernising and improving their agronomic and socio-economic indicators.

Given the evidence, a possible mild correlation could be seen between the amounts contracted for the modernisation of the agricultural holdings and the indicators representing the number and the average size of agricultural holdings.

On the other part, it is very difficult to find a link with the economic indicators besides the total current assets of a farm, where there is a mild correlation in the analysed period.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

TRENDS IN ECOLOGICAL AGRICULTURAL PRODUCTION IN ROMANIA

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Abstract

The "Farm to Fork" European Union Strategy sets as key strategic objective to reach "at least 25% of the EU`s agricultural land under organic farming and significant increase in organic aquaculture by 2030". The purpose of this paper is to assess the main ongoing trends of the organic farming in Romania. Statistical data was collected from the official website of the Romanian Ministry of Agriculture by studying the conversion and ecological attestation certificates published by the local certification bodies. In Romania there are 11 inspection and certification bodies that have certified 7,977 producers in 2021, mainly having as main activity the vegetable sector. The results reveal that in Romania around 3% of the land is under organic certification that is far below the above-mentioned EU thresholds. In conclusion, Romanian organic agriculture has many farmers who own small plot of land. Although there has been a growing trend of the organic certification over the past few years, the number and area of organic land is largely dependent on the CAP incentives and to a less extent to market opportunities.

Key words: *Green Deal targets, ecological agriculture, leverage points, Romania.*

INTRODUCTION

The European Commission proposes, as part of the European Green Deal, a set of measures aimed to combat climate changes and mitigate biodiversity degradation, which would ultimately lead to a more modern, competitive, and resource-efficient European economy [8].
The European Green Deal is a strategy for sustainable growth, that aims to protect, preserve, and enhance the EU's natural capital and to protect the health and well-being of citizens from environmental risks and their associated impacts. With its eight areas of transformation, it targets zero net greenhouse emissions by 2050 and an economy decoupled from fossil resources use, while making sure that no person or place is left behind [8].
The 'Farm to Fork' and the "Biodiversity' Strategies are ways to achieve the European Green Deal targets in agriculture, to support a food system that answer the needs of Europeans and the protection of the planet [8].
With the help of the European Green Deal, all actors in the food value chain, and especially farmers, can find new measures to make their development possible [10].
The Farm to Fork Strategy is one of the main instruments of the European Green Deal that aims to make food systems cleaner, healthy and greener. The aim of the strategy is to make possible the transition to a sustainable food system, that should [10]:
-have a favourable environmental impact;
-help to reduce climate change;
-to maintain and increase biodiversity;
-assure access for all to sustainable, safe and nutritious food;
-maintain fair trade and food accessibility.
Objectives of the strategy also include the promotion of organic farming, as it is environmentally friendly by reducing the use of pesticides and chemical fertilisers also having a positive impact on biodiversity. That is why an increase of the organic area to 25% of the total agricultural area is expected by 2030.
The Biodiversity Strategy aims to restore biodiversity in Europe by 2030 for the benefit of people, the climate and the planet. The strategy aims to increase the resilience of our

societies to future risks (eg Covid-19), similarly [9]:
-the impact of climate change
-forest fires
-food insecurity
-disease outbreaks - including the protection of wildlife and combating illegal wildlife trade.
Organic farming promotes [2, 23]: the responsible use of energy and natural resources, the preservation of biodiversity, the maintenance of regional ecological balance, the enhancement of soil fertility and the conservation of water quality, which are among the objectives of the European Green Deal. Organic farming can bring significant contribution to sustainable development, environmental health and expansion of the green economy. It produces food safe, healthy for humans but also for the environment because no genetically modified organisms, fertilizers, pesticides, hormones and antibiotics are used. Moreover, there are no chemicals and additives involved in the food processing industries [1].
The EU has put in place a rigorous system to monitor and enforce organic food standards so that farmers feel the benefits of organic farming as a production method, and consumers can be sure that organic production rules are being followed. It is the European Parliament Regulation 2018/848, which sets the rules for organic production and labelling of organic products.
Monitoring and certification of organic products in Romania is performed by private certification and control bodies. They are regulated and operate according to the rules of Regulation no. 65/2010, approved by the Romanian Ministry of Agriculture and Rural Development, and their accreditation becomes a competent body for this purpose, according to the European standard EN ISO 45011: 1998 [7].
Organic farming owns almost 13.8 million hectares of agricultural land in the EU-27 in 2019, respectively 8.5% of the total utilized agricultural area of the EU-27 (Figure 1). The ecological area varies between 0.5% and - 25% in different EU Member States [12].

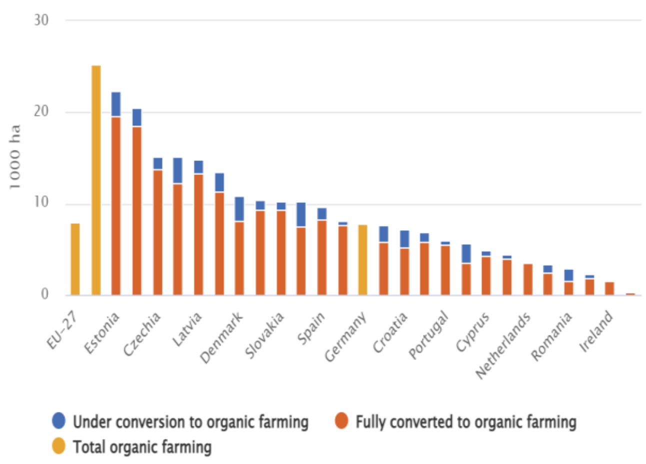

Fig. 1. Share of organic area in total utilised agriculture area, by country, 2019.
Source: Eurostat (online data codes:org_cropar and apro_cpsh1) [12].

To achieve the objectives of the European Green Deal, an Organic Action Plan has been drawn up, based on three interlinked axes sustained by 23 actions [11]:
Axis 1: encourage demand and ensure consumer trust;
Axis 2: increase conversion process and booster the entire value chain;
Axis 3: enhance the contribution of organic farming to environmental sustainability;
Financial support for this Organic Action Plan will be supported by the Common Agricultural Policy through agri-environment schemes. In addition to the financial support advice will be granted as part of the Agricultural Knowledge and Innovation Systems (AKIS) [11].
About 1.8% (€7.5 billion) of CAP is currently used to support organic farming. The future CAP will include green programmes supported with a budget of €38-58 billion for the period 2023-2030.
One objective of the "Farm to Fork Strategy" is to increase the agricultural area used in the ecological system, therefore the purpose of this research is to identify the current situation in Romania.
The natural conditions that Romania has, such as: large areas of pastures and hayfields, reduced historical amounts of chemical fertilizers, pesticides and herbicides applied, and low degree of water and soil pollution in comparison with other countries, are potential

advantages in the transition to organic farming [5].
In Romania, organic farming is supported by the European Agricultural Guarantee Fund through Measure 11: Organic farming in the form of compensatory payments paid annually, as a fixed amount per ha [21]. They are granted following voluntary commitments in two directions: conversion to organic farming methods and maintaining organic farming practices.

Table 1. Compensation payments Measure 11: Organic farming (2014-2020)

Measure 11: Organic farming-package	**Compensation payments**	
	Sub-measure 11.1 - Support for conversion to organic farming methods (€/ha/year)	Sub-measure 11.2 - Support for the maintenance of organic farming practices (€/ha/year)
Package 1- agricultural crops on arable land (including fodder plants)	293	218
Package 2 - vegetables	500	431
Package 3 - orchards	620	442
Package 4 - living	530	479
Package 5 - medicinal and aromatic plants	365	350
Package 6 - permanent meadows:	-	-
6.1 (applicable at national level on areas without commitment M.10)	143	129
6.2 (applicable in the eligible areas and only together with an M.10 commitment)	39	73

Source: Agricultural Payments and Intervention Agency [3].

Therefore, two sub-measures are implemented (Table 1):
-11.1 support for conversion to organic farming practices and methods;
-11.2 support for the maintenance of organic farming practices and methods
In the period 2015-2020, 236.42 million euros were allocated from the European Agricultural Fund for Rural Development and the Romanian state budget for Measure 11: Organic Farming (EAFRD 200.69 million euros and state budget 35.76 million euros) [19].
In addition to these compensatory payments, there are various rural development measures under the National Rural Development Programme that encourage the development of green activities by providing more support than for conventional activities.

MATERIALS AND METHODS

The materials used in this research were: official reports; official statistical data about organic farming in Romania. The sources of these materials are the Romanian Ministry of Agriculture and Rural Development, the European Commission, the Research Institute of Organic Agriculture and the International Federation of Organic Agriculture Movements. In addition, the ecological conversion certificates and the ecological certificates provided by the local certification bodies were analysed.
The research methods used were the bibliographic study, the documentary analysis and the descriptive statistics to show the development of organic agriculture in Romania. The agricultural area, the number of certified operators in organic farming, the types of crops or animal species and the number of certification bodies were used as main results indicators.

RESULTS AND DISCUSSIONS

The organic farming sector in the European Union has generally experienced great development between 2007-2020. This is a characteristic of the organic certified farmed area, which has in average a yearly growing rate of 5.4%. Romania registered the same trend, with growth rates higher than those observed at the European level (Figure 2) as also pointed out by Angelescu et al. (2021)[4].
In 2020 the ecological certified area was 3.45% of the total agricultural area [12], representing only 468,887 ha, which places Romania on the last places in the European Union.

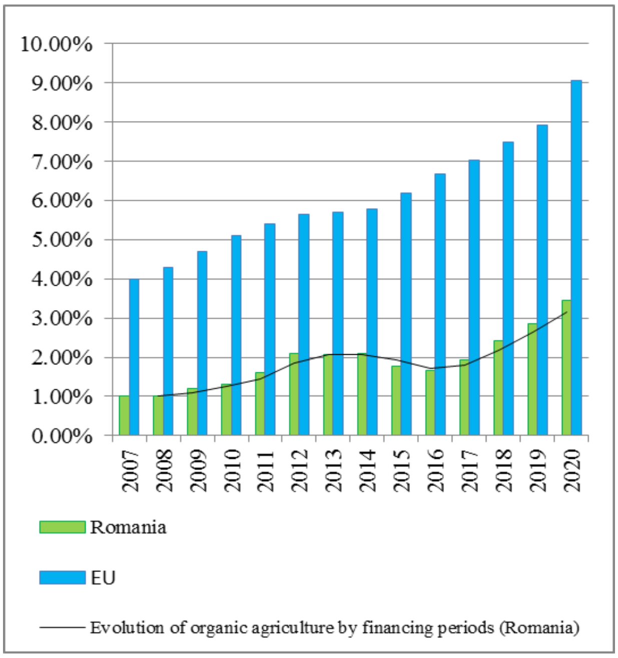

Fig. 2. Evolution of the agricultural area in Romania (%) and EU.
Source: Eurostat [12].

Before accession to the European Union, the area under organic farming was less than 1% [12], reflecting the lack of interest in the sector. However, after accession, support for maintaining certified land for organic farming was introduced in the Romanian National Rural Development Program 2007-2013 as measure 214 "Agri-environment payments", while at the same time payments were granted for the conversion period in accordance with Article 68 of Regulation (EU) No. 73/2009. The effect of this measure can be seen in Figure 2, where there is an important increase in organic area after a period of 3 years of conversion and 5 years of the commitment period (2010 – 2012) and (2017 -2020).

The decrease in organic area observed between 2015-2016 can be explained by the fact that the area under permanent grasslands (that accounted more than 70% of organic land) was subsidies only in the conversion period. This meant that after the 3 years of conversion, the farmers returned to the conventional farming[18].

The National Rural Development Program 2014-2020 encourages existing organic practices, but also the transition from conventional to organic farming [18].

The increase in organic area from 2017 to 2020 is mainly a consequences of Measure 11 Organic Farming, which supports farmers with high payments/hectare as compared to those in the conventional system. During the conversation, the support represents between 143-620 euros/ha/year, and the certified areas receive between 129-475 euros/ha /year. Comparatively in the conventional system, the value of support is 96 euros/ha/year [17].

Regarding the types of products under organic certification, the largest area is occupied by cereals (32% of the organic agricultural area in 2019) (Figure 3). In 2020, the first place was represented by permanent pastures and meadows with around 33% of the total certified area. due to low historical levels of chemical fertilisers in use. Areas with fresh vegetables have declined from 1,928 ha in 2015 to 847 ha in 2020.

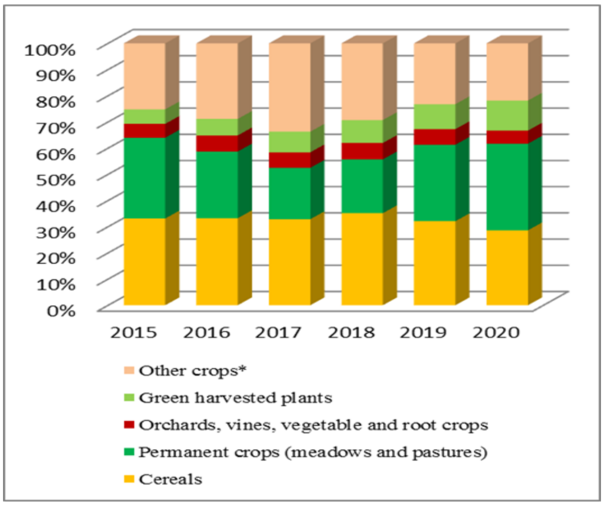

Fig. 3. Evolution of types of organic crops in Romania (%)
Source: Data communicated by the control bodies approved by MARD [16].
*Other crops: grain legumes, industrial plants, other crops and unused land

There are strong variations in the livestock organic flock size (Table 2). For most species (cattle, swine, sheep, goats) there is a decreasing trend, but for poultry, bee families and equidae there is an increasing trend.

Table 2. Evolution of livestock under organic farming, in Romania, 2015-2020 (heads)

Year	Cattle	Swine	Sheep	Goats	Poultry	Equidae	Bees
2015	29,093	86	85,419	5,816	107,639	485	81,583
2016	20,093	20	66,401	2,618	63,254	0	86,195
2017	19,939	20	55,483	1,653	78,681	202	108,632
2018	16,890	9	32,597	1,360	83,859	0	138,557
2019	19,358	9	19,367	8,161	128,596	297	175,959
2020	19,870	14	13,189	830	171,391	506	170,789

Source: Data provided by the control bodies approved by MADR [16].

According to the Romanian certification bodies (Table 3) in 2021 there were 8,289 operators that can be divided in: 7,975 producers, 93 processors, 193 traders, 8 importers, 3 exporters, 3 in aquaculture production and 14 in spontaneous flora. Moreover, the ecological agricultural area is divided between many operators who own small plots.

Table 3. The inspection and control bodies accredited by the Ministry of Agriculture and Rural Development

Romania authority code	Control authority	% of certified operators 2021
RO-ECO-007	SC ECOCERT SRL	34.76
RO-ECO-008	SC ECOINSPECT SRL	27.07
RO-ECO-009	BIOS SRL ITALIA ROMANIA BRANCH	3.62
RO-ECO-015	AGRECO R.F. GODERZ GMBH GERMANY ROMANIA BRANCH	1.22
RO-ECO-016	BIOAGRICERT SRL ITALY ROMANIA BRANCH	1.07
RO-ECO-018	AUSTRIA BIO GARANTIE GMBH ENZERSFELD BUCHAREST BRANCH	1.87
RO-ECO-021	CERTROM SRL	5.60
RO ECO-024	CERES ORGANIC CERT SRL	4.16
RO-ECO-025	BIO CERT TRADITIONAL SRL	9.62
RO-ECO-026	SC SRAC CERT SRL	10.16
RO-ECO-027	SC TUV AUSTRIA ROMANIA SRL	0.85
RO-ECO-028	RINA SIMTEX– ORGANISM DE CERTIFICARE SRL	0

Source: Ministry of Agriculture and Rural Development (2021) [16].

Table 4 shows that the number of organic producers varies greatly both in total number and by county.

According to the last 6 years averages, the county with the highest number of organic producers is in Satu Mare county located in the North part of the country (755 producers). On the other hand, Ilfov county is on the last place (in average with only 17 producers).

The organization structure shows that more than 53% of producers are individual farmers with no legal status (Figure 4), thus making difficult to sell any products on the market.

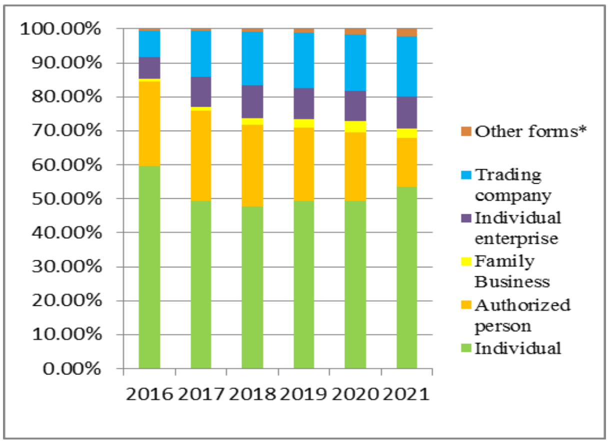

Fig. 4. The evolution of the form of organization of ecological producers in Romania.
Source: Data communicated by the control bodies approved by MARD [16].
*Other forms: Cooperatives, agricultural society, associates, composers and institutions (high schools, parishes, universities, research centers)

Consumption of organic products in Romania represents only about 1% of total food consumption, while the European average is between 3-5% [20, 22]. Consumption is still low compared to other European countries, mainly due to low purchasing power but also due to the socio-demographic characteristics (level of education and social status). Another factor is represented by the price difference of about 20-40% compared to conventional products [22]. The low level of the internal market for organic products is illustrated by the per capita expenditure on organic products, which was only 2 euros in Romania in 2019, while the average in the European Union was 84 euros [12]. The total sales volume of organic products represented 41 million euros in 2019 [12].

Moreover, only 10% of organic food consumption comes from domestic sources, the remaining 90% being imported [14]. Although Romania imports many organic products, it exports a large amount of organic raw materials [6]. Thus, exports in 2020 (10,888 thousand tonnes) [13] increased by about 20% compared to 2019 (9,025.71 thousand tonnes) [12].

Table 4. Evolution of organic producers in Romania by county

No	County	Number of organic producers					
		2016	2017	2018	2019	2020	2021
1	Alba	1,930	683	266	281	276	100
2	Arges	23	62	97	105	114	50
3	Arad	107	141	186	280	314	358
4	Bucuresti	70	93	122	140	131	87
5	Bacau	95	109	146	124	115	56
6	Bihor	215	214	203	232	279	284
7	Bistrita-Nasaud	517	363	379	400	418	463
8	Braila	23	40	86	139	328	465
9	Botosani	163	169	189	123	119	67
10	Brasov	311	299	267	288	290	227
11	Buzau	47	71	130	120	110	61
12	Cluj	553	438	340	417	400	363
13	Calarasi	32	37	40	39	39	37
14	Caras Severin	525	437	369	363	358	298
15	Constanta	92	119	171	178	218	205
16	Covasna	172	132	64	82	89	79
17	Dambovita	21	32	35	42	44	25
18	Dolj	57	77	111	126	166	47
19	Gorj	12	18	42	114	141	9
20	Galati	71	110	147	183	203	141
21	Giurgiu	32	34	26	34	27	23
22	Hunedoara	438	215	178	163	163	106
23	Harghita	218	223	298	281	297	603
24	Ilfov	11	15	27	20	18	14
25	Ialomita	44	34	34	34	31	24
26	Iasi	557	365	330	285	272	74
27	Mehedinti	15	23	40	43	47	19
28	Maramures	326	253	297	367	379	381
29	Mures	331	287	233	360	415	355
30	Neamt	41	56	83	96	111	31
31	Olt	13	26	41	68	110	78
32	Prahova	19	40	66	73	70	49
33	Sibiu	56	84	118	162	200	178
34	Salaj	551	527	548	779	825	777
35	Satu Mare	639	707	722	915	813	737
36	Suceava	854	223	726	663	380	282
37	Tulcea	166	259	341	293	312	238
38	Timisoara	106	155	222	292	370	410
39	Teleorman	45	56	94	91	87	58
40	Valcea	11	41	82	93	106	24
41	Vrancea	46	50	61	60	69	67
42	Vaslui	35	48	73	86	90	25
	Total	9,590	7,365	8,030	9,034	9,344	7,975

Source: Data communicated by the control bodies approved by MARD [15].

CONCLUSIONS

In the last years, the organic farming has an increasing trend in Romania. Even so, the current trend cannot support the achievement of the desirable threshold of 25% by the end of 2030. The development of the ecological area is highly dependent to the CAP support measures. Large parts of the organic areas received only subsidies without decisively contributing to an increase in the domestic offer of organic products.

Romanian organic agriculture is characterized by many producers, with extremely small average sizes. More than half of the operators are individuals without having any legal status. In terms of certified crops, Romania is very diverse, with a focus on cereals and meadows thus having marginal effects on the high value-added products.

Moreover, almost 90% of organic products come on the internal market from imports due to the low number of organic processors.

Unfortunately, consumer awareness of organic food is also low. However, more and more domestic consumers are looking for high quality food products respecting in the same time environmental and biodiversity integrity.

The certification process in organic agriculture is not driven by the market forces. Currently the main leverage point is represented by the financial support provided by the CAP.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support of FoodLevers project provided by transnational funding bodies, partners of the H2020 ERA-NETs SUSFOOD2 and CORE Organic Cofund, under the Joint SUSFOOD2/CORE Organic Call 2019.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC MANAGEMENT OF RURAL AREAS: ON THE WAY FROM LINEAR TO CIRCULAR ECONOMY

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Abstract

Waste management in the fruit and vegetable industry is becoming an increasingly important issue, as a significant part of the raw material ends up in the waste. Improper waste management can lead to environmental pollution and therefore must be disposed of in an acceptable way, but also to exploit the commercial potential of processing residues. In Požega-Slavonia County and Pannonian Croatia, very little attention has been paid to this issue, both by the scientific and professional public, and by those who have remnants of processing. This is a potential that has not been recognized, and consequently not used, and there is a lot to do in this area. The paper presents a research that defines products that can be produced from the remnants of fruit and vegetable processing and analyzes which raw materials can be processed and in which products given the level and capacity of production in Požega-Slavonia County and surrounding counties. A market analysis was performed for the identified products and the need to establish a plant was defined. The work is also a good basis for further research and development and production of products with higher added value, as a part of shift from the existing linear economy to a circular economy.

Key words: *circular economy, by-product, rural development, waste processing, environment*

INTRODUCTION

Man and nature have always been in constant interaction, and the segment in which man acts on nature in order to provide resources for development and life is especially important. Over the years, man has increasingly exploited natural material resources from his environment, and with the development of technology, exploitation has accelerated significantly. During this period, man considered natural resources unlimited and actually used the strategy of linear economy.

At a lower level of industrialization, the concept of linear economy had no serious limitations. Raw materials were becoming more accessible and cheaper, technologies were advancing and the concept of a linear economy was actually a model of growth. This growth has led to an increase in production, employment, profits, living standards, and consequently an increase in demand for all types of goods. In the context of the present study, it is crucial to emphasize that the concept of linear economy implied that waste generated as a result of production is thrown into the environment.

The development of the economy has continuously increased the demand for raw materials, while reducing the available quantities of natural resources. In addition, the impact on climate and the environment is significant, as excessive energy consumption directly affects the increase in CO_2 emissions.

Fig.1. Concept of linear economy
Source: Analysis of the potential and development of agricultural production in Požega-Slavonia County [1].

Such awareness began to change a hundred years ago when it was realized that natural resources were limited and that their overexploitation had a negative impact on the environment. The term sustainable development entered general terminology in the 1980s and was defined as a development that meets the needs of today's generations without compromising future generations.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

This issue was only seriously considered in 2008 during the great economic crisis, which was accompanied by the crisis of climate change. It was then that the introduction of the concept of a circular economy began, which was a response to the global environmental crisis and accelerated climate change. Thus, in 2010, the European Commission (EC) adopted the Europe 2020 strategy, a ten-year development strategy focused on sustainable growth, transition to a circular economy and waste reduction. The logical continuation is the Green Plan presented by the EC in 2020.

The circular economy is a completely different concept of managing economic processes in the field of sustainable use of natural resources and balanced economic development. It seeks to abandon the concept of a linear economy that has become unsustainable in the long run. In order to slow down the exploitation of natural resources, the circular economy is based on the principles of waste collection and recycling and its reuse as input raw materials in the production process. Thus, one type of waste could be recycled several times and used in the production process, depending on its technological characteristics. In this way, natural resources would be used much more optimally and their lifespan would be extended.

For citizens, the circular economy will provide highquality, functional and safe products, which are efficient and affordable, last longer and are designed for reuse, repair, and high-quality recycling. A whole new range of sustainable services, product-as-service models and digital solutions will bring about a better quality of life, innovative jobs and upgraded knowledge and skills [9].

The Circular Economy concept (CE) has gained momentum both among scholars and practitioners. However, critics claim that it means many different things to different people [4].

The term circular economy, like many other terms in science, and especially in economics, does not have a unique meaning. While some are focused on what constitutes the circular economy itself (input), meaning the process itself, others are focused on the determinants of that process, and still others on the results (outputs) of that process.

The Circular Economy represents the most recent attempt to conceptualize the integration of economic activity and environmental wellbeing in a sustainable way [5].

A central theme of the CE concept is the valuation of materials within a closed-looped system with the aim to allow for natural resource use while reducing pollution or avoiding resource constraints and sustaining economic growth [10].

Circular Economy is little implemented in practice, and in the present paper barriers to a transition to Circular Economy is identified. Barriers are financial, structural, operational, attitudinal and technological [7].

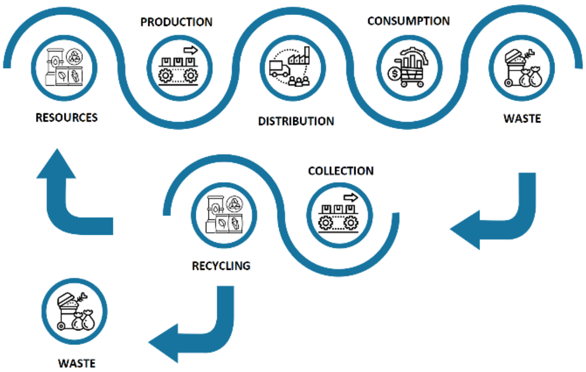

Fig. 2. Concept of circular economy
Source: Analysis of the potential and development of agricultural production in Požega-Slavonia County [1].

The Concept of the circular economy is based on the collection and recycling of waste, which eliminates its harmful impact on the environment, and through recycling it returns to the production process as a valuable material resource or raw material. This only permanently disposes of a small part of non-recyclable waste. In this way, the production process continues in cycles with the rational use of material resources and environmental protection. This concept implies that with the help of nature, everything that man needs is produced, and that he then takes care of how to return to nature what he took from it. With such management, the added value of the product lasts significantly longer in use before it becomes waste.

The concept of the circular economy is ubiquitous today and is embedded in

European regulations that all EU member states implement as regulations in their national institutional framework and their national economy.

The transition from the concept of a linear economy to the concept of a circular economy requires a number of changes in the overall value system. It is primarily necessary to change the consciousness of society as a whole, create an appropriate institutional framework, create an appropriate material infrastructure, devise new business and market models, use modern technologies for the circular economy, develop a waste management system etc.

MATERIALS AND METHODS

The focus of this research is on the disposal and processing of by-products and residues in the processing of fruits and vegetables. Capacities, obligations and possibilities of everything related to by-products and/or residues in fruit and vegetable processing, such as mixed municipal waste management centers, residues and by-products of field production, etc. were taken into account. The key document on which the data on the quantities of fruits and vegetables and projections until 2025 are based is the study of the Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University in Osijek "Analysis of the potential and development of agricultural production in Požega-Slavonia County" made in 2020 [1]. Pozega Slavonia County (from now on, PSC) is part of Pannonian Croatia, as the least developed Croatian region, and also most significant agricultural region. Characteristics of this region are a decrease in population, stagnation in terms of development, lack of recognized prospective [2].

In addition to the above materials, a comprehensive search of all available sources of information was performed, and through the chapters of this study an overview of everything relevant to the implementation of appropriate analysis and projections was presented. economic justification of the investment. All products that can be produced from the remnants of fruit and vegetable processing are defined and it is analyzed which raw materials can be processed and in which products with regard to the level and capacity of production in PSC and surrounding counties.

Based on the conducted analysis, the processing of wine production products, ie wine pomace oil and pellets, was identified as an important option. Given the quantities of grapes produced in the County, it is estimated that such an investment would be economically justified, but for detailed economic justification of such an investment it is necessary to prepare a feasibility study with appropriate economic assessment of the project in accordance with the European Commission Guide for the current programming period 2021-2027 [3].

Based on the total processed amount of grapes and the resulting pomace, it is estimated that the maximum production can be 27,222 liters of oil and 544 tons of pellets, which is a sufficient and serious amount of products that can be sold on the market. During the analysis, a conservative estimate of the processing of 1,000 tons of grape pomace per year was taken into account, with a production of 10 tons of oil and 200 tons of pellets. It is envisaged that the plant for the production of grape pomace oil and pellets would be operational 50 days a year, given that white grape pomace is processed immediately after grape mulching and pressing, while black grape pomace would be taken over after maceration.

An overview of the necessary equipment for technological processes of oil and pellet production indicates significant possibilities of overlap with part of the equipment for the planned cold store and dryer as well as possible with part of the equipment for composting. This represents a great potential for eliminating the problem of seasonality of oil and pellet production from grape pomace, and would enable even year-round productivity of most production machines.

RESULTS AND DISCUSSIONS

The production of fruits and vegetables in PSC is diverse, but in the context of the production of by-products from the remnants of fruit and vegetable processing, the possibilities are limited. In order to identify raw materials that can be processed into some of the by-products, the Analysis of the potential and development of agricultural production in PSC was used. For the purposes of this study, figures for 2019 and projections for 2025 were taken [1].

According to the analysis, there are 44,956.04 ha of agricultural land in operation in the County. Observing the structure of agricultural land according to the method of use, most agricultural land belongs to the category arable land (82.7%), followed by meadows (5.9%) and pastures (2.4%). These categories make up 91% of the total agricultural land in the County. Areas for fruit and vegetable production make up only 8.8% of the area, and the largest share among them are orchards with 5.2%.

Furthermore, the Analysis shows that on 36,895.06 ha of agricultural land there are areas in the support system, and they are divided into cereals, oilseeds, vegetables, fruits and grapes. Cereals are on a total of 67.0% of the land, oilseeds on 19.8%, vegetables on 0.9%, and fruits on 8.2%.

Since each crop differs in yield per hectare, taking it into account, the Analysis showed the total production in tons for each crop. The total production at the county level in 2019 amounted to 205,147 t, and according to estimates in 2025 it will amount to 237,868. Looking at the structure in 2025, the largest share will be cereals (76.9%), followed by oilseeds (12.3%), followed by fruits (7.7%) and vegetables (3.1%).

For the purposes of further analysis, as a starting point for the processing of by-products from residues from fruit and vegetable production, projections of fruit and vegetable production in 2025 were taken. Compared to the last available year 2019, vegetable production will increase by 12.3%, to 7,380 t. Vegetable production will increase by 12.7% in the same period, to 18,341 t, for a total of 25,721 t.

Furthermore, the vegetable crops that dominate the County are cabbage and potatoes, which in 2025 will account for 86.0% of production in the vegetable segment. These are vegetables that are primarily sold as a fresh product in markets and shopping malls (especially potatoes), while only a small part of cabbage is processed. As the market of companies that would buy these products as raw materials and use them in processing (which would generate waste) is not developed in the County, the part of the product that ultimately ends up in processing is processed outside the County. According to the Croatian Chamber of Commerce, in activity C 10.3. Processing and canning of fruits and vegetables, only two companies operate in the County.

The situation with fruit indicates that grapes are the dominant product, accounting for 71.2% of total fruit production. They are followed by apples with 16.3% and plums with 5.9%, while nuts (walnuts and hazelnuts) account for 3.3% of total production. In this case, too, most fruit is sold as a finished product, but in this segment there is the potential to use waste from grapes for wine production and from apples, plums, pears and peaches for juice production, to produce by-products from fruit waste.

Based on the analyzed situation in the County, which includes the amount of waste from fruit and vegetable processing, technological and human capacity, it was determined that the real options are, according to priority: 1) compost production, 2) wine pomace oil and pellet production, 3) bioactive components and 4) production of synthetic organic leather. Biofuel production is economically unprofitable due to insufficient waste, biodegradable polymers are based on advanced technology that is still in the process of research and development, while alternative products can be produced for personal use.

Almost 12,000 t of grapes are produced annually in PSC, of which 80% is used in grape production, or slightly more than 9,000 t. This amount of processed grapes results in approximately 2,300 t of pomace, a by-product that has not been recognized as a high-value raw material, but ended up in compost or discarded into the environment causing major pollution, so pomace is a major environmental problem. Namely, the process of humification of the pomace is long and therefore the piles of discarded pomace pollute the environment for a longer time.

In addition, the pomace is a problem for the winemakers who produce it, because if they do not take care of it properly, they pollute the soil and the environment, and large accumulations of pomace attract pests and flies that can cause the appearance and spread of various diseases.

On the other hand, pomace can be a quality raw material, highly sought after by the food, pharmaceutical and cosmetic industries, and can also be used as animal feed, natural organic fertilizer, and building materials. Therefore, a logical question arises, why the raw material that is in large quantities, and which represents waste to winemakers, is not used for further processing of highly sought-after by-products.

Wine pomace was once primarily used for the production of spirits, the production of which over time became unprofitable due to a significant reduction in market price due to the increase in quantity. Today, winemakers can use it in larger quantities for planting new vineyards when the soil is too wet when preparing the soil, so by adding the pomace, it can be acidified. But this is not a continuous need, so the problem of care arises again.

With the emergence of the circular economy, which has become a key factor in sustainable economic development, many studies have been conducted through the development and application of new technologies that enable new methods of recycling and reuse, ie the use of wine pomace as a byproduct with great potential for further processing. Thus, wine pomace has become a highly sought-after raw material in the food, pharmaceutical cosmetic industries, and some of the most commonly produced products are grape seed oil, grape seed flour and skin, and pomace pellets.

Based on the conducted analysis, as a logical continuation of the project of building a ULO cold store for fruits and vegetables, the option of establishing a production plant for grape seed oil and pomace pellets was recognized. It would solve the problem of wine pomace that winemakers face, and would provide the possibility of organized collection and processing of pomace at the county level.

Grape seed oil was chosen for its growing use in Europe and its use in many industries, from gastronomy to the pharmaceutical and cosmetics industries.

Grape is one of the main fruit crops produced worldwide, being *Vitis vinifera* L. the most common cultivated specie. Approximately 71 % of the grape production is used in winemaking production, while 27 % in direct consumption as table grapes and 2 % as dried fruits. [6]. If we took in consideration well known fact, that after the processing of wine, the ¼ weight of grapes remains in the pomace, when compared to the figures on the total processing of grapes into wine, we come to a significant potential for the use of wine pomace.

Functional food is point of interest for many and for a long time. Not only food chemists but also many scientists from diverse areas, including biology, biochemistry, botany, plant/animal sciences, and nutrition as well as medical science, have become involved in research associated with functional foods today. Moreover, consumers are now deeply interested in the food factors which provide beneficial effects to humans in terms of health promotion and disease risk reduction. They also demand more detailed information about food factors in order to obtain appropriate functional food products [8].

Namely, grape seed oil contains high-value ingredients that have a positive effect on human health, such as omega 6 and 9, 3, 5 and 7 fatty acids, vitamin E and antioxidants. In addition, it tolerates high temperatures and is increasingly used in gastronomy as a substitute for conventional oils for this purpose. The plant proposal is based on, widely available, cold pressing technology.

In order to fully implement the concept of circular economy, the plant proposal also includes the production of pomace pellets. In that way, the residues from the production of oil would be further used for the production of pellets. Due to the high content of organic matter and potassium and significant amounts of nitrogen and phosphorus, wine pomace can be used as a biofuel in the form of pellets for heat production. Wine pomace pellets have a calorific value of fuel released during complete combustion of 19 MJ/kg, which is more than, for example, coal with 17 MJ/kg. From the aspect of environmental protection, wine pomace pellets have a minimum content of harmful substances caused by combustion, especially sulfur. Based on calorific values, it can be determined that 2 kg of wine pomace pellets has an approximate value as well as 1 liter of fuel oil, and 1 m3 of wine pomace pellets weighing 650 kg can replace approximately 300 kg of fuel oil. The technology for the production of pomace pellets is also widely available.

CONCLUSIONS

The production of oil and pellets from wine pomace is recognized as a potential of PSC in the context of processing by-products from fruit processing, given the quantities of grapes produced in the County. Investment in such a plant is not realistic at the level of an individual winemaker, primarily due to insufficient quantities of processed grapes and the resulting pomace. For this reason, production needs to be centralized and a production facility set up to collect the sufficient amount of pomace needed for profitable production. According to estimates, 2,722 tons of wine pomace will be produced in 2025. If the conservative estimate is taken into account that it is possible to collect and process 1,000 t of wine pomace, it is possible to produce 10,000 l of oil and 200 t of pellets.

Furthermore, the production of grape seed oil and pomace pellets is seasonal because they can only be produced during the grape harvest. As at that time all the focus of winemakers was focused on wine harvesting and production, they also have insufficient human and time capacity. This is one of the biggest problems, because the pomace needs to be collected and processed within 24 hours in order to prevent spoilage of the raw material. Therefore, the whole process is logistically demanding, because in a short time it is necessary to collect and process extremely large quantities of pomace. An additional problem of such production is the storage of raw materials that require large capacity, because the wine pomace has a high proportion of water (55-60%).

By establishing the plant in question, every winemaker would solve the problem of the pomace that he has to take care of, without having to invest significant time that is important for his harvesting and production of wine, but only needs to agree on taking over the pomace.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC AND ENERGY EFFICIENCY OF SOYBEAN GROWING UNDER NO-TILL AND SALICYLIC ACID IN SOUTHERN UKRAINE

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Abstract

The research is devoted to a comprehensive approach to the study of soybean productivity depending on the different tillage technologies and plants' spraying of salicylic acid of climate change in Southen Ukraine. The proposed measures will save water resources up to 30% through the use of portable moisture meters to control soil moisture and the no-till technology; increase the soybean yield by up to 14% by spraying plants of salicylic acid. It was determined that the density of soybean plants during the growing season decreased on variants with traditional technologies in comparison with no-till the deviation makes almost 6%. The soybean water consumption coefficient in the experiment varied significantly in the range from 1,710 to 2,330 m^3/t. Soybean plants used water reserves most rationally in variants where traditional technologies were used. The average increase in yield according to the experiment under traditional technologies was 5.4%, with no-till was 20.3%. In terms of economic and bioenergy efficiency, no-till does not have significant advantages over traditional technologies. Reduction of costs in the introduction of no-till for energy consumption of machinery, fuel, electricity is fully offset by the growth of indirect energy costs, in particular, the cost of herbicides, due to high weed infestation of uncultivated crops.

Key words: *soybean, salicylic acid, yield, economic efficiency, energy efficiency*

INTRODUCTION

Soybean has been actively grown in Ukraine for more than 10 years. Still for now, it has not yet been fully explored and time-tested cultivation technology has not yet been developed. At the same time, interest in soybean cultivation is growing in all soil and climatic zones of Ukraine [40].

The consequences of global climate change are becoming more tangible in the world, and also in Ukraine. Over the last 20 years, the average annual temperature has increased by 0.8 ° C, and the average temperatures in the winter months by 1-2° C. Due to climate change, weather conditions are becoming more severe. In summer, record daytime temperatures up to + 45º C and a sharp decrease at night, sometimes up to + 10-15º C are recorded. The heavy rains are also recorded. Moisture deficiency is one of the main problems in growing agricultural crops, including soybean. Reducing the amount of precipitation in the winter time, increasing the frequency of droughts in the springtime, sharp changes in temperature during the day lead to an increased risk of plant death in the early stages of ontogenesis. The losses of Ukrainian farmers from drought, in the context of climate change, in some years exceed 20 billion UAH per year [19, 31]. But despite this, farmers rely on soybean and consider it the main legume of world agriculture in the XXI century and emphasize that it is the focus of world agricultural science and production [33].

Today, soybean ranks fourth in the world in terms of production after corn, wheat, and rice. According to its chemical composition, the seeds contain an average of 39% protein, 20% semi-drying oil, 24% carbohydrates, 5% ash elements with a predominant content of phosphorus, potassium, and calcium, as well as human and animal bodies, need various enzymes, vitamins (A, B, C, D, E) and other important organic and inorganic substances. Soybean absorbs nitrogen from the air, leaves behind 60-90 kg/ha of biologically fixed nitrogen, improves soil structure, and it is a good precursor for subsequent crop rotations.

Over the past 50 years, world soybean production has grown from 26.9 million tons to 263 million tons, an increase of almost 10 times, with a population growth of only 2.2 times.

Compared to last year, the soybean harvest increased by 500 thousand tons is up to 4.3 million tons. Such volumes will allow Ukraine to take 8th place among world soybean producers, and 7th place of export indicators [41].

Today, scientists are proposing two ways to reduce agricultural losses due to drought (i) the introduction of sustainable crops varieties; (ii) the plants' treatment with substances that increase their resistance to drought [1, 21, 32, 13, 34, 37]. Also, important to develop and implement in the production of scientifically modern, competitive technologies for growing and using the potential of new and promising varieties.

It was found that some phytohormones, vitamins, polyamines, phenolic compounds, synthetic compounds of the triazole group, plant extracts, humic acids, etc. may be inducers of drought resistance of plants [17, 35, 36]. Main attention is paid to ascorbic, salicylic acids, and flavonoids, which are natural substances that do not pollute the environment and agricultural products [13, 5, 15].

Salicylic acid in the plant body performs a number of regulating and signaling functions, but its role is most fully expressed by the action of stressors of various natures [20]. In particular, one of the most important effects of salicylic acid is the possibility of tolerance to the damaging effect of abiotic stressors, such as salinity, drought, heavy metals, etc. [17, 29].

There are many studies that have shown that the effects of salicylic acid and other salicylates in many biological processes in plants [16, 22]. Larque-Saavedra [22] used different concentrations of the substance to test the effect on plant leaves. Also, he recorded significant reductions in transpiration and closed of plants' stomata [16, 22]. It was found that soybean respond to drought, especially during the period of flowering to the formation of beans [18], and also confirmed that water stress during the flowering period reduces soybean yield by 43.9% [10].

Salicylic acid used for soybean spraying according to scientists from Tabriz University, Iran showed an improvement in plant biomass of 10% and yield increase to 17% [3].

Likewise, an important feature of soybean growing are soils and fertilizer systems.

According to research [3, 2], deep furrow plowing for soybean after winter wheat growing on soil with heavy mechanical composition improves its aeration, promotes moisture accumulation, better plant growth and development, more incredible leaf surface formation, better branching, and bean formation efficiency, and the result is a yield increase of soybean. For the central areas of the Steppe zone in Ukraine, the following tillage system is recommended peeling to a depth of 6-8 cm after harvesting the predecessor, re-peeling in the event of rain and weed emergence, and deep plowing to 30 cm in III decades of September or I decade of October [2**Error! Reference source not found.**]. The same tillage system of basic tillage operation is proposed by other researchers [25, 6]. However, the main tillage should not allow over-compaction of the arable layer of heavy soils, which bring cracking, changes of soil structure, especially important for the irrigated lands of the south of Ukraine. Recently, most farmers are switching to more economical and ecology-friendly technologies.

In countries of intensive agriculture, the system of minimum tillage (mini-till) has become widesprea. The reduction in tillage intensity differs significantly even in Europe, Great Britain, Denmark, and the Scandinavian countries, where the traditional depth of the main tillage is 15-20 cm, with the most

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

common shallow tillage up to 15 cm [27].
In European countries have the classification of soil suitability for minimum tillage and direct sowing has been developed.
Today is very important to scientific substantiation of the most economical and environmentally friendly tillage systems in combination with other components of the agricultural system and their impact on improving soil fertility and product quality. In recent years, the technology of growing crops without mechanical tillage has been gradually spreading, which is often ineffective on soils of heavy mechanical composition, according to some scientists and explains that this technology is not suitable for all types of soils and climatic conditions. In particular, no-till does not work on soils of heavy mechanical composition in combination with arid conditions [4, 28, 26].
Study results show that the use of direct sowing in such conditions gives a yield of sunflower by 58.6% less than the traditional technology, and sorghum by 36.8%. At the same time, on lighter soils, for example, southern chernozems and especially ordinary chernozems, the use of no-till does not significantly reduce the yield of sorghum and sunflower, and in some wet years, it is even at the yield level when used the deep plowing [4].

MATERIALS AND METHODS

The experimental plot was established at the State Enterprise "Research Farm "Askaniyske" Askaniyska State Agricultural Research Station of the Institute of Irrigated Agriculture of National Academy of Agrarian Science of Ukraine (latitude 46°55'16.72"N, 33°82'20.49"E). The research territory is characterized by low rainfall, low humidity, frequent dry spells, warm autumn, and winter, as well as a long frost-free period. The average annual air temperature in the region is + 9.8 °C, the lowest is in January minus 3.2 °C, the highest is in July + 22.5 °C). The sum of positive temperatures for the warm period of the year (above 0 °C) is 3,800 °C. The sum of positive temperatures for the vegetation period (above + 5 °C) is 2,400 °C, the sum of active temperatures (above + 10°C) is 3,200°C. The average number of days with a temperature of + 25 °C and above is 80. The duration of the frost-free period in the air is 200 days, on the soil surface 180 days.
Among winter temperatures, the average number of days with a temperature of minus 10°C and below occurs up to 20 days, below minus 25°C is a very rarely to 1-2 days. In winter time there are up to 60 days with thaws. The average of the longest thaws are 22 days.
In summer time, precipitation falls unevenly. Rains are often showers and accompanied by hail, thunderstorms, and storms. On average, rains with thunderstorms are up to 26 days, with hails are up to 2-3 days.
The total evaporation during the summer period is 160 mm, which exceeds the amount of precipitation. The humidity factor is less, so the area belongs to the regions of insufficient natural moisture. The average annual relative humidity is 73%.
The soil of the study area is dark chestnut slightly saline light-clay. The mechanical composition of the arable layer (0-30 cm) is light-hearted. The presence of fractions of coarse dust is 38.18%, silt is 34.10% (Table 1).

Table 1. Mechanical composition of the soil

Depth of soil, cm	Fraction size (mm), quantity,%						
	1.00-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	< 0.001	< 0.01
0-20	0.15	4.98	38.18	10.84	11.75	34.10	56.69
40-50	0.07	4.53	35.85	10.23	10.39	38.93	59.55
55-61	0.12	2.36	37.09	10.12	12.93	37.38	60.43
80-90	0.08	1.83	39.39	8.96	11.95	37.79	58.70

Source: original data calculated based on the experimental data obtained.

The amount of organic matter in 0-30 cm layer is consist of 3.20% and changes in the deeper soil profile in the range of 3.04-3.24%. The reaction of the soil solution is alkaline (pH 7.4-8.7).
The soil bulk density in 0-30 cm is 1.17-1.26 g/m^3, with deeper layers is fixed increasing the bulk density to 1.52 g/cm^3. The total moisture content of the arable layer is 42.2-47.7%, the maximum field capacity is 26.5-30.4%, which are lower down in profile are

decreased to 29.6 and 21.8%, respectively. The coefficient of moisture yield of the arable layer is 40.5-46.0%, aeration is 19.8-20.7%.

The total amount of water absorbed for the first time was 91.2 mm. Water permeability changes gradually from very high (absorption coefficient 0.005166 cm/sec) in the first 10 minutes of determination to medium (absorption coefficient 0.001693 cm/sec) in 7 hours after the start of determination.

The total moisture reserve, with the corresponding maximum field moisture capacity in layer 0-30 cm is 1,000 m^3/ha, for the layer 0-50 cm is 1,700 m^3/ha.

The field experiment was conducted in three replications with the split-plot method. The study was dedicated to the evaluation of the following cultivation technology elements are tillage technologies and spraying treatment of plants. The tillage system, where were compared no-till with the traditional tillage system, the last one included plowing to a depth of 28 cm, disking to 12 cm, pre-sowing cultivation to a depth of seed earning up to 6 cm. Another factor of research treatment was, where compared plots with salicylic acid spraying and non-spraying.

Internet meteorological station from i-Metos of Pessl Instruments was used to collect and analyze weather data during growing season on the research area. The meteorological station records the following indicators: surface soil temperature, solar radiation, precipitation, wind speed, air temperature, relative humidity, dew point and evaporation. Data is recorded every hour and stored on the server. Additionally, the non-uniformity of precipitation was recorded with measuring cups.

The generally accepted methods of conducting field experiments and performing laboratory experiments during the research were guided. The appropriate observations, measurements and analysis of soil and plant samples were accompanied. Remoute sensor (RS) methods was used.

The Least Significant Difference (LSD) test was used to separate the means of the dependent variables in response to predictor variables at $p \leq 0.05$ unless otherwise mentioned.

The economic efficiency of soybean with the generally accepted method using zonal production standards was determined [11, 30 14]. Calculations of bio-energetic efficiency according to the guidelines of bioenergy assessment of crop production technologies were performed [8, 12, 23, 24, 42].

Diona is a soybean variety was sown, which is characterized by increased adaptability to adverse growing conditions. It belongs to the group of very precocious varieties (81-85 days). The variety belongs to the subspecies Manchurian, albo-sublutea variety, approbation glauca group, plant height is 70-90 cm, laying the lower beans up to 12-14 cm bush compressed, and compact. The leaves are narrow, dark green. The color of the flowers is white. The pubescence of stems and beans is gray. Seeds round-oval, yellow, light seed scar with eye. The color of the beans is light yellow, mostly three- and four-seeded.

Soybean growing techniques were generally recognized for the irrigated conditions of the Southern Steppe of Ukraine, with the exception of the studied cultivation techniques. After harvesting the predecessor (corn), double disking of stubble was performed to a depth up to 12 cm. The traditional tillage according to the experimental scheme was performed. Mineral fertilizers at a dose of N_{21} were applied under pre-sowing cultivation. Ammonium sulfate (N-21, S-24%) was used as fertilizer. Pre-sowing tillage was performed at the depth of seed wrapping up to 6 cm using the John Deere 960. There were 13 irrigations with a Renkel sprinkler, the irrigation rate fluctuated in the range of 250-400 m^3/ha, with total irrigation rate of 4,400 m^3/ha. Salicylic acid spraying was carried out in the phase of the appearance of the third trifoliate leaf and the phase of bean formation. Integrated plant protection against weeds, pests, and diseases was used during the growing season. Harvesting was carried out by John Deere T660.

RESULTS AND DISCUSSIONS

Extremely important indicators in the study of tillage technologies are biometric indicators of plants. It gives the opportunity to analyze the condition of the plants and also count the harvest.

The vegetation cover of the territory was quantified using RS and analysis of the Normalized Difference Vegetation Index (NDVI). This index is a simple quantitative indicator of the magnitude of photosynthetic active biomass, commonly referred to as the vegetation index. According to the obtained experimental data, the vegetation density at a certain point in the image is equal to the difference between the intensities of reflected light in the visible and infrared range divided by the sum of their intensities.

It was found that the vegetation density during the season varied in the range of 0.83-0.08. The change in the density of vegetation cover is well traced to the average value (Fig. 1).

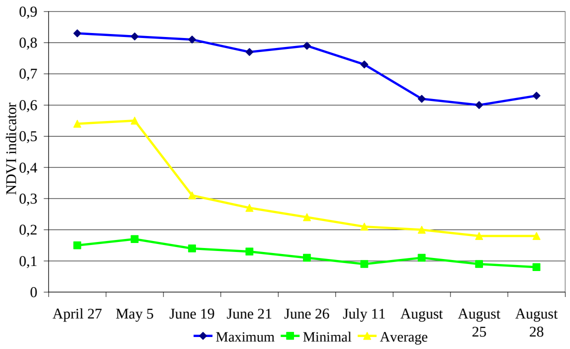

Fig. 1. Dynamics of the Normalized Difference Vegetation Index (NDVI) during the growing season
Source: original data calculated based on the experimental data obtained.

The sharp decline of this indicator in the period of May-June shows the sensitivity of this index and is due to the presence of weeds in the field, which was detected by visual inspection of areas.

The value of total water consumption in our experiments was 4,400 m^3/ha (Table 2).

Table 2. Soybean moisture use efficiency depending on the soil tillage and plant treatment

Methods of soil tillage and plant treatment	Water consumption ratio, m^3/t
Traditional tillage (control)	1,810
Traditional tillage (salicylic acid)	1,710
No-till (control)	2,330
No-till (salicylic acid)	1,860

Source: original data calculated based on the experimental data obtained.

The determined coefficient of water consumption indicates the saving of water consumption by plants to create the unit of yield. Researchers have found that the water consumption rate decreased significantly with the application of fertilizers with a well-balanced ratio of nitrogen, phosphorus, and potassium. In more productive years it is less than in less productive years.

The soybean water consumption coefficient in the experiment varied significantly in the range from 1,710 to 2,330 m^3/t. Soybean plants used water reserves most rationally in variants where traditional technologies were used. Studies have also shown that salicylic acid spraying also affected water consumption.

According to the results of research, the tillage system and treatment of plants with salicylic acid significantly affected the soybean yield. Depending on these parameters, soybean yields ranged from 1.64 to 3.11 t/ha.

The lowest yield was recorded in the variant under no-till 1.89 t/ha, which is 22.2% lower than with traditional tillage (Table 3).

Table 3. Soybean grain yield depending on the method of soil tillage and plants treatment, t/ha

Methods of soil tillage and plant treatment	Yield, t/ha
Traditional tillage (control)	2.43
Traditional tillage (salicylic acid)	2.57
No-till (control)	1.89
No-till (salicylic acid)	2.37
LSD_{05}	0.049

Source: original data calculated based on the experimental data obtained.

Salicylic acid spraying increased soybean yield in all variants. The average yield increase with traditional technology was 5.4%, for no-till was 20.3%. In general, salicylic acid spraying increased yield up to 14%. Effective functioning of any production system is impossible without a rationally built and efficient mechanism for obtaining the financial results of economic activities. At the same time, the only significant source of reproduction of the working capital of an agricultural enterprise is the sale of its main products [38].

In modern conditions of agriculture, an important requirement for the elements of cultivation technology, which are developed and implemented in production, need to reduce energy costs, unit cost and increase profits. Production of crop products in conditions of scarcity of resource potential requires a revision of the approaches that existed in the distribution-planned economy for the distribution of production costs in the development of technologies for growing crops [7]. Improving the efficiency of agricultural production requires radical improvement of technologies for growing crops, providing them with the necessary logistical and financial resources, clear implementation of all technological techniques in the relevant agro-technical terms. Soybean growing technologies are based on the achievements of science and best practices of the best domestic agricultural enterprises, as well as take into account global trends in agricultural production. Technologies are offered and the economic estimation was presented about results at various tillage technologies and plants treating with the use of traditional most widespread samples of domestic techniques with the application of a necessary complex of fertilizers and means of plants protection. The calculation of indicators of soybean economic efficiency growing by different technologies is presented in Table 4.

Table 4. Indicators of economic efficiency of soybean growing with different tillage technologies and plant treatment

Indicators	Traditional technology		No-till	
	Soybean (control)	Soybean (salicylic acid)	Soybean (control)	Soybean (salicylic acid)
Grain cost, UAH/t	8,631.3	8,235.5	9,146.5	7,487.3
Costs and invoices, UAH/ha	20,973.95	21,165.16	17,286.80	17,744.81
Profit, UAH/ha	3,326.05	4,534.84	1,613.20	5,955.19
The level of production profitability, %	15.86	21.43	9.33	33.56

Source: original data calculated based on the experimental data obtained.

There are several reasons for implementing the new system of agriculture (i) economic, which saves spare parts, fuel, wages, and labor, (ii) agronomic, which improves the water regime of the soil, (iii) environmental, which reduces CO_2 emissions from the soil by binding carbon to soil organic matter, as well as reducing degradation soils by stabilizing erosion processes.

During the analysis, the cost of 1 quintal of soybeans in traditional technologies without spraying (control) was 5.6% lower than in no-till, in the variant with spraying on the contrary the cost of products in traditional technologies is 9.1% higher than under no-till.

The profit from the sale of products on the variant under no-till with salicylic acid spraying is higher than on other variants; it was by 44.1% compared to traditional technologies (control) and by 23.9% on traditional technologies with spraying.

The highest level of profitability of 33.56% was obtained under the no-till and salicylic acid spraying, the lowest was 9.33% under no-till without spraying (control).

Widespread use of intensive technologies has led to increased consumption of fuel, electricity, chemicals, and protection and, as a result, energy costs. Modern science-based technologies must be energy-efficient and rationally use both non-renewable and natural renewable energy, as well as perform environmental functions [39].

According to the scientists' results [9], the most complete assessment of the effectiveness of technology is the bioenergy methodology, which quantifies and analyzes the processes of transformation of free energy flows in agricultural landscapes. Production technologies should ensure the fullest use of natural agri-energy resources while reducing the specific costs of anthropogenic energy per unit of output and preventing negative impacts on the environment.

Energy analysis allowing to develop and evaluate the effectiveness of resource- and energy-saving technologies. The indicator of energy efficiency in different models of soybean growing technologies can be a decisive and equivalent criterion for the efficiency of grain production of this crop, which was determined by energy analysis. This analysis was performed to determine the degree of using fertilizers, pesticides, irrigation water, fuels and lubricants, various types of units of the machine-tractor fleet, natural resources, soil and climatic conditions, solar radiation, and other factors affecting soil fertility and crop formation.

Indicators of bioenergetic efficiency of soybean growing with salicylic acid spraying are much higher than in the control. The energy efficiency ratio in the version with no-till and spraying is 1.57, which on 9.6% higher than under traditional technologies with spraying. The energy intensity of 13.4 GJ/t was obtained on the variant under no-till (control), which is 3.7% less than on the variant with traditional technologies (control).

From the energy point of view, the technology is considered effective if the planned level of crop yield provides the condition Ev> Eo; Ke≥1.0, which is confirmed by the data presented in Table 5.

Table 5. Indicators of bioenergy efficiency of soybean growing with different tillage and plant treatment

Indicators	Traditional tillage		No-till	
	Soybean (control)	Soybean (salicylic acid)	Soybean (control)	Soybean (salicylic acid)
Energy yield, GJ/ha	42.99	45.46	33.43	41.93
Energy consumption, GJ/ha	31.34	32.03	25.40	26.69
Increse of energy, GJ/ha	11.64	13.44	8.04	15.24
Energy efficiency ratio	1.37	1.42	1.32	1.57
Energy consumption, GJ/t	12.9	12.5	13.4	11.3

Source: original data calculated based on the experimental data obtained.

At the same time, it should be noted that energy costs for tillage are not crucial. They range from 20-30%, and the fuel component is only 10-20%, and their reduction by excluding certain technological operations, or using no-till does not have a decisive impact on the total amount of total anthropogenic energy used in crops.

CONCLUSIONS

Large losses of traditional technologies accompained by soil plowing, repeated deep pre-sowing and post-sowing cultivation, encourage the establish under no-till, which have no mechanical impact on the soil, and all plant residues remain on the surface, which in turn will increase yields and reduce costs.

It was determined that the density of soybean plants during the growing season decreased in two ways; on variants with traditional technologies in comparison with the variant without processing the deviation makes almost 6%. In addition, the data was confirmed using RS.

The soybean water consumption coefficient in the experiment varied significantly in the range from 1,710 to 2,330 m^3/t. Soybean plants used water reserves most rationally in variants where traditional technologies were used.

It was determined that the factors in the research, namely tillage, and treatment of plants with salicylic acid significantly affected the soybean harvest. The average increase in yield according to the experiment with traditional technologies was 5.4%, with no-till was 20.3%. Salicylic acid allowed an increasing yield of 14%.

In terms of economic and bioenergy efficiency after one year of research, no-till do not have significant advantages over traditional tillage. The reduction of costs in the introduction of no-till for energy consumption of machinery, fuel, electricity is fully offset by the growth of indirect energy costs, in particular, the cost of herbicides, due to high weed infestation of uncultivated crops. It should be noted that with the long-term use of no-till, the situation may change for the better.

ACKNOWLEDGEMENTS

This research was performed within the framework of the International Project "Impact of Sustainable Agricultural Management Practices on Soil Quality and Crop Productivity" with the support of the U.S. Civilian Research & Development

Foundation (CRDF Global) under the Grant Agreement FSA3-18-63886-0 and the Ministry of Education and Science of Ukraine (MES).

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MATHEMATICAL-ECONOMIC METHODS FOR STUDYING DATA ON HOUSEHOLD CONSUMPTION OF FOUR BASIC FOOD PRODUCTS

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Abstract

The article presents mathematical-economic methods for studying data on household consumption of four basic food products in Bulgaria for the period 2004-2020. The mentioned information concerning meat, yoghurt, potatoes and dry beans has been structured and saved in a built relational database. Certain sets of criteria are used to form queries from the database. Subsequently, the obtained information from the queries has been processed. The pace of growth, respectively decrease of the considered indicator for the listed products has been analyzed. Hierarchical cluster analysis has been applied to these data on household consumption, average per person. The results showed a relative increase of the indicator for two foods (meat and yoghurt) during the last five years of the period. The indicator values for potatoes declined significantly for 2012-2017. The same dependence has been established for dry beans from 2011 to 2015. Grouping the indicated foods according to the values of the household consumption shows two clusters. Three clusters are obtained by grouping the relevant years according to the values of this studied indicator.

Key words**:** *analysis, data processing, relational database, basic food products, household consumption*

INTRODUCTION

Different organizations use significant amounts of data in their daily practice. The provided information should be complete, accurate and comprehensive (Kostagiolas, P., 2006 [8]). The mentioned requirement is not met in certain cases. The main reason is that the data are located in different sources and file formats. The data can be structured into relational databases. The study of Jatana N., et al., 2012 [6] notes that "A relational database is a collection of data items organized in formally-described tables from which data can be accessed or reassembled in many different ways" [6]. Relational databases often are used for storing different economic and financial data. According to Dongare Y. V., et al., (2011) [4] "success of relational database modeled for a given enterprise is depending on the design of relational schema" [4]. In addition, modern information technology offers powerful tools and approaches for data processing in each area [3].

National Statistical Institute of Bulgaria provides information concerning household consumption of certain foods [11], [12], [13] on its website [10]. The indicated data are extracted and entered into a built relational database [1], [2]. In this regard, a new relational scheme (Household consumption) has been created. As can be seen from figure 1, it contains eight attributes. Seven of them are strictly informational. The relational scheme Type of foods [1], [2] has been related to the mentioned above scheme. New information concerning consumption of the indicated products for the first, second, third and fourth quarters of each of the considered years, as well as the total quantities has been entered in chosen database tables.

One of the advantages of the database is the opportunity to expand it. Specially for the users, this process is quite important, as it allows the necessary additions and changes to be made. New records can be entered in selected tables, as well as new relational structures can be designed. The database provides relatively faster access to the listed objects, which are saved in certain tables. As a whole, it contains 9 relational schemes (Fig. 1). Different sets of criteria are used to form queries from the database. The obtained information from the queries can be analysed.

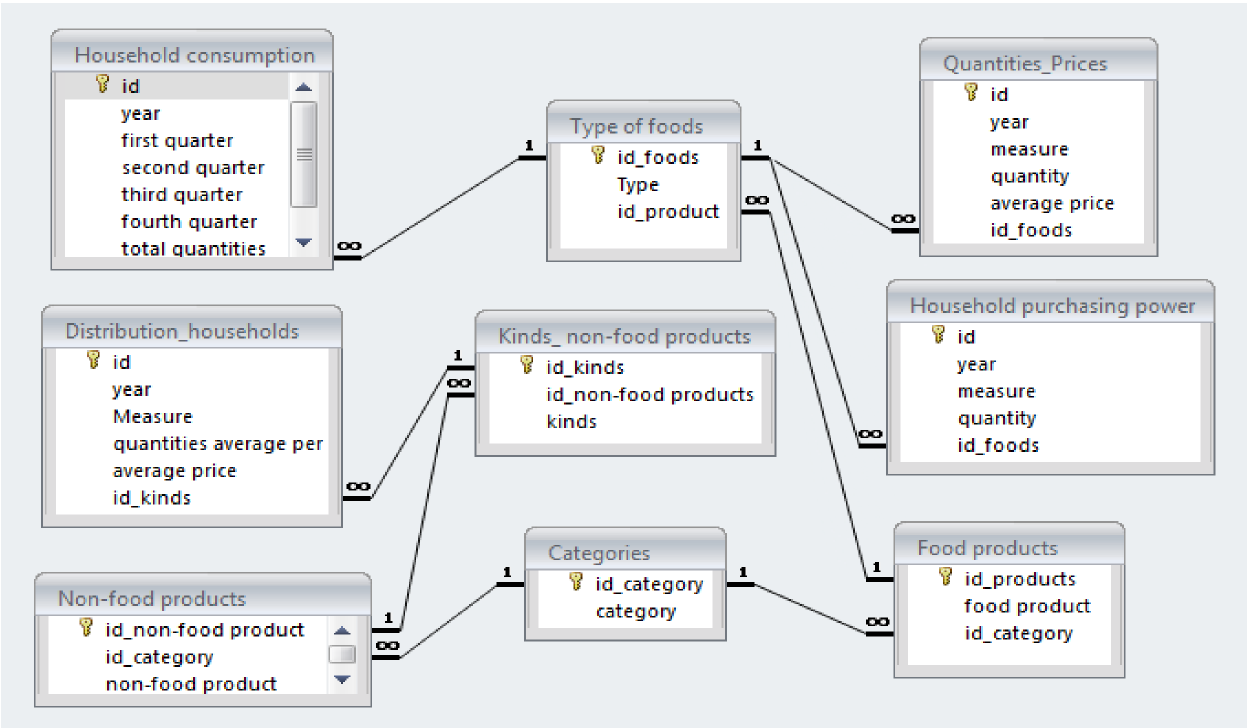

Fig. 1. General scheme
Source: Own conception.

The aim of this article is to present the application of mathematical-economic methods for studying data on household consumption of four basic food products in Bulgaria for the period 2004-2020.

MATERIALS AND METHODS

The designed database contains information related to various foods for twenty years interval. A part of them are considered in the current paper. The household consumption, average per person is investigated for the following basic foods:
- Meat;
- Yoghurt;
- Potatoes;
- Dry beans.

The characteristics of the listed objects have been entered into several fields located in different database tables. Certain subsets of data can be searched and found [14] through using different queries. Practically, they include the following components:
- Household consumption of the four foods, average per person during selected years;
- Chosen values of the attribute (household consumption) for the examined time interval;
- Household consumption of the given element (foods) for each quarter of the indicated year from the period.

The obtained data from the queries should be processed and summarized. In this regard, it is necessary to find:
- The sum (T_i) of the consumption of each product for the seventeen years time interval

$$T_i = \sum_{j=1}^{17} h_{ij}$$

where: h_{ij} - household consumption of i^{-th} food product during j^{-th} year, 1<=i<=4, 1<=j<=17;
- The sum (A_j) of the consumption of the four foods in a given year from the mentioned period

$$A_j = \sum_{i=1}^{4} h_{ij}$$

- The variable (W_{ij})

$$W_{ij} = \frac{h_{ij}}{h_{ij-1}}$$

where: h_{ij} and h_{ij-1} household consumption of i^{-th} product during $(j-1)^{st}$ and j^{-th} year, 2<=j<=17;

- The variable (V_i)

$$V_i = \frac{T_i}{j}$$

where: j=17, 1<=i<=4;

- The relative share (N_{ij}) of household consumption of the considered product for one year to the total household consumption of this product for the indicated period:

$$N_{ij} = \frac{h_{ij}.100}{\sum_{j=1}^{17} h_{ij}}$$

- The relative share (B_i) of household consumption of the indicated food type to the total household consumption of the studied foods for the seventeen years interval:

$$B_i = \frac{\sum_{j=1}^{17} h_{ij}.100}{\sum_{w=1}^{4} T_w}$$

The dynamics of change of the mentioned indicator for the listed four products (meat, yoghurt, potatoes and dry beans) was investigated. The listed foods were grouped according to the values of the indicator (household consumption, average per person) through using the hierarchical cluster analysis [16], [7].

The MS Excel program [9] and software R Commander [5], [15] were applied for data processing. The obtained results were discussed and the relevant conclusions were presented for the seventeen years time interval.

RESULTS AND DISCUSSIONS

Data related to the household consumption in Bulgaria for the considered four food products were studied in the period from 2004 to 2020. Certain queries were defined in order to find and extract chosen set of objects from the built database. These elements were searched from ten fields located in four related tables. The found information about each of these four foods were evaluated and compared in the relevant time intervals. The dynamics of change of the indicators were also tracked and analyzed for the given period.

The calculations show that the pace of growth of the variable A_j is more intensive for the first seven years. Practically, the total household consumption of the listed foods increased by 13.7 kg. The sum A_j over the next five years is relatively smaller. The levels of the examined indicator from 2010 were reached only in 2018-2020.

In the first half of the period the values of the second variable W_{ij} (i=1, 2<=j<=8) belong to the interval (1; 1.09). This means that the household consumption of meat average per person grow (Fig. 2). This process continues during 2013-2015 and 2017-2020, where the growth pace is slower.

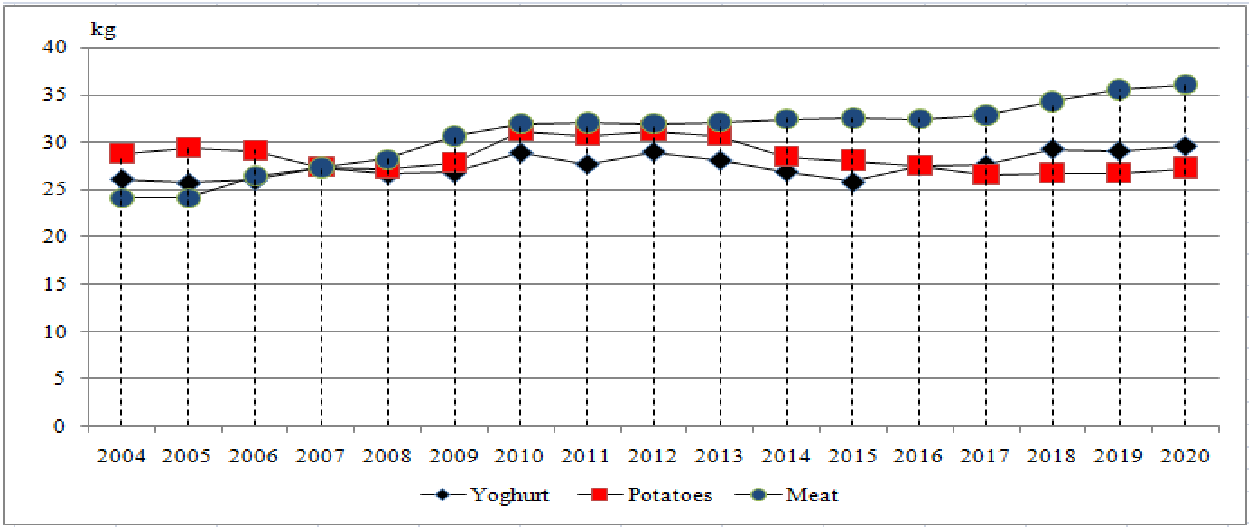

Fig. 2. Dynamics of household consumption for the examined three foods
Source: Data from [10, 11, 12, 13].

The situation for the studied data about the household consumption of yoghurt average per person was different. The indicator changes quite dynamically from 2004 to 2014. It grows or decreases in very small periods, which include one or two years. Over the next three years, the values of W_{ij} (i=2, 10<=j<=12) vary in range from 0 to 1. The obtained decline here is approximately 8%. This means that household consumption of yoghurt is reduced by 2.3 kg. The indicator for 2020 reached higher levels by about 7%.

The evaluation for the third considered element showed one decrease of 14% for the five years period (2013-2017). Therefore, the household consumption of potatoes average per person reduced by about 4.6 kg. Similar results were obtained for 2006-2008, where the variable W_{ij} (i=3, 3<=j<=5) is less than one. It should be noted that the decline here is only 2.3 kg. The growth pace of the indicator for the potatoes is much faster in the years 2009-2010 in comparison with the years 2018-2020, as can be seen from Fig. 2.

The processed data for the dry beans are quite more different. The values of the variable W_{ij} (i=4, 5<=j<=6, j=8 and j=17) are equal to 1 in some years of the studied period. Then, the household consumption of dry beans average per person remained unchanged in 2007-2009, 2010-2011 and 2019-2020. The levels of the studied indicator marked a huge increase of about 25% for 2010. As is shown in Fig. 3, the decrease pace is slower for 2012-2015.

The present work calculates the total sum of the consumption of each one product (T_i) for the seventeen years period. Invariably, the highest value of T_i (i=1) is obtained for the meat (526.1 kg). The found values for the next two foods (yoghurt and potatoes) are 468 kg and 485.4 kg, respectively. Quite naturally, the value of T_i (i=4) is the lowest for the dry beans (71.700 kg).

The presented results for the variable B_i (1<=i<=3) showed close percentages for three of the considered elements (meat, yoghurt and potatoes) (Fig. 4). The share of dry beans is about 6 times smaller than the share of listed foods.

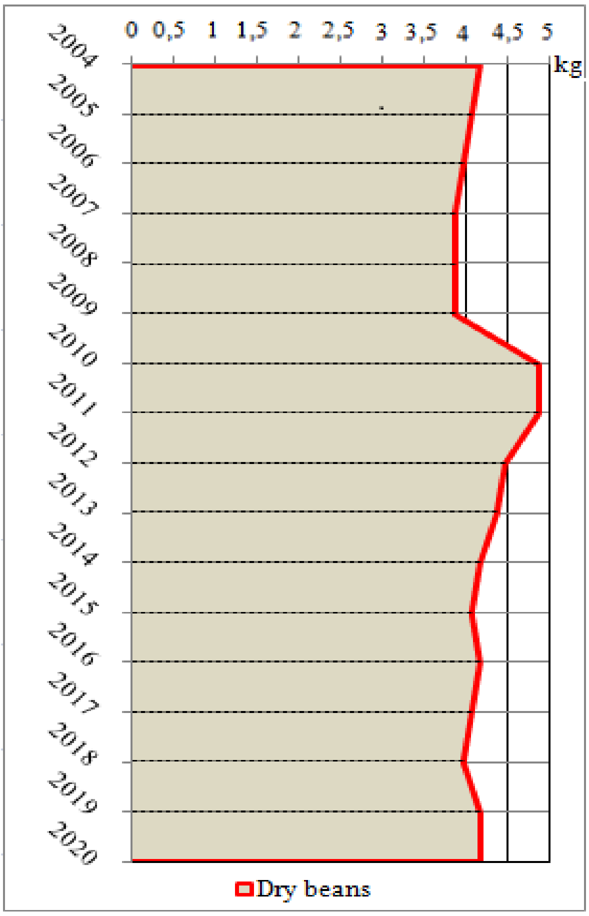

Fig. 3. Dynamics of the indicator for dry beans
Source: Data from [10, 11, 12, 13].

In addition, the average consumption of each product V_i for the investigated period was found. The value of the indicator for the meat is 30.947 kg, while for the other three foods (yoghurt, potatoes and dry beans) - 27.529 kg, 28.553 kg and 4.218 kg respectively.

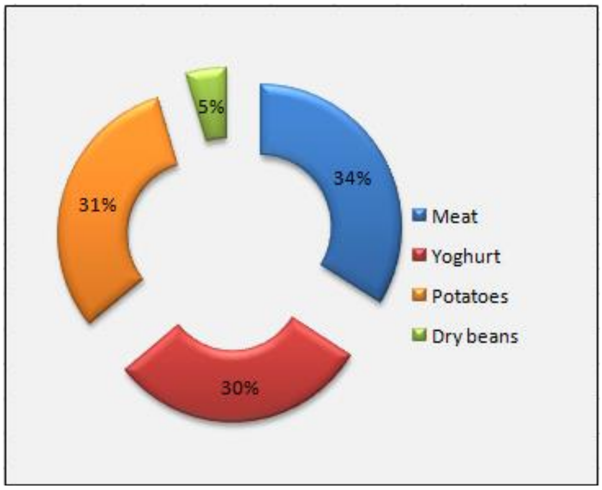

Fig. 4. The shares of the household consumption of considered four foods
Source: Own calculations on the basis of data from [10, 11, 12, 13].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The current paper also studies the share of household consumption of a given food product for each year to the total household consumption of that product for the considered time period. Table 1 visualizes the results from the respective calculations. Generally, the surveyed variable N_{ij} for two of the foods (yoghurt and potatoes) varies in range from 5.48% to 6.43%. For the other two foods - meat and dry beans the mentioned variable is changed between 5.44%-6.83% and 4.60%-6.86%, respectively.

Table 1. Calculated values of relative shares N_{ij} (%)

Year	Meat	Yoghurt	Potatoes	Dry beans
2004	4.60	5.58	5.93	5.86
2005	4.60	5.49	6.08	5.72
2006	5.04	5.56	6.02	5.58
2007	5.21	5.83	5.64	5.44
2008	5.38	5.68	5.60	5.44
2009	5.84	5.73	5.75	5.44
2010	6.08	6.18	6.43	6.83
2011	6.10	5.92	6.35	6.83
2012	6.08	6.20	6.43	6.28
2013	6.12	6.00	6.35	6.14
2014	6.18	5.75	5.87	5.86
2015	6.20	5.51	5.79	5.72
2016	6.18	5.88	5.67	5.86
2017	6.25	5.90	5.48	5.72
2018	6.52	6.26	5.50	5.58
2019	6.77	6.22	5.50	5.86
2020	6.86	6.32	5.62	5.86

Source: Own calculations on the basis of data from [10, 11, 12, 13]

The examined data related to the household consumption of the listed four foods average per person are grouped according to their values. For this purpose, hierarchical cluster analysis is used. The results from the processed information are presented in Table 2. Three of the considered foods (meat, yoghurt and potatoes) are included in one cluster. The next cluster contains only one product - dry beans.

Grouping the relevant years according to the household consumption of the considered foods is visualized in Table 3:

- Five of the surveyed years (from 2004 to 2008) form a cluster;
- The time interval 2014-2017 as well as 2009 are included in the next cluster;
- The third cluster contains the following years: 2010-2013 and 2018-2020. The indicator values here are the highest.

Table 2. The results from the processed data on household consumption, average per person

Cluster	**Studied foods**	**Household consumption (kg), average per person in 2004-2020**
1	Meat	526.000
	Potatoes	485.400
	Yoghurt	468.000
2	Dry beans	71.700

Source: Own calculations on the basis of data from [10, 11, 12, 13].

Table 3. Formed groups as a result from the performed analysis

Considered product types		
Cluster	Year	Total quantities (kg)
1	2004	83.300
	2005	83.500
	2006	85.700
	2007	86.000
	2008	86.00
2	2009	89.300
	2014	92.100
	2016	91.700
	2015	90.600
	2017	91.200
3	2012	96.700
	2010	97.000
	2020	97.200
	2018	94.300
	2019	95.600
	2011	95.500
	2013	95.500

Source: Own calculations on the basis of data from [10, 11, 12, 13].

CONCLUSIONS

The designed database contains information concerning basic foods in Bulgaria. They are organized in several fields located in the relevant database tables. Different queries have been used to extract and visualize the necessary information from the indicated database. Subsequently, the obtained subsets of data are processed and summarized.

The article presents application of mathematical-economic methods for studying data on household consumption of four basic foods (meat, yoghurt, potatoes and dry beans) in Bulgaria. The investigated period includes the years from 2004 to 2020. The presented results from the performed analyses showed the following:

- The pace of growth of this surveyed indicator for meat was faster during the first eight years from the period;
- A relative increase of the indicator for two of the considered foods (yoghurt and meat) was calculated for the last five years;
- The indicator values for potatoes declined significantly from 2012 to 2017, while for the dry beans in the period 2011-2015;
- Grouping the mentioned foods according to the household consumption presented two clusters;
-Three clusters were obtained by grouping the indicated years according to the values of this examined indicator (household consumption).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STUDY ON THE USE AND MARKETING OF PESTICIDES IN ROMANIA IN THE CONTEXT OF APPLYING THE FARM TO FORK STRATEGY

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Abstract

The use of pesticides represents a step forward for agriculture, in terms of the fight against the main diseases and pests, in order to ensure some productions destined for the market and implicitly for food safety. The world consumption of pesticides was captured in the main European Union countries highlighted in statistics such as NIS, Faostat, Eurostat and ITC, the position occupied by Romania being highlighted, in terms of quantities used and the surfaces on which they were applied (2010-2019). The comparative analysis of Romania's situation with the other member countries in terms of pesticides is presented in this paperwork in terms of the quantities of pesticides used, the areas with registered pesticides, imports and exports. At Romania's level, the analysis focused on the evolution of the main indicators that characterize pesticides, both at national level and at the level of the development regions, concluding that, at this level, pesticides are applied differently, depending on a series of exogenous and endogenous factors. But, the European agriculture and implicitly the one in Romania, must respond to a new challenge, that of reducing the quantities of pesticides used, according to the requests of the Farm to Fork strategy, component of the Green Deal, which requires that 25% of the agricultural area to be destined for organic agriculture and a 50% reduction in the use of pesticides, an aspect that we will detail in this scientific communication.

Key words*: *Farm to Fork Strategy, pesticides, consumption, areas with pesticides, import, export, Romania

INTRODUCTION

According to the specialized literature, pesticides are those substances that are used to remove pests and weeds that negatively impact agricultural crops. Thus, a pesticide can also be represented by an organism such as the bacterium "Bacillus thuringiensis". This bacterium is used in agricultural activity to control a certain number of insects [20].

The composition of pesticides refers to the following types of substances: herbicides; insecticides; insect growth regulator; therticides; nematicides; avicides; molluscicide; pesticide; rodenticides and antibiotic. The most commonly used are herbicides, which account for about 80% of the entire amount of pesticides used [3].

In modern agriculture, the use of fertilizers and pesticides is a necessity, because the world's population grows in geometric progression, being estimated that by 2050 it will reach 9.1 billion inhabitants. In these conditions, specialists in the field recommend increasing agricultural production by 70% [15, 16, 21].

It is necessary to specify that both the use of fertilizers and the use of pesticides cause, on the one hand, various imbalances to the environment and to the health of the population, and on the other hand, contribute to the increase of the expenses incurred by farmers [9, 10, 11,16, 21].

According to the researches carried out, it has been revealed that 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 [12, 17].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

According to a published study, it was shown that 64% of the areas used for agriculture, respectively for food crops in 168 countries, are prone to the risk of pollution with pesticides. Specialists in the field have pointed out that the use of large quantities of pesticides, on the one hand, will destabilize ecosystems, and on the other hand, will negatively impact the quality of water sources [2].

Photo 1. Culture to which pesticides are applied
Source: [14].

The total consumption of pesticides worldwide recorded oscillations from one year to another, during the period under analysis. In 2019, the total consumption of pesticides worldwide increased by 3.84%, compared to 2010 (Fig.1).

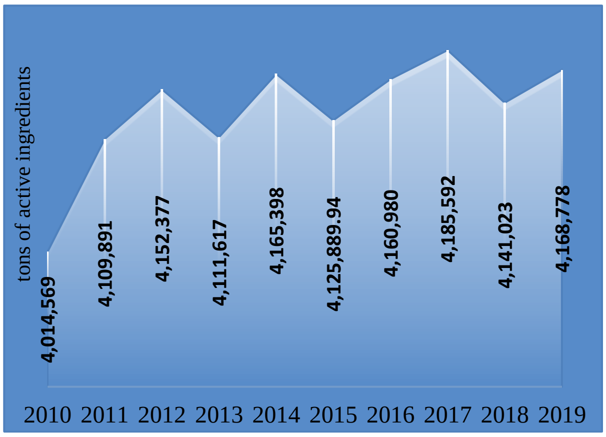

Fig. 1. Total consumption of pesticides worldwide during 2010-2019 (tons of active ingredients)
Source: [6].

The multiannual average for the period 2010-2019 of pesticides consumption indicates that more than half of all pesticides were used in Asia (52.58%), followed by Americas (31.84%) and Europe (11.75%) (Figure 2). The lowest pesticide consumptions were recorded in Africa (2.39% of the world total) and Oceania (1.45% of the world total).

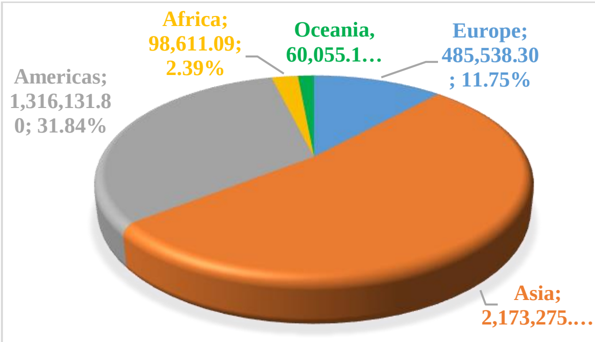

Fig. 2. Multiannual average (2010-2019) of total global pesticide consumption (tons of active ingredients, %)
Source: [6].

Pesticides are used by most countries that obtain agricultural productions, because they directly contribute to the destruction of pests that compromise crops. At global level, the ranking of the top 10 pesticide-using countries, according to the multiannual average (2010-2019), was the following: China (1,777,486.40 tons of active ingredients); USA (402,834.90 tons of active ingredients); Brazil (365,865.30 tons of active ingredients); Argentina (206,958.20 tons of active ingredients); Canada (79,445.20 tons of active ingredients); France (70,882.50 tons of active ingredients); Ukraine (60,281,00 tons of active ingredients); Italy (60,218.90 tons of active ingredients); Russian (59,122.70 tons of active ingredients) and Spain (56,101.90 tons of active ingredients) (Fig. 3).

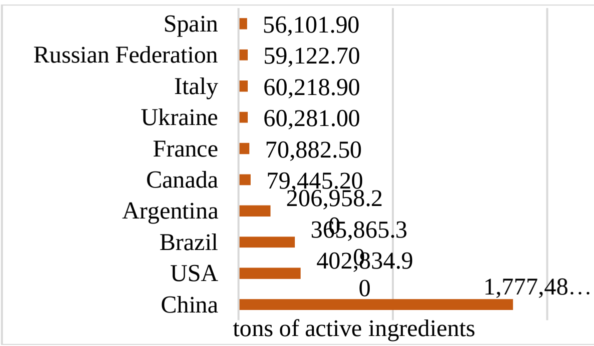

Fig. 3. Ranking of the top 10 pesticide-using countries by multiannual average (2010-2019) (tons of active ingredient)
Source: [6].

From the data presented in Figure 3, it can be seen that the countries of the European Union are found in the second half of this ranking, namely: France (6th place); Italy (8th place) and Spain (10th place). During the analyzed period.

According to published statistical data, more than 200,000 tons of pesticides are used in Europe to combat diseases, weeds and pests in agriculture [21].

In this context, the European Commission has published the strategies. From Farm to Consumer (Farm to Fork) and Biodiversity 2030. According to specialists in the field, these strategies will determine, on the one hand, a new way of obtaining food products, and on the other hand, farmers will have to adapt their production mode and the way of relating to the environment. The "Farm to Consumer" strategy aims to improve production, but also, sustainable food consumption through a holistic approach. The implementation of these strategies was determined by the need to mitigate climate change. In this respect, it is necessary to identify the most pertinent solutions that are in accordance with the objectives pursued [1, 4, 19].

Nowadays, reducing the consumption of pesticides is still a challenge for farmers, because, on the one hand, they must consider increasing agricultural production due to the increase in population, and on the other hand, they must not forget about the purpose of the activity of any economic agent, namely, increasing the profitability of agricultural activities [10].

At the level of the European Union, the aim is to obtain a sustainable use of pesticides by reducing, on the one hand, the risks, and on the other hand, the effects on the environment and the health of the population. In this context, the European Union states must consider the previously specified objective and are determined to include in their national plans quantitative targets related to pesticides. In order to measure the progress regarding the reduction of the risks, as well as of the effects of the pesticides, it was found the need for the existence of specific risk indicators. They must be valid at European Union level. Another important aspect to mention is that risk assessment is not a simple operation. This situation is due to the fact that the risks related to plant protection products are not homogeneous, they are correlated with the modification of specific factors such as:

-active substances that are part of plant protection products;

-their composition;

-the quantity used per hectare and the frequency of application;

-when, where and how farmers use them in their work.

In the European Union, the harmonization of the risk indicators was imposed, on the one hand, due to the need to make comparisons between the Member States, and on the other hand, in order to achieve a realistic evaluation of the EU policy.

In this context, according to the EU directive, member states have the obligation to:

-calculate the risk indicators;

-ascertain the needs for the use of active substances in plant protection products;

-identify those elements that require increased attention.

Currently, in the European Union there are two harmonized risk indicators. The first harmonized risk indicator was established on the basis of the sales of the active substance, and the second indicator was established based on the number of emergency authorizations granted (Fig. 4).

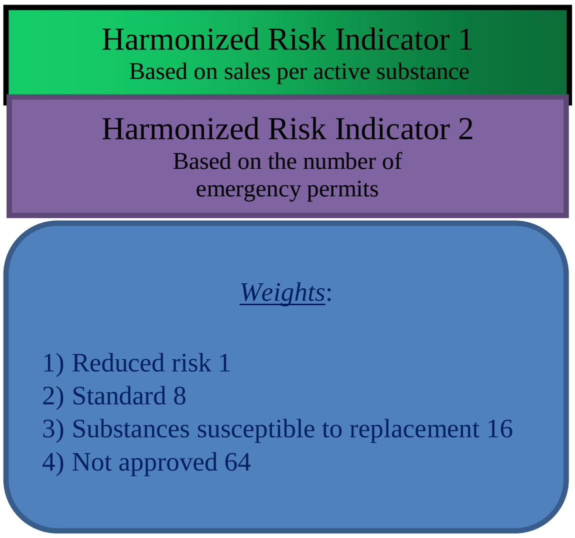

Fig. 4. Harmonized risk indicators
Source: [7, 18]

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
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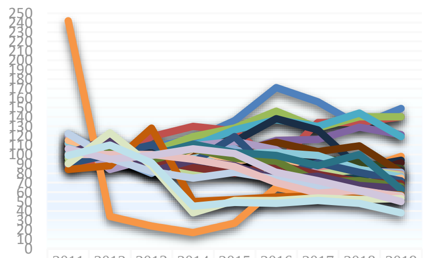
PRINT ISSN 2284-7995, E-ISSN 2285-3952

It is necessary to specify that the harmonized risk indicators evaluate the progress made regarding the achievement of the objectives aimed at reducing the risks and effects of the use of pesticides on the environment and human health. It also aims to promote the use of integrated pest management, but also alternative approaches to reduce dependence on the use of pesticides [7, 11, 18, 19].

The evolution of the harmonized risk factor in the European Union, between 2011 and 2019, is presented in Figure 5.



	2011	2012	2013	2014	2015	2016	2017	2018	2019
Estonia	88	104	108	116	136	171	156	131	149
Cyprus	89	93	119	130	125	89	134	134	140
Latvia	92	106	103	119	128	146	128	140	140
Austria	102	106	92	95	101	115	116	129	121
Finland	97	101	101	109	126	137	130	144	119
Bulgaria	242	34	24	17	27	65	56	83	98
Lithuania	96	102	102	103	114	138	126	86	94
Spain	112	90	98	107	107	88	68	78	91
Italy	115	101	85	90	102	99	96	91	85
Germany	107	100	93	97	98	94	91	82	83
Poland	115	94	91	96	98	98	89	78	81
Slovenia	111	99	90	99	103	113	103	109	81
UK	122	98	80	106	106	85	86	82	81
European Union	111	97	92	96	97	91	82	83	79
Slovakia	96	112	91	81	82	78	79	84	78
Ireland	120	84	96	109	114	105	79	69	77
Hungary	112	104	84	96	101	102	99	84	76
Portugal	115	103	82	106	93	99	72	66	75
Malta	90	100	110	92	119	76	91	81	72
Netherlands	104	102	94	86	80	89	79	71	69
Belgium	102	104	94	106	96	93	71	72	66
Sweden	101	117	82	94	88	74	77	67	64
France	102	99	99	111	102	99	88	100	63
Greece	84	88	128	50	52	55	56	59	57
Czechia	122	96	82	75	81	74	65	61	56
Croatia	100	100	100	95	87	70	59	62	55
Denmark	90	123	88	38	51	51	54	52	53
Luxembourg	106	95	99	106	101	81	72	62	50
Romania	99	110	91	45	49	48	51	48	38

Fig. 5. Evolution of the harmonized risk factor in the European Union, during 2011-2019
Source: [5].

At the level of the European Union, it registered changes from one year to another. The highest risk factor recorded was 111 (2011) and the lowest was 79 (2019). In the countries of the European Union it was different and varied during the analyzed period. For Romania, the harmonized risk factor recorded values below the European Union average, with one exception, namely, in 2012 (110 -Romania and 97- European Union). From the data presented regarding the harmonized risk factor it can be easily seen that since 2014, it has registered low values. Romania recorded the lowest harmonized risk factor in 2019 (38).

In these conditions, various solutions are sought in order to reduce the negative effects caused by their widespread use. In the short and medium term, it is not possible to eliminate them, but it is possible to reduce the quantities used.

Specialists in the field have highlighted several possibilities of reducing pesticides used in agriculture, considering that innovation is an important segment of the solution. For example, in Romania, NHR Agropartners has identified several directions of action, as presented in Fig. 6.

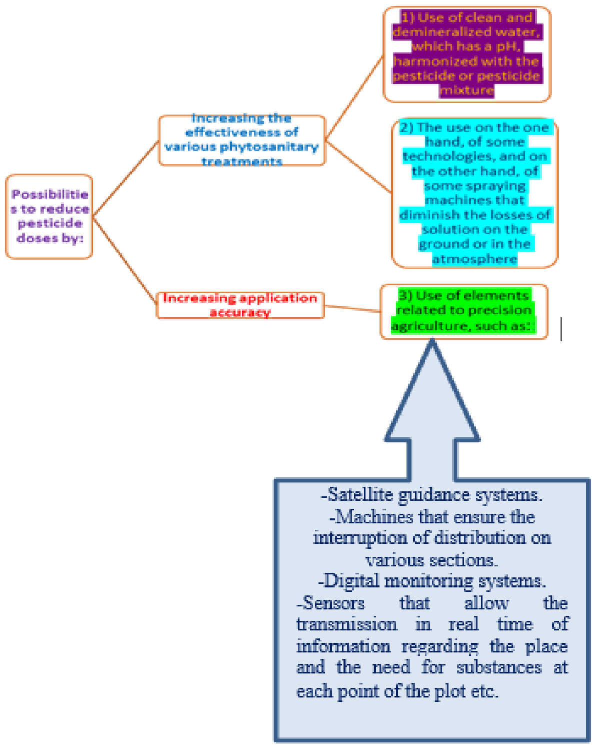


Fig. 6. The main solutions proposed by NHR Agropartners that contribute to reducing the amount of pesticides
Source: [10.]

The solutions proposed by NHR Agropartners lead directly to the decrease of the quantity of pesticides used in agriculture, while

increasing the accuracy of application without negatively impacting the production achieved, the environment and people's health. From the above, it emerged that the widespread adoption of digital agricultural technologies could represent a solution to reduce the consumption of pesticides. It is necessary to specify the need to financially stimulate the farmers who adopt these technologies [10].
In this context, the goal of the paper is the comparative analysis of Romania's situation with the other member countries in terms of pesticides regarding the quantities of pesticides used, the areas with registered pesticides, imports and exports. The analysis is made both at the national and regional level.

MATERIALS AND METHODS

In the paperwork were analyzed a series of statistical data, starting with 2010. These data focused on the use of pesticides and the main categories of products included in this class (insecticides, herbicides and fungicides) in Romania, as well as in the European Union, in the context of applying the "Farm to fork" strategy. The main analyzed indicators were: consumption of pesticides in the European Union; the surface of the lands on which pesticides have been applied in Romania; the amount of pesticides used in Romania and in the development regions; the world's leading importers of pesticides; Romania's imports of pesticides by sources of origin; the world's leading exporters of pesticides; Romania's exports of pesticides and the main markets. The data collected are expressed in tons of active pesticide ingredients used or sold in the agricultural sector for crops and seeds. This data was taken from the following statistical sites: Faostat, Eurostat, ITC and NIS. It was used the linear regression equation, Y= bx + a, where Y is the dependent variable and X is the independent variable. In the paper, the results were presented in tables and graphs.

RESULTS AND DISCUSSIONS

The total consumption of pesticides in the main consuming countries of the European Union varied from one year to another, during the analyzed period (Fig.7). From the published statistical data on the total consumption of pesticides, it resulted that France is on the first place in the ranking of the European Union countries consuming pesticides, in 2010-2019. The highest pesticide consumption recorded in France was 85,072 tons of active ingredients (2018-2019), and the lowest consumption was 61,352 tons of active ingredients (2011). In 2019, in France, pesticide consumption increased by 37.4 2%, compared to 2010. Romania, in 2019, ranked 13th in the EU in terms of pesticide consumption. Malta recorded the lowest pesticide intakes during the analysis period. Here, the consumption varied between 89 -125 tons of active ingredients.

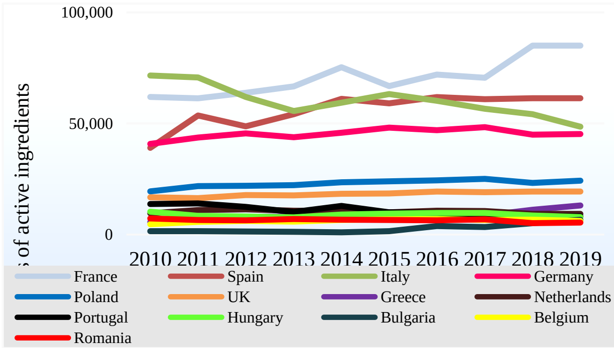


Fig. 7. Pesticides consumption (total) of the main consuming countries in the EU (2010-2019) (tons of active ingredient
Source: [6].

The consumption of insecticides in the consuming countries of the European Union has undergone changes during the period under analysis (Fig. 8).

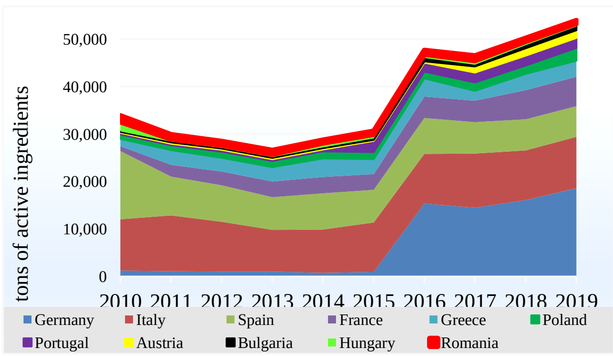


Fig. 8. Consumption of insecticides of the main consuming countries in the EU (2010-2019) (tons of active ingredient)
Source: [6].

In the case of insecticides, if we take into account the entire interval under analysis, from the presented statistical data it can be seen that Italy is the leader of the ranking in terms of the consumption of insecticides. The maximum quantity used was recorded in 2011 (11,795 tons of active ingredients), and the minimum amount was 8,713 tons of active ingredients (2013). In 2019, the amount of insecticides used in Italy decreased insignificantly (-0.23%), compared to 2010.

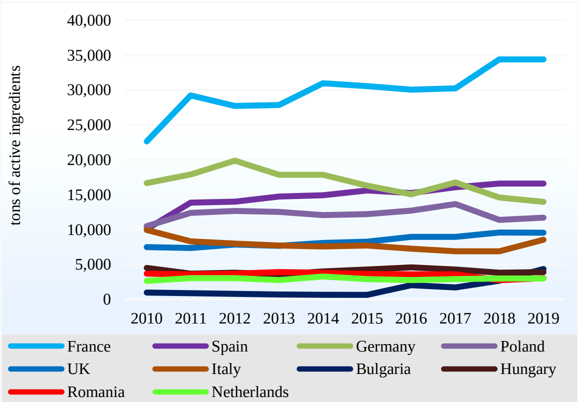


Fig. 9. Consumption of herbicides in the main states, 2010-2019 (tons of active ingredient)
Source: [6].

The consumption of fungicides and bactericides afferent to the main consuming countries in the European Union, recorded changes from one year to another, during the considered period (Fig.10).

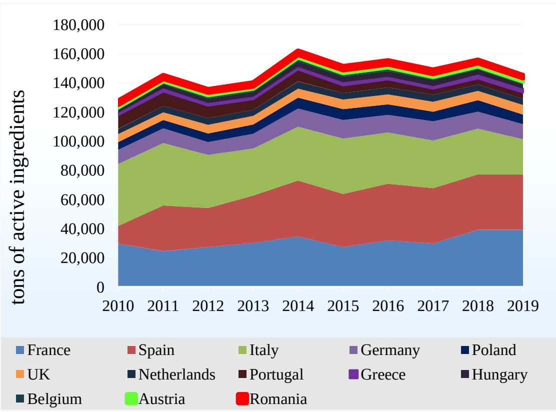


Fig. 10. Consumption of fungicides and bactericides of the main consuming countries in the EU (2010-2019) (tons of active ingredient)
Source: [6].

From the analyzed data regarding the consumption of fungicides and bactericides, it resulted that France is the largest consumer of fungicides and bactericides in the period 2010-2019. The highest consumption of fungicides and bactericides recorded in France was 39,112 tons of active ingredients (2018-2019), and the lowest consumption was 24,532 tons of active ingredients (2011). In 2019, in France, the consumption of fungicides and bactericides increased by 31.12%, compared to 2010. On the second position in the top of the big consumers of fungicides and bactericides in the European Union is Spain. Here, the highest consumption of fungicides and bactericides was recorded in 2016 (38,919 tons of active ingredients), and the lowest consumption was 11,878 tons of active ingredients (2010). In 2019, in Spain, there was a substantial increase in the consumption of fungicides and bactericides by 220.48%, compared to 2010. The third place in this ranking is occupied by Italy. The highest consumption of fungicides and bactericides in Italy was 42,726 tons of active ingredients (2011). In Italy, in 2019, the consumption of fungicides and bactericides was substantially reduced, by 43.70% compared to 2010. On the following places in the ranking of the largest consumers of fungicides and bactericides are the following countries: Germany (+5.74% in 2019, compared to 2010); Poland (+25.33% in 2019, compared to 2010); UK (+18.13% in 2019, compared to 2010); Netherlands (+18.68% in 2019, compared to 2010); Portugal (-55.86% in 2019, compared to 2010); Greece (+85.86% in 2019, compared to 2010); Hungary (+22.30% in 2019, compared to 2010); Belgium (+35.13% in 2019, compared to 2010); Austria (+22.90% in 2019, compared to 2010).
Romania is on the 13th position in the ranking of countries consuming fungicides and bactericides. The largest amount of fungicides and bactericides consumed by Romania was 2,293 tons of active ingredients (2014), and the smallest amount consumed was 1,711 tons of active ingredients (2019). From the analyzed data, it was found that in Romania, in 2019, the amount of fungicides and bactericides consumed was reduced by 23.38%, compared to 2010. It was noted that

in 2019, Romania consumed only 4.37% of the amount of fungicides and bactericides consumed by France.

In Romania, the surface of the lands on which pesticides (insecticides, fungicides and herbicides) were applied, has changed from one year to another during the period under analysis (Fig. 11).

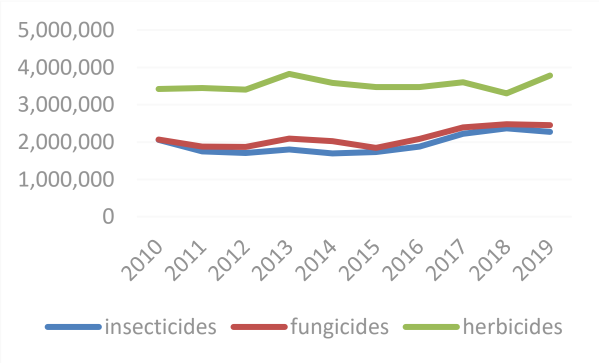


Fig. 11. The area of land on which pesticides were applied during 2010-2019 (ha)
Source: [13].

The largest area of land on which insecticides were applied was recorded in 2018 (2,367,251 ha). In 2019, the area of land where insecticides were applied increased by 10.13%, compared to 2010. Regarding the surface of the lands where fungicides were applied, in Romania, it varied between 1,872,709 ha-2,478,309 ha. In 2019, the area of land on which fungicides were used increased by 18.77%, compared to 2010. Regarding the surface of the lands on which the herbicides were applied from the data presented in Figure 11 it can be easily seen that it recorded a series of oscillations. The most significant area on which herbicides were applied was recorded in 2013 (3,825,368 ha), and the smallest area was 3,304,749 ha (2018). In 2019, the area on which herbicides were applied increased by 10.55%, compared to 2010.

It should be noted that in Romania, the National Institute of Statistics presents data on only 3 categories of products from the class of pesticides, namely: insecticides, fungicides and herbicides.

In Romania, during 2010-2019, the quantities of insecticides, fungicides and herbicides recorded changes from one year to another (Fig. 12). The highest amount of insecticides used in Romania was 1,327,660 kg of active ingredients (2019). At the opposite pole, the smallest amount of insecticides used was 590,021 kg of active ingredients (2019). In Romania, in 2019, the amount of insecticides decreased by 55.56% compared to 2010. This was due, on the one hand, to the increase in the prices of insecticides, and on the other hand, to the warnings made to farmers about the negative impact on health, due to the use of insecticides in agriculture [9].

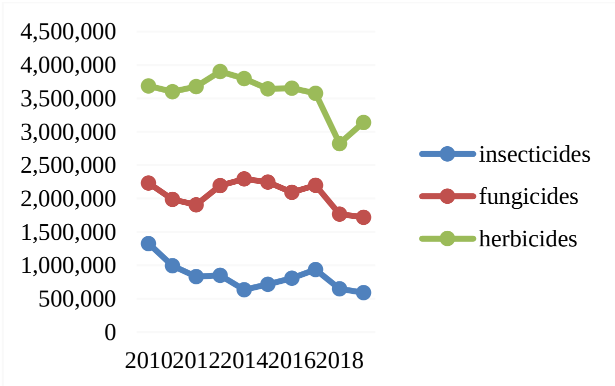


Fig. 12. Pesticide quantities applied in the period 2010-2019 (kg of active ingredients)
Source: [13].

From the data presented in Figure 12, we can observe oscillations from one year to another regarding the consumption of fungicides recorded in agriculture. The most significant amount of fungicides used in agriculture was in 2014 (2,293,286 kg of active ingredients). The lowest amount of fungicides used was 1,720,401 kg of active ingredients (2019). The amount of fungicides used in Romania in 2019 decreased by 22.94%, compared to 2010. The quantity of herbicides used in the Romanian agriculture recorded changes from one year to another during the period under analysis. The highest herbicide consumption recorded in Romania was 3,903,714 kg of active ingredients (2013), and the lowest consumption was 2,824,733 kg of active ingredients (2018). In 2019, herbicide consumption decreased in Romania by 14.82%, compared to 2010. From the data presented and analyzed, it is found the reduction of the consumption of insecticides, fungicides and herbicides in Romania, in 2019, compared to 2010. It is necessary to

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
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PRINT ISSN 2284-7995, E-ISSN 2285-3952

specify that in 2019, compared to 2010, there was an increase in the area of land on which pesticides were applied.

In 2019, according to the published statistical data, the consumption of products from the pesticide class, at the level of the Development Regions in Romania, was as follows:

-*insecticides*- the first three Regions, which used more than half of the entire amount, were: South-West Oltenia (127,696 kg of active ingredients); South-East (90,686 kg of active ingredients) and West (88,044 kg of active ingredients);

-*fungicides*- the first three consuming regions were, in order: South-East (423,945 kg of active ingredients); North-East (354,660 kg of active ingredients) and Centre (291,708 kg of active ingredients), and the quantities used accounted for 62.21%;

-*herbicides*- the main consuming regions, whose used quantities amounted 57.43%, were: North-East (764,364 kg of active ingredients), West (552,575 kg of active ingredients) and South-East (487,569 kg of active ingredients).

In Romania, according to official statistical data, in 2016, the following were sold: 4.5 million kg of bactericides and fungicides; 5 million kg of herbicides and over 700,000 kg of acaricides and insecticides [11].

In the period 2010-2020, the decreasing trend of the amount of insecticides used is observed. Thus, according to the determined linear model, the average annual decrease in the amount of insecticides is 51,908 kg of active ingredients/year (Fig. 13).

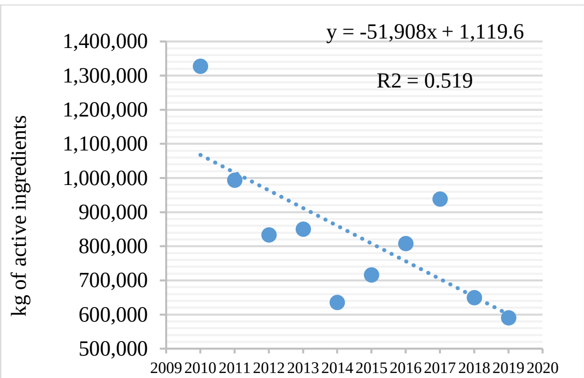

Fig. 13. Dynamics of the amount of insecticides used in Romania (2010-2019) (kg of active ingredients)
Source: Own processing based on NIS data [13].

In the period 2010-2020, the slightly decreasing trend of the amount of fungicides used is observed. Thus, according to the determined linear model, the average annual decrease in the amount of fungicides is 30,517 kg active ingredients/year (Fig.14).

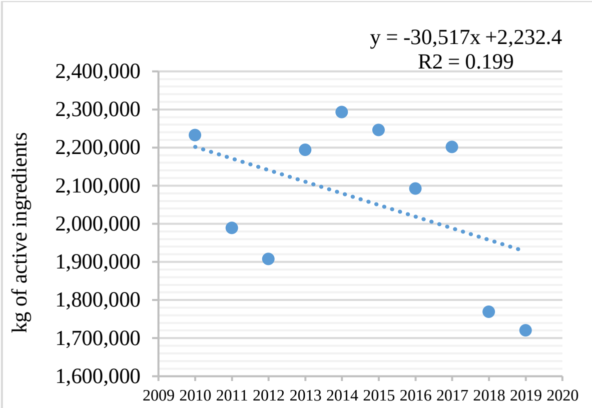

Fig. 14. Dynamics of the amount of fungicides used in Romania (2010-2019) (kg of active ingredients)
Source: own processing based on NIS data [13].

During 2010-2020, the decreasing trend of the amount of herbicides used is observed. Thus, according to the determined linear model, the average annual decrease in the amount of herbicides is 71,288 kg of active ingredients/year (Fig.15).

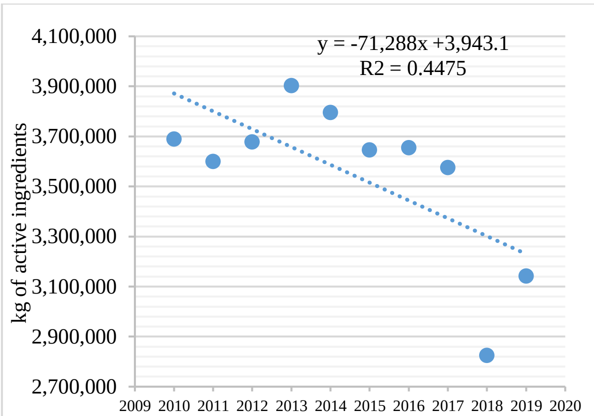

Fig. 15. Dynamics of the quantity of Herbicides used in Romania (2010-2019) (kg of active ingredients)
Source: own processing based on NIS data [13].

In Table 1, there are highlighted the main importers of pesticides in the period 2017-2019, registered worldwide. From the data presented in Table 1, it is easily found that the first position in the ranking of pesticide importers is occupied by Brazil. Brazil's quantitative imports of pesticides have been on an upward trend. The largest amount of pesticides imported was in 2019 (397,617 tons). In Brazil, in 2019, quantitative imports increased by 37.44%, compared to 2017. The second position in this ranking is occupied by France. The most significant imports of pesticides made by France were in 2017 (285,521 tons). In 2019, France's quantitative imports of pesticides decreased by 25,432 tons compared to 2017. France in 2019 imported only 65.41% of the quantity of pesticides imported by Brazil in the same year.

Table 1. Main importers* of pesticides worldwide, 2017-2019 (tons)

Position	Importers	Years		
		2017	2018	2019
1	Brazil	289,288	339,005	397,617
2	France	285,521	269,712	260,089
3	Canada	307,981	247,380	235,071
4	Germany	195,928	195,636	201,466
5	USA	-	-	187,814
6	Belgium	157,482	162,946	153,172
7	Nigeria	No Quantity	147,446	152,651
8	Thailand	222,303	193,221	149,782
9	UK	146,854	160,165	140,942
10	Spain	140,528	136,827	133,516
11-25	….	-	-	-
26	Romania	49,759	55,464	55,941

Source: [8], *quantity 2019.

On the third place in the top importers of pesticides is ranked Canada. Here, the most significant imports of pesticides were made in 2017 (307,981 tons).

It is noticed that in 2019, the quantitative imports of pesticides made by Canada decreased by 72,910 tons, compared to 2017. Canada, in 2019, imported only 59.11% of the amount of pesticides imported by Brazil. The following places in the top 10 importers of pesticides highlighted worldwide in 2019, are occupied by: Germany (201,466 tons); USA (187,814 tons); Belgium (153,172 tons); Nigeria (152,651 tons); Thailand (149,782 tons); UK (140,942 tons) and Spain (133,516 tons). In the extended top of pesticide importers registered worldwide is Romania. It was positioned in the range under analysis on the 26th position. Imports of pesticides related to Romania recorded an increasing trend in the period 2017-2019.

From a quantitative point of view, Romania's imports of pesticides recorded a maximum in 2019 (55,941 tons). In 2019, pesticide imports related to Romania increased by 12.42%, compared to 2017. Romania, in 2019, imported only 14.06% of the quantity of pesticides imported by Brazil in the same year.

Table 2 presents the main partners from which Romania imported pesticides, during 2017-2019. The largest quantities of pesticides imported by Romania came from France. This fact was expected, because, on the one hand, France is part of the European Union, and on the other hand, it is on the fourth position in the top of pesticide exporters registered during 2017-2019. The largest quantity of pesticides imported by Romania from France was 11,066 tons (2019). The quantities of pesticides imported by Romania from France increased by 7.75%, in 2019, compared to 2017. Romania imported 2.46% of the total amount of pesticides exported by France in 2019. Germany is Romania's second partner, in terms of quantitative imports of pesticides. From Germany, Romania imported the largest quantity of pesticides in 2018 (7,937 tons). In 2019, the imports of pesticides from Germany decreased compared to 2018, by 5.91%. In 2019, Romania imported 1.57% of the total quantity of pesticides exported by Germany. The most significant amount of pesticides imported by Romania from Belgium was 6,122 tons (2018). In 2019, Romania imported 1.33% of the quantity of pesticides exported by Belgium. In 2019, Romania imported the largest quantity of pesticides from Spain, of 4,059 tons. Imports of pesticides from Spain increased in 2019 by 1,069 tons, compared to 2017. The largest quantity of pesticides imported from Poland by Romania was 4,024 tons (2019). Romania, in 2019, imported over 57.0% of the total quantity of pesticides from: France; Germany; Belgium; Spain and Poland.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. The main partners* from which Romania imported pesticides, 2017-2019 (tons)

Specification	2017	2018	2019
France	10,270	10,198	11,066
Germany	6,772	7,937	7,468
Belgium	4,719	6,122	5,336
Spain	2,990	3,380	4,059
Poland	1,903	2,977	4,024

Source: [8], *quantity 2019.

In Table 3, there are presented the main exporters of pesticides registered worldwide, in the period 2017-2019. From the data presented in the table below, it can be seen that the leader in terms of pesticide exports is China. During the analyzed period, the exports of pesticides made by China have changed from one year to another. China's largest pesticide exports were 1,632,281 tons (2017) and the lowest were 1,468,275 tons (2019). China's quantitative exports of pesticides in 2019 decreased by 164,006 tons compared to 2017.

Table 3. The world's leading exporters* of pesticides, 2017-2019 (tons)

Position	Exporters	Years		
		2017	2018	2019
1	China	1,632,281	1,490,373	1,468,275
2	Germany	471,734	465,754	475,567
3	India	415,699	442,740	460,959
4	France	415,182	418,326	448,091
5	USA	477,006	435,447	421,937
6	Belgium	436,835	420,700	398,719
7	UK	156,912	170,024	193,620
8	Spain	166,121	178,265	182,102
9	Netherlands	115,549	120,464	118,497
10	Italy	103,965	95,739	89,996
11-39	….	-	-	-
40	Romania	7,758	10,751	11,093

Source: [8], *quantity 2019.

The second place in the top of pesticide exporters is occupied by Germany, but at a significant distance from China. Germany's exports of pesticides have changed from one year to the next. The largest exports of pesticides were recorded in 2019 (475,567 tons). From the data presented, it can be seen that, in 2019, Germany's quantitative exports of pesticides increased by 0.81%, compared to 2017. Germany exported to the international market in 2019, only 32.38% of the amount of pesticides exported by China in the same year.
On the 3rd place in the top of pesticide exporters registered worldwide is India. During the analyzed period, India's quantitative exports registered an upward trend. The highest quantity of pesticides exported by India was recorded in 2019 (460,959 tons). At the opposite pole, the smallest amount of pesticides exported was 415,699 tons (2017). India, in 2019, increased the quantitative exports of pesticides to the international market by 45,260 tons, compared to 2017. In 2019, India exported only 31.39% of the pesticides exported by China in the same year. The following places in the ranking of the top 10 pesticide exporters registered worldwide in 2019 are occupied by: France 448,091 (tons); USA (421,937 tons); Belgium (398,719 tons); UK (193,620 tons); Spain (182,102 tons); Netherlands (118,497 tons) and Italy (89,996 tons). From the data presented in Table no.3, it is found that Romania ranks 40th in the extended ranking of pesticide exporters registered worldwide. During the analyzed period, Romania's exports of pesticides were on an upward trend. The largest quantitative exports of pesticides were 11,093 tons (2019). Romania's pesticide exports in 2019 increased by 3,335 tons compared to 2017. Romania exported to the international market, in 2019, only 0.75% of the quantity exported by China in the same year. From the data presented and analyzed, it appears that Romania is not an important player on the international market of pesticides.
Table 4 presents the main markets for pesticides exported by Romania during 2017-2019. From the data presented in the table below, it can be seen that the exports of pesticides made by Romania recorded changes during the analyzed period. The largest exports of pesticides were directed to the Bulgarian market. The largest quantity of pesticides exported to Bulgaria was 4,693 tons (2018). In 2019, the quantity of pesticides exported to Bulgaria decreased by 22.74%, compared to 2018. Another market for Romanian pesticides was in the analyzed period, the Republic of Moldova. The amount

of pesticides exported to the Republic of Moldova varied between 1,425 tons and 1,930 tons. In 2019, pesticide exports to the Republic of Moldova market decreased by 8.19%, compared to 2018. In 2019, Romania exported to the Republic of Moldova only 48.86% of the quantity of pesticides exported to Bulgaria in the same period.

Table 4. The main partners* to which Romania exported pesticides, 2017-2019 (tons)

Specification	2017	2018	2019
Bulgaria	3,336	4,693	3,626
Republic of Moldova	1,425	1,930	1,772
UK	292	580	720
Hungary	534	736	677
Germany	315	376	668

Source: [8], *quantity 2019.

The quantitative exports of pesticides that were oriented to the UK market registered an upward trend during the analyzed period. The most significant quantity of pesticides exported to the UK was in 2019 (720 tons). In 2019, Romania's pesticide exports oriented to the UK market increased by 146.57%, compared to 2017 and by 24.13%, compared to 2018. Romania exported in 2019 to the UK, only 19.85% of the quantity exported to Bulgaria in the same period. Another partner of Romania, in terms of pesticide exports between 2017 and 2019, was Hungary. Exports of pesticides oriented to the Hungarian market have seen changes from one year to the next. In 2018, a maximum of exports oriented to Hungary was recorded, of 736 tons. In 2019, quantitative exports of pesticides to Hungary decreased by 8.02%, compared to 2018. Germany is on the last place, in terms of Romania's main partners for pesticide exports. During the period under analysis, pesticide exports to Germany recorded an upward trend. The highest amount of pesticides exported was 668 tons (2019). The exports of pesticides made by Romania to Germany increased by 112.06%, in 2019, compared to 2017. Romania, in 2019 exported to the main 5 markets analyzed, 7,463 tons of pesticides. From the data presented in Table 4 it can be easily ascertained that Romania's exports of pesticides have been oriented to markets in Europe.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the Project no. 182/23.11.2021, Impactul socio-economic al aplicării strategiei FARM TO FORK în agricultură și transpunerea în România (The socio-economic impact of the application of the FARM TO FORK strategy in agriculture and transposition in Romania) contracted with "Asociația Producătorilor de Porumb din România" (Romanian Corn Producers Association).

CONCLUSIONS

Currently, there is a special emphasis on reducing pesticide pollution. This directly contributes to the protection of biodiversity, which on the one hand, maintains a high soil quality, and on the other hand, influences food security. Following the analysis of the main indicators related to the use and marketing of pesticides, the following conclusions were drawn for the period 2010-2019:

-In France the highest consumption of pesticides was 85,072 tons of active ingredients (2018-2019);

-The most significant consumption of insecticides and bactericidals was recorded by France between 2018-2019 (39,112 tons of active ingredients);

-In 2018, in Romania, the largest area of land on which insecticides were applied was recorded (2,367,251 ha);

-In Romania, in 2019, there was an increase of 18.77% compared to 2010, of the land areas on which fungicides were applied;

-In 2013, at national level was registered the largest area on which herbicides were applied, of 3,825,368 ha;

-In 2019, in Romania was recorded the highest consumption of insecticides, of 1,327,660 kg of active ingredients;

-In 2014, internally, the highest consumption of fungicides was observed, of 2,293,286 kg of active ingredients;

-The most significant consumption of herbicides highlighted in Romania was in 2013 (3,903,714 kg of active ingredients);
-At the level of the development regions, the quantity of pesticides used during the analyzed period recorded changes
-In Romania, in 2020, the volume of pesticide sales decreased by 20% compared to 2011;
-Brazil is the world's largest importer of pesticides. The most significant quantity imported was 397,617 tons (2019);
-Romania imported the most significant quantities of pesticides from France during the analyzed period;
-China is the world's largest exporter of pesticides. In 2017, China exported 1,632,281 tons of pesticides;
-Romania exported in 2018, the largest quantity of pesticides to Bulgaria (4,693 tons).
In our opinion, the double challenge for farmers is obvious: on the one hand, reducing the amount of fertilizers used, and on the other hand, reducing pesticides used in agriculture. These two aspects mentioned previously will contribute to the achievement of sustainable agriculture. Will farmers be able to face the new challenges of sustainability requirements, ensuring food security and business continuity?

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AUTHENTIC ROMANIAN AND RURAL TOURISM IN THE SUB-CARPATHIAN MUNTENIA AREA. ORIGINAL CASE STUDY "SATUL BANULUI GUEST HOUSE"

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Abstract

In contradiction with globalization, we meet the increasingly current of conservation of the traditional regional specificity of each area in Romania, the trend also found in other European countries. The study aims to promote the authentic traditional in a guest house representative for the sub - Carpathian Muntenia area. In this sense, we observe the development of rural tourism in the Sub Carpathian Muntenia area, presenting a case study based on a private tourism initiative. The guest house from "Satul Banului", Măgureni, Prahova, consists of a set of buildings organized in a specific smallholder property, which offers tourist services: accommodation, local gastronomy and tourist-cultural routes, all in the spirit of a peaceful, specific life. We argue for the traditional authentic value of each element, through a careful documentation that we will present punctually, using bibliographic references from the ethnographic and monographic literature as well as original local sources. Promoting the authentic Romanian, through a private initiative in tourism, proves to be a successful way, which draws attention to the traditional local specificity, helps to preserve the characteristic ethnographic elements.

Key words: *authentic, traditional, Muntenian household, rural tourism*

INTRODUCTION

Despite the last 20 years trend towards globalization in Romania (EU integration), preserving the specific values of the regions, the traditional elements /resources characteristic of each area in Romania, are elements found also in other European countries. In this sense, we observe the local specific tourism development in the sub-Carpathian Muntenia area, presenting a case study based on a private tourism initiative, which strongly reflects the Romanian authenticity of this province. Each of the elements that make up this rural household, as a local socio-economic nucleus (buildings, functions of buildings, exterior and interior decorations, customs, gastronomy) can be found in the tourist offer for amateurs for traditional with local specifics.

In this context, the purpose of the paper is to promote the authentic traditional in a guest house that is representative of the sub-Carpathian Muntenia area more exactly it is about Satul Banului Guest House, 702c Vlaicu Street, Măgureni village, 107350, Prahova County, Romania [15].

MATERIALS AND METHODS

Promoting the authentic Romanian through a private initiative in tourism, proves to be a successful way, which draws attention to the traditional local specificity, and helps to preserve the characteristic ethnographic elements.

In fact, in contradiction with globalization, we meet more and more the current of conservation of the traditional regional specificity, characteristic of each area in Romania, this trend is also found in other European countries.

In this sense, we observe the development of local tourism in this province, presenting a case study based on a private tourism initiative which strongly reflects the Romanian authenticity of this province.

The paper is based on the description of the exterior and interior of the guest house with its specific items reflecting the fold architecture and decorations.

The information were collected directly from the owner of the guest house who allowed to be presented an promoted within this research work.

RESULTS AND DISCUSSIONS

The guest house from Satul Banului, Măgureni village, Prahova, consists of a group of buildings organized in a typically local smallholder property – named "gospodărie moșnenească" which offers tourist services: accommodation, local gastronomy and tourist-cultural routes, all in the spirit of a peaceful, specific life, of old village courtyard that preserves the Muntenian lifestyle.

The village is documented in 1526 and developed until 1897 as the village of Măgurenii Banului [2].

It is a hilly area, full of forests, meadows, and springs and is part of a larger area, metaphorically called "under the mountain Muntenia", a sub-Carpathian zone, located south of the Carpathian Mountains and north of the Romanian Plain, from the Olt River on the west to the Buzau area on the east [4].

The village was formed at the intersection of two extremely important trade routes, near Provița River. The most important road was the Trade Road on which the Dacians transported salt. This road was part of the "Silk Road". The second road, perpendicular to the first, appeared with the development of the King's Road from Prahova Valley, to Câmpina where custom was located. For those who wanted to bypass the toll point, and there were many of them, the Provița Valley was the best alternative.

After reaching the left bank of Prahova and leaving Comarnic, the traders turned right over the water towards Gura Beliei, Târsa Valley, and from here they went down on Provita Valley until they crossed with Târgoviște trade road. Practically all those coming or going to Transylvania to avoid the customs, passed and stopped through the Satul Banului area [5].

A characteristic of the peasant household, especially the old one in this region, is the tendency to withdraw the house towards the middle of the lot that forms the yard, even in the villages drawn to the road line, the house remains towards the bottom of the yard [3]. (Photo 1).

The façade of the house is oriented to the south and only sometimes the houses on the right side of the roads (generally in a north-south direction) face the road and therefore to the east at the same time.

The traditional household in this area includes the main house, stable, hay deposit, food and drinks storage, cellar, summer kitchen, or even craft workshop, due to specific occupations. The fencing of this big household is traditionally made of wooden gutters, the traditional type has the quality of being "transparent", so the perception of public and private space is unitary. All these buildings can be merged or isolated but are usually located independently of the main house [10]. (Photo 1).

Photo 1. Main house with a pavilion, towards the middle of the lot that forms the yard
Source: Satul Banului Guest House [15].

The main house is a tall house with a pavilion. Defined by the placement of the porch and the pavilion and considering the number of rooms and entrances, we find several types of house plans in the presented region. The most common is the one with two rooms with a single entrance. In our case, the 3-room type was chosen, with two entrances and a porch with a pavilion. The pavilion is centrally positioned, the porch is fenced with a

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

"parmalâc", along the entire length of the house, and with wooden lace poles specific to the area. The specific volumetry in this area is 0.5/ 1/ 1, with a four-pitched roof, with spikes or bolts at the top of the roof, with double-pitched skylights. The roof is covered with broken oak shingles, beaten in 3 or 4 rows. The windows had a cross at the bottom to protect against evil spirits. The house has on the ground floor a cellar with the entrance usually through the base of the pavilion, a front entrance of the cellar named "gârlici". In order to enter the cellar, there are two doors, the first made of crossed and joined in half thick slats - "zăbrele" and the second, at the entrance to the cellar, built on the wall line of the floor, massive, strong, door closed with a padlock [10].

The specific interior of the house includes some basic elements: plastered and whitewashed walls, ceilings with exposed beams hatched carved and fir plank floors. In the large room, on the opposite corner of the entrance there is a large brick stove with a hob, the dowry box on the opposite wall to the stove, placed on a bench [16, 17] (Photo 2).

Photo 2. The living room with a large brick stove
Source: Satul Banului Guest House [15].

The table with the chairs, the bed, the cabinets without doors, are decorated with great finesse perforated or inlaid geometric motifs. In the "clean" room we find a stove without a hob and a bed decorated with chisels and perforations at the bar that surrounds it on three sides. Also, here we find a high table with drawers. In the whole house there are tassels, supports, hangers made of a fir stalk with the legs up, on which are hanged cups, woolen tools, and sometimes pieces of smoked cheese made in patterns [16, 17]. Inside the houses in the Prahova area, the current and decorative fabrics with vegetal and anthropomorphic motifs are remarkable from a chromatic point of view: pillows, rugs, wiping, walling, decorative plates which give the interior a sumptuous look [18, 19]. (Photos 3 and 4).

Photo 3. Bedroom interior with decorative fabrics - walling
Source: Satul Banului Guest House [15].

Photo 4. Interior decorative fabrics – decorative plates, walling
Source: Satul Banului Guest House [15].

The main annex is the stable, with two rooms, left and right and in the center a gangway with a role of passage and shelter for harness and chariots. It has the same volume, a gabled roof and the hay deposit is present on the first floor, the access to this being made through a central skylight.

The hay deposit has the bars, beaten obliquely, and is made 0.5-0.7m out of the console [10] (Photo 5).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The summer kitchen is traditionally present in all courtyards, it is equipped with a foot stove, oven and a hob. The roof is made in one rafter, supported on four legs and a fixed work table with two or four legs, embedded in the ground (Photo 6).

Photo 5. The stable and hay store
Source: Satul Banului Guest House [15].

Photo 6. Summer kitchen interior
Source: Satul Banului Guest House [15].

Photo 7. The corn warehouse -– loft on pillars
Source: Satul Banului Guest House [15].

The corn warehouse (loft on pillars), built of woven twigs, retains the important stock of corn.
It is built on 6-8 pillars, about 3-4 meters high, the access being made through a staircase [10] (Photo 7).

The villagers worked with wood, a source of raw material for practicing the trades of carpenters, and others. In order to complete the household, it was absolutely necessary to build the craft workshop, which contains the original equipment used in carpentry. Specific to the workshop are the small windows frameworks, the porch that was used to dry wood materials in the sunny days.

Photo 8. Craft worshop interior
Source: Satul Banului Guest House [15].

Photo 9. Craft worshop exterior
Source: Satul Banului Guest House [15].

In order to be inhabited, the craft workshop has a bedroom in the attic and a living room downstairs [16, 17]. (Photo 8 and 9).

The wealthy villagers' traditional houses were made of masonry walls, with plaster ornamentation, and window frames with wooden ornaments, perforations including traditional symbolic elements.

They have a special value maintained on the basis of an old and strong tradition and proves the social status of the owner [11, 9, 8]. (Photo 10).

Photo 10. Wooden ornaments, perforation in the pavilion
Source: Satul Banului Guest House [15].

As a peculiarity of Satul Banului village, almost 80% of the households had a lime kiln in the yard - "varnița".
Tourists come to stay "in the yard" and for this purpose the buildings that are part of the household have acquired functions specific to accommodation and meals. Thus, the stable is reorganized as a dining room and relaxation area, the hay deposit is divided into 3 rooms with private bathroom, the corn warehouse has two rooms with individual bathroom and the craft workshop is arranged as a house with ground floor and an attic and can accommodate up to 4 people. Each of these household buildings is decorated inside with traditional elements in full accordance with the interior elements of the main house. This recreates the old ambiance in the present modern comfort (Photo 11 and 12).

Photo 11. Inside traditional elements - walling
Source: Satul Banului Guest House [15].

Photo 12, Inside with traditional elements – decorative plate and walling
Source: Satul Banului Guest House [15].

If you step into the atmosphere of the Muntenian village and you know their true values, you will notice that in fact Muntenia hides a much more beautiful and much richer history than the ones you have heard so far in this country, with worthy personalities who have honored this nation.
The multitude of historical relics in these places and the people who brought them to life make of it our duty to promote and bring to light all their stories. Even though some have been "mutilated" by times and history and are almost unrecognizable, they are part of the real and beautiful history of this nation.
From this point of view a great advantage of this pension is given by the fact that the distance to the farthest historical /cultural objective is less than 50 km and an hour by car, no road to the proposed objectives does not overlap with another busy road on Prahova Valley.
On the way to the Iulia Hasdeu Museum, you can visit the ruins of the Mavros Cantacuzino Palace, the Măgureni Church, the ruins of the Drăghici Cantacuzino Palace, the Ruins of Lady Stanca's Princely Court and the Memorial House Nicolae Grigorescu. You cannot miss Little Trianon from Florești that was erected by Gheorghe Grigore Cantacuzino (Nababul) the richest man in Romania of 19th century and designed by architect Ion Berindei and also Drăghici Cantacuzino's Palace "The Wonder of Magureni". Pană Filipescu Mansion, was erected in the 18th century by Pană Filipescu,

the husband of Maria Cantacuzino, the eldest daughter of Postelnicul Cantacuzino. Over time, the manor degraded and it was restored between 1968 and 1971and now is a splendid museum.

Many of the village's customs are from the pre-Christian period, the Getae period and the Roman period (carols) [7].

One of these customs, like shouting over the village/ over the hills, as it was called in the village, symbolizes the beginning of the new agricultural year [7]. In the Christian period this custom was practiced in the evening before the beginning of Easter fasting the coincides with the new agricultural year. Dialogues on tabu subjects dialogue taking place over the village and all the people listening to what was said. Children's choir, which was held the night before Christmas Eve. Groups formed in the morning, leaving the village singing carols, the girls had triads and the boys had "carols" (wooden sticks) in their hands [6, 7].

Eaters of wild mushrooms - "burețari", of pies - "plăcintari", of potatoes "cartofari" or brandy drinkers - "țuicari", are the nicknames that the inhabitants of the area have received over time. And these are completely justified because Satul Banului is also an area rich in extremely tasty wild forest mushrooms. Radu Anton Roman mentioned in one of his books that "between Cheia and Tismana, in all the Wallachian under the mountain villages, I ate corn cakes with anything or as anything" [13].

Throughout the household there are many common spaces, which bring us together, to rejoice that we are together, to give us peace and respite to know the customs of the place, to taste with pleasure the dishes prepared according to traditional recipes, but reinterpreted.

The culinary habits of the place are brought to the fore, stories about the dishes that the housewives made on certain holidays or on other special occasions. We value the fruits of the earth and tell our guests that the vegetables from our or the villagers' gardens are put on the table, and we get the meat products from the small local farms. We like to honor our guests with Dealul Mare wines and homemade brandy - "țuica". Quality is our best business card and we do not discount it and, along with cleanliness, it impresses anyone who crosses our doorstep.

The most sought after and most promoted dishes made at the pension are: tăbârca - baked pumpkin with walnut milk and honey (Photo 12), wild mushrooms soup, onion of Câmpina – cheese and tomato paste in an onion, sărățele - salted Muntenians bakery, mâncare de orez cu prune loșnite - rice food with dried smoked plums, măcinici – cooked pasta with nuts and cinnamon (Photo 13).

Photo 12. Tăbârca
Source: Satul Banului Guest House [15].

Although it is cooked subtly, elaborately, with jeweler's ticks - something unusual for a "peasant" dish - the "ingredients" are elementary, of a primary simplicity " said Radu Anton Roman [12].

Photo 13. Măcinici
Source: Satul Banului Guest House [15].

The process of economic and social transformation, with industrial transport system development, the modern, intensive tourism, the influences of modern construction techniques, have gradually determined the disappearance of the old village architecture. In this context, the restoration of some old houses, the reconstruction of some traditional households, to bringing back to the tourists the customs and traditions in a setting as close as possible to the original one, represents a tendency to approach the authentic traditional values.

This tendency to return to traditional values is found everywhere in Europe, each region is thus distinguished by its local specificity and preserves traditional values. Promoting these values through tourism is a viable solution along with promotion actions through ethnographic culture institutions.

More and more agrotourism pensions in Romania, gathered in rural profile associations, such as ANTREC (National Romanian Association for Rural, Ecologic and Cultural Tourism) [1], offer tourist accommodation services, local gastronomy and tourist routes oriented towards Romanian traditions and customs specific to different areas of the country.

In this sense, the Satul Banului Guest House was recognized by Romanian Association of Tourism Journalists and Writers in 2019 for the way of life and by the boarding of ANTREC for the quality of the services offered to the tourists and for the preservation of the authentic Muntenian with the Golden Daisy award in 2021 (Photo 14 and 15).

Photo 14. Diploma - Golden Daisy award 2021
Source: ANTREC, 2021 [1].

Photo 15. Diploma -The way of life 2019
Source: Romanian Association of Journalists and Writers of Tourism from Romania [14].

CONCLUSIONS

Promoting the authentic Romanian, through a private initiative in tourism, proves to be a successful way, which draws attention to the local traditional specificity, helps to preserve the characteristic ethnographic elements and offers the possibility to experience a complex, beautiful and peaceful life like our ancestors.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Satul Banului Guest House, which provides the original photos and documents with permission for publication.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PUBLIC FOOD PROCUREMENT - A TOOL FOR A SUSTAINABLE ECONOMY DEVELOPMENT IN RURAL AREAS

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Abstract

Annually, the state allocates significant amounts of money for the carrying out of public procurement contracts concerned with the supply of food products. Rural areas, due to their natural potential, but also to their existing human resource, can further develop through the implementation of projects concerned with circular economy and a sustainable food chain. The implementation of Green Deal policies, the integration of appropriate sustainable development strategies will allow the economic growth of rural areas. In the making of this article, information published in the Electronic Public Procurement System (EPPS), during the 2018-2021 period was collected, concerning contracts for the supply of various food products. The novelty of this article consists in the analysis carried out on food related public procurement, by product categories and institutions. Based on the results of this research, there are suggestions for opportunities of development in rural areas, issues related to the sustainability of the food chain which should be integrated in sustainable public procurement procedures.

Key words: *public procurement, food, enterprise, sustainability, rural*

INTRODUCTION

The Green Public Procurement (GPP) represents, for each state, a system through which the sustainability policies set by the European Commission can be applied, so that the Sustainable Development Goals (SDGs) can be achieved. The public institutions, called contracting authorities (Directive 24/2016, EU) [1], must approach sustainable procurement just like a jigsaw puzzle [3], that fits perfectly into the field for which it is intended, but also, they must comply with the legislation applicable to the public procurement and contract field. The circular economy (CE) must be found in everyday life; moreover, it must become a normal behaviour of any citizen and be present in all areas of activity. The European Union, through the policies of the Green Pact [5], outlines the directions to follow for a sustainable society development. The goals of the 2030 Agenda (UN) [13], show us that we do not have time to waste to achieve the SDGs and that there is much to be done. Each state must pay more attention to achieving the goals of sustainable development, must set clear directions and the path it has to take. Five categories of the SDGs have been taken over by the Food and Food Agriculture Organization [7], for countries to reduce food waste by 50%, by 2030.
Sustainable procurement for goods, services or works must be realised with minimal damage to the environment. The inclusion of green products in public procurement contracts means that they are already part of a sustainable supply chain [15], and that are developed/created in a circular economy [11].
Through the public procurement contracts, the volumes of goods and services generated by these, the companies can develop thus contributing to the implementation of sustainability policies. At the same time, a reduction in the procurement interest, from the state, can produce imbalances in the economic activity of the companies. The study in this paper looks at the evolution of public procurement in Romania between 2018-2021 in the field of “Agriculture and food”, as well as the influence of the Covid pandemic on the volume of goods purchased

by contracting authorities. Also, by analysing the data collected from the Electronic Public Procurement System (EPPS) [4] and processed in this paper, we demonstrate the role of procurement in the rural areas economy and propose directions for the development of these areas through public procurement. The novelty of the paper is given by the research on public procurement from Romania in a certain field.

From the structural point of view, the paper consists of a section dedicated to the applied research method (in which we presented the information source and the comparative method used). The article continues with the section "Results and discussions" (which contains an analysis of the procedures for awarding contracts in the field of information on "Agriculture and food", from 2018-2021), followed by the chapter "Conclusions" (where we proposed topics for future research, but also directions to follow in the rural areas development, with the help of public procurement).

The aim of the paper is to identify the interest shown by the contracting authorities (CA) in procuring products that could come from local rural areas and to identify, at the same time, the opportunities for the development of these areas through public procurement.

MATERIALS AND METHODS

The data analysed in this paper were collected from (EPPS). This is an electronic platform [4], through which the contracting authorities are obliged to carry out the procurement procedures whose estimated values are above certain value thresholds (according to Law no. 98/2016 on public procurement). This paper did not take into account the procurements carried out outside EPPS as the respective data are not found, centralized, on public sites.

The chosen reference period was between 01.01.2018-31.12.2021 due to the fact that the current form of SEAP is functional from 2018. Of interest for research, are the public procurement procedures completed by contract/framework agreement, grouped in EPPS, in the field "Agriculture and food". All information is centralized according to the total amount of estimated values related to the procedures performed. In order to establish the role that public procurement has in the rural areas development, for the period 01.01.2018-31.12.2021, the types of contracting authorities that initiated procedures in the field "Agriculture and food" and product categories included in this domain were analysed.

The comparative method was used to determine the evolution of procurement, in the period 2018-2021, and to establish the factors that influence such contracts. By centralising and interpreting the data taken from EPPS, factors were identified that may influence the procurement of products that can be purchased from rural areas.

RESULTS AND DISCUSSIONS

In carrying out the activities and missions for which they were established, the public institutions must procure various types of products (office supplies, IT equipment, cars but also food, firewood, plants etc.), but also services (for example, cleaning, catering, security) or works to achieve investment objectives. In this paper, we analyse the product procurements made through EPPS and grouped in the field of "Agriculture and food", such as: dairy, meat, fruits, vegetables, bakery products, but also plants, seeds, animal feed, timber etc. Of interest are the public procurement procedures, in the mentioned field, initiated in the period 01.01.2018-31.12.2021 and which were finalized by awarding a contract or concluding a framework agreement.

In order to demonstrate the influence that public procurement has on the development of rural areas, we are concerned with identifying the product volumes and the financial (monetary) values generated by products that could come from such areas, but also the contracting authorities that require such products. In this sense, the analysis of the collected data was performed in several aspects: identifying the CAs that need products, in the field of "Agriculture and

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

food" and establishing the categories of products that are most requested.
A first indicator of interest is the CA categories, respectively the activity field of the institutions that purchase products included in "Agriculture and food". From the data collected, most of the contracts concern food products purchased by entities that have to provide food for people. Most such CAs are from: the medical field (hospital units, rest and recovery centers), social assistance (social assistance units), defense (military units), education (kindergartens, schools, universities), the penitentiary system, territorial administrative units-ATU (county councils, local councils that provided, for students, food packages or hot meal, milk). The entities also include national companies, sports clubs, ministries, research institutes, zoos etc. In Table 1, the contracting authorities were grouped by field of activity and ordered in descending order, by the total amount of the procurement procedures estimated values, in the four years that were analysed.

Table 1. The procurements volume depending on the contracting authority activity field

	Contracts' estimated value (RON)				
CA field	**2018**	**2019**	**2020**	**2021**	**Total**
Other entities	46,885,970.38	1,358,726,223.39	81,403,895.08	168,486,496.55	1,655,502,585.40
ATU	616,657,016.64	289,855,812.74	434,638,687.03	190,970,459.93	1,532,121,976.34
Social assistance	182,833,955.16	224,884,246.02	308,592,298.31	325,149,217.02	1,041,459,716.51
Medical	127,272,926.32	282,154,959.11	259,778,284.45	201,716,927.07	870,923,096.95
Defence	36,476,690.63	58,632,730.04	102,272,199.38	133,946,750.30	331,328,370.35
Penitentiary	29,304,708.70	54,956,113.17	63,151,314.17	50,574,500.76	197,986,636.80
Education	40,030,739.83	59,275,603.12	31,907,045.08	58,973,505.02	190,186,893.05
Total	**1,079,462,007,66**	**2,328,485,687.59**	**1,281,743,723.50**	**1,129,817,856.65**	**5,819,509,275.40**
	Number of initiated procedures				
Total	**725**	**1,095**	**931**	**891**	

Source: [4].

Between 2018-2021, through EPPS, 3,642 award procedures were carried out (out of which, 1,638 open tenders, 22 accelerated open tenders and 1986 simplified procedures), whose estimated values were, in total, de 5,819,509,275.40 RON.
In the situation that life would have been normal, without a pandemic, and the population structure and the need for purchase would have remained approximately the same, the estimated value of products in the field of "Agriculture and food" should have increased from 2018 to 2021, proportional to the rate of inflation.
But in 2020 and 2021, their value has almost halved due to the pandemic situation.
The reasons for their reduction shall be detailed after determining the percentage of the CA representative categories and the types of products that are found in the field of "Agriculture and food".
Of all the CA categories, ATUs initiated the most procedures, for which the total estimated value of the contracts, 1,532,121,976.34 RON, represents 26.32% of the total of 5,819,509,275.40 RON.
An edifying picture (Table 2) of the CA that buys the most products in the selected field is obtained by comparing the estimated values percentages of the procedures initiated by each category (percentage obtained by reporting the estimated value on a category of CA, to the total estimated values of that year).
Every year, the ATUs made the most purchases in the field of "Agriculture and food", mainly for the development of food package programs for students and preschoolers.

Table 2. The estimated values percentage on a CA category (%)

CA field	2018	2019	2020	2021
Other entities	4.34	58.35	6.35	14.91
ATU	57.13	12.45	33.91	16.90
Social assistance	16.94	9.66	24.08	28.78
Medical	11.79	12.12	20.27	17.85
Defence	3.38	2.52	7.98	11.86
Penitentiary	2.71	2.36	4.93	4.48
Education	3.71	2.55	2.49	5.22

Source: [4].

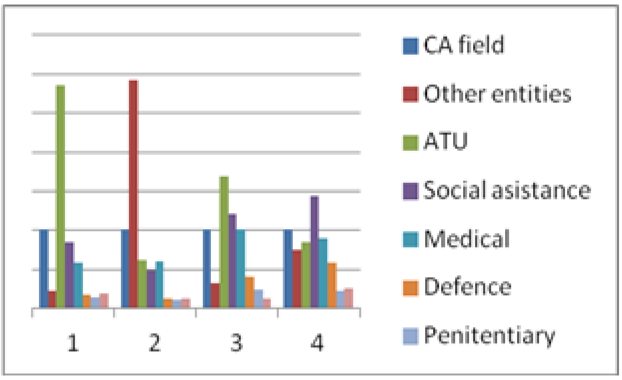

Fig. 1. Percentage of procurements volume by CA areas of activity
Source: [4].

In the next place, are the social assistance units that have to provide food for the people in care. Naturally, the health units and medical units allocated significant sums of money for the procurement of food for the sick, respectively for the employed staff. CAs in the penitentiary system also carried out significant value procedures for food procurement.

A relatively small percentage is held by educational institutions, through acquisitions made, in particular, by universities.

A similar distribution of the supply level (presented in Table 2) was also established by [12], but with the following order of CA activity sectors: medical assistance, social assistance, education, business and industry, penitentiaries, military services.

From the comparative analysis of each CA percentage, the influence of the pandemic on the needs of the contracting authorities can be easily observed.

In 2019 and 2020, the school activity took place mainly on-line. Under these conditions, the ATUs no longer had to provide the students with the "milk-corn-apple" package or a hot meal (in the units that carried out this project). Also, the universities did not have students to provide food for.

The medical system was the only one to record an increase in food consumption, which could be explained by the increase in the number of patients.

The centralised data show that a significant volume of food is purchased by county councils, local councils, local welfare departments, but also hospitals.

Table 3. The procurements volume by product categories

	The estimated value of performed procedures (RON)				
Product categories	**2018**	**2019**	**2020**	**2021**	**Total**
Food	1,036,163,623.92	2,244,523,544.56	1,235,087,295.03	1,045,560,138.39	5,561,334,601.90
Wood	15,465,184.37	32,554,353.75	23,218,790.86	30,100,374.07	101,338,703.05
Plants	10,401,779.07	21,110,228.13	8,918,014.53	37,380,137.39	77,810,159.12
Animal feed	16,711,196.30	13,027,330.58	11,493,430.08	13,539,047.08	54,771,004.04
Seeds	235,015.00	13,592,493.07	2,085,827.00	1,873,819.00	17,787,154.07
Horticultural products	485,209.00	3,643,937.50	935,066.00	830,680.72	5,894,893.22
Animals		33,800.00	5,300.00	533,660.00	572,760.00
Total	**1,079,462,007.66**	**2,328,485,687.59**	**1,281,743,723,50**	**1,129,817,856.65**	**5,819,509,275.40**

Source: [4].

Of interest in our research, is the volume of food that could be provided by rural areas. In this sense, depending on the contract’s object, the procurement procedures were grouped by the authors in various categories: food, animals, animal feed, wood (predominantly firewood), plants (bulbs, trees, shrubs etc.), horticultural products (especially grass) and seeds (Table 3). The largest amounts are spent on food.

After separating the product categories and ordering them according to the cumulative total in the four years, we found that most of the purchases (95.56%) related to the analysed field, is represented by food, followed by firewood (1.74%) and plants (1.34%). The rest of the products represent only less than 1% of the total period.

From Table 3, the influence of the pandemic on the supply need is observed. In 2020 and 2021, the value of purchased food decreased compared to 2019 (most of them being purchased for school food programs). Also, in 2020 and 2021, the purchase of seeds and horticultural products (especially grass) decreased. However, in 2021, there is an increase in the acquisition of small animals (mice), for research programs, in order to prevent SARS-COV-2.

An in-depth research of the food product types purchased through EPPS, led to the conclusion that significant values are allocated for the provision of food to students and preschoolers, through the "Romanian School Program for 2017-2023" (approved by G.D. no. 640/2017) [16],, “Pilot program for providing food support for preschoolers and students” (approved by G.E.O. no. 9/2020) [17], or through various other projects for providing a hot meal to students (Table 4).

Table 4. The procurements volume depending on the food recipients

	The estimated value (RON)		
Year	Food for school programs	Other product categories	Total
2018	597,664,004.53	481,798,003.13	1,079,462,007.66
2019	271,505,580.82	2,056,980,106.77	2,328,485,687.59
2020	426,001,060.57	855,742,662.93	1,281,743,723.50
2021	159,550,944.58	970,266,912.07	1,129,817,856.65
Total	1,454,721,590.50	4,364,787,684.90	5,819,509,275.40

Source: [4].

In the 4 years that were analysed, procurement procedures amounting to de 1,436,449,012.43 RON ((approximately 25%, out of a total of 5,819,509,275.40 RON). dedicated to food supply programs and catering services were carried out through EPPS (to ensure a warm meal), in schools and kindergartens. Out of these procedures, 94.63% are for the purpose of granting food packages containing milk, corn and apples.

Taking into account the data from Table 1 (procurements volume depending on the CA activity field), together with those from Table 3 (procurements volume by product categories) and Table 4 (procurements volume by food recipients), it is observed that an increased need for food (25% of the procedures total value) is registered by ATUs, for the development of students and preschoolers food supply programs. Significant food purchases are also recorded by the CA from the social assistance system, the medical system and in the military units.

The products procurement in the field of “Agriculture and food” generates contracts with high values and large product volumes that, for the most part, could be supplied by rural areas from Romania. Or, many vegetables, fruits, dairy products, but also meat or other foods and raw materials necessary for food preparation come from imports, to the detriment of local, Romanian products.

The supply of these products is part of a food chain, with many companies involved, between which there must be collaboration: agricultural producers, processors, packers, transporters [1]. Most of the producers operate either on the outskirts of cities or in agricultural areas, mostly rural. The information extracted from the EPPS shows that, if the amounts in these contracts were to “remain” in rural communities, they would register a different economic level. However, for the procurement to be made from local products, it is necessary to have a political shall, the contribution of the local authorities, but also of the central ones.

The state, through its double quality of constant buyer, but also of regulator, must be the engine of the rural areas development, of the local productions promotion, but also of the sustainable public procurements. The contract award documentations for the provision of food products and services must reflect EU recommendations. The correct application of these recommendations would lead to the supply of products from rural, local areas. The introduction of criteria regarding the position of the supplier in the supply chain [8], the criteria regarding certified organic products, the reduction of excessive packaging [12], or the ecological transport would provide a chance to gain profit for the economic operators located closer to production source.

Setting some criteria on nutrition [19], on student food recipes to include, in certain percentages, organic products (such as dairy, eggs, vegetables, fruits, meat) would encourage farmers to introduce sustainable practices into their agricultural production. Such recipes/consumption patterns for organic products are found in many countries: in Belgium, rules are established regarding the consumption of meat, dairy and vegetables; Ireland has schemes that include eggs and poultry; in Austria, 15% of meals must include organic products; in Italy, it is recommended that, in certain percentages, meat and fish be made from organic products [12].

Imposing green product lists and green public procurement rules shall change the way all participants work in the complex supply chain network which, in turn, consists of several subnets [2]. New strategies for approaching public procurement shall be created, and producers shall be forced to create organic farms, to collaborate with partners who also respect the circular economic rules. The development of ecological practices in rural areas, as well as the need to find new production solutions requires cooperation between companies that form the food chain [20]. The agricultural production includes both policies regarding the environment and conservation of natural resources and biodiversity, but also practices for animal breeding and plant cultivation [3].

In the food products supply, the practices of the circular economy must be encouraged, with the reduction of food waste, the selective collection of waste, the reintroduction of some products in the industrial circuit and packaging re-use [21]. The economy must move from the linear recycling path "take - transform - throw", to the circular one "take - transform – re-use" [14]. In the provision of food and catering services, but also of other services adjacent to them, the economic operators must reduce the impact on the environment, such as reducing pollution with kitchen equipment, means of transport and waste [12].

The use of "clean" local products in food preparing shall reduce the supply chain, which means a reduction in the pollution created by processing, transport, storage, packaging etc. At the same time, in order to establish a menu based on organic products, the state must supplement the funds needed to purchase them because these products are more expensive than the "classic" ones.

The introduction of sustainability rules in the food supply must be done gradually in order to avoid unbalancing the supply process that could be generated by the small number of farms with organic products, but also by the high values of the products.

The rural areas can be supply sources and other categories of products, such as plants, seeds, shrubs, grass, as shown by the information collected from EPPS (Table 3). Even if their estimated value, in the period 2018-2021, represents only 4.44% of the total acquisitions, the need to supply them creates business opportunities in the respective areas.

Not only is the actual supply of products a way of economic growth of an area, but also the services through which it is obtained. Without the creation of an infrastructure, one cannot speak of long-term business, but only of seasonal activities. The construction of greenhouses, farms, raw material processing sections, but also packing workshops, as well as the construction of cold storage, irrigation works are some of the minimum investments necessary for a rural area to raise its socio-economic level. The involvement of local and central administration in making different categories of investments, establishing procurement mechanisms and regulating the prices of organic products would contribute to increasing the welfare of private companies in these areas, in proportion to living standards improvement [9]. The implementation of the projects from the National Recovery and Resilience Plan, provided for the rural regions, shall have an immediate effect on the attraction of economic agents.

The obligation to make green public procurement and the establishment of sustainability criteria in the award procedures shall increase the demand for green products. This direction must drive local firms to formulate new business models in order to meet the demands of the public procurement market.

The role of the state in the organic products procurement, but also in the development of local business, is capital without a doubt [10]. On the one hand, as a buyer, through the development of various food procurement programs, catering services, respectively through the volume of purchases it makes. It may also impose, in the public procurement procedures, criteria in order to oblige economic operators to comply with the requirements of sustainable development. On the other hand, as a provider of services (medical, health care, education etc.), through the way it provides them, the state can impose working models and practices to comply with the rules of sustainability (for example, recycling and reuse of food packaging, re-use of used oils in food preparation, reduction of food waste).

Through financing programs, through subsidies, by supporting local producers, but also by creating the infrastructure necessary to carry out commercial activities, the state can boost the rural economy.

Farmers need to take advantage of the high demand for food from public institutions in order to sell their products and increase their future production by taking part in public procurement procedures. By knowing the areas where the largest volumes of food are required (Table 1), the economic operators can establish new business directions and improve their company's development strategies. The above analysis showed that most of the procurement is made through simplified procedures. The SME companies with a small number of employees and a low turnover may also take part in such procedures. Manufacturers should have the courage to participate especially in the simplified procedures, where qualification requirements are minimal, appropriate to the tendering capacity of the SMEs. But in order to win a procedure, producers need to know how to prepare the offer. Their lack of experience in preparing tender documents shall reduce their chances of winning public procurement contracts. Many companies consider that their professional experience, skill in their field of activity, their production capacity and the quality of their products are enough assets to win the procedures. However, an open tender or a simplified procedure is won only if the tenderer proves, by all the documents he has submitted, that he can meet the need of the contracting authority. The hiring of trained staff in public procurement to prepare the tender shall be reflected in the positive rate of participation in contract award procedures [18].

As award procedures are conducted electronically, rural producers must learn to bid electronically, to sell via the internet. The development of the business with the help of the internet shall ensure a larger sales area, shall create a virtual market, but also a direct, efficient and faster communication.

Sustainable public procurement represents a challenge for all parties involved, both for the public buyer - the state, and for the seller - the economic operator. Sustainable development of rural areas can be stimulated through procurement if CAs, bidders find a balance between meeting consumer needs, protecting the environment and supply capacity.

CONCLUSIONS

The public procurement contracts, through the important values they generate, are of high interest to all economic operators. This paper has focused on analysing the impact that food procurement may have on the economy of the rural areas. This analysis reveals that the high volume of food supply contracts, correlated with the requirements of sustainable procurement, is an opportunity for the development of enterprises from the rural areas. The results obtained through this paper identify the public sectors that procure the largest quantities of food. The EPPS information allows companies to find new business opportunities that are appropriate for their work capacity. The participation of producers in public procurement procedures, for the supply of organic food, is a chance for the development of both companies, and rural areas. Also, through this paper, it is highlighted the fact that the state, by establishing some sustainability criteria, may determine the way to be followed for the fulfilment of the sustainable development objectives.

Based on the findings of this paper, research can be developed on: (i) sustainable evaluation factors that can be used in award procedures; (ii) the creation of lists for organic agricultural products which may be imposed on institutions that provide food; (iii) ways to reduce the carbon footprint in the supply chain.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IDENTIFICATION OF COMMERCIAL ORGANISATION FINANCIAL RISKS AND MECHANISMS TO NEUTRALISE THEM

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Abstract

The article provides an assessment of the financial risks of a poultry company over the last three years. Particular attention was paid to insolvency risk, credit risk and inflation risk. The calculations proved the presence of rather high financial risks in the organization's activity. The company in the first two years of the analyzed period had a high probability of insolvency and therefore the risk of bankruptcy is maximum, in the current year the situation has normalized. An assessment of the credit risk of the company from the perspective of both the borrower and the lender showed that this risk was reduced during the analyzed period. But the organization may face the risk of not securing its liabilities, i.e. a peculiar form of credit risk, since the amount of borrowed capital exceeds equity by 75.3 times. The level of inflation risk in the current period is high due to rising inflation in the country. The authors proposed mechanisms to ensure financial stability of the studied company, which are divided into internal and external. The main types of internal mechanisms of financial recovery of the company were strategic tactical and operational ones.

Key words: *commercial organizations, financial risks, mechanism, assessment, company*

INTRODUCTION

The main objective of any business activity is considered to be achieving maximum profit at the lowest possible cost of financial resources. In order to achieve this goal it is necessary to compare the amount of resources invested with the financial results obtained. But there is a possibility of financial losses, depending on the size and type of activity of the business entity [10, 11].

In Russia, despite the instability of the economy, which worsens the situation of organizations, insufficient attention is paid to the assessment and integrated management of risks that arise during the operation of enterprises [12].

In this context, the purpose of the paper is to analyze the financial risks in terms of risk of financial stability, credit risk, inflation risk, insolvency risk of an agricultural company dealing with poultry farming specialized in egg production for consumption and recommend what the company has to do to avoid financial risks in the future.

MATERIALS AND METHODS

OAO "Poultry farm "Kolyshleyskaya" (OJSC) is specialized in the production of edible chicken eggs. Currently, the financial position of the studied enterprise is stable and improves every year. But in the process of its activities OAO "Poultry farm "Kolyshleyskaya" bears a variety of financial risks, the main of which include the risk of reduced financial stability, credit risk, inflation risk, the risk of insolvency, etc.

We carried out a detailed analysis of some of risks and assessed the level of their management.

Today there are many methodologies allowing to predict the risk of bankruptcy of an enterprise. These methods suggest assessing the risk of an enterprise on the basis of calculating the degree of its solvency, liquidity and financial stability [6].

RESULTS AND DISCUSSIONS

In order to predict the bankruptcy of OAO "Poultry farm "Kolyshleyskaya" (OJSC) several Russian methodologies were used (Table 1).

Table 1. Calculation of insolvency indicators for OAO "Poultry farm "Kolyshleyskaya" (OJSC) using different methodologies

Indicator	2018	2019	2020
(a) A model by R.S. Saifullin and G.G. Kadykov			
K1 – equity ratio	-1.26	-1.35	-0.62
K2 – current ratio	0.81	0.76	1.20
K3 – the turnover rate of the capital invested	1.64	1.71	1.91
K4 – management ratio	0.01	0.04	0.11
K5 – return on equity	-0.10	-0.32	16.47
R (integral indicator)	-2.40	-2.78	15.55
Financial status	unsatisfactory	unsatisfactory	stable
(b) A model for predicting company bankruptcy of ISEA			
X1	-0.13	-0.16	0.10
X2	-0.06	-0.21	15.95
X3	1.64	1.71	1.91
X4	-0.01	-0.03	-0.12
R-model	-1.04	-1.51	16.84
Probability of bankruptcy	90-100%	90-100%	up to 10%
(c) A model by O.P. Zaitseva for predicting company bankruptcy			
X1	0.00	0.00	0.00
X2	2.98	4.59	5.21
X3	10.14	11.76	6.45
X4	0.00	0.00	0.00
X5	-5.20	-5.13	-10.80
X6	0.61	0.58	0.52
Kfact	1.87	2.36	0.78
Kn=0.25*0+0.1*1+0.2*0.7+0.25*0+0.1*0.7+0.1*X6	1.64	1.63	1.63
Probability of bankruptcy	high	high	company is stable

Source: Compiled by the authors based on the accounting data of an agricultural organization.

Having analyzed the risk of bankruptcy of OAO "Poultry farm "Kolyshleyskaya" (OJSC), we could see that this organization in the first two years of the analyzed period had a high probability of insolvency, and, therefore, the risk of bankruptcy was the highest. In the current year the situation has normalized. But the company's management has to use the maximum set of measures to stabilize the situation in the short term in order to consolidate the result.

Credit risk is the possibility of incurring losses due to non-payment or delayed payment of the client's financial obligations, i.e. the company would not be able to repay its debts in full and on time. Both the lender (credit institution) and the borrower (enterprise) are exposed to credit risk [3].

Figure 1 shows the data on the sources of financing of OAO "Poultry farm. "Kolyshleyskaya" (OJSC). It shows that the ratio of equity and debt capital in OAO "Poultry farm "Kolyshleyskaya" is not optimal. Equity appeared in the organization only in 2020 in the amount of only 1,249 thousand rubles, and in the previous two years it had a negative value due to the presence of an uncovered loss (unprofitable activities in 2010-2012). Borrowed capital decreased by 22.5 % in three years. If we consider the ratio of equity to borrowed capital, borrowed capital in 2020 is 75.3 times higher than equity.

This situation indicates that the organisation may face the risk of not securing its obligations, i.e. a peculiar form of credit risk. In order to determine the possibility of its occurrence, we analysed in more detail the quality of credit liabilities of OAO "Poultry farm "Kolyshleyskaya" (Figure 2).

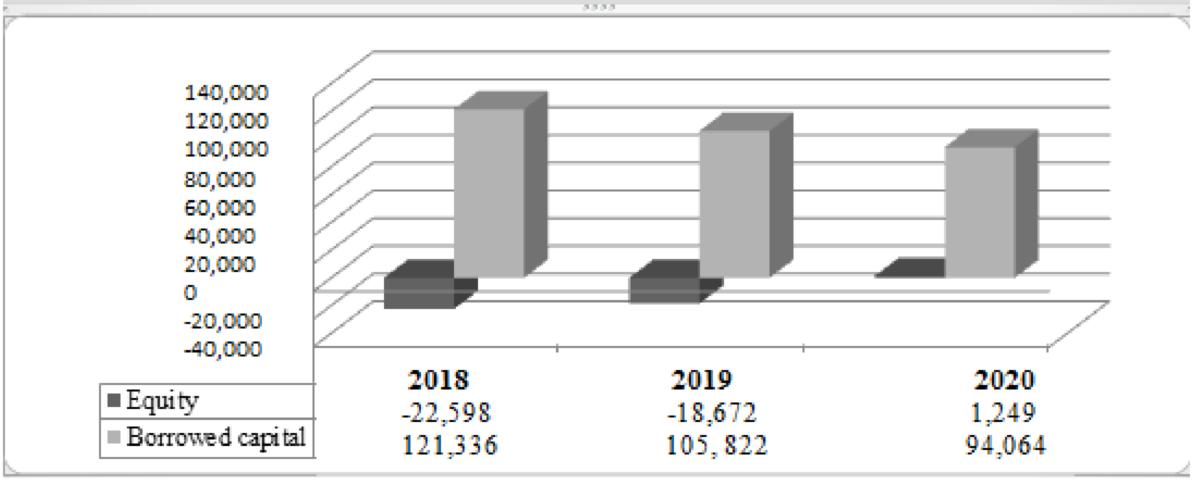

Fig. 1. The ratio of debt to equity at OAO "Poultry farm "Kolyshleyskaya", (Thousand rubles)
Source: [5].

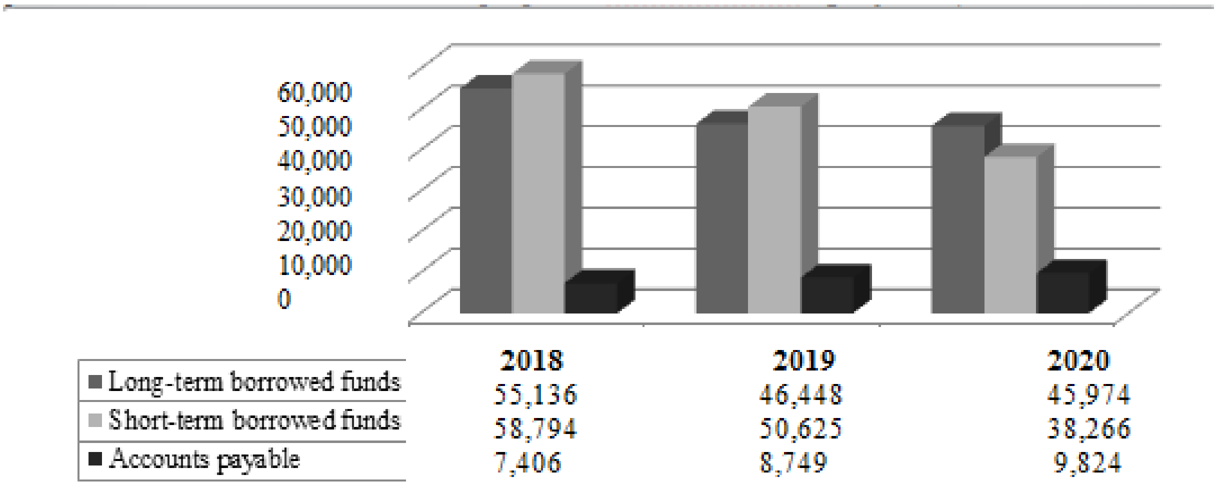

Fig. 2. Dynamics of borrowed funds of OAO "Poultry farm "Kolyshleyskaya", (Thousand rubles)
Source: [5].

Figure 2 shows that both long-term and short-term borrowings are decreasing every year. Accounts payable increase every year, but remain at a rather low level. In this connection, it was concluded that the credit risk in the researched organization is decreasing.

The credit policy of OAO "Poultry farm "Kolyshleyskaya" was further analyzed.

To do this, the dynamics and effectiveness of the use of accounts receivable and accounts payable were considered, as the organization when providing commercial credit to its buyers and customers becomes exposed to the risk of loss of income due to the possibility of non-repayment by the debtors.

Table 2 shows that the value of accounts receivable in the researched enterprise is not high and, moreover, it decreased during the observed period from 2,482 thousand rubles to 1,885 thousand rubles.

This led to improvement of the efficiency indicators of accounts receivable use.

Thus, the turnover ratio increased by 18.68 for the period, while the receivables turnover period decreased by 1 day and was only 4 days in 2020.

Accounts payable, on the other hand, increased, and its size in 2020 was 9,824 thousand rubles. The turnover period of accounts payable also decreased by one day and its duration is also not great, although it is higher than the duration of accounts receivable.

This indicates that the organization in question is paying its liabilities more slowly than it is receiving funds from its debtors.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. Efficiency indicators of the use of accounts receivable and accounts payable in OAO "Poultry farm "Kolyshleyskaya"

Indicator	2018	2019	2020	Deviation (+,-) 2020 from 2018
Value of accounts receivable, thousand roubles	2,482	1,906	1,885	-597
Revenue, thousand roubles	162,140	149,452	182,350	20,210
Accounts receivable turnover ratio	77.52	68.12	96.20	18.68
Accounts receivable turnover period, days	5	5	4	-1
Accounts payable	7,406	8,749	9,824	2,418
Accounts payable turnover ratio	19.19	18.50	19.64	0.45
Accounts payable turnover period, days	19	19	18	-1

Source: Compiled by the authors based on the accounting data of the agricultural company [5].

In general, based on the results of the analysis of the credit risk of OAO "Poultry farm "Kolyshleyskaya", we could say that the company reduced the level of the risk for the period under analysis from the borrower's point of view. The assessment of credit risk from the lender's point of view showed that its level in 2020 also decreased. This fact is due to the reduction of the organization's accounts receivable, however, this risk should be kept under constant control.

The next type of risk that an organization bears as it conducts its business is the risk of inflation. All money-flow processes in the Russian economy are subject to inflation, and to understand how significant this risk is, it is necessary to analyze the dynamics of inflation (Figure 3).

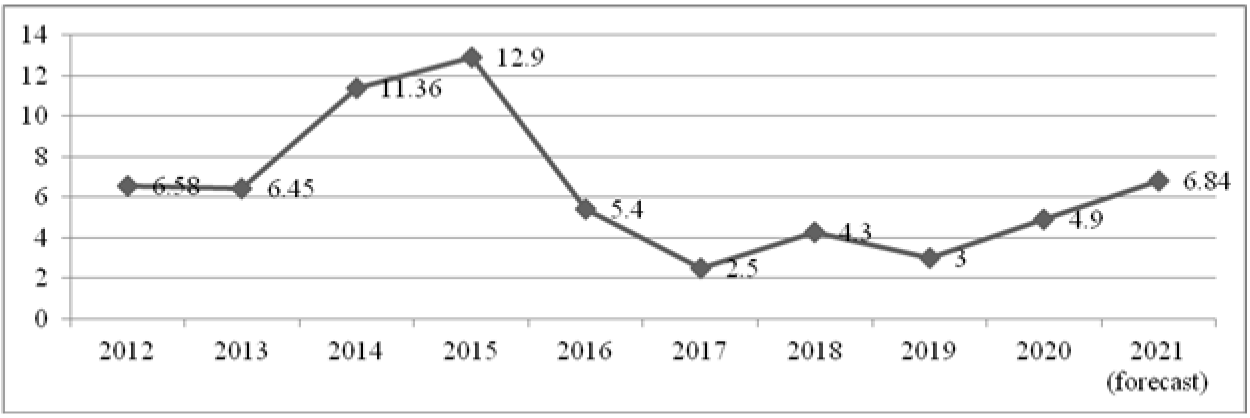

Fig. 3. Inflation in the Russian Federation, %.
Source: Rosstat [9].

The inflation rate trended downwards from 2015 to 2017. In 2020, inflation was the highest since 2016 (5.4%), in 2017 the price increase was only 2.5%, in 2018 - 4.3% and 3.0% in 2019.

The main reason for the acceleration of inflation in the Russian Federation to 4.9% in 2020 was the weakening of the national currency. In 2020, the difficult epidemiological situation in our country prevented a normal rate of development, due to which the purchasing activity of the population decreased.

Inflation in 2021 also appears to be higher than forecast by the Bank of Russia. As of 13 September, annual inflation is estimated to have risen to 6.84%.

According to the above data, we could conclude about the high level of inflation risks for all Russian organizations, including OAO "Poultry farm "Kolyshleyskaya" (OJSC).

The consequence of the inflationary process is the depreciation of available funds, so the financial management of OJSC "Poultry farm "Kolyshleyskaya" could be recommended to use funds as efficiently as possible [2, 8].

Thus, the financial risk management in OAO "Poultry farm "Kolyshleyskaya" requires some improvement, as the calculations proved the presence of sufficiently high financial risks in the organization's activities.

In order to solve the problems of financial recovery of the company, standard and universal measures are used, forming mechanisms to ensure financial sustainability [1].

There are external mechanisms (with the help of external individuals and legal entities) and internal (within the enterprise itself).

Table 3 shows the main types of internal mechanisms of financial recovery [4].

Figure 4 shows the proposed activities to be included as part of the operational framework for financial recovery.

In order to reduce short-term financial liabilities the organization should use an increase in the maturity of commodity credit, restructuring of the short-term financial credit portfolio, deferral of settlements on some types of internal accounts payable, etc.

The sale of unused equipment, leasing operations are proposed as measures to accelerate the disinvestment of non-current assets of the company [7].

Table 3. Stages and internal mechanisms for company financial recovery

Stages for company financial recovery	**Mechanisms for financial recovery**		
	Operational	Tactical	Strategic
Insolvency elimination	Ensuring "cutting off the excess"	-	-
Restoring financial sustainability	-	Implementing "enterprise compression"	-
Ensuring a long-term financial equilibrium	-	-	Based on sustainable economic growth

Source: Compiled by the authors based on the accounting data of the agricultural company [5].

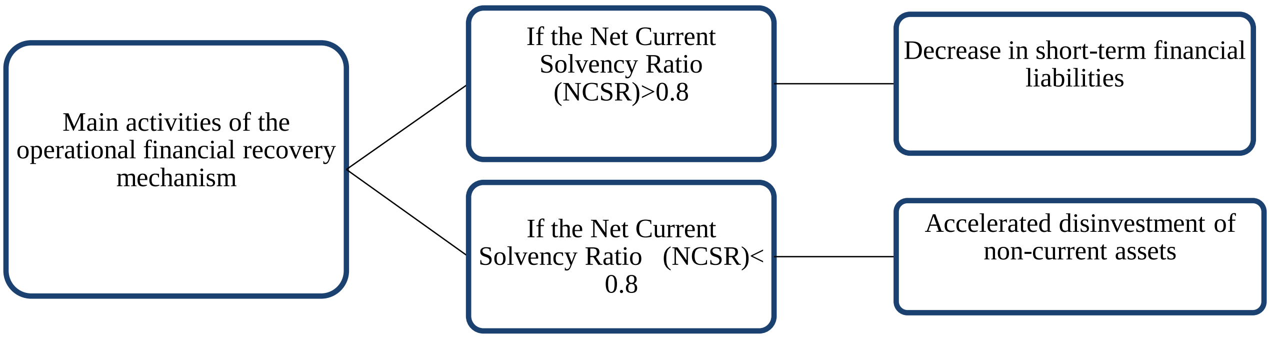

Fig. 4. The main activities of the operational mechanism for the financial recovery of OAO "Poultry farm "Kolyshleyskaya".

Source: Compiled by the authors based on the accounting data of the agricultural company [5].

CONCLUSIONS

The analysis of the state of financial risks of OJSC “Poultry Farm “Kolyshleyskaya” in the first two years of the analyzed period has a high probability of insolvency, and, therefore, the risk of bankruptcy is maximum. This year the situation has normalized. According to the ratio of own and borrowed capital, it was concluded that the organization may face the risk of the possibility of failure to secure its obligations, i.e. a form of credit risk. In order to determine the possibility of its occurrence, the quality of credit obligations of OAO Poultry Farm Kolyshleyskaya was analyzed. The next type of risk that an organization bears when carrying out its activities is inflation risk. The situation with accelerating inflation in the last two years has affected the value of the inflation risk of the organization under study, which is increasing. The financial risk management policy of Kolyshleyskaya Poultry Farm OJSC requires some improvement, since the calculations performed have proved the presence of fairly high financial risks in the organization's activities. In our opinion, it is necessary not only to reasonably assess the level of the corresponding risks, but also to introduce at the enterprise under study some methodology for their more detailed identification in the long and short term. In this regard, it would be justified to use an in-depth methodology for scoring the financial risk of an organization's insolvency with the calculation of the final coefficient.

The paper proposed the main directions to reduce or eliminate some of the risks. The internal elements of financial risk management of Kolyshleyskaya Poultry Farm OJSC should be formed at the operational, tactical and strategic levels.

The main content of the operational mechanism for reducing the risks of the threat of insolvency is to ensure the balance of monetary assets and short-term financial liabilities of the enterprise.

As directions for eliminating the problem of insolvency, one should choose the reduction of liabilities through the prolongation and restructuring of loans, the postponement of certain types of accounts payable, the increase in the terms of commodity credit, etc. Non-current assets of the company are financed by only long-term liabilities, which is not quite an adequate situation in the current environment.

Therefore, it is advisable to optimize the capital structure by increasing the amount of own funds. This can be achieved through the use of a depreciation premium. At the same time, it is inappropriate to use only non-linear methods with decreasing coefficients, since they not only do not provide tax benefits, but also significantly reduce the amount of depreciation.

Combining the existing depreciation methods allows us to develop a more efficient depreciation policy aimed at updating fixed production assets. As measures for the accelerated deinvestment of non-current assets of the company, it is proposed to sell unused equipment, rent fixed assets instead of buying, leasing operations. The implementation of the proposed measures to eliminate, avoid or control financial risks would allow Kolyshleyskaya Poultry Farm OJSC to significantly reduce the threats to its financial stability.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MONITORING, ASSESSMENT AND DEVELOPMENT PROSPECT OF THE CEREAL CROP MARKET IN UKRAINE

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Abstract

The cereal industry in the aspect of ensuring the food security of the country, is a strategically important component of the grain food market, but requires solving a number of important problems in achieving sustainable development, increasing production volumes and increasing export potential on the world market. The production of cereals remains a problem industry, as demonstrated by the significant fluctuation and high level of prices for the main types of cereals. Mixed research methods were used in the analysis of cereal crop market data. The theoretical and methodological basis of the study was a dialectical method of cognition, a systematic approach to the use of general provisions of economic theory. Conducted studies of cereal crop cultivation in Ukraine evidenced that gross yield of buckwheat increases on an intensive basis - with a decrease of 11.3 per cent, an increase in yield of 21 per cent; tends to decrease in gross millet yield (62.3 per cent) under the influence of reduced acreage and yields, rice production remains stable. Growing and processing of cereals are concentrated in the Eastern and central regions of Ukraine, and rice - in the Southern part. Increase the efficiency of cereal crop production in Ukraine can be achieved through the use of production reserves associated with the intensification and optimization of the organizational and economic mechanism of the industry.

Key words*: *buckwheat, rice, millet, economy, production dynamics, Ukraine

INTRODUCTION

The current stage of development of the national economy of Ukraine is marked by a high level of self-sufficiency in the main types of food. In 2020, the level of production for domestic use in the territory of Ukraine in the group of cereals amounted to 323.3%. This indicates that production exceeds 3.2 times the volume of consumption in the domestic market.

The culture of consumption of cereals in Ukraine is quite high and is due to their use in the preparation of various dishes. Traditionally, in the diet of Ukrainians there were always porridge of different types of cereals and today they form the basis of the food supply of the population. Cereals are part of the group of cereals, which are the second most important in the nutrition of the population and the volume of processing, so they are given an important place in agro-industrial production. Grain production is an important component of the specialization of agricultural producers, which aims to meet the needs of the domestic market for seeds, grains for food, fodder and technical purposes. At the present stage, manufacturers face the challenges of improving the quality characteristics of cereals, creating and expanding the cereal component of the export potential of the grain market [4, 6, 7, 11, 19].

The market of cereal crops is a system of economic relations between market subjects that arise in the process of production, storage, sale and consumption of cereals in conditions of free competition and market pricing, wide choice of directions, forms and methods of product sales and state market regulation and product quality control [3, 8]. Processing grain for cereals is an important processing industry in terms of value added, because cereals are the final product of consumption and their price is much higher than the price of raw materials. When processing rice, buckwheat and wheat grains

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

there is no waste, that is, they are fully liquid and are used as a feed base in livestock or raw material for further processing. These advantages form competitive positions in grain processing.

At present stage, Ukraine is part of the world of grain producers, and is also among the three leaders in the export of cereals. Ukraine is integrated into the world grain market, which is why changes in the world market affect the domestic grain market.

In Ukraine, almost all cereals are grown, from which cereals are produced, so the prospects for the development of the cereal market directly depend on the volumes of production, their yield and territorial, as well as the availability of grain reserves. But research on these indicators is complicated by the fact that cereals are not separated into a separate group, as cereals produce from almost all cereals - wheat, barley, oats, and corn. Grain production of cereals satisfies the domestic needs of the country, but the industry must have access to external markets [5, 10].

Cereals occupy an important place in the world food market and are not overlooked by scientific research.

Practically all grain crops from which cereals are produced are grown in Ukraine, so the prospects for the development of the cereal market directly depend on the volume of production, their yield, and zoning, as well as the availability of grain stocks. However, research on these indicators is complicated by the fact that cereals are not allocated to a separate group, as cereals are produced from almost all cereals - wheat, barley, oats, corn [14, 15, 21].

Development of domestic crude production for the security of the State is one of the main directions [13]. The study and identification of the main problems of the relevant cereal market development makes it possible to note the priorities of its development strategy, the implementation of which provides for active state intervention, which is ambiguous in the conditions of liberalization and integration into the world economic space [12]. In conditions when the state intervenes in the price formation in the market of cereal crops is negative, therefore, one way to address this issue is to limit the State's intervention or subsidy of agricultural producers through commodity and financial interventions [9]. The application of market-based regulatory mechanisms in conjunction with the intensification of integration processes is another way of addressing this problem, which will provide an impetus for the effective development of the market for cereals [16, 18].

The main obstacles to the expansion of exports of Ukrainian products are the low quality of a large part of the raw materials and outdated processing technologies don't allow the manufacture of cereals, which meets European standards. But domestic producers of organic cereals are gradually increasing sales in the EU and North American markets. The expansion of domestic sales can be achieved through the integrated application of non-tariff restrictions and is not in conflict with WTO agreements. This calls for further research on the experience of developed countries in low-quality, low-quality dumped imports of cereals [20].

MATERIALS AND METHODS

Strategic goals and the necessary condition for the development of the market of cereals are the production of high-quality grain, its rational use and the provision of raw materials to the processing industry in the required quantity.

In analyzing statistical data, mixed methods of research were used. The theoretical and methodological basis of the study was a dialectical method of knowledge, a systematic approach to the use of the general provisions of economic theory, scientific developments of domestic and foreign scientists on the formation of cereal cultures and their infrastructure.

In the process of studying the market of cereals, the generally accepted methods and techniques were used: a set of scientific methods of the abstract-logical method (induction, deduction, analysis, synthesis, analogy, comparisons) - in the process of studying the theoretical foundations of the formation and development of the market;

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

monographic method - used in the development of literary sources, legislative and other legal acts, in order to illuminate the views of scientists on the studied problem; the method of retrospective analysis - in the study of the main prerequisites of the formation and development of cereal crops; factor and graphical methods - in determining and studying the impact of the market situation on the development of the market.

The infobase of the research was made up of scientific works of domestic and foreign scientists on the problems of the studied issue, legislative and regulatory acts, materials of the State Statistical Service of Ukraine, sources of information and analytical materials of specialized organizations and periodical industry publications [1, 17].

RESULTS AND DISCUSSIONS

The greatest food value and distribution in the domestic market of cereals are such crops as buckwheat, rice and millet, which are grown by different sizes and organizational and legal forms of farms. The share of sown areas for traditional cereal crops in 2020 in the total area of cereals and pulses in all categories of holdings is small - only 1.66% (1.04% under millet, buckwheat - 0.55%, rice - 0.07%) consequently, cereal grain production as a percentage of gross cereal production is even lower - 0.63% (millet 0.39%, buckwheat 0.15%, rice 0.09%), which indicates a lower level of yield compared to other grain crops [2].

Rice is grown only in the southern regions of Ukraine in special agro-ecological systems. Its production is quite stable and depends on the area of rice receipts - for 2016-2020 area of rice 10.5-12.7 thousand hectares and production volumes remain at the level of 54.6-69.2 thousand tons.

The dynamics of production indicators of the main cereal crops for 2016-2020 indicates a decrease in the area from which the yield of buckwheat was harvested by 45.3%. Since the yield remains at almost the same level, the gross yield of buckwheat also decreases 44.7% (Table 1).

Table 1. Dynamics of cereals production in Ukraine

Indicators	Years					2020 in per cent to 2016
	2016	2017	2018	2019	2020	
Buckwheat						
Area from which the crop is harvested (thousands of hectares)	153.7	185.3	113.3	69.2	84.1	54.7
Gross harvest in mass after finalization (thousand tons)	176.4	180.4	137.0	85.0	97.6	55.3
Yield (tons per hectare)	1.15	0.97	1.21	1.23	1.16	100.9
Millet						
Area from which the crop is harvested (thousands of hectares)	107.7	56.1	54.8	93.3	159.1	147.7
Gross harvest in mass after finalization (thousand tons)	189.7	84.4	80.5	169.7	256.1	135.0
Yield (tons per hectare)	1.76	1.50	1.46	1.81	1.61	91.5
Rice						
Area from which the crop is harvested (thousands of hectares)	12.0	12.7	12.6	10.5	11.2	93.3
Gross harvest in mass after finalization (thousand tons)	64.7	63.9	69.2	54.6	60.7	93.8
Yield (tons per hectare)	5.39	5.05	5.49	5.22	5.40	100.2

Source: official data of the State Statistics Service of Ukraine and original data calculated based on the data obtained.

The gross millet harvest in 2020 was a record level of 159.1 thousand tons, which is 47.7% more than in 2016. The yield of millet remains low - 1.40-1.81 tons per hectare, this is due to its cultivation in rain-fed conditions, with the use as an insurance crop under difficult climatic conditions for other cereals, taking aside under millet low-potential land. However, the drought resistance of the crop has a positive impact on its production volumes. In the context of global warming, the natural habitat of millet cultivation and its share in the area under cultivation are increasing. Also, the price of millet has a positive trend both in the domestic and foreign markets.

The volumes of production have a direct impact on the volume sales of products and, respectively, on the activity of processing

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

enterprises. Enterprises' implementation of the main cereal crops has different tendencies. The volume of realization of buckwheat in 2019 is almost half less than in 2018 - 27.2 against 51.5 thousand tons (Table 2).

Table 2. Volumes and average prices of the main cereal crops sold by enterprises

Crops	Years			2020 in per cent to 2018
	2018	2019	2020	
Implemented by enterprises - in total, thousand tons				
Buckwheat	51.5	66.3	27.2	52.8
Millet	41.1	55.0	96.9	235.8
Rice	27.1	28.7	25.3	93.4
Average realized sales prices, UAH/t				
Buckwheat	5,827.8	7,158.7	14,550.8	249.7
Millet	7,700.2	6,929.5	5,974.6	77.6
Rice	7,909.4	7,898.7	8,663.6	109.5

Source: official data of the State Statistics Service of Ukraine and original data calculated based on the data obtained.

Noted that the price of selling buckwheat increased by 2.5 times - from 5,827.8 to 14,550.8 UAH/tons, which is a consequence of the decline in production at the unsatisfied demand within the population, because buckwheat is the most popular and, at the same time, the most expensive cereals. It is on the market of buckwheat that there are significant price fluctuations due to the shortage of products, which influenced the decision of the state to introduce subsidies to producers for its cultivation in the amount of up to 5,000 UAH per hectare of harvested area. However, the grant didn't affect the decision of the agrarians to increase the area of buckwheat. The reasons lie in the peculiarities of cultivation of this crop, low level of agricultural equipment, significant risks of crop loss due to the influence of external climatic factors.

The implementation of millet by agricultural enterprises in 2020 is 2.35 times higher than in 2018. It is 96.9 thousand tons. The sale price has decreased from 7,700.2 to 5,974.6 UAH/t, or by 22.4 per cent.

The study of regional aspects of the implementation of buckwheat shows that production is concentrated in the central, western and eastern regions. In 2020, the most sold buckwheat agricultural enterprises of the Sumskyi region 4,434.1 tons (16.3%), Kyivskyi - 3,262.5 tons (12.0%) and Khmelnytskyi - 3,174.4 tons (11.7%) (Table 3).

Table 3. Implementation of buckwheat by enterprises by region, tons

Regions	Year			2020 in per cent to 2018
	2018	2019	2020	
Ukraine	51,525.8	66,326.1	27,229.2	52.8
Vinnytska	5,062.1	4,798.5	2,620.8	51.8
Volynska	1,056.1	1,033.0	168.4	15.9
Zhytomyrska	5,563.4	5,285.0	1,957.8	35.2
Kyivska	6,653.2	8,836.3	3,262.5	49.0
Kirovohradska	1,249.3	2,558.0	743.9	59.5
Lvivska	3,877.1	1,407.9	941.1	24.3
Poltavska	1,852.0	2,903.3	890.5	48.1
Sumska	5,002.0	13,086.5	4,434.1	88.6
Ternopilska	3,050.2	2,168.7	1,822.1	59.7
Kharkivska	4,089.6	8,350.8	1,888.6	46.2
Khmelnytska	4,187.1	4,750.6	3,174.4	75.8
Chernihivska	6,058.2	4,881.3	2,633.7	43.5

Source: official data of the State Statistics Service of Ukraine and original data calculated based on the data obtained.

The volume of sales of buckwheat in 2020 in all regions decreased from 11.4% in Sumy region to 84.1% in Volyn. This represents that buckwheat is inferior to other crops in terms of profitability, so producers prefer other crops that provide higher results.

Millet is more evenly distributed throughout the country, it is grown in almost all regions. The leaders in 2020 are the Chernihivska area in terms of production volumes 11,325.5 tons and the largest share among the regions of Ukraine - 11.7% (Table 4).

Table 4. Implementation of millet by enterprises by region, tons

Regions	Years			2020 in per cent to 2018
	2018	2019	2020	
Ukraine	41,061.8	55,048.6	96,870.5	235.8
Vinnytska	553.2	2,591.5	3,078.9	556.6
Dnipropetrovska	4,317.5	4,346.2	3,622.7	83.9
Donetska	340.0	2,272.9	3,313.0	974.4
Zhytomyrska	5,097.0	3,516.9	6,393.7	125.4
Zaporizka	4,079.6	4,762.9	10,496.6	257.3
Kyivska	1,476.0	3,892.0	5,790.1	392.3
Mykolaivska	1,659.1	1,726.2	3,610.0	217.6
Odeska	3,709.3	4,311.6	7,672.0	206.8
Poltavska	3,022.8	4,352.1	6,937.6	229.5
Sumska	1,167.2	624.2	4,169.6	357.2
Kharkivska	6,203.0	3,459.4	8,398.9	135.4
Khersonska	811.2	4,421.8	5,950.3	733.5
Cherkaska	1,003.7	1,492.5	4,158.0	414.2
Chernihivska	2,903.8	3,791.3	11,325.5	390.0
Kyiv	1,183.9	*	5,153.7	435.3

Note: * - trade secret (restricted access).
Source: original resultsa calculated based on the data from State Statistics Service of Ukraine.

In the Zaporizka area 10,496.6 tons of millet were realized, in Kharkivska - 8,398.9 tons, which corresponds to 10.8 and 8.7 per cent of the overall indicator for the country in 2020. The highest increase in sales over the past three years provided Donetska (9.7 times), Khersonska (7.3 times) and Vinnytska (5.6 times) area.

An important direction for improving organizational and economic relations between the subjects of the cereal crops market is vertical integration between producers, processing enterprises and intermediaries who sell products on the domestic and foreign markets, which, as a result, will contribute to better provision of their financial resources, a fair distribution of added value, material and technical support of production and economic processes, increasing the level of mechanization of processing, packaging, supply.

Of the total production volumes in 2020, processing enterprises received 4,589,407 tons of grain and leguminous crops. The processing structure is as follows - for compound feed - 53%, for flour - 42% and the share of cereals is only 5% (Figure 1).

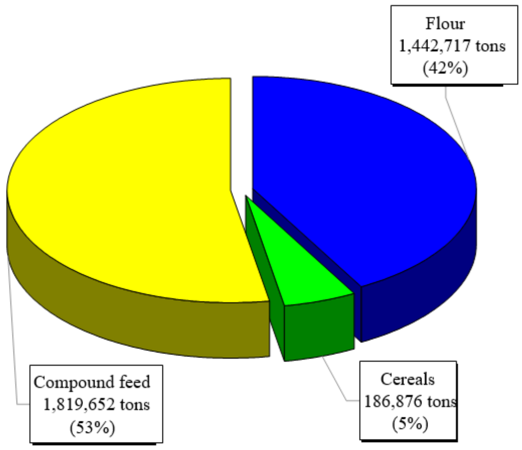

Fig. 1. Structure of processing of cereals, pulses enterprises engaged in their storage and processing in 2020, tons
Source: official data of the State Statistics Service of Ukraine.

The production rate of cereals in 2020 was 186,876 tons higher than in 2016, when 170,883 tons were produced - 9.4 per cent (Table 5).

Table 5. Processing of cereals, pulses in storage and processing enterprises, tons

Crops	Year					2020 in per cent to 2016
	2016	2017	2018	2019	2020	
Grain crops and leguminous crops	170,883	186,369	202,378	189,718	186,876	109,4
of which wheat	32,366	32,211	32,162	32,496	29,776	92,0
corn on grain	4046	3,690	917	*	1,526	37,7
barley	14,413	15,459	10,704	*	*	-
rye	679	715	576	451	485	71,4
oats	15,756	15,994	13,252	*	11,890	75,5
buckwheat	51,151	49,888	72,417	76,090	*	-
millet	9,213	15,004	8,153	9,653	*	-
rice	580	7,911	4	-	*	-
dried legumes	42,409	45,497	64,192	46,823	56,070	132,2

Note: * - trade secret (restricted access).
Source: official data of the State Statistics Service of Ukraine and original data calculated based on the data obtained.

Of the total production of cereals in 2020, wheat accounts for 29,776 tons (15.9%), corn - 1,526 tons (0.8%), rye - 485 tons (0.3%), oat - 11,890 tons (6.4%), dried legumes - 56,070 tons (30.0%). For the group of cereals and barley processing enterprises did not indicate, exercising the right not to disclose data on the basis of ensuring compliance with the requirements of the Law of Ukraine «On State Statistics» regarding the confidentiality of information. One can only determine that the share of barley, buckwheat, millet, rice in the structure of production of cereals in 2020 is 46.6%. It is worth noting that rice is processed directly in the enterprises that produce it, therefore, its share in the overall structure of the processing industry is insignificant. The analysis can only be detailed at the enterprise level, which limits information and does not release data on rice sales.

In 2018, cereals accounted for 40% of the total cereal and legume cereals production (Figure 2).

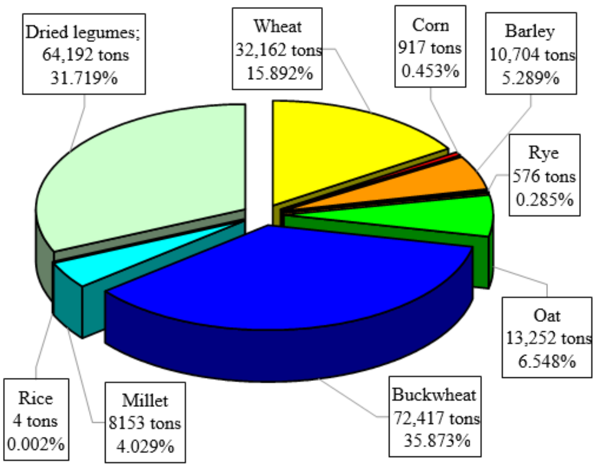

Fig. 2. Structure of cereal production in 2018.
Source: official data of the State Statistics Service of Ukraine.

The largest producers of cereals in Ukraine are the following companies: Cereal Ukraine, Terra, Shevchenkivskyi zavod, TOV «Nadiia», Altera, Art Foods, «Serpen», «Makfa», «Narodna», «Sto pudiv», «Takida», «Furshet», «Khutorok».

CONCLUSIONS

The success of the resolution of the problem of increasing the economic efficiency of grain production involves the implementation of a comprehensive system of measures to increase the production and improve the quality of cereals while reducing labour and material costs per unit of production. The intensification of production as the main direction of economic growth of the branch of cereal crops is a complex, multi-factor process of application of efficient and environmentally friendly means and technologies on the basis of scientific and technological progress, innovation, use of improved forms, organization and wage, management and effective market mechanisms.

Industrial crops are an important component of the grain industry, the production of which saturates the domestic market with the necessary products. Agricultural enterprises that grow oats, buckwheat, millet, rice and provide raw materials processing enterprises form a supply in the market of cereals.

Studies of the dynamics and structure of the cultivation of these crops in Ukraine show that the gross yield of buckwheat is increasing on an intensive basis - with a decrease of 11.3%, the increase in yield is 21.0%; tends to decrease gross millet yield (by 62.3%) as a result of reduced sown area and reduced yields; rice production remains stable. Cultivation and processing of cereals are concentrated in the eastern and central regions of Ukraine, and rice - in the southern.

To increase of efficiency of production of industrial crops in Ukraine can be achieved through the use of production reserves associated with intensification and optimization of the organizational and economic mechanism of the industry, namely: 1) the introduction of a set of necessary organizational and economic measures that will maximize the potential productivity of industrial crops while minimizing the cost unit production costs; 2) the introduction of scientifically founded doses of mineral fertilizers, the use of plant protection agents and plant growth regulators; the use of intensive varieties and hybrids for the best predecessors; 3) reduction of crop losses during harvesting and storage; 4) transformation of the cost policy for purchasing high-quality seeds, efficiency of fertilizers and plant protection means and increase of endowment of farms with basic funds; 5) intensification of search of internal reserves optimization and reduction of expenditures on individual items; 6) development of all elements of infrastructure of cereal crops - construction, reconstruction and modernization of capacity for grain storage and processing; 7) substantiation and introduction of effective measures to stimulate and support the production of grain with to market conditions.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SPECIFIC FEATURES OF ENVIRONMENTAL RISK MANAGEMENT IN ENVIRONMENTAL PROJECTS

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Abstract

The selection and justification of the feasibility of any environmental, including water projects, are always associated with the analysis of future events and uncertainty of the outcome of the project. Therefore, one of the most important tools of project management is a risk management framework. Risks usually arise from the uncertainty and variability of the economic, environmental, political, social environment, as well as the different operation conditions of a particular object. Weather and climate risk, as a subtype of general environmental risk, reflects the degree of loss of potential yields, and consequently the amount of income, as a result of uncontrolled meteorological factors. Reducing such risk provides a decrease in the impact of adverse natural factors on the efficiency of economic activity, and hence on the degree of technological excellence and environmental reliability of the selected alternative design solutions.

Key words: *environmental risk, weather and climatic risk, project management, environmental governance, modeling*

INTRODUCTION

The existence of global climate change is now recognized by the world community and is beyond doubt. The problem of global warming arose at the end of the last century. Addressing this problem requires the development and implementation of strategies to adapt to global climate change. The implementation of such measures will increase productivity, efficiency and profitability, especially agricultural production as an important component of nature management [7, 18, 19].

According to the UN Framework Convention on Climate Change, adaptation means adapting natural, social or economic systems to actual or expected climate change and its consequences [11, 24].

To clarify and make wider use of the concept of "adaptation to climate change", clear definitions of the following categories were considered and given: adaptation potential; propensity to influence; sustainability; risk; sensitivity; vulnerability [13].

Risk category is a combination of the probability (or frequency) of natural disasters and the scale of the consequences of their impact. Risk is a function of the object's propensity to influence and the perception of the consequences of that influence by the community or system.

According to the international policy documents on this issue in the field of climate diplomacy in Ukraine and the EU as a whole, based on real research by IPPC (International

Plant Protection Convention) criteria, on climate change in Ukraine until 2100, pursuant to the Decree of the President of Ukraine "On the decision of the National Security and Defense Council of Ukraine" of September 14, 2020 and "On the National Security Strategy of Ukraine" and others, Ukraine, like other member states, has committed itself to allocating funds for adaptation to climate change and preparation for its implementation [2, 7].

That is why the issue of disclosing the concept of "risk" and its use in the field of nature management, which is most affected by weather and climatic conditions and their changes, is extremely important [1, 5, 14, 20].

Ensuring the sustainable development of modern enterprises in the field of nature management is impossible without the introduction of innovative technologies. Innovative technologies reduce or avoid the negative impact of economic activities on the environment and provide more efficient use of natural resources [6, 15, 17, 22, 23].

The selection and justification of the feasibility of any environmental, including water projects, are always associated with the analysis of future events and uncertainty of the outcome of the project. Therefore, one of the most important tools of project management is a risk management framework. Risks usually arise from the uncertainty and variability of the economic, environmental, political, social environment, as well as the different operation conditions of a particular object.

At the present stage, taking into account the specific features of project implementation in the field of nature management, an environmental risk framework has become extremely popular due to the capability to predict the amount of such risk at the stage of project development in most cases will prevent the transformation of a potential environmental risk into a real one.

The urgency of taking environmental risk into account when implementing investment projects is growing due to global climate change, which requires the adaptation of natural and economic sectors to new conditions [8, 10, 12, 23].

Numerous aspects of environmental risk are studied in the works of many scientists. However, the issues of environmental impact assessment of projects in the field of nature management and their consideration when economically evaluating project decisions are still insufficiently studied.

MATERIALS AND METHODS

In the field of nature management, climatic or weather conditions dramatically affect the formation of technical, economic and environmental indicators [4, 8]. Such indicators are the basis for assessing environmental risk.

That is why the following research methods were used: methods of qualitative risk analysis (to identify the main factors and the corresponding risks that affect environmental projects); methods of quantitative risk assessment – statistical analysis and matrix modeling (to assess the probability of achieving project objectives and the degree of risk impact on project results); retrospective statistical observations (to create databases of meteorological conditions in different climatic zones); system approach (to consider of nature management projects as complex ecological and economic systems), methods of economic and mathematical modeling.

When studying climate change and its impact on various aspects of agricultural production on the drained lands of the Forest-Steppe zone of Ukraine, in order to develop appropriate adaptive measures, a set of forecasting and simulation models was used. Such a set includes: a model of the local climate; model of water regime and water control of drained lands; model of development and crop formation of cultivated crops. Such models are mostly implemented on the basis of long-term forecast [4, 8, 9]. In addition, the main methods of general experimental theory were used: analytical, experimental, statistical, mathematical modeling, machine experiment using modern information and computer technologies.

Such research methods are based on the application of systems theory along with a systems approach, systems analysis and modeling. These methods are focused on the widespread use of computers and related software and information support when developing modern approaches to justify technical and technological solutions in the projects in the field of nature management in a changing climate.

RESULTS AND DISCUSSIONS

The basis for quantitative risk assessment is, first of all, the idea of the concept of "risk". In addition, it is a distinction between different types of risk depending on the content and the field of detection.

Currently, there is no unambiguous interpretation of the term "risk". However, most often in the literature, "risk" is considered as the possibility of deviating from the goal for which the chosen alternative is realized or material, environmental, moral and other losses associated with the implementation of the chosen alternative in conditions of uncertainty.

When systematizing risks as to an economic object, it is customary to distinguish between external and internal risks. By the field of detection, the impact of economic, market, political, industrial, financial, environmental and other risks is more often assessed. However, in the process of planning and justifying projects, first of all it is necessary to determine which specific types of risks are a priority and directly affect the effectiveness of their implementation.

The analysis of the implementation of water management projects allows making conclusions. First, the implementation of water management projects has an impact on the environment, thereby generating anthropogenic environmental risk. Secondly, the results of project activities directly depend on changing and difficult to predict meteorological conditions, which leads to natural environmental risk.

Such features of environmental risk have different nature and content. In our opinion, that necessitates the identification of different types of environmental risk, which must be determined by different quantitative methods.

So, depending on the regularity and impact areas, environmental risks of water management project may include:

1. *Weather and climatic risk.* This type of risk arises under the influence of uncontrolled environmental factors that cause uncertainty and cyclicity of meteorological conditions. Weather and climate risk as a type of environmental risk provides extremely important information about the degree of the maximum possible economic result when using different ways of project implementation and allows choosing the best option.
2. *External environmental risk.* External environmental factors that cause this type of risk include: possible natural disasters, accidents, environmental cataclysms; radiation and chemical pollution of soils, water and air; extreme manifestations of natural phenomena (cyclones, hurricanes, downpours, floods, inundations, droughts, frosts, squalls, hail, etc.). Such risk is probabilistic and should be determined on the basis of statistics, long-term studies and forecasts.
3. *Internal environmental risk.* Irrational actions within the project activities can cause some damage to the environment. The most stringent criterion for assessing environmental risks is the assessment of changes in the state of environment: extinction of plant and animal species, changes in the chemical composition of environmental components, and so on. Various economic or other decisions must be made in a way preventing exceeding the limits of harmful effects on the environment.

Considering the planning of projects in the environmental field, including water management projects, it should be noted that one of the most important stages is the development of alternative design solutions, their comparison and selection of the best option for implementation according to certain criteria.

When analyzing the above types of environmental risk, it can be concluded that the weather and climate risk is decisive at the planning stage of project decisions, as meteorological conditions determine the

results of economic activities within the project, based on the following arguments:
– agricultural productivity, including on reclaimed lands, is affected not only by biological capabilities of crop varieties, available agronomic tools and mechanisms, timely and high-quality tillage, fertilizer application, crop rotation, etc., but also the results of interaction of a number of meteorological factors;
– randomly compiled weather conditions of each current year and long-term climatic characteristics, specific to a particular area, cause significant fluctuations in crop yields;
– it is the weather conditions in the relevant or estimated year have a decisive influence on the annual effect of the reclamation project and its deviation from the expected scale. Accordingly, the weather conditions will have a great influence on the final integrated effect for the entire period of operation of the facility.

As a result of this analysis, the economic content of weather and climate risk was made, based on the following considerations:

1. The assessment of such risk is carried out at the design stage according to a long-term forecast, which is based on a certain technological basis. Such calculations enable: firstly, to determine the objective potentially possible yield of each crop on a certain object, which is formed in ideal (optimal) conditions as to climate, solar radiation, soil quality, agricultural technology, water regime, etc. Secondly, depending on the weather conditions of a particular estimated year and the technological capabilities of the reclamation system, the projected technological yield is determined for each design solution. The projected technological yield, as a rule, does not reach the potentially possible yield. The difference between them characterizes weather and climatic risk.
2. In general, reclamation measures are carried out in areas with adverse natural conditions. Thus, weather and climate risk has a predominantly negative impact on the economic effect and in this sense it can be classified as "pure" risks.
3. Therefore, in our study, the weather and climatic risk of the water management project is considered as an absolute or relative deviation of the actual effect of the design solution from its potential value due to the mismatch of real weather conditions - optimal. In this context, weather and climate risk can also be considered as environmental losses from the increased potential income as a result of adverse natural factors. After all, the maximum yield is limited by the optimal ratio of environmental components [3, 10, 16].

The economic aspect of the assessment of water management projects on the example of the drainage system reconstruction project is also the aim of our study. Therefore, it is necessary to assess the impact of weather and climate risk on the economic performance of the object. Conditionally, it can be called a production effect (E_i) in the corresponding estimated year. To apply statistical methods to assess the impact of risk on the outcome of production activities on reclaimed land, it is necessary to know exactly how the effect depends on changes in weather conditions.

General approaches to making and implementing the models of business decisions optimization at different levels using climate data and meteorological forecasts when creating and operating complex meteorological and economic systems are outlined in our studies [8].

In view of natural seasonal cyclicity of agricultural production on reclaimed lands, there are different in terms of heat and moisture supply periods of vegetation, which can be grouped into estimated (typical) groups of years. The distribution of these groups of years within the project life cycle is uneven. This distribution can be done using a share coefficient (probability of detection) of the relevant group of years in the total project implementation period [4, 9].

In addition, the type and design of water management system affects the amount of the expected yield and, consequently, the overall economic effect. The type and design of water management system determine the appropriate technology of water regime control (water regulation) on reclaimed lands.

That is why the results of agricultural production on reclaimed lands during the project period of operation of the water facility depend on three main factors:

1. Meteorological conditions in the relevant typical estimated years, an aggregate of sets $P = \{p_j\}, \quad j = \overline{1,m}$.
2. Frequency (probability) or detection share of the relevant group of years over the design period of object operation – $\{\alpha_{p_j}\}, \; j = \overline{1,m}$.
3. Type and design of reclamation system by the appropriate method, water regulation scheme, an aggregate of sets $S = \{s_i\}, \; i = \overline{1,n}$.

Thus, in the general implicit form, the utility function of the water management project can be presented as:

$$E_{ps} = E(P, \alpha_p, S), \qquad j = \overline{1,m}, \quad i = \overline{1,n} \qquad (1)$$

For greater clarity and simplicity of calculations, this function can be presented in the form of a payment matrix [9, 21].

As we have noted, risk can be considered as an absolute (*R*) or relative (*f*) deviation from the potentially possible effect. Then, in general, the elements of the risk matrix are a deviation from the weighted average potential effect ($\overline{E}_n$)

$$R_{ij} = (E_{ij} - \overline{E}_n), \qquad i = \overline{1,n} \quad j = \overline{1,m} \qquad (2)$$

In economic statistics, the standard deviation has become the absolute variation measure. Therefore, the absolute amount of risk for each of the alternative design solutions is determined by the formula:

$$\overline{R}_i = \sqrt{\sum_{j=1}^{m} (E_{ij} - \overline{E}_n)^2 \cdot \alpha_{pj}} = \sqrt{\sum_{j=1}^{m} R_{ij}^2 \cdot \alpha_{pj}}, \quad i = \overline{1,n} \qquad (3)$$

When addressing the issues of increasing the economy resilience to the influence of meteorological factors, it is better to consider not the variance of fluctuations, but some complex criterion that takes into account both the variance of results and their average degree. Therefore, a relative degree of weather and climatic risk, as a risk degree per an unit effect in the form of shares or percentages, can be calculated by the formula:

$$f_i = \frac{\overline{R}_i}{\overline{E}_n} \cdot 100, \qquad i = \overline{1,n} \qquad (4)$$

Thus, in general, the criteria for selecting the best option for the project, including water management project, taking into account the impact of weather and climatic risk on the final result, can be given as:

a) by the criterion of effect maximization

$$E(s_o) = \max_{\{i\}}(\overline{E}_i - \overline{R}_i), \qquad i = \overline{1,n} \qquad (5)$$

б) by the criterion of cost minimization

$$B(s_o) = \min_{\{i\}}(\overline{B}_i + \overline{R}_i), \qquad i = \overline{1,n} \qquad (6)$$

As an example, the impact of weather and climate risk on the choice of design solution can be considered on the example of the reconstruction of drainage system located in Kiev region (the Forest-Steppe zone of Ukraine) in an area of 360 hectares.

Predictive calculations in simulation are performed on the following multiple variable conditions:

– by the typical for this zone grown crops of the aggregate of sets $\{k\}, \; k = \overline{1,n_k} \; (n_k = 6)$, and the corresponding share of their sown areas f_k: winter grains (with a share $f_k = 0.2$), sugar beets ($f_k = 0.1$), potato ($f_k = 0.1$), root crops ($f_k = 0.1$), perennial grasses ($f_k = 0.4$), corn for silage ($f_k = 0.1$).

– by the typical (estimated) in terms of heat and moisture supply periods of the growing seasons of the aggregate of sets $\{p\}, \; p = \overline{1,n_p}$ $(n_p = 5)$;

At the stage of formation of design solutions, the most rational of them were selected, which were technologically possible for implementation in natural-agro-ameliorative conditions of the studied object: option 1 – preventive sluicing (PS); option 2 – sprinkling on the background of preventive sluicing (SPS); option 3 – moisturizing sluicing (MS); option 4 – drainage (D); option 5 – sprinkling on the background of drainage (SD).

Based on simulation modeling when the corresponding set of optimization and forecast-simulation models was used, the main technical and economic indicators of the considered options of design solutions were obtained. At the same time, the influence of meteorological conditions on the options of design solutions in different by heat and moisture supply years was taken into account.

Generalized results for the changes in the relative degree of weather and climatic risk for a particular studied object by individual crops and estimated groups of years by heat and moisture supply on the example of moisturizing sluicing are presented in Fig. 1. These results showed that the greatest risk of crop loss is inherent for perennial grasses and winter grains in wet and very wet years. In average and dry years, the risk for these crops is reduced by means of humidifying measures. The expected degrees of weather and climate risk by the options of design solutions in terms of different technology of water regulation of drained lands in the years of different weather conditions are presented in Fig. 2.

It is obvious that the use of more advanced technology of water regulation on drained lands can significantly reduce the degree of weather and climatic risk compared to drainage in adverse dry years (40 ... 55%): for preventive sluicing – on average up to 30%, for moisturizing sluicing – up to 20 ... 25% and for sprinkling on the background of drainage – 5 ... 20%.

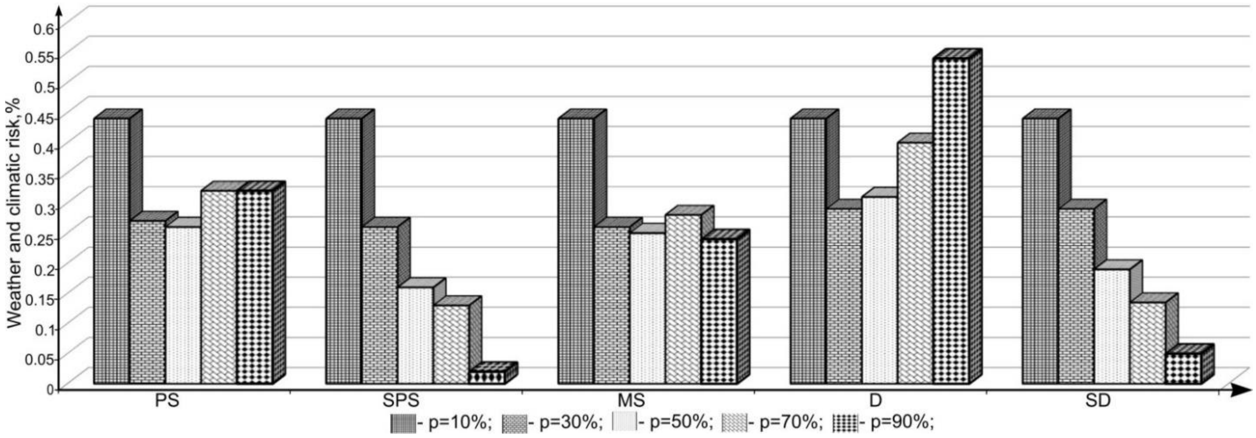

Fig. 1. Characteristics of the relative degree of weather and climatic risk when applying moisturizing sluicing for the crops of project crop rotation by the years of different weather conditions in the Forest-Steppe zone of Ukraine
Source: Own research.

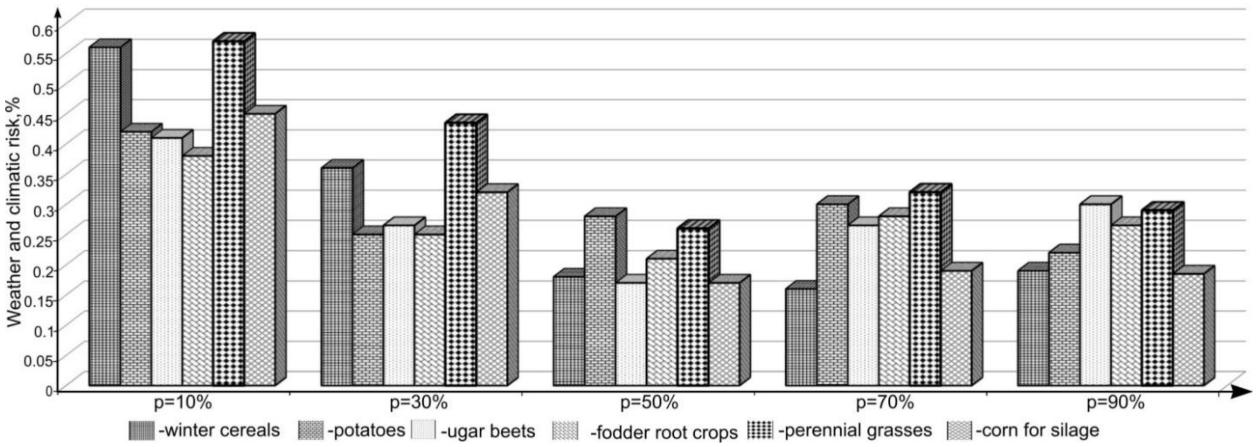

Fig. 2. Relative degree of weather and climatic risk by the options of reclamation project in the years of different weather conditions in the Forest-Steppe zone of Ukraine
Source: Own research.

This convincingly demonstrates the high overall efficiency of double regulation of water regime of drained lands.

These results of the study confirm that the more technologically advanced the design of a reclamation system is, the lower the weather and climatic risk it expected. Such advanced water regulation technology on drained lands provides higher crop yields and reduce the dependence of agricultural production on the effects of unpredictable weather conditions.

As noted above, the most optimal way to take into account the influence of meteorological factors in economic calculations is to introduce an indicator (absolute or relative) of weather and climate risk in the formula for calculating criteria for comparing alternative design solutions. Traditionally, the criterion for comparing reclamation projects is the minimum given costs [21].

For example, we calculated the indicators of given costs for design solutions by a traditional approach, which takes into account only the direct production costs, as well as by a modified approach taking into account weather and climatic risk, Table 1.

It is obvious that by the traditional approaches, the best option for reclamation project in humid areas is drainage, which is considered to be an obsolete technology for today and provides the least increase in yield. In addition, it is estimated to be characterized by the highest degree of weather and climatic risk, that is almost 40%. That is, by the assessment scale it is between medium and high degree. When using the proposed approach, taking into account weather and climatic risk the best options are more technologically advanced options of design solutions that reduce the dependence of yields on meteorological conditions.

Table 1. Results of the comparison of the efficiency of water regulation technology by the traditional and modified criteria of cost minimization in the Forest-steppe zone of Ukraine

	By the traditional criterion of given costs		By the criterion of given costs taking into account weather and climatic risk	
	Options of design solutions	Value	Options of design solutions	Value
1.	Drainage	0.867	Moisturizing sluicing	1.321
2.	Preventive sluicing	0.874	Preventive sluicing	1.323
3.	Moisturizing sluicing	0.935	Sprinkling on the background of drainage	1.385
4.	Sprinkling on the background of drainage	1.114	Sprinkling on the background of preventive sluicing	1.408
5.	Sprinkling on the background of preventive sluicing	1.163	Drainage	1.519

Source: Own research.

Thus, modeling different scenarios of economic activity taking into account weather and climatic risk enables to choose a more advanced technology of water regulation as an optimal model at a particular object in specific natural and agro-ameliorative conditions.

In addition, the forecast assessment of the degree of weather and climate risk can also be effectively used for other purposes – when determining a discount rate in investment calculations; when making decisions on the feasibility of using credit resources to finance projects; when substantiating the degree of agricultural insurance risk, etc.

CONCLUSIONS

The introduction of scientifically sound and effective methods of using climate information in economic calculations will significantly reduce losses (up to 40%) caused by natural conditions as well as get a greater effect due to the implementation of the optimal strategy for sustainable agricultural production on reclaimed lands.

The introduction of scientifically sound and effective methods of using climate information in economic calculations will significantly reduce losses (up to 40%) caused by natural conditions as well as get a greater effect due to the implementation of the optimal strategy for sustainable agricultural production on reclaimed lands.

Weather and climate risk, as a subtype of general environmental risk, reflects the degree of loss of potential yields, and consequently the amount of income, as a result of uncontrolled meteorological factors. Reducing such risk provides a decrease in the impact of adverse natural factors on the efficiency of economic activity, and hence on the degree of technological excellence and environmental reliability of the selected alternative design solutions.

The use of the proposed author's approaches as to taking into account weather and climatic risk in economic calculations enables:

– to model different scenarios of economic activity and to optimize the number of crops in crop rotation by the years with different climatic conditions to achieve the greatest effect;

– to reduce weather and climatic risk in adverse dry years (on average up to 40 ... 55%): for preventive slicing – up to 30%, for moisturizing sluicing – up to 20 ... 25%, for sprinkling on the background of drainage – up to 5 ... 20% due to introducing the most advanced and relevant to local conditions water regulation technology at a particular object

– planning the measures to reduce the negative impact of weather conditions in the years of the greatest risk.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

GREEN POLICIES TO INCREASE CLIMATE RESILIENCE AND WATER SECURITY FOR RURAL DEVELOPMENT

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Abstract

The paper aimed to present the research results on some environmental challenges and priorities of climate resilience. The research work was carried out in 2021 and referred to the analysis of the transcendence character corresponding to the environmental policies according to the strategic guidelines of recovery and resilience for sustainable development and green transition. Although sustainable development of the Romanian water sector has been approached in the past, the present paper has new research related to the water security and its role in building the climate resilience of agriculture and rural development in the European Union and our country. From a methodological view, there are used accumulations and outcomes from the specialty literature, from previous researches, the own data processing in figures and tables to describe some conceptual relationships, comparative analyses of the developmental state and the climatic vulnerability of the Romanian water infrastructure sector. The conclusions and recommendations highlight backlogs, needs and opportunities in the context of implementing the European Green Deal and the National Recovery and Resilience Plan.

Key words: *climate change, resilience, water security, irrigation, adaptation*

INTRODUCTION

The Covid-19 pandemic humanity has been facing since 2020, poses an unprecedented threat to sustainable development, especially in terms of social and economic pillars.
It is inextricably intertwined with global environmental issues such as biodiversity loss, climate change, air and water pollution and waste management, both in terms of its origin and the implications for environmental outcomes and the future well-being of societies around the world.
The policies and recovery plans currently in place aim to create a recovery that is both green and inclusive. A policy of sustainable recovery is defined by its dual potential to create activities or opportunities for income, jobs and growth and, at the same time, to accelerate the process of achieving medium- and long-term environmental objectives, both at national and global level.
The main objective of research conducted in 2021 is analysis of the transcendence character corresponding to environmental investments according to the strategic guidelines for recovery and resilience for sustainable development in Romania and in the EU.
In order to have an approach of both theoretical and practical synthesis and transcendence, based on accumulations and analyses from the past, the present research will refer to the challenges and perspectives of sustainable and resilient development in the water sector, considered both from an ecological and economic-social point of view.

MATERIALS AND METHODS

From a methodological point of view, the following methods, tools and procedures shall be used:
-accumulations and outcomes from the specialized literature:
-results from previous research;
-own data processing, figures and tables to describe conceptual relationships;
-static and dynamic comparative analyses on the development status and climatic

vulnerability of the Romanian agricultural water security.

The period analysed in this study was 2007-2020, that is after the accession of Romania in the European Union.

The main data sources are:

-The Eurostat database [10];

-The database Tempo online database published by the INSSE (National Institute of Statistics and Economic Studies) [23];

-The relevant statistical publications on the topics approached by the United Nations, IPCC, INSSE and Eurostat [21, 23].

RESULTS AND DISCUSSIONS

Climate resilience - conceptual framework

Although for about 3 decades they have been analysing and building on the global, European and national levels [11], past policies and strategies on sustainable development have failed to achieve the objectives (e.g., SDGs of the UN 2030 Agenda). A reason may be insufficient awareness and addressing of the resilience of sustainable development to climate change (CC).

The joint of an economic, environmental and recent health crisis has considerably increased the sense of vulnerability at all levels, stimulating the search for new ways to assert resilience, since the integrated approach to sustainable development cantered on the concept of resilience can increase the understanding of the forces influencing both the scope and the conceptual frameworks of measures and policies [4].

The water sector, to be considered both from an ecological point of view, respectively through the available water resources but also from an economic point of view, through the way of managing and efficient use of these resources, it is of essential importance both for sustainable development and for resilience [9].

Next are resumed, presented and analysed some important concepts for any sustainable development and resilience strategy (in this case, for the water sector). These are: Water security, Hazard, Vulnerability, Resilience.

Water security

Improving water security is essential to achieve environmental protection, economic growth, poverty reduction and public health. Water security is often presented as a predominantly technical challenge, but the decisions that define it are deeply political. Often, the risks to the poor are not even identified, not addressed.

Improving water security requires managing complex and competing water risks to deliver sustainable and equitable results for all. For our research, it is essential to consider the water system beyond hydrology and infrastructure to include the social and political factors that influence institutions and governance [17].

Hazard

Hazard is a phenomenon with the potential to cause damage. A water-related hazard can arise as a result of a "natural" event, such as a tsunami or extreme climate, a "human" threat caused, such as weak governance or financial instability, or a "hybrid" phenomenon resulting from natural and human interactions [26].

Vulnerability

Vulnerability is the tendency to experience injury as a dynamic function of the ability to anticipate, cope and recover from harmful events. The approach to vulnerability is based on different disciplines, following these principles:

-Vulnerability is dynamic and placed within the broader framework of political economy, historical heritage, social norms and power relations. It should be viewed within the complex system, along with physical exposure to hazard, as well as the ability to cope with individuals, social groups and ecosystems on different scales [13];

-It involves particular forms of activity and agency [27].

Resilience

Resilience theory is a useful concept to define persistent and emerging threats to the water system. Resilience to climate change is the process of including climate hazards and vulnerability in decisions. Resilience to climate change strengthens society's inherent capacity to mitigate, prepare for and adapt to climate hazard risks, changing the patterns in terms of climate hazards and variability for all.

In order to strengthen climate resilience in water systems, it is imperative to understand regional climate processes and risks related to climate change, existing socio-ecological resilience, community adaptation strategies and policy processes, to strengthen the capacity to integrate climate information into water policy and practice.

As will be analysed, further for the case of Romania, obtaining and maintaining the water security in the negative context of the CC now doubled by the Covid-19 health crisis is an urgent requirement, but also a great challenge. Achieving the objective of water security was already a difficult but a vital problem of sustainable development, since in addition to the meteorological variation of the water cycle, there are many areas that compete for finite water resources. In addition, water pollution through the discharge of insufficiently treated domestic or industrial wastewater will reduce the amount of water for consumption [14].

A new approach or addition to water security has been imposed with the increasingly clear manifestation and awareness of climate change, as: "Water is the basic environment through which climate change (CC) will have an impact on people, ecosystems and economies" [30].

That is why, in the activity of water management, it is necessary to achieve adaptation to climate change as soon as possible, and water is a problem but may become a factor for solving or adapting to CC. So sustainable water management is a factor in climate resilience.

Not only does the average temperature rise, but CC brings multiple different changes in various regions that increase with subsequent warming. For example: CC intensifies the water cycle. This brings more intense rainfall and associated flooding, as well as more severe drought in many regions; CC affects precipitation patterns. At high latitudes, precipitation is likely to increase, while it is estimated to decrease for much of the subtropics, along with changes in monsoon rainfall [20].

Resilience to CC is the capacity to consider climate hazards and vulnerability in all policies. Resilience to climate change fosters the ability of the society to expect and mitigate climate hazards risks, changing the behaviour in terms of climate hazards and variability for all [25].

For the increase of the climate resilience in the water systems, it is necessary to acknowledge the regional climate hazards and vulnerability related to climate change, the socio-ecological resilience, adaptation strategies and policies, eventually integrating climate information in the water policy and practice.

Challenges regarding water security and climate resilience in Romania

Undoubtedly, Romania, like the entire European Union, is currently facing climate change and environmental degradation at the same time. These dual challenges require coherent national and European policies for sustainability.

Romania is among the EU countries that are most exposed to large-scale floods, since about 13% of our country's surface is represented by floodplains.

Between 2002 and 2020, unfortunately in our country there were a significant number of deaths and relatively many homes damaged or destroyed due to floods.

Extreme phenomena are more and more being felt in the last 20 years. For example, Romania was hit by significant floods in 2005 (high material damage and 76 deaths), but then in 2007 there was a serious drought. The impact of these disastrous weather events was represented by significant economic damage, especially in the agricultural, transport, energy and water management sectors.

Without climate change policies, the climate will change quite a lot in Romania in 50-100 years, which will cause a decrease of about 8-10 percent of GDP per capita in Romania by 2100. (European Semester - Romania country report 2020).

The total potential quantity in Romania's surface waters is 127 bn m^3/year, of which:

-internal river basins contribute 30 bn m^3;

-about 87 bn m^3 are available from the Danube basin;
-and the groundwater adding a potential quantity of 10 bn m^3 per year.

However, the part of the total water resources (surface and underground) that can be used, given by the existing water extraction and use capacity, is only 40 bn m^3/year (at a total demand of 8 bn m^3/year).

For the current population of about 19 million loc., the average available volume is over 2,000 m^3/inhabitant/year, so it is higher than the threshold defined for water stress (1,700m^3/inhabitant /year), but it is lower than the average in Europe (about 4,500m^3/ inhabitant/year).

This highlights the need for judicious management in the conservation and sustainable development of the Romanian water resource. In addition, there is a geo-meteorological specificity that makes available water resources to show great differences from year to year. Unfortunately, in the driest years, the available water resource has dropped by half, so only 20 bn m3/year.

On the other hand, there is also the important territorial variation of the waters in Romania, where some hydrographic basins (such as Argeș-Vedea, Buzău-Ialomița, Siret and Dobrogea-Litoral) sometimes face large water deficits.

Currently (2020) the demand for water is based on the use of the municipality or population (about 33%), in agriculture (about 48%) and industry (about 12%). Water consumption has been steadily reduced since the 1990s, due to structural changes, through:
-reduction of industrial production;
-the abandonment of economically unprofitable irrigation systems;
-introducing metering and tariffs for the supply of domestic water and reducing of losses in the system.

Thus, the general water consumption has decreased drastically since 1990 – from 20.4 (close to the country's current usable resource) to about 7 billion m^3 per year, for all uses (population, industry and irrigation) – registering the largest decrease in water abstraction in that period among all the 13 new entrants to the EU.

It seems that the drastic reduction of the water demand represented a temporary relaxation in the management of water resources, thus from a quantitative point of view, in Romania there is a certain hydrological security, threatened nevertheless by climate changes [31].

Thus, in order to strengthen climate resilience in the management of water resources, it is necessary to raise awareness of some of the hazards and vulnerabilities, as well as of the still high investment need for the sector. They are own summaries based on the report Rapid assessment of integrated water resources, the Agreement for consultancy services concluded between the Ministry of Environment and Climate Change and the International Bank for Reconstruction and Development, Project co-financed by FERD.

These climate water issues are primarily:

Flooding. Unfortunately, in Romania, a large area of the territory is floodable, respectively over 1 million ha. Important investments have been made for a specific defence infrastructure (dams of over 9,000 km, regularization of water courses of over 6,000 km, more than 1,200 storage lakes). Still, floods occur almost annually and their severity seems to be increasing. The investments of infrastructure work necessary for flood management amount to about. 17 bn. €. [15].

Flash floods: they are different from floods in that they are large-scale and shorter-lived overflows of water. In Romania, they have manifested themselves more and more frequently, under the influence of climate change that has led to extreme weather events such as very heavy rains. In addition, the scale of the floods is enhanced by the massive deforestation of recent decades.

If for floods, there are warning systems that can ensure the early warning of events (even 48 hours before) the anticipation time for the waters in the mountains that are exposed to floods is only 2 hours, so that downstream localities are vulnerable to risks. To increase the warning time interval to at least 5 hours, important investments are needed to modernize radars for precipitation intensity

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

and capacity increases at regional flood forecasting centres.

Droughts: due to the increase in temperature and a decrease in the flow of rivers the frequency of occurrence of droughts has risen. Although the National Meteorological Administration owns 55 agronomic tracking stations throughout making forecasts of up to 3 months on the degree of moisture in the soil, these provisions are not sufficiently seconded by other agronomic services for farmers to manage drought conditions.

Some studies forecast that in southern Europe the annual average rainfall will decrease by 5 to 20% in southern Europe and the Mediterranean in the period 2071- 2100, compared to the average reported between 1961 and 1990. Corresponding to these changes in precipitation, the annual flows of the rivers in the north will increase but decrease to those in the south, a trend that will manifest itself more and more intensely in the future. According to the European Commission, "the extreme droughts in Central and Western Europe in 2018, 2019 and 2020 caused considerable damage. [...] With global warming of 3°C, droughts occur twice as often and, absolutely, the annual losses caused by drought in Europe would increase to EUR 40 billion per year ...'. (COM (2021) 82 final) [3] Romania's agricultural sector is facing the inevitable effects of climate change. A significant change in Romania's temperate-continental climate is expected in the coming decades, especially an increase in the annual average air temperature and a decrease in the annual amount of precipitation, on average by 10- 20%. This sector is most vulnerable to the impact of floods, droughts or other adverse events, as extreme weather events will lead to an increase in variability in agricultural production, food prices and farmers' incomes.

Previous studies have highlighted the fact that the climate vulnerability in Romania, including the one regarding the water security, has regional specificity so areas with a very high risk of drought are in the plains of Oltenia, Bărăgan and in the Moldavian Plateau. The main vulnerability is that of the decrease in agricultural productivity, generated especially by the insufficient security of the waters, respectively by the exposure to drought and desertification. [12].

Latest data on the agricultural exploitation in Romania from the National Institute of Statistics show that according to the provisional results of the General Agricultural Census (2020), the utilized agricultural area (UAA) was 12,763 thousand ha. In the last ten years, since the General Agricultural Census of 2010, the agricultural area has decreased by 543 thousand ha (4.1%). In 2020, arable land and permanent crops increased by 258 thousand ha (3.1%), respectively by 32 thousand (10.4%), while the area with pastures and meadows decreased by 783 thousand ha (Table 1).

Table 1. The main categories of utilized agricultural area in Romania (Thousand ha, %)

	2010		2020	
	Thou. ha	%	Thou. ha	%
Arable land, including greenhouses and solariums	8,306	62.4	8,571	67.2
Pastures and meadows	4,506	33.9	3,724	29.2
Permanent crops	312	2.3	344	2.7
Family gardens	182	1.4	124	1.0
Utilized Agricultural Area (UAA)	13,306	100.0	12,763	100.0

Source: Own computations of data from the NIS, accessed March 2022 [23].

In the structure of the agricultural area, the share of arable land was 67.2%, which indicates an increase of 4.8 percentage points compared to 2010, the share of pastures and meadows was 29.2% down by 4.7 percentage points, while the area of permanent crops had a share of 2.7%, increasing by 0.4 percentage points.

Given the duration of droughts from one to several months, there is high volatility in crop production in the most vulnerable regions and with insufficient infrastructure or adaptation measures; due to food chains, the entire agricultural production, not just the vegetable one, will be affected, with undesirable consequences for the supply or even the food security of the national economy [16].

In the latest IPCC report the chapter on the effects of global warming in Europe signals that Europe will warm up more than the rest of the world and southern Europe in particular will have to deal with drought [21].

There is still a significant challenge of climate change adaptation because a significant part of Romania's agricultural area experiences the negative effects of drought, insufficient water reserves and poorly functioning irrigation facilities. The absence or the high degree of degradation of the irrigation infrastructure made that approximately 48% of the total agricultural area (7.1 million ha) is affected by these CC phenomena.

Indeed, according to our own computations, as based on data from the National Statistical Institute database (Tempo-on-line) [23], the trend of nonfunction of irrigation systems in Romania has continued, so that in the period 2007-2020, (Figure 1) the share of the actually-irrigated agricultural area (at least one watering) was less than 15%.

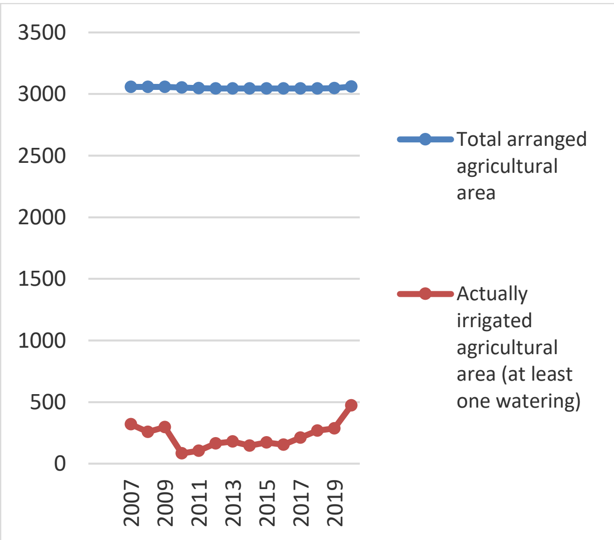

Fig. 1. Total arranged and actually irrigated agricultural areas in Romania (Thousand ha), 2007-2020
Source: Authors' own research.

However, the total amount of water abstracted by agriculture (including forestry and fishing) in Romania, although representing about 20% of the total water abstraction in Romania, is quite important, amounting to a volume of about 1,500 million cubic meters/year, which is since 2012 quite similar or even more than the amount of water abstraction for the very activity of public water collection, treatment and supply (Figure 2).

It is obvious that currently, although the risk of drought is high, the old irrigation facilities generate a high consumption of water and energy, which has a negative impact on the water reserves of Romania.

The country is classified in the category of countries with low water reserves (the average amount of water available per inhabitant is 2,660 m^3 water/person/year, including the Danube, just over half of the European average 4,230 m^3 water/person/year) [31].

In Romania, the irrigation facilities are at an advanced stage of degradation and on 75% of the area of these facilities, irrigation is not functional. The functional irrigation facilities are inefficient in terms of water and energy consumption and too costly for farmers.

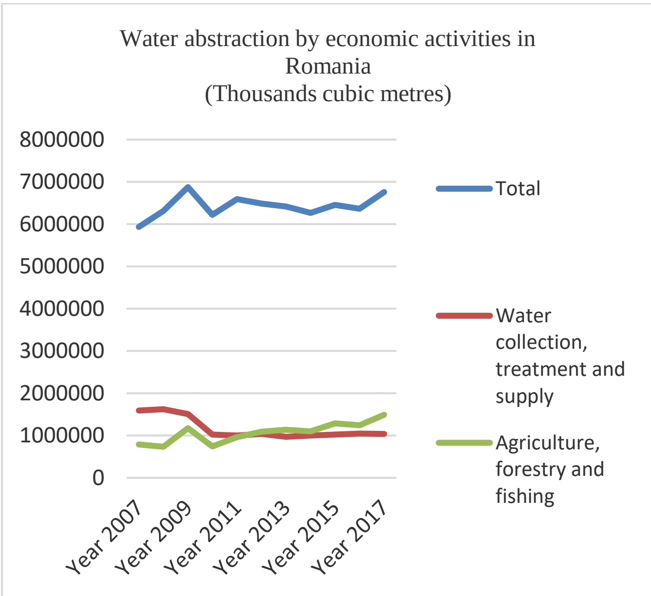

Fig. 2. Evolution of share of water abstracted, by sectors and economic activities in Romania, 2007-2017
Source: Authors' own research.

Policies on agricultural water security and climate resilience in the EU

Romania is very keen to benefit of the European Structural and Investment Funding and other available financial instruments to at least rehabilitate the existing irrigation infrastructure. However, to implement the European Green Deal and the sustainable development strategy, the European Commission has become particularly attentive to the integration of all environmental and climate resilience considerations into absolutely all sectoral and structural investment policies and programs [8, 2, 24].

Nevertheless, irrigation has a high potential impact on regional hydrology and water management [7].

Thus, it is increasingly important to balance the benefits of irrigation water abstraction to increase crop production against the negative environmental impacts and water demands from other sectors, such as public water supply and sanitation, or energy production [32].

In fact, the EU has many policies in place to improve water safety by ensuring the quality and quantity of water (the Urban Waste Water Treatment Directive and the Nitrates Directive) since 1991. In 2000, the Water Framework Directive (EC/60/2000) introduced policies that promote an ecosystem approach to water management.

Unfortunately, by now, the Common Agricultural Policy (CAP) has not been particularly effective in promoting the sustainable use of water in agriculture, since ”CAP income support does not promote efficient water use or water retention” [6].

Besides, climate change studies suggests that: “Drought leads to the construction of more irrigation systems, but those systems attract new agriculture. As a result, water demand continues to increase, while less and less water is available. That is why irrigation is not a sustainable investment” [21].

The further analysis made by the European Commission on the effects of the CAP on water has identified several issues, especially related to irrigation support, as to guarantee that supported investment will not rise pressure on water resources with the irrigated area increase. For instance, there are some conflicts to be solved:

-sectors with high impact on the water quality and quantity (fruits, wine) are not always eligible for direct payments thus not subject to corresponding greening criteria;

-greening practices do not apply on permanent crops;

-support for water-related practices may be contrary to climate objectives (support to irrigated sectors in areas where water resources are already overexploited). (EC-DGARD, 2020).

The Common Agricultural Policy has among its objectives the sustainable management of natural resources (including water) in the period 2014-2020 but also post-2020.

In addition, the application of the rules of the "Do No Significant Harm" (DNSH) analysis and taxonomy regulation to all investment and development measures financed in the future by the EC strongly penalizes projects that although they have positive effects for a certain area may have a negative impact on another environmental factor.

One of the biggest projects that Romania has tried unsuccessfully to impose in the National Plan of Recovery and Resilience (PNRR) is that of irrigation. The project was rejected because the Romanian authorities, namely the Ministry of Agriculture, failed to prove to the Commission that it does not endanger Romania's natural water resources.

In the initial version of PNRR (the National Plan of Recovery and Resilience, in the form subjected to informal discussions of European and Romanian experts), Romania proposed to allocate 2 billion euros for the restoration of the national irrigation system in the southern area of the country, an area that, under the effect of climate change, registers the decrease of the water reserve in the soil [22].

Nevertheless, there are some EAFRD-funded investments aimed at adapting to climate change to modernize secondary irrigation infrastructure; 463 contracts are financed, out of which 69 contracts transferred from the NRDP 2007 - 2013 to the NRDP 2014 - 2020. [28].

It is also important to know that by rural development policies and projects the national or regional authorities may support:

-agricultural practices or green infrastructure with a positive effect on water availability in agricultural soils (water retention measures, applied in Belgium Flanders, Spain, Hungary, Italy and Portugal;

-the farmers for the additional costs and lost income stemming from implementing WFD requirements (policy not applied yet in any EU member state ;

-waste water treatment plants or networks for water reuse in irrigation, this being already implemented in Cyprus and Belgium [6].
In order to comply with the Water Framework Directive (EC/60/2000) the green irrigation projects that may be funded under the European AFRD should comply with the conditions and criteria described in Figure 3.

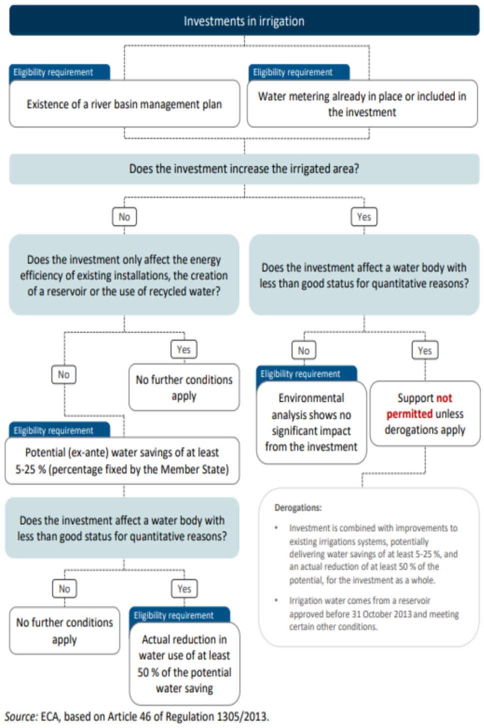

Fig. 3. Conditions for irrigation projects under rural development
Source: [6].

The most advanced trend analysed [12, 16] is that for transition to a green economy (circular), investments in water security systems (WSS networks, including wastewater treatment plants and irrigation facilities) in Romania are of crucial importance.
Properly treated wastewater can be reused for a variety of applications: aquaculture, industry, irrigation, reuse in residential areas, for recreation and swimming, or regeneration of water resources [19].
The reuse of treated wastewater is a practice that is part of the circular economy. According to a study carried out in 2015 for the Commission, around 100 million m³ of waste water is reused annually in the EU in the EU (equivalent to around 0.4% of annual freshwater abstractions in the EU)) [1].
In May 2020, the EU adopted a regulation on the reuse of waste water for agricultural irrigation. It sets minimum requirements on water quality, monitoring, risk management and transparency and will apply from June 2023 [29].
The Regulation (EU) 2020/741 will allow for the reuse of 'more than 50% of the total volume of water theoretically available for irrigation from EU waste water treatment plants and could avoid more than 5% of direct abstractions from water bodies and groundwater, which would overall lead to a reduction of more than 5% in the water stress'.
The CAP can finance water treatment infrastructure that could enable waste water reuse for irrigation [5].

CONCLUSIONS

Climate change is a long-term crisis and has a particularly severe impact on the countries in the southern part of the Eastern and Central European region, including Romania. This research has emphasized some water security and climate resilience vulnerabilities .
The conclusions are not yet too optimistic, since there are quite obvious issues and challenges of climate change adaptation.
Water security and, implicitly, climate resilience are still relatively fragile or insufficient in Romania, due to the increased vulnerability to drought or floods, but also to the almost perpetual deficit of water/ wastewater including irrigation infrastructure.
Still important investments are needed in Romania for water infrastructure, but also for strengthening the capacity for sustainable water management.
A paradigm shift in water policy is also needed, not only to prevent environmental pollution, but to emphasize that wastewater is a resource (of water and nutrients for agricultural use) whose effective management is essential for future water security.
Although Romania lost the minimum 2 billion. euro for irrigation investments required in the National Plan for Recovery and Resilience (PNRR), a rehabilitation of the

main and secondary channels, is one of the investment priorities of the sector according to the representatives of the companies in the field. The needs are obvious since in 2020 the drought affected one fifth of the areas cultivated with cereals (over one million ha, out of about five million ha cultivated), being effectively irrigated only about 500 thousand ha (less than 20%).

Currently, there is quite a lack of integration of water policies with other sectors, strategies and plans, for example, water and land use management. It is important to be aware that the plans to relaunch the economy do not aim to bring back the previous status quo, but look to the future, to the improvement of water security, climate resilience and transcendence.

Although in the National Reform Program 2021 there are useful and welcome strategic measures to adapt the agricultural sector in Romania to the CC, in the future it will be possible to achieve and obtain more investment grants, including from the CAP or private financing for the irrigation infrastructure in Romania only if and to the extent that these projects will be truly "green" and/or integrated with the national network of water and wastewater infrastructure, in order to promote the transition to circular economy and comply with the taxonomy regulation or the DNSH (Do No Significant Harm) principle.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AGRICULTURAL LAND, RENT SEEKING AND TRANSACTION COSTS

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Abstract

The study aims to assess the dualistic impact of the rents and transaction costs on the farmers regarding agricultural land use. The theoretical framework is based on Rent-seeking (RS) theory and the Transaction cost of economics (TCE). The review of both doctrines explains the "outflow" or "absorption" of value. The study observes the negative aspects of maximizing the functions of farmers with rents. They lead to distortions related to monopolies or unlimited market power. On the one hand, transaction costs are setting market inefficiencies due to the lack of consolidation of property rights and loss of time. On the other hand, rents can positively contribute to the mobility of other factors and, hence, the more efficient allocation of the resources. The transaction costs represent a positive effect of the risk distribution associated with the use of resources, which determines their positive role in protecting property rights. The study uses different methods, such as comparative institutional analysis, which retrospectively shows the effect of the institutional change and, more importantly, the impact of rent-seeking and transaction costs on main actors in the agricultural sector. The study aims to answer the question: rent-seeking or transaction costs are more important for agricultural activities, and how should they be reduced to maintain better agricultural land use.

Key words*: *agricultural land, rent seeking, transaction costs

INTRODUCTION

The study adapts an analytical framework for the effects related to the use of agricultural land. The concept is linked to the rules for conducting transactions. The topic is important not only because is associated with the efficiency of markets and agriculture in general but also related to fundamental issues such as human nutrition and food security [9].
The effects linked to the agricultural land use and the rules of the current market have no rational explanation, in particular:
(a)Despite the increased level of consolidation, there is a decline in agricultural production, economic efficiency and value-added in agriculture.
(b)The role of the type of land use, organisations creating the economic distribution, respectively the rents value and costs related to agricultural lands.
The main focus of the study is on the social effects related to agricultural land. The non-market benefits, rent-seeking (RS) and transaction costs (TC) are one of the explanations for the positive on the one hand and the negative role on the other of the effects of economic allocations on agricultural land. The theory of rent-seeking observes the relationship between institutions and political and economic distortions, also the non-market advantages [6]. Based on the institutional theory, RS links the analysis of property transfer organisations and their effects, and on that basis, creates a framework for analysing the issues with land access [10].
The study investigates the land use in Bulgaria and its impact on all markets, focusing on the following main topics:
(1)Trends in institutional change that influence the production factors and the possible integration in the value chain;
(2)The influence on organisations which distributes agricultural land property rights.
(3)The indirect consequences for the adaptation of the governance structure - market actors, hybrids, hierarchy because in

agricultural land contracts, different types of institutionally defined actors could participate.

Theoretical background

The market is considered a classic measure of rent [15]. The profit is based on the temporarily transferring part of a property right. In this regard, the labour of the rentier is equal to zero. In modern doctrines and concepts, efforts are linked to controlling resources or cash flows, and rent is seen as a maximizing activity [14]. In addition, the rent-seeking paradox points out to the unearned profits [21]. On the other hand, [24] studies rent-seeking in relation to the non-market advantages and almost complete lack of cost, as well as the achievement of economic goals even without the production of new goods. There also may exist a monopoly in the transactions or the contractual process, creating barriers over the other participants and causing issues with their access to resources and information [19, 20]. Barzel [2] even linked the rent issues to the duration of transactions. According to the authors' concept, the delay in a process may affect how the rules and legal principles are observed in the exchange process, for example: „first in time is first in the right „is associated with the existing possibilities for rent-seeking. Rents can predetermine non-market decision-making and the cost effects. However, they are also a consequence of the cost effects. On one hand, the costs are a consequence of the choice, and on the other - the costs predetermine the choice [5].

Williamson [26, 27] develops Transaction Cost Economics (TCE), explaining the subordination and impact of institutions at the micro level. Governance structure does not analyse social, non-market effects measured as transaction costs [28]. In this regard, the main question is if the payments in the contract process can be defined as a non-market advantage [23] or costs in favour of some and burden to other actors [22], can we consider the payments only as a negative external effect [7]?

Similar to the understanding of the dualistic nature of transaction costs [12], the link between the non-market part of the transaction and the rent seeking and its transaction cost effects should be analysed. Based on the literature review, it can be concluded that a new analytical framework should be developed and adapted to the current dynamics.

MATERIALS AND METHODS

Legal realism is a concept in American legal doctrine that allows the analysis of rules to be reduced to a synthetic format [13]. Relatively institutional analysis assesses the trajectory of institutional change. Based on different studies, the adaptive capacity of institutional actors is strongly influenced by formal rules and their changes [29] and the formalization and capitalization of property rights [8].

Discrete structural analyses (DSA) observe (abstractly) the processes of individual micro analytical actions [28]. Based on that, these processes can be measured as cost effects and included in the calculations of non-market benefits once as a subjective market value and a second time as objectively determined rents.

Rent-seeking can be the value of a market service: a document gravitating around a property right or payment in some quasi-markets: subsidy, state aid.

Benham and Benham [3, 4] define the transaction costs as the sum of the subjective and objective value, the opportunity costs, in which market and non-market payments are integrated. Transaction costs are also considered as the subjective and objective elements of production and time resources [25]. The methodological approach in the study adapts to the value of the processes as costs of property rights generated with time expenses [1, 16, and 17]. On the other hand, it excludes the market price of the object (land) from equality, due to the dualism of the doctrine. The concept represents it as a cost for some actors and an income (possible rent) for another [11].

RESULTS AND DISCUSSIONS

In the period 1990-2020, serious variations are observed in the normative framework defining agricultural land. Due to the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Constitutional Reform in 1991, the institution of the property is changed, and a restitution process is launched. The restoration of private property makes both hereditary and market relations extremly dynamic.
Institutional change continues due to the fact that by 2001, when restitution process was completed and there were already more than 2 million private, fragmented agricultural properties in the country.
The latter means a high level of co-ownership (sometimes a property has more than 20 co-owners) and a high level of non-market distribution of property rights.

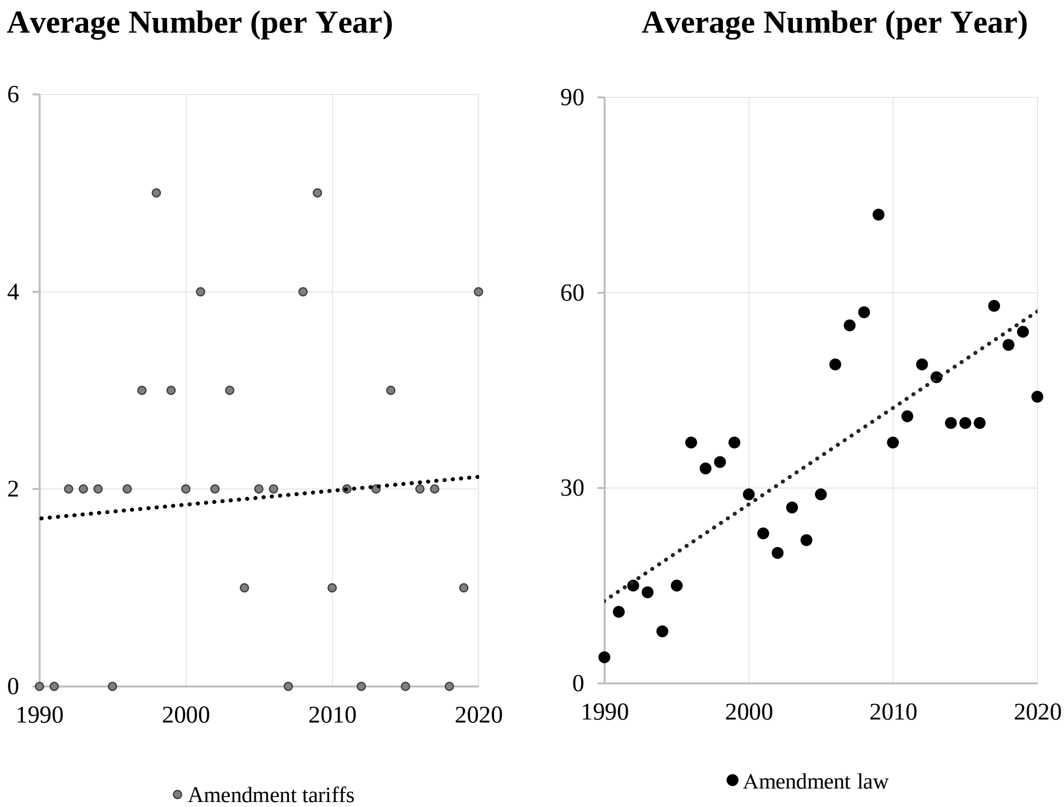

Fig. 1. Formal Institutions: Law, Tariffs and Agricultural Land in Bulgaria (1990-2020)
Source: Own survey.

The costs in the processes and those related to access to the resource is increasing. In addition, the transaction cost is high.
The accession of Bulgaria to the European Union led to a new opportunity in the Constitution linked to an institutional trajectory related to the financial support of agricultural land. Special Investment Purpose Companies Act (SIPCA) further accelerated the process, and with the change in Art. 37c of the Ownership and Use of Agricultural Land Act, which starts the consolidation of agricultural land based on the use (not sale), with the help of lease agreements. The subsidies received per unit area, together with the procedure under Art. 37c led to an increase in the number of land transactions and to land consolidation. These incentives stimulate the rise to new forms of rent-seeking. In some cases, the subsidy can be directly defined as rent-seeking.
Figure 1 shows the formal change in legislation related to agricultural land. The total number of normative acts is 51; tariffs have been changed 61 times (Figure 1a), and the total number of formal institutional changes is 1,094 (Figure 1b). Intense institutional change negatively affects the adaptive capacity of actors. Based on the analysis, it can be concluded that the latter increases individual transaction costs and rent-seeking.
Figure 2 shows the average prices, rents and transaction costs per decares. The costs of

access to the property, collected with the costs of adaptation, are accumulated cumulatively during the process in which the contracts run. This makes the total transaction costs relatively higher in the unfinished contracts. After the prices and rents are subtracted from the measurement of transaction costs, it can be noted that the completed contracts price of agricultural land covers the total amount of transaction costs. In unfinished contracts rent does not cover the total amount of contract transaction costs.

Based on the analysis, it can be concluded that in 2008-2011 there was an initial decrease in prices and an increase in rents and transaction costs. After 2011, prices rise faster than rents, and the reason for this trend is related to the increased size of rent-seeking.

The constant demand for agricultural land (in parallel with constant supply) is a prerequisite for land prices to increase during the observed period. With the "accumulation" of agricultural land of large landowners, they have changed their strategies by refusing to sell, but only to manage it, which is why there are more unfinished contracts (leases) and more slightly completed (sales).

This trend has gradually created a shortage of agricultural land, as a large group of farmers already have issues with land access.

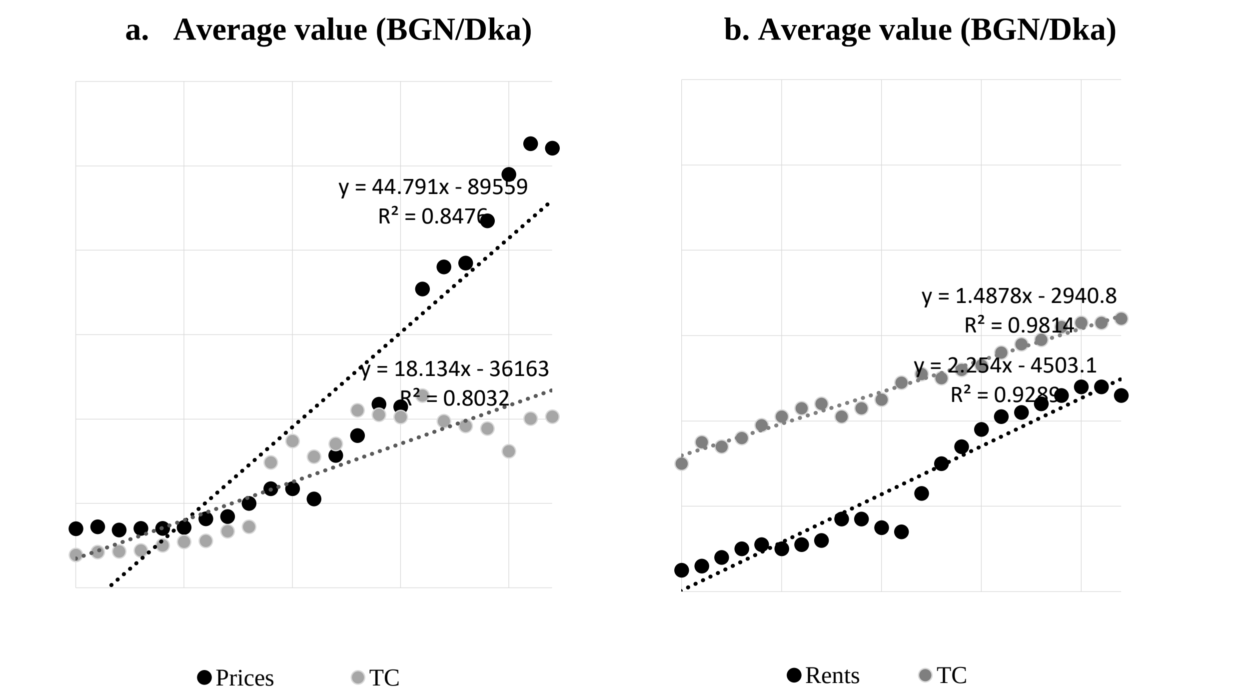

Fig.. 2. Prices, Rents and TC in Bulgaria (1998 -2021)
Source: [18], transaction cost calculation are based on own survey
*In the calculation is included tha government support during COVID-19 pandemic

Participation in the market remains possible for larger producers or other large landowners due to increased land prices. Uncertainty related to land access leads producers to smaller and lower-risk initial investments with a low payback period, which stimulates the increase of unfinished contracts.

After 2011, extensive crop production with lower added value became dominant in Bulgarian agricultural structure, and rent is preferred in farming, with a continuous decrease in sales.

Large landowners have market power, which is expressed in preserving some of the rights.

Therefore they control the land access through unfinished contracts, assimilate and capitalize their advantages. For example, rent-seeking can be observed as a type of: "substitutions" related to the burden of contract activities as (1) unregulated ways of receiving part of the subsidy, direct state aid; (2) indirect control by redirection of distribution channels in order to maintain lower prices of the resources; (3) indirect cost transfer strategies - large landowners prefer to enter into long-term contracts only with large farmers.

In practice, some owners have increased their non-market advantages by maintaining high prices and low rents. It is necessary to clarify who benefited from these forms of rent-seeking and how contracts are distributed. The study measures the distributions of rent and transaction costs in the contracts by actors.

Figure 3 shows the distribution of rent and transaction costs by actors in 1999 and 2020.

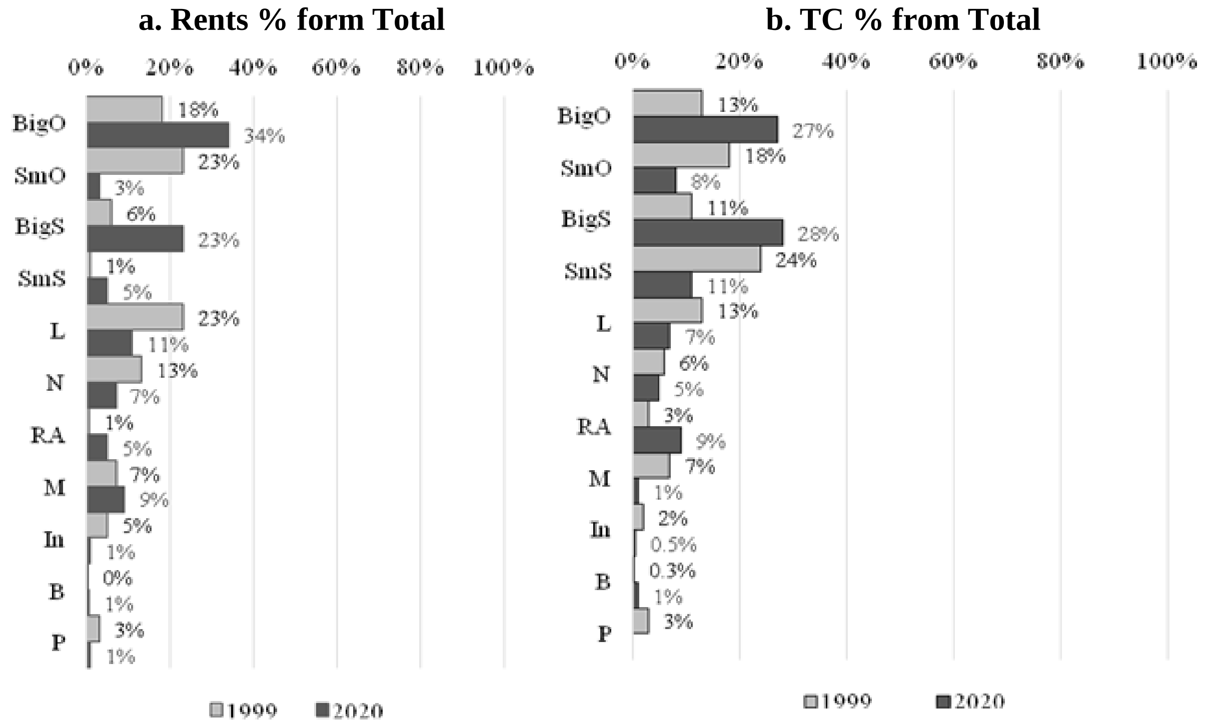

Fig. 3. Distribution by actors

Source: Own survey

Notice: BigO - large land sellers and landlords ; SmO - small land sellers and landlords; BigS - large expropriators of land (buyers; tenants); SmS - small expropriators of land (buyers; tenants); L - Lawyers; N - Notaries; RA - Registry Agency; M - Municipality; In - Intermediates; B - Banks; P - Private actors

At the beginning of the analysed period, the large agricultural landowners received considerable rents from the contacts. On the other hand, small landowners also had a high share of the rent. The transaction costs of large landowners have decreased. By contrast, the smaller owners have increased their transaction costs dramatically. Large producers had a high share of received rent, in contrast to small ones. The trend is continuing by 2020.

The explanation for the observed trends should be linked to levels of adaptive capacity and economies of scale. By 2020, small producers have lost their adaptability, and part of the transaction costs have been indirectly passed on to them.

Among the institutional actors participating in agricultural land contracts, the largest share received as a fee for paid services and taxes is directed to lawyers and notaries. They also had the highest transaction costs compared to other institutional actors. The decrease in the relative value of transaction costs by 2020 is due to the increased labour cost. This trend allows lawyers and notaries to capitalise on some of the non-market advantages by passing on the burden to other actors.

CONCLUSIONS

Both rent-seeking and transaction costs can exist independently. Transaction costs may be a consequence of issues with access to resources or adaptation of the actors. Rent-seeking and transaction costs do not necessarily overlap as reciprocal payments in contracts. Intensive institutional change creates conditions for increasing both processes.

The study concludes that their level increased in unfinished contracts. Unfinished contracts (lease, rent) allow the owner to maintain long-term control over resources and capitalize on non-market advantages. One of the advantages is the indirect ability to transfer individual transaction costs.

Large owners and producers have managed to boost their most significant non-market advantages of rent-seeking, some of which have been indirect transfers of transaction costs to smaller owners.

Some institutional intermediaries have managed to get more benefits in the contract. The same actors have shifted the burden of their individual transaction costs to farmers and producers. However, the distribution of financial flows around hybrids does not give reason to conclude that the total transaction costs in contracts decrease due to this type of actors.

ACKNOWLEDGEMENTS

This paper was supported by the Bulgarian Ministry of Education and Science under the National Research Program "Healthy Foods for a strong Bio-Economy and Quality of Life" approved by DCM # 577/17.08.2018.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESEARCH REGARDING THE METHODS OF VALORIZATION OF VEGETABLE PRODUCTION AT THE LEVEL OF AGRICULTURAL HOLDINGS IN ROMANIA

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Abstract

Perhaps one of the most difficult stages in the entire production process is the sale of vegetable production at a price high enough to cover production costs, and especially profitability which is a key factor contributing to the continuation of the activity. In this sense, the present study aims to identify the main ways to capitalize vegetable production of agricultural holdings in Romania. In order to identify the ways of capitalizing the production, a questionnaire was applied to 180 respondents, represented by the managers of some agricultural farms from all over the country. The purpose of the application of this questionnaire was to identify the aspects that hinder the capitalization of vegetable production. According to the study, the majority of farms in Romania are still run or managed by mostly men. At the same time, according to the analyzed sample, young people have the highest share of total respondents, so that the measures pursued through the two Rural Development Programs, namely to rejuvenate generations of farmers, we can say that they have achieved the goal.

Key words: *agriculture, capitalization, vegetable production, Romania*

INTRODUCTION

Conventional agriculture is a broad term, it is generally associated with high consumption, which includes the use of synthetic chemical fertilizers, fungicides, insecticides and herbicides [2, 6].
Conventional agriculture involves maximizing yields through the use of industrial products, based on monoculture. monoculture has a significant impact on soil fertility and viability. The use of chemicals makes the maintenance of conventional systems relatively easy for farmers, requiring a higher ratio of energy and money. Because this production system aims to maximize profits, biodiversity and environmental health are often neglected [3, 7].
Biodiversity can be protected by reducing the amounts of chemicals and energy used, by adapting soil conservation practices and adapting sustainable practices [1].
Organic farming is the production system that maintains soil health and soil sustainability of ecosystems, promoting a better quality of life and ensuring equity for all actors involved in the food chain [9, 10, 14].
Organic farming is based on specific and clearly established objectives and principles that maintain the health of fauna and flora, contributing to the fight against subsidence and soil erosion. Ecological practices prohibit the use of fertilizers, pesticides, hormones, as well as growth stimulants and antibiotics. At the same time, the use of complementary substances, chemicals and additives is excluded in food processing [8].
Recognition of this type of agriculture around the world shows that traditional agriculture is not enough to meet the challenges of world food security. Traditional agriculture faces the problem of low yields and high input costs [10].
Intensive agriculture has contributed to some extent to yields and poor quality land,

preventing further deforestation. Intensive agriculture requires less land than a large farm, making a similar profit, and the optimal use of these products and mechanization are used to reduce capital and labor [14].

Organic farming generates a positive impact among consumers who become more aware of the implications of consuming healthier products, but also of the fact that this type of agriculture uses more responsibly the resources involved in the production process [17].

Regardless of the production system used, agriculture plays a crucial role in food production as well as in protecting the environment.

Organic food production uses techniques that combine the rational use of resources with animal fertilizers, respectively a biological control of diseases and pests. To maintain soil fertility, farmers use in addition to natural fertilizers from animals, green manure obtained from plants, which is also a natural alternative, but much more expensive [15].

Organic farming takes time to increase productivity, but it is a perfect alternative to conventional farming, as organic farming practices do not cause pollution problems and do not compromise human health [16].

The new "organic" label is a recent phenomenon, which has grown to illustrate the expansion of organic surfaces, but this mechanism has been used for thousands of years, rooted in traditional practices.

Organic farming is based on 3 principles [16]:

-The cyclicity principle;

-The precautionary principle;

-The closeness principle.

The principle of cyclicity is the oldest and is based on the interaction of crops with nature. The second principle is based on caution in technological and practical changes, promoting clean, safe and risk-reducing techniques. The last principle aims at the correct distribution of information between consumers, inter-consumers, producers, researchers and other actors involved, in connection with the systems and techniques used. All stakeholders should be actively involved in the process of developing organic farming, transparency and cooperation being important principles in this process [18].

The two-way influence of agriculture on the natural environment refers primarily to dependence on environmental conditions, variations in climatic conditions and environmental factors [19, 11].

Conventional agriculture limits these factors, contributing to the control of environmental conditions using mechanized techniques and new forms of engineering of seeds, irrigation and phytosanitary products.

Organic farming aims to develop sustainable and productive farms, while maintaining the natural balance of the environment. The main objective of organic farming is to obtain organic products that meet the specific principles, being controlled and then to obtain certification by a specialized body. Consumer confidence in organic products is ensured by European legislation [5, 4].

In this sense, the present study aims to identify the main ways to capitalize vegetable production of agricultural holdings in Romania.

MATERIALS AND METHODS

This study was conducted on a sample of 180 respondents, consisting of representatives (managers, associates, individuals) of agricultural holdings throughout Romania, in order to identify ways to capitalize on production obtained in agricultural holdings.

The data collection was performed between 27.08-26.09.2021, and the data collection method was a field survey based on structured questionnaire submitted in electronic format (unassisted). The questions that the respondents had to answer were closed, with a single answer selected.

The objectives of this research have been the following ones:

-Identification of average productions obtained in a conventional and ecological system;

-Identification of the average cost of production in conventional and ecological system;

-Identification of direct expenditures in conventional and ecological system;
-Identification of indirect costs in a conventional and ecological system;
-Identification of the selling price of the products obtained in a conventional and ecological system;
-Incomes obtained by farmers in the period 2018-2020;
-Identification of the degree of processing of the raw material obtained at farm level;
-Identifying the way to capitalize on the production obtained;
-The importance of subsidies on the continuation of activity;
-Identifying the profitability of the activity it carries out.

The main social and economic characteristics of the respondents based on the structural analysis of the sample are:
-Gender: men - 81.67%; women - 18.33%;
-Age: 18-35 years - 52.78%; 36-50 years - 30%; over 50 years - 17.22%;
-Education: secondary school education - 5%; high school education - 40%; university studies - 55%;
-Legal status: SRL - 35%; II - 22.22%; PFA - 19.44%; NFP - 16.67%; I.F - 5%; others 1.67%;
-Economic dimension: 2,000 - 7,999 SO - 23%; 8,000-49,999 SO - 27%; 50,000-999,999 - 44%; over 1,000,000 - 6%.

RESULTS AND DISCUSSIONS

Analyzing the income registered by the farmers who answered the questionnaire, it can be noticed that 57.22% register an income of over 100,000 lei from the capitalization of farm products, while 19.44% registered incomes between 50,000 lei and 100,000 lei (Fig.1).
Those who registered an income of less than 10,000 lei represent 5%, while those who have an income between 10,000 lei and 50,000 lei represent a percentage of 18.33% of the total respondents (Fig. 1).

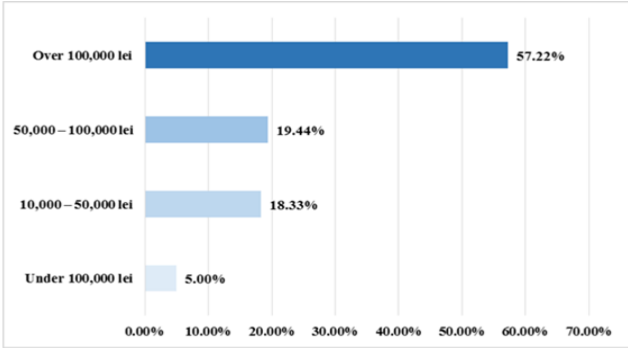

Fig. 1. Distribution of respondents according to the income registered as a result of the capitalization of agricultural products obtained on the farm
Source: Own results [13].

Regarding the percentage of raw material processed in the farm, it was observed that 77.22% of farmers process less than 10% of the amount of agricultural products obtained in the farm, 10% of farmers process between 10% and 30% of the quantity of raw material obtained at farm level, while 3.33% process between 71-100%. The explanation of these figures is highlighted by the situation in Romania regarding the existence of the raw material processing component directly on the farm. At the national level, raw materials such as cereals, oilseeds and other agricultural products are generally exported and finished products are imported at higher prices (Fig. 2).

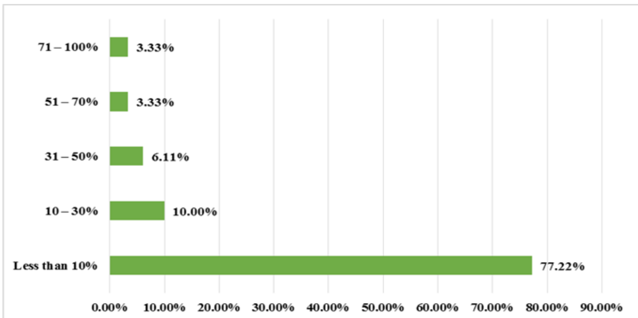

Fig. 2. Distribution of respondents according to the percentage of raw material processed at the farm level
Source: Own results [13].

Analyzing the quantity of raw material used directly from the farm, it is noted that 62.22% of respondents directly use the production in a percentage between 71-100% of the total amount of raw material obtained at farm level. 22.78% of farmers sell less than 10% of the amount of agricultural products obtained in the farm and 15% of farmers sell between 51-

70%. The high percentage of raw material used directly from the farm can be attributed to the fact that farmers fail to capitalize the production of cereals obtained in the farm either by processing in the form of finished products or integrated into the animal feed. This is closely related to the lack of processing capabilities at the farm level and the lack of integration of plant production in the animal husbandry process (Fig. 3).

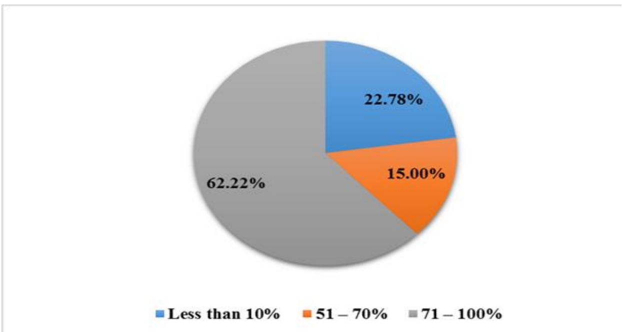

Fig. 3. Distribution of respondents according to the percentage of raw material processed at the farm level
Source: Own results [13].

Regarding the way of capitalization of the production obtained at the farm level, it is observed that 68.89% capitalize the products from the farm to intermediaries and only 9.44% realize the capitalization of the production directly to the consumers.

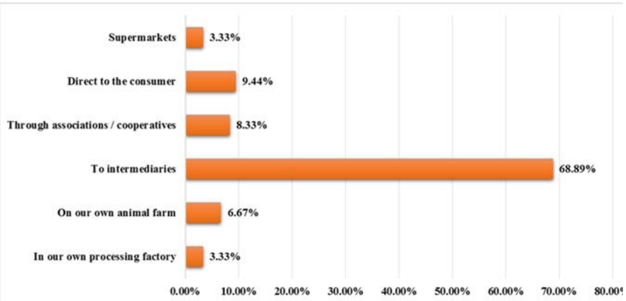

Fig. 4. Distribution of respondents according to the way of capitalizing on the production obtained at farm level
Source: Own results [13].

Only 8.33% of farmers realize the joint capitalization of production, through farmers' associations and cooperatives and a percentage of 6.67% capitalize the raw material obtained from the cultivation of plants in their own animal farm. Only 3.33% of farmers sell their products directly to a supermarket (Fig. 4).

According to the data obtained, the structure of the respondents depending on the extent to which production costs are covered by income from capitalization shows that 67.22% of farmers manage to cover production costs without problems, 27.78% barely manage to cover the production costs from the incomes registered from the capitalization of the production, while 5% fail to cover the production costs (Fig. 5).

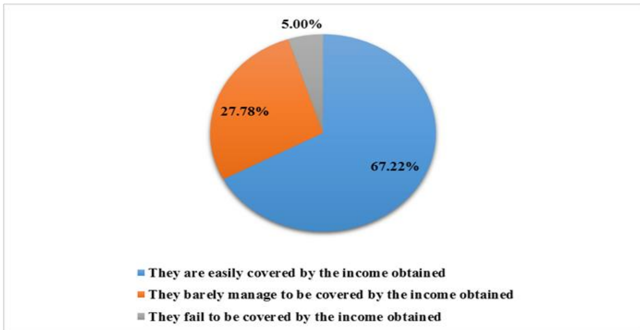

Fig. 5. Distribution of respondents according to the percentage in which production costs cover the income obtained from the capitalization of production on the farm Source: Own results [13].

Analysis of the financial resources used to procure the necessary inputs (seeds, plant protection products, fertilizers, etc.) in the agricultural activity is presented in Figure 6.

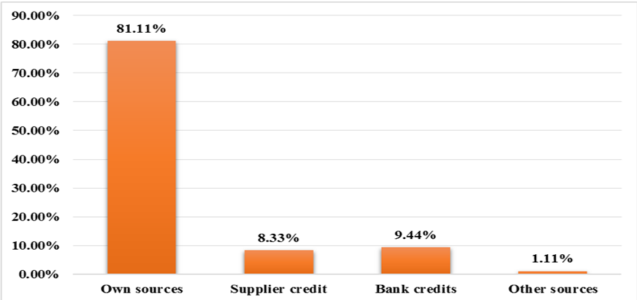

Fig. 6. Distribution of respondents according to the financial resources used to purchase the inputs needed for agricultural activity
Source: Own results [13].

From Figure 6 we may see that 81.11% farmers use their own funds to buy the necessary inputs, 9.44% access bank loans to ensure the necessary products for development of the production activity, while 8.33% farmers resort to loans to the supplier so as to carry out their production activity under normal conditions (Fig. 6).

Analyzing the obtained data taking into account the ways that farmers develop their business, 56.67% would choose for accessing European funds provided through the National Rural Development Program, 24.44% would use their own sources to develop the farm, while 15.56% take into account a bank loan to properly endow their farm (Fig. 7).

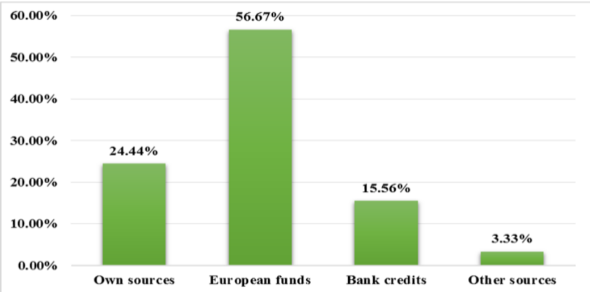

Fig. 7. Distribution of respondents according to the financial resources used for business development
Source: Own results [13].

Regarding the opinion of the respondents regarding the extent to which their business would remain profitable even in the absence of European funds, it is found that 84.44% of farmers consider that their business would go bankruptcy in the absence of subsidies, while 15.56% believe that their business would remain profitable even in the absence of subsidies (Fig. 8).

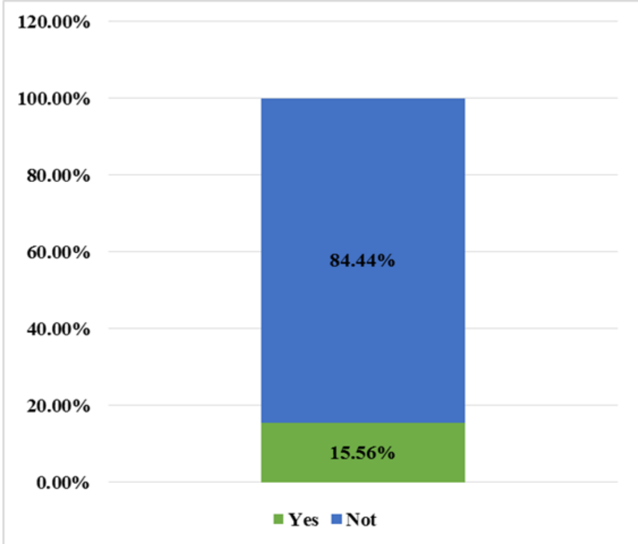

Fig. 8. Distribution of respondents according to the trends in their business
Source: Own results [13].

Regarding the problems that farmers are facing in the current activity, the answers highlighted that 22.78% farmers consider the lack of the sales market, 19.44% state that they are facing the climate change mainly in terms of extreme pedological drought of the year 2020, which affected production performance, and 16.11% concern the endowment with agricultural equipment (Fig. 9).

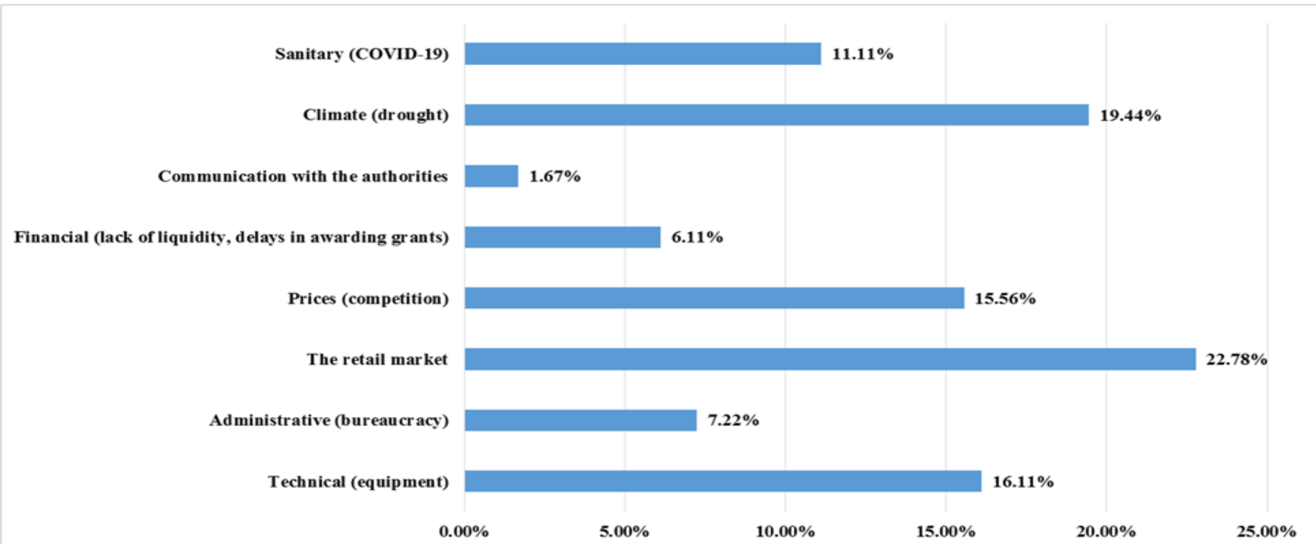

Fig. 9. Distribution of respondents according to their opinion on the main problems facing the agricultural sector
Source: Own results [13].

CONCLUSIONS

According to the study, most farms are still run by males. At the same time, according to the analyzed sample, young people have the highest share of total respondents, so that the measures pursued through the two rural development programs, namely to rejuvenate generations of farmers, we can say that they have achieved their goal.

Farmers specializing in large crops, suffered from extreme pedological drought, which affected a significant part of agricultural land worked by them, identifying significant decreases in production. These decreases in production, also recorded in European countries, led to increases in the selling price for these products, including the buyer.

The high percentage of raw material used directly from the farm can be attributed to the fact that farmers fail to capitalize on the production of cereals obtained on the farm either by processing in the form of finished products or integrated into the animal feed. This is closely linked to the lack of processing capacity at farm level and the lack of integration of plant production in the animal husbandry process.

Access to European funds is the first option to develop the farm, mainly due to the fact that these sources of financing are safe options for business development in the agricultural sector, whether the purchase of equipment and machinery is considered, or whether the farmer wants to invest in processing or storage spaces for the production of cereals and oilseeds. Both lines of development are covered by the funds included in the National Rural Development Plans implemented at national level in each financial year.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the sectoral project ADER 23.1.1: “Technical-economic basis of production costs and estimates regarding the prices of capitalization of the main plant and animal products, obtained in conventional system and in organic farming” Subcontract no: 23.1.1./2-03.10.2019 contracted with the Ministry of Agriculture and Rural Development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MAPPING SUSTAINABILITY ASSESSMENT METHODS IN AGRI-FOOD SUPPLY CHAINS: A CIRCULAR ECONOMY PERSPECTIVE

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Abstract

The agri-food sector is critical for humanity because it has mutual links to all pillars of sustainable development. Circular economy is an emerging paradigm that aims to change human and organizational behaviour and practice patterns by taking a different approach to production and consumption. A shift to a circular model tries to put a stop to the imprudent use of natural resources and replace it with a philosophy of reusing, repurposing and regenerating. The supply chains of the agri-food system constitute a significant area of intervention in the transition of the sector towards sustainability. In this vein, one may find a growing literature on existing tools, techniques and methods (such as material flow analysis, water footprint, social life cycle analysis, etc.) which can be used for the sustainability assessment of (existing and planned) agri-food networks. This paper adopts a circular economy perspective and discusses the afore-mentioned methods with respect to their potential to depict the transformation of the current inefficient, wasteful, and linear production and consumption model.

Key words: *circular economy, agri-food supply chain, quantitative methods, sustainability*

INTRODUCTION

Food systems are becoming increasingly vulnerable to change drivers, and the use of circular economy in the agri-food sector is a vibrant topic of contemporary research. Food waste is considered as one of the five priority sectors, in the EU's action plan stated in 2015. In addition, the United Nations, in the Sustainable Development Goals, established a goal of decreasing per capita food waste by half at the retail and consumer level, as well as minimizing food losses throughout the manufacturing and agri-food supply chains. Food waste is a phenomenon that takes place during production, in shops, in restaurants and catering facilities but also at home [12, 9].

According to the EU's action plan, a future step would be to create a common methodology, based on guidelines given by the Commission, and a platform for all members of the EU, in order to be able to measure the amount of food waste and to define relevant indicators but also take measures to make a clear legislative framework about waste, food and feed; make food donation and the utilization of leftover foods and by-products easier; and take actions on date marking alteration, especially the 'best before' [9].

Food systems have been characterized by traditional management approaches, and the last 50 years has been a major contributor in the environmental deterioration, natural resources depletion and pollution from field to fork [12]. Based on this, in the EU's action plan, a plan towards circular economy has been fostered.

The model of circular economy in the agri-food sector holds great potential since it could have a very important outcome, that could be beneficial for food security, create price stability, and resilience in the economy but also environmental prosperity while preserving natural resources and minimizing environmental impacts [16].

In order to be able to make an assessment on the progress towards this more sustainable production model, it is important to describe the adoption of circular economy, and the effectiveness of the plan both on the EU and the national level using reliable indicators. Eurostat, has collected relevant data, in order to form the basis for this monitoring system. At the same time a Resource Efficiency Scoreboard and a Raw Materials Scoreboard, which contain a set of indicators and analysis related to these two matters, would be a great guide in order to assess and keep a track of the progress. In cooperation with the EU Member States and the European Environmental Agency, the Commission has been developing a simple but effective set of regulations in the form of a framework for the transition to a circular economy, which will include key indicators that encapsulate the model's core aspects [9].

In this paper, the focus is mainly on the production plants, and we will try to explore the current state of measurement indices, used currently in the production and manufacturing sector, in order to better monitor and report sustainability matters as well as try to figure the ability to cooperate in a model of circularity in the agri-food sector.

MATERIALS AND METHODS

This paper is based upon, relevant bibliography that revolves around the current and emerging paradigm of circular economy with a specificity of application of the agri-food systems. The set of papers was refined after evaluation of the authors in order to form a basis to identify potential interventions of indices and certifications that are currently used in production systems and food manufacturing enterprises with the prospect of setting a higher pace in the transition of circular economy and sustainability.

It has been proposed that in order to shift towards circular economy there are five factors that need to be monitored: starting from redesigning the products, then redesigning the processes, creating innovation in the current business model, reducing or reusing of the produced waste, creating internal regulation frameworks, increasing the possibilities of collaboration, financial and fiscal stimulation, and finally altering consumer behavior make the set of the factors that need to be monitored [23].

The ReSOLVE framework has proposed a set of actions that are based on three classification criteria: Optimize, loop, and regenerate [12]. Increasing product performance and efficiency while eliminating waste across the production process and in the supply chain by developing new loops is part of the optimization of activities across the food supply chain. Reusability or even infinite life, such as glass or steel in packaging, characterizes a regeneration mentality in which resources are utilised in a cyclical manner. Furthermore, single-material usage and contamination are prevented, and new technology aimed at recovery operations is used. Indices that are used to explain and to measure in order to be able to compare the impact on several phenomena, such as climate change by measuring water or carbon footprint, energy consumption and other have been developed.

In the European Environment Agency report [10], five main categories have been introduced:

(1) Reduction of natural resource uses and input materials: the depletion of the ecosystem is currently at a high and unsustainable rate mainly caused by the effect of the traditional production model. There is a need to create more with less, preserve the natural resources and this could only be possible if the raw materials, water and energy are used efficiently.

(2) Reduction of emissions: it refers to both direct and indirect emissions of agri-food systems.

(3) Reduction of the loss of materials: reducing production energy by avoiding waste creation, limiting incineration and landfilling, and reducing waste production, and losing materials through closed-loop models, higher recovering rates, and recycling of products.

(4) Increase of the renewable and recyclable resources shares: reduce emissions throughout the whole material cycle and achieve overall reduced pollution through cleaner practices along the material cycles, reduce raw material intake and implement sustainable sourcing.

(5) Longer value durability: extension of the life of products, adopting new business models based on services that can be described

In publications made on the matter of circular economy, [7] has identified the "building blocks" for promoting the adoption of the circular economy paradigm; the framework contains four types of actions:

(1) Adapting to the circular model by redesigning the processes and the production, several actions can be taken such as eco-design methods oriented towards product re-use, refurbishment and recycling, and use of materials with less hazardous output materials.

(2) Adoption of innovative business models such as product service systems instead of ownership and customer-to-customer channels.

(3) Cascade/reverse skills in order to support closing material loops and incorporating secondary materials.

(4)Collaboration between cycles of productions and sectors, which fosters the development of a collaborative environment across the value chain, by preventing of by-products going to waste through industrial symbiosis.

[8] finally proposed a four levels framework for supporting measurement of the circular economy paradigm adoption by identifying:

(1) the processes to monitor,

(2) the actions involved,

(3) the requirements to be measured, and

(4) the implementation levels of the circular economy paradigm

RESULTS AND DISCUSSIONS

The difficulties of attaining supply chain sustainability have sparked substantial debate in the literature and among industry [11], while the circular model holds is the most promising. In order to be able to measure if a system is efficient but also to facilitate comparisons, an attempt to gather the most widely accepted indices has been made. As the physical and organizational sizes of activities grow, achieving circularity becomes more difficult. In order to improve their efficiency with a clear objective, to optimise their supply chain with effective and efficient practices taking into consideration, material flows, integration of the supply chain and the value stream [4].

Measuring indices coupled with green accounting methods can be used at the level of an organization, food processing unit as well as municipality level, country or even worldwide in order to assess and report on the sustainability levels of an organization [6].

In that way, we can consider how the universal map of flows is built and gain a deeper grasp of current biomass, nutrient, and energy movements within these systems, as well as how these flows are related at various geographical scales [14]. In this section we provide an overview of the methodological approaches that have been developed in order to tackle various sustainability issues, mostly from an environmental viewpoint. Our objective is to examine whether they could be suitable for addressing circular economy practices and challenges, despite the fact they have originally been developed for the traditional linear models.

In their study, [8] provided various methods that aim at dealing with material and energy flows as well as with aspects such as land use and consumption. In addition, currently developed indices that take into consideration social impacts are analysed.

Material flow indices include the Water Footprint which is used and as an indication shows the potential impact on the environment that is related to freshwater. The Material Inputs Per Unit of Service approach may be used to assess the effects of a certain type of material flow, such as the material input of a product, service, or process. The approach of Ecological Rucksacks refers to the entire sum of material inputs lessened by the product's mass, and it describes the influence that the items utilized have on the environment. A systematic evaluation of the flows and stocks of materials within a system characterized in place and time is described as Material Flow Analysis, which constitutes a multiple indicator-based assessment. The use of this index has increased over the last decades especially in the plastic packaging sector but also several other materials and geographical areas [19]. It is commonly used in Environmental and Economic Accounting to create the framework for internationally comparable data on the environment and its link to economic, environmental and social matters. The development of sustainable accounting and of a financing system described as ”green” is an emerging global financial centre following the evolution of the sustainable global development [21]. Through a system specified in place and time, Substance Flow Analysis is used to estimate the fluxes and stocks of particular compounds that pose a risk to the environment and human health.

A material flow analysis could support the adaptation of the methods in reducing input and use of the natural resources, as well as deducing material loss.

The indicator of the Nutrient Flow is promising in cases where nutrient recycling and bioenergy production are considered, especially in a non-compete cases with food production. A ‘Nested circularity’ supported by research based on this index suggests localizing food systems by closing nutrient, biomass and energy loops is a sustainable solution [14].

Nutrient pollution, has been studied mostly from the environmental perspective. The heavy use of pesticides and fertilization in Agriculture or wastewater treatment has been measured by applying this index, in their study [15] conclude that nutrient pollution is the most import cause of pollution of water.

Economically extended-Material flow analysis, has also been suggested as an approach for investigating the links between economically motivated human behaviour and resource use. The model proposed by [17] can be used for the analysis and the assessment of alternative strategies towards resource efficiency enhancement.

The food sector, with a starting point on agriculture and across the whole supply chain, is accountable for a percentage of about 20 to 35% according to the total global energy use during the course of its entire life cycle. While the largest amount is considered to be during agricultural production, food processing is accountable for a large amount as well [24].

There are three types of energy indices that are extensively utilized [8].

Cumulative Energy Demand encompasses all energy from raw material extraction, manufacturing, and ultimate disposal and is used to define the total amount of energy necessary to generate a product (or a service) during its entire life cycle. The Embodied Energy Index, which is a measure of the amount of energy integrated in a product and is a dependable instrument to explain the inefficiencies caused by energy consumption, is used to characterize all essential energy flows utilized to make a product or a service. Finally, Energy Analysis centers on a specific work and defines the maximum quantity that a system, a matter flow, or energy may create as it approaches equilibrium with the environment.

Energy efficiency is used as a link between energy performance and environmental impact with costs, and is an indicator that expresses the sustainability of a system and provides information such as cost of energy and loss of productivity [2].(

An energy flow measurement, in the cases of bio-based produced energy or biofuels could have a very important application. Because energy losses are difficult to quantify, especially in complicated operations, relationship equations or measured data from the literature can be quite valuable in some circumstances [24].

Consumption and Land Use indices are commonly utilized [8]. The Ecological Footprint, which is used to calculate the planet’s biological capacity as a result of human activity or population, specifies the acreage necessary, including demand for food, crops, timber, energy, infrastructural space, and the area required to absorb carbon emissions emitted. The Sustainable Process is another index that evaluates the required area to support human activities over their whole life cycle. Such measurements support decision-making and forecasting since for example, the case of the rising trend of energy consumption that was noticed between 1990 to 2010 and that raised concerns due to the increased energy and fossil resources demand [5].

It is also worth noting that calculating the land, water, or sea area necessary to supply a person's food, shelter, mobility, commodities, and services in a given region is the first step in estimating their environmental footprint. [3].

A Life Cycle Assessment (LCA) includes Single or Multiple indicator-based assessments. In the first category of single indicator assessments, the Carbon Footprint is an environmental performance indicator that measures the impact of human activities and the resulting GreenHouse Gas emissions on global climate and is measured in carbon dioxide equivalents. (CO_2 eq). It addresses all GHGs (contribution (CO, CH_4, N_2O, HFCs, PFCs, SF_6) assessed on an equivalent based to their contribution [3]. The Swiss Federal Institute of Technology has established an indicator called the Ecosystem Damage Potential, which is intended to assess the ecosystem's affects as a result of land use and change.

An Environmental Performance Strategy Map is a depiction with a transversal cost-dimension that depicts five footprints (water, carbon, energy, emissions, and work environment) in a web graph (Elia et al., 2017) [8].

LCA is a broadly used multiple indicator that has been used for several years now in order to assess the environmental impact at a macro, meso, and micro level. The ISO 14040 family has standardized it as a technique, and producing LCA involves a large quantity of data that is not always accessible, increasing the uncertainty of the conclusions. Furthermore, it takes longer than other approaches, and outcomes' communication need an experienced audience [3]. Social LCA (S-LCA) uses a similar cradle–to–grave approach to environmental LCA, but it focuses on social issues linked to the quality of life and welfare of all categories of stakeholders participating in the processes under examination (Oliveira et al., 2021) [22]. A fresh interpretation of society life cycle costing is also possible using the S-LCA model method where societal hazards are valued [25].

In their study, [20]attempted to adapt the LCA to broader spectrum that of the social and organizational level proposing the new SOLCA. The frameworks of the current S-LCA and O-LCA have the potential to be applied, but additional obstacles emerge, such as data collecting in complex organizations with several sites or the difficulty of disseminating or aggregating social characteristics inside an organization.

Through a LCA, the obtained energy quantification during food production and consumption could be the key to identify intensive activities, and revaluate these processes in order to make significant reductions [18]. Currently, the majority of research is concentrated on product evaluations, followed by sector and process evaluations [1].

The model of circular economy finds application in all three pillars of sustainable development and the micro (i.e resources, processes, products) meso (i.e. supply chain, industrial parks) and macro (i.e. national, global economy) level. The identification of the process and the extent it impacts all three levels is the starting point for an integrated assessment framework. [22].

Reporting methods such as the Global Reporting Initiative [13]. and the development of certifications and certification bodies such as B Corp related to circular economy can accelerate the transition towards its application [23].

CONCLUSIONS

At the moment most of the developed measuring methods have been optimized on the widely used linear model and the limitations of application to circularity and feedback loops is obvious. Several approaches on the application of the circular economy model have been made but the transition has not yet completed.

The circular economy model has been strongly proposed as strategy to tackle the unsustainable use of resources. The evolution and expansion of application of the measuring indices and the process behind them, has been an alert for business to the realization of resource efficiency.

The practical importance of reporting and being a certified organization could provide better circular economy based management and compel an alteration that in the long term brings results to the environmental and sustainability management as well. An alignment of businesses processes with environmental and social needs is of prime importance.

A combination of these methods or assessments holds potential for further research on measurements since any economic system has an underlying physical structure while at the same time gives a holistic view on both financial and material flows to optimize procedures on the three pillars of sustainable development.

ACKNOWLEDGEMENTS

We acknowledge support of this work by the project "SMART AGRICULTURE AND CIRCULAR BIO-ECONOMY – SmartBIC." (MIS MIS5047106) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FORMATION AND DEVELOPMENT OF AN ECONOMIC MECHANISM FOR MANAGING LAND RESOURCES IN THE CONTEXT OF DIGITALIZATION OF AGRICULTURE

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Abstract

The purpose of paper consists in developing the economic mechanism for increase in effective management of land resources in agriculture. Theoretical provisions of institutionalism, management, system approach, the general scientific and special methods were used in the course of the research. Considering influence of negative externalities on the market of the agricultural land and a deviation of the prices from equilibrium level, it is expedient to influence a market turnover of agricultural grounds by means of the priority directions of development: reductions of transactional costs for execution of transactions and registration of the property rights to the land plots, updating of cadastral cost of the land plots, accelerations of differentiation of the lands which are in federal, regional, regional property, etc. As a result of a research authors constructed the regional economic mechanism of management of land resources in agriculture on the basis of use of digital technologies. Thus, the mechanism includes the executive power, scientific centers, higher educational institutions, software products providing accumulation, updating, structuring, storage of cartographic and thematic information for adoption of optimal management decisions. The offered economic mechanism is recommended to be used when developing state programs.

Key words**:** *economic mechanism, land resources, agriculture, digital technologies, science*

INTRODUCTION

Development of the organizational and economic mechanism of management of land resources is based on institutional, neoinstitutional theories, theories of public administration, management, systems.

From the philosophical point of view management is an art of correlation purposes with funds from a position of its efficiency [22], deliberate orientation of action [33], ability of systems to keep the qualitative definiteness, to maintain dynamic balance with environment, to be improved [5], to direct and adjust various manifestations of their internal and external activity by means of accumulation, transformations and information transfers [1].

The humanitarian portal contains interpretations of management as actions – "impact (the subject of management) on the operated system (object of management) for the purpose of ensuring the behavior demanded it or change of its characteristics" and as functions, "which provides: maintaining certain structure of a system and its system characteristics; maintenance of the set mode of activity of a system and its optimization; realization … the set program of activity of a system (achievement of the goal)" [4].

The modern institutional economic theory defines management as concentration of external efforts in a certain direction [16]; the influence directed to change of a condition of an object on some interval of time [34].

In the theory of public administration this term is considered as the conscious organizing and regulating impact of the state on public (public) activity of people for its streamlining, preservation or transformation [3], the purposeful, organizing and regulating influence of people (and the institutes created by them) on own, public, collective and group activity in definite purposes and interests [29].

From a position of the theory of administrative management, management is the universal process consisting of functions of forecasting, planning, the organization, motivation, coordination and control, directed to a formulation and achievement of the goal of the organization [32].

On the basis of synthesis of the accumulated theoretical experience, results of the previous researches [38] management of land resources can be interpreted as the system consisting of set of the interconnected and interacting elements, allowing to create objective prerequisites for adoption of the correct decisions on development of the land relations in agriculture.

This term is used by the United Nations for designation of the processes including definition of property rights and other attributes of the earth (cost and use), shooting and the graphic description, detailed documenting and granting the relevant information for support of the land markets [25].

For the last decades in scientific literature a definition "mechanism" and its specifications are widely used: economical, organizational, organizational and economic, mechanism of management, etc.

In modern economic science use as the equivalent or complementary definition "the economic mechanism" entered into a terms framework of mainstream economic by Nobel Prize laureates on economy of 2007 Hurwicz, Maskin, Myerson. In vision of Hurwicz and his adherents working within the theory of economic mechanisms, the mechanism is the interaction between subjects and the center consisting of three stages: each subject in a private order sends to the center the message of m_i; the center, having received all messages, calculates estimated result: $Y = f(m_1, \ldots, m_n)$; the center announces result of Y and as necessary realizes it [15]; it is "game" which participants communicate with each other or with "the center of messages" [2].

There are different views of the maintenance of a concept of the mechanism of economy: [8] considers it expedient to understand as him set of resources of economic process and ways of their connection, [13] – characteristics of process: ways, methods, norms, means, forms of functioning something or impact on something, but not set of resources or conditions of an object.

Opinions of scientists which define the economic mechanism as the tool (a set of economic methods, ways, forms, tools, influence levers) are known. So, for example, by [30], the economic mechanism is meant as set of methods and levers on economic processes, their regulations; [37] – "… set of the economic levers of the subject on the operated object determined by the conditions of market economy following from interrelation of subjects of a market system", [35] – the certain objective tool existing in a social system, consisting of the organizational relations and economic levers, allowing to transform an economic system and also to change its technical and economic indicators during time.

Some authors speak about the economic mechanism as about the system of economic regulators (their interconnected, interdependent combination). In understanding [18] the economic mechanism is "… specific set of the elements, states and processes located in this sequence, which are in certain communications, the relations and determining an order of any type of activity", [7] – set of ways of management and interaction of subjects which criterion function is rational managing and formation of steady regularities in development of economy, [27] – the uniform system of the complex economic relations, actions, tools and receptions focused on realization of any economic purposes or the solution of the tasks causing interdependence of economic events.

The description of a phenomenon of the economic mechanism of [19] is of scientific interest. The scientist treats it as "the system of interrelations of economic events which arise in certain conditions under the influence of an initial impulse", notes that it is possible to talk about the economic mechanism "… in case a certain initial economic event involves some other, and their emergence does not require an additional impulse. They follow one another in a certain sequence and lead to certain obvious results. Thus, the economic mechanism is defined by either the nature of the initial phenomenon, or the end result of a series of the phenomena. But as the making mechanism elements always both the initial phenomenon, and the finishing phenomenon, and all process which happens in an interval between them" at the same time act. The similarity of views of [14] is traced: "economic mechanisms are not certain manifestations of these or those lines of economic activity autonomous, not dependent from each other. Working at the same time, causing and mutually supplementing each other, all set of economic mechanisms represents a big system with all regularities inherent in it. Such mutually interlacing of the economic mechanisms functioning within the country and in interaction with a world economic system makes intrinsic (substantsionalny) fundamentals of national economy".

Among the points of view of scientists on concepts of the mechanism is management and the organizational and economic mechanism of management it is possible to allocate the following directions (Table 1).

Thus, it is logical to consider the mechanism as unity of structural and process components, a form of the system interaction of various subjects and objects having entrance parcels (impulses) and the resulting reaction. Depending on overweight of accents this or that mechanism will have the name.

Table 1. Scientific ideas of the content of categories "mechanism of management", "organizational and economic mechanism of management"

Approach	Author	Example of the formulated position
Set of administrative tools	Lafta	The mechanism of management is the set of the levers used in management or more precisely, a complex of the levers used in management
	Tretyakov	The mechanism of management is the set of the interacting elements (states, processes, social and economic norms and rules) united by a definite purpose and which are the tools transferring an object from one state to another by influence of the making elements on it
	Buleev	The organizational and economic mechanism of management is the set of forms, methods and instruments of management
	Malyshev	The organizational and economic mechanism of management is the operating in the institutional environment of society, organized to adequately legal form, target, interconnected effectively functioning device, set of states, processes, social and precepts of law and rules of which there is a management as the social phenomenon
System of administrative influence	Goncharov & Oleynikova	The mechanism of management is an implementer of management decisions, actuating of some links of the operated system for the purpose of stimulation of other links of a system on the necessary movement aimed at obtaining positive result
	Kournikova	The mechanism of management is the set of various methods of management used by the subject of management and making impact on the relations, communications between system elements (object of management) for the solution of the put, relevant tasks
	Mishenina & Kovalenko	The organizational and economic mechanism of management isa complex of organizational, economic, motivational, legal and other ways of interaction of subjects of managing and impact on their activity which provides coordinating of the interacting objects and subjects of management
	Litvinov & Kaptalan	The organizational and economic mechanism of management is the set of the administrative actions directed to the organization of interaction between system elements for the purpose of achievement of their economic interests taking into account features of external and internal environment

Source: Made by authors by [20, 36, 6, 24, 12, 17, 26, 23].

In our opinion, the economic mechanism of management of land resources in agriculture is a form of system interaction of subjects and objects for impact on a market turnover of agricultural grounds by means of the priority directions of development taking into account influence of negative externalities on the market of the agricultural land and a deviation of the prices from equilibrium level.

In this context, the purpose of the paper – to offer the economic mechanism of management of land resources in agriculture.

MATERIALS AND METHODS

The theoretical and methodological basis of the study was the works of Russian and foreign scientists and specialists of theories of economic policy, public administration, management, institutional management, organizational mechanisms, economic mechanisms.

The consolidation of information resources for land management was made, the data of the Ministry of Agriculture of Russian Federation, official government publications (federal laws, departmental project, land code, resolution) were used in the preparation of the paper.

The research on development of the economic mechanism of management of land resources in agriculture is conducted on the basis of system, functional, information approaches with application of various methods of scientific knowledge: abstraction, scientific idealization, axiomatic, induction, deduction, analysis, synthesis, structurization, systematization, interpretation, modeling, etc.

RESULTS AND DISCUSSIONS

Management of the market of the agricultural land difficult according to the contents as includes obligatory elements of public administration by land resources and market mechanisms of impact on this process (Figure 1).

In the developed economic mechanism of management of land resources in agriculture externalities (outer effects) of a regulation of operations with the land plots from structure of agricultural grounds are allocated, corrective actions on a market turnover of lands are proposed. Subjects of the mechanism are the Government of the Russian Federation, owners of lands, the market of the agricultural land; objects are the land plots.

The main regulating documents are the Land Code of the Russian Federation [21], the Federal Law "About land turnover of agricultural purpose" [11], the State program of effective involvement in land turnover of agricultural purpose and development of ameliorative complex of the Russian Federation [31]. Administrative influence can lead to negative externalities, overestimate of the prices of the land plots that will be reflected in a market turnover of the agricultural land.

Increase in efficiency of functioning of the land market has to be promoted by a control system with application of methods of impact on a market turnover of the agricultural land. Streamlining of the procedure, elimination of additional need of providing documents, visits of specialized institutions, implementation of payments, use of the information portal allow to reduce transactional costs for execution of transactions and registration of the property rights to the land plots [41].

Market price of the land plots from structure of the agricultural land does not form the objective basis for determination of their mortgage cost. The corresponding point that the mortgage cost of the land plot of a such type can be determined by the agreement of the depositor with the pawnbroker proceeding from its cadastral cost without evaluating its market value is introduced in the Federal Law "About a Mortgage (Pledge of the Real Estate)" [10]. Similar assessment is subjective, it is confirmed in practice by insignificant transactions between interested parties and demands development of land mortgage lending. Methods of comparison of sales and capitalization of a land rent are most perspective for high-quality improvement of reliability of assessment of cadastral cost of the agricultural land. As the cadastral cost of the agricultural land assumes mass market assessment, one of the called methods conforming at the moment to methodical requirements and conditions of active sales or rent of lands in areas is chosen.

Their registration by the declarative principle became the reason of low level of registration of the rights for the land plots: the big areas of agricultural grounds are legally not involved in a market turnover, and the state receives less the essential sums of land payments in the budget. Besides, account of lands by Federal State Statistics Service (Rosstat) is kept only on one sign – agricultural grounds, without indication of their structure (the arable lands, haymakings, pastures, deposits, lands occupied with long-term plantings). In practice such approach led to division of agricultural grounds into land shares only on arable land, without the areas of meadows and pastures; to receiving by owners of lands a possibility of the unauthorized and free translation of meadows and pastures in an arable land that can have further negative impact on development of livestock production.

Some of the main directions of increase in effective management of land resources should consider process of acceleration of differentiation of the agricultural land which is in the state, regional (republican) and municipal landed property. The lack of accurately established borders between various forms of the landed property develops the shadow sector of economy.

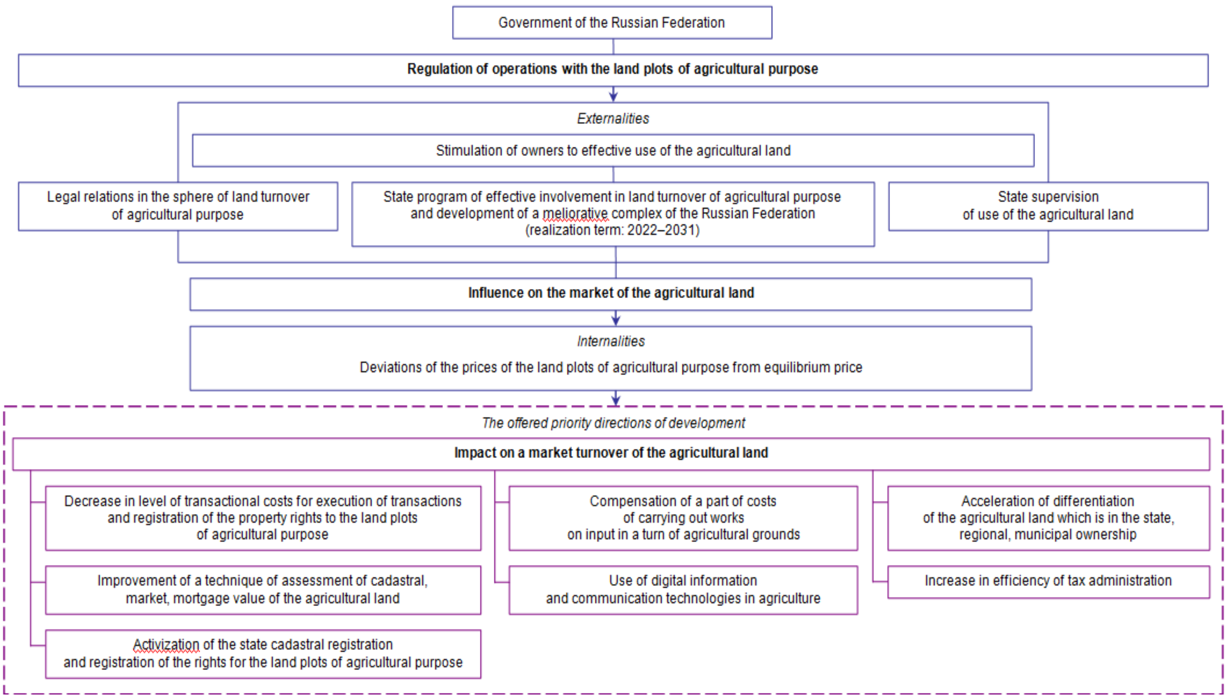

Fig. 1. The developed economic mechanism of management of land resources in agriculture
Note: The dotted violet line selected authors' offers.
Source: Author's own elaboration.

The institutional form of government the economic relations assumes improvement of administration of land tax due to granting tax benefits when involving of not used agricultural land in economic circulation, applications of the raising coefficient at calculation of the amount of tax concerning not used lands.

Due to the annual increase in the areas of intensive overgrowing of an arable land, haymakings, pastures the bush and low wood for agricultural producers set tasks of involvement of lands in economic circulation, carrying out a complex of actions for improvement of natural fodder grounds and to development of new lands for the subsequent their use in agriculture. Space overgrown with the small wood works demand essential investments therefore it is necessary to provide allocation of subsidies for compensation of a part of expenses from federal and regional budgets.

The high importance of use of information and communication technologies in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

agriculture caused need of development of model of a common information space for formation and development of the economic mechanism of management of land resources (Figure 2).

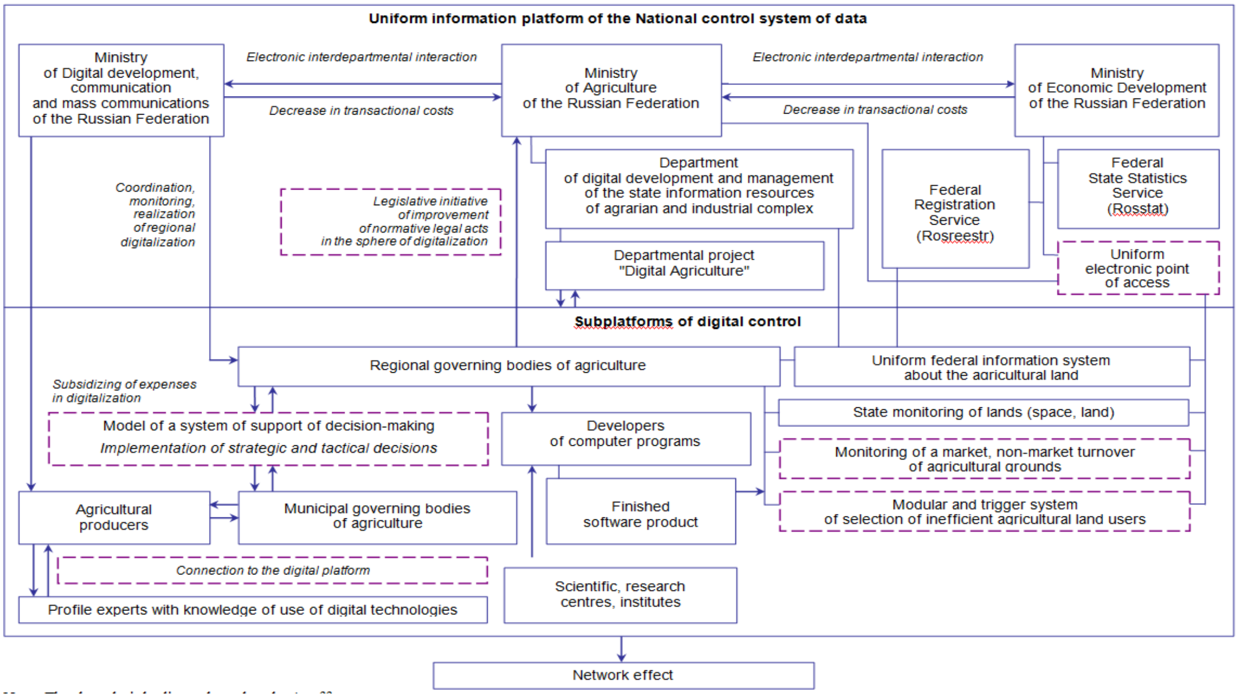

Fig. 2. Model of a common information space of the economic mechanism of management of land resources in agriculture
Note: The dotted violet line selected authors' offers.
Source: Author's own elaboration.

At the federal level implementation of exchange of information between the Ministry of Agriculture of the Russian Federation, the Ministry of Digital development, communication and mass communications of the Russian Federation and the Ministry of Economic Development of the Russian Federation for the purpose of effective management of land resources in agriculture through the Federal state information system "Uniform Information Platform of the National Control System of Data" (FGIS "EMP NSUD") is supposed.

The Ministry of Agriculture of the Russian Federation developed the departmental project "Digital Agriculture" [9]. The national platform of digital public administration has to be integrated by agriculture vertically with digital subplatforms at the regional and municipal levels for digitalization of agriculture by means of development and deployment of digital technologies and platform decisions for ensuring development of the industries of agro-industrial complex. Especially for these purposes the Department of digital development and management of the state information resources of agrarian and industrial complex having two divisions in the structure is created: department of project management by the state information systems, the department of information and analytical providing and information security [28], interacting with the similar structures of regional governing bodies of agriculture which are responsible for introduction of digitalization at regional and municipal levels.

At the regional level application of incremental approach during the developing and improvement of the software on model of the management of land resources in agriculture consisting in the gradual approbation increasing quality of the software product is required. Executive authorities and agricultural producers have to select the service suitable them in the set parameters, giving the chance of carrying out analytical interpretation, adoption of effective management decisions. The similar campaign allows to consider completeness of the obtained information, to reveal mistakes, to change algorithms in process of management of land resources. For assessment of efficiency of use of agricultural grounds producers of the Saratov region recommend developed by scientists of the Povolzhskiy Scientific Research Institute of Economic and Organization of Agroindustrial Complex (PSRIEOAIC) the modular and trigger system of selection of inefficient agricultural land users [40].

The Ministry of Agriculture of the Saratov region carries out monitoring of agricultural grounds, drawing up analytical information on the happened changes of quality indicators of soils with the software product of LLC CentrProgrammSistem. Timely reaction provides reproduction of soil fertility agricultural producers whose majority has no funds for a covering of the corresponding expenses. Therefore it is offered to develop the new software product on monitoring of market and non-market land turnover of agricultural purpose. Creation of digital service, development, service of the program will demand the corresponding financial security. Subsidizing of expenses - allocation of budgetary funds for development of network infrastructure and transmission media of data can become one of sources of financing of digitalization.

Now implementation of digital technologies in production and administrative activity of agricultural producers generally has fragmentary character. First of all, it belongs to carrying out remote sensing, use of methods of predictive modeling of indicators of field agroecosystems. It is necessary to use the model of a system of support of decision-making including conceptual, information, component, methodical support which is considered effective, including at the solution of semistructured problems. (Service providers and users) at use of digital technologies the positive network effect which is formed on condition of stimulation of demand for services and increases in number of consumers has to become result of interaction of interested parties.

For this purpose existence of mechanisms of the system involvement of agricultural producers into this process is necessary.

Formation of a system of public administration during digital transformation of the industry is based on legal regulation and its development and also creation of safe information infrastructure. Regional governing bodies of agriculture can bring the relevant legislative initiatives in higher bodies (in this case – in the Ministry of Agriculture of the Russian Federation).

Are the characteristic reasons of complexity of the regional economic mechanism of management of land resources in the conditions of digitalization of agriculture (Figure 3):

– weak legislative and a regulatory framework concerning informatization and digitalization in agriculture from a position of creation of the corresponding infrastructure and subsidizing of this process;

– absence of uniform governing body of land resources and dispersal of administrative functions in the Ministry of Agriculture of the Saratov region, the Ministry of Economic Development of the Saratov region, Committee on management of property of the Saratov region;

– discrepancy of the available software products to requirements for ensuring rational management of land resources;

– need of involvement of private business structures for a computerization, digitalizations in agriculture.

Management of agriculture and land resources at the regional level by means of the digital platform "Digital Agriculture" has to be carried out in interaction of executive authorities by means of combination of functionality of digital platforms (subplatforms) on a seamless basis with application of feedback mechanisms for obtaining internal office information and performance of tasks on implementation of state programs.

The important stage of digitalization of management of land resources in agriculture consists in design and introduction of programs, applications, services. It assumes holding competitions on the basis of open data between developers. According to us, it is expedient to involve scientists of profile research institutes, higher education institutions, experts of GIS technologies to it.

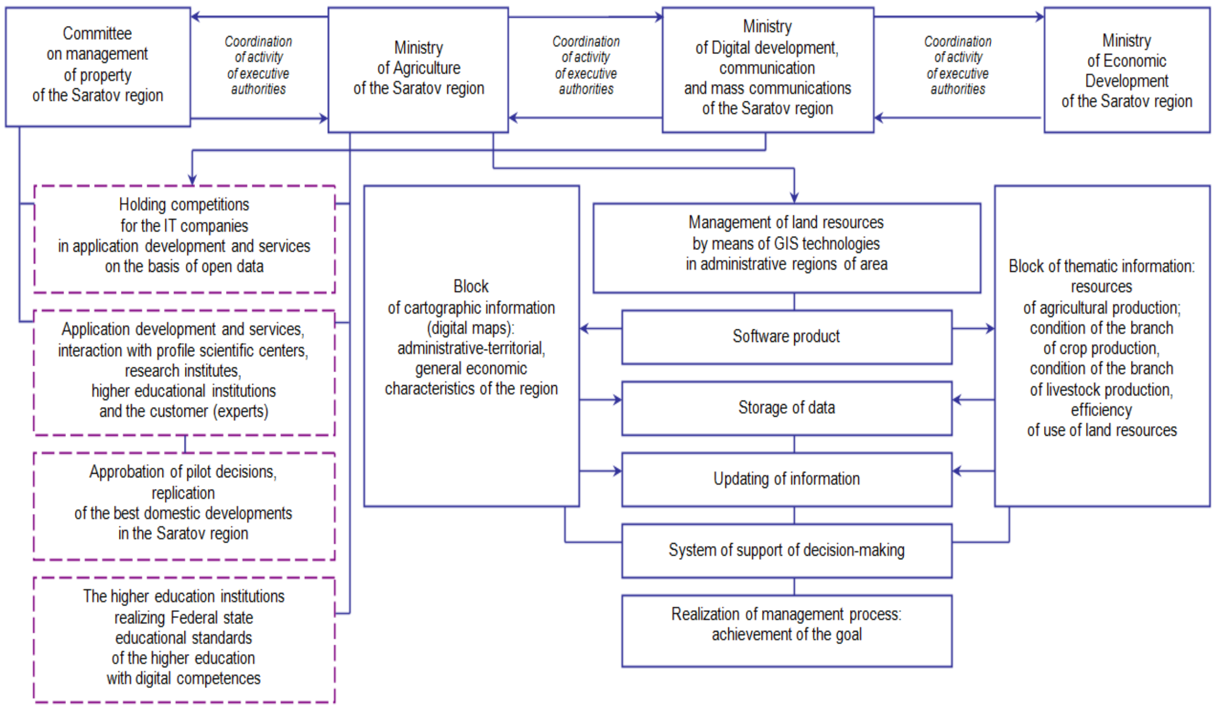

Fig. 3. The regional economic mechanism of management of land resources in agriculture on the basis of use of digital technologies
Note: The dotted violet line selected authors' offers.
Source: Author's own elaboration.

The software product on management of land resources has to undergo the corresponding approbation regarding quality and efficiency of the decisions made on its basis in agriculture, the subsequent replication to users. It contains two blocks of information.
The block of cartographic information is administrative-territorial maps and general economic characteristics of regions. Visual images are used: administrative-territorial division (number of rural districts, number of settlements), area of the territory (sq. km, share in the general indicator), area of agricultural lands (hectare, specific weight of an arable land), cadastral cost of agricultural grounds (million rubles, share in the total cadastral cost), etc. Digital maps give the chance to automatically observe significant deviations of the corresponding indicators a certain period, to establish the reasons of such changes and to make the relevant management decisions. Addition of new data on land resources provides formation of the following layer of visual space on condition of their usefulness.
The block of thematic information is one of the most important elements of process of management of land resources, includes use of the agricultural land (structure, dynamics of the areas, distribution on forms of ownership, the area not used, involved in a turn), a condition of the agricultural land on categories (level of natural and artificial fertility, monitoring of negative processes, the structure of sown areas and productivity of crops, use of the reclaimed lands, existence of especially valuable productive agricultural grounds), etc.
The information massif is going to storage of data, the algorithm of calculation of indicators is modelled, there is their continuous updating that allows authorities to make timely,

effective decisions on management of land resources in agriculture. PSRIEOAIC's scientists in Federal Service for Intellectual Property (Rospatent) registered the databases "Quantitative assessment of economic value of the agricultural land", "Tools for assessment of efficiency of use of lands from structure of agricultural lands in the Saratov region", "Analytical information on the market of the agricultural land in the Saratov region" [39, 43, 42].

At the final stage for performance of the specified functions the system of support of decision-making which on the basis of processing, structuring the obtained information provides acceleration of adoption of rational management decisions has to be created. Realization of process of management of land resources consists in achievement of the goal (purposes), is carried out by competent specialists in all vertical of administrative hierarchy.

CONCLUSIONS

Essential factor of increase in effective management of land resources in agriculture is use of the developed economic mechanism. Considering influence of negative externalities on the market of the agricultural land and a deviation of the prices from equilibrium level, it is expedient to influence a market turnover of agricultural grounds by means of the priority directions of development: reductions of transactional costs for execution of transactions and registration of the property rights to the land plots, updatings of cadastral cost of the land plots, accelerations of differentiation of the lands which are in federal, regional, regional property, etc.

The constructed model of a common information space of the economic mechanism of management of land resources in agriculture assumes the organization of digital interaction of the ministries, departments by means of use of specialized information, the corresponding portals, implementation of space, land monitoring of lands, monitoring of a market, non-market turnover of agricultural grounds, selection of inefficient agricultural land users through modular and trigger assessment, development of the system of support of decision-making on regional and municipal subplatforms of digital control, ensuring the network effect which is expressed in increase in value of information and communication technologies with increase in number of users among participants of the land relations.

The evidence-based regional economic mechanism of management of land resources in agriculture designed on the basis of use of digital technologies involves executive authorities, scientific centers, higher educational institutions when developing the software products providing accumulation, updating, structuring, storage of cartographic and thematic information for efficiency of adoption of management decisions.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PROBLEMS AND PROSPECTS OF THE MARKET OF FODDERS FOR ANIMAL HUSBANDRY IN UKRAINE

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Abstract

The research is devoted to studying the problems of fodder production in Ukraine, which are caused by the mismatch between demand and supply, impact of the world grain prices on the pricing processes in fodder production, disparity of prices of agricultural and industrial products, weak innovative activity of enterprises engaged in fodder production, low purchasing capacity of agricultural enterprises and population. It is determined that the balance between demand, supply, competition, state regulation, level of infrastructure development positively influences development of commercial fodder production. The work identifies participants of the fodder market (producers, consumers, intermediaries) and their features. The research outlines the dynamics of fodder production and tendencies of relationship between the volume of fodder production and the stock of agricultural animals and poultry. The authors of the work composed a model of fodder market performance in Ukraine. It is noted that fodder market can be regulated by such instruments as marketing, institutional support, state support, cooperation and clusterization.

Key words**:** *market, fodder, demand, supply, animal husbandry, fodder producers, fodder consumers.*

INTRODUCTION

Effective development of animal husbandry, increase of agricultural animal productivity and reduction of animal product costs greatly depend on the science-based feeding because in the structure of material costs of agricultural enterprises, almost 22% is taken by fodder costs, whereas at the farms, the figure reaches 7% [1, p. 124; 5, p. 13]. Development of fodder production for agricultural animals in Ukraine happens in compliance with the global tendencies and requires close cooperation and radical steps concerning the fodder market deregulation. Nowadays, animal husbandry is developing in two sectors of agricultural commodity producers (corporate and individual). Therefore, the fodder market entities include all categories of agricultural enterprises, farms of population and enterprises, engaged in commercial production of feed for animal husbandry. Moreover, structural and industrial distortions in the Ukrainian agrarian sector cause the highly competitive market environment, in which enterprises of animal husbandry and fodder enterprises are forced to build their effective business. Under such conditions, all entities of fodder market should develop approaches and apply principles, which would support the growing competitiveness, including at the foreign market.

Thus, considering the current problems of animal husbandry and commercial fodder production, which are related with the disparity of prices of agricultural and industrial products, low purchasing capacity of some agribusiness entities and population, poor investment activity of agricultural commodity producers, slow adaptation of agricultural enterprises to the conditions of the competitive environment performance, it is necessary to conduct more researches on fodder market, to study available mechanisms and instruments of formation of the fodder base of agricultural commodity producers on the fundamentals of partnership relationship between the fodder market participants.

MATERIALS AND METHODS

A complex of methods of scientific knowledge has been applied to shape theoretical and applied aspects of the research on the fodder market development and its importance in formation of the resource supply for agricultural commodity producers of Ukraine. A system approach of research was used for decomposition of the fodder market, identification of the mechanisms of its elements interaction; methods of induction and deduction – for consolidation of the phenomena and processes, related with development of the domestic fodder market; abstract and logical – for identification of characteristics of the fodder market consumers; comparison – for determination of the tendencies of fodder production and stock of agricultural animals and poultry, bred by all categories of agricultural commodity producers in Ukraine; modeling – for shaping a scheme of the fodder market performance; graphical – for visual presentation of the research material; SWOT analysis – for identification of strengths and weaknesses, opportunities and threats at the fodder market in Ukraine. The information base of the research is made by the official data of the State Statistics Service of Ukraine; scientific works; Internet resources; personal studies of the authors.

RESULTS AND DISCUSSIONS

A priory, any economy can be effective if it performs in compliance with the market laws, involving competition, free flow of commodities and information, dominating economic freedom and equality of all business entities. Therefore, the issue of market as an economic category attracts attention of many Ukrainian researchers. In scientific works, the category of market is interpreted as a multi-aspect and multi-variant one. Dudar V.T. insists that market is an effective mechanism to satisfy demands of commodity producers and requests of consumers, whereas its most important property is that it acts as a sensitive regulator and coordinator of the system of commercial efforts of entrepreneurs, focused on production and sale of competitive goods and services [2]. However, similar to all markets, the fodder market is influenced by different macro and micro economic factors. The main ones, which outline the prospects of commercial fodder production development include demand, supply, competition, state impact on the branch development, infrastructure [13, p. 13].

Definitely, the role of the state in the market relations regulation, including fodder one, is significant. Scientists identify gaps in the sphere, particularly they stress that the vectors of the state impact are mainly focused on development of unattainable projects of the market development, issues of registration and certification of fodder products and their components, whereas ignore regulatory mechanisms of recovery of the domestic demand for mixed fodder and stimulation of the export of grain processing products with high added value [9, p. 387-388; 10, p. 13]. Moreover, in no uncertain terms, development of fodder production is of crucial importance for recovery of animal husbandry as a branch, which is a key component of the economic independence and food safety of Ukraine [4, p. 287]. Therefore, scientists mention that a cluster system as a promising organizational structure among the directions of development of the Ukrainian commercial fodder production [6, p. 36].

The task of the research is to study the tendencies and main parameters of the fodder market in Ukraine, to identify a complex of problems of its development and to shape recommendations on application of the regulatory measures, focused on solution of the problems of the fodder market performance.

In economic sense, market is a specific sphere of goods and services exchange, an area of appearance and exercising of the relations, related with the process of purchase and sale of goods, their promotion from producers to consumers. Therefore, market can be characterized as a mechanism of producers' and consumers' need satisfaction.

Adequate performance of fodder market is primarily determined by proportion of its elements, achievement of the appropriate balance, particularly of demand and supply. It results in creation of favorable conditions both for fodder producers and for consumers, i.e. farms of population and agricultural enterprises, engaged in animal husbandry. Supply at the fodder market is determined by the volume of forage grain and bulky feed; products of processing of mixed fodder, flour, sugar beet, oil and fat industries. That list is supplemented with the products of chemical industry, i.e. fodder additives. The fodder producers supply the amount and quality of fodder that is demanded by consumers. Demand for fodder is shaped under the impact of many factors, including price (demand price elasticity). The number of buyers at the market is also of great importance, as well as expected changes of prices; level of income of a definite category of consumers, which shapes the purchasing capacity of both agricultural commodity producers and farms of population, etc.

Therefore, the main constituents of the fodder market, similar to any other market, are demand and supply. Their variation causes changes both of the level of fodder production and consumption of it. Supply at the fodder market depends on a complex of factors and is mainly made by domestic production and partial import. Demand for the products of commercial fodder production is made by some groups of consumers, which can be classified into groups according to the level of production organization and scales of activities. Producers of animal products create the largest group of the fodder market participants. In Ukraine, the group is divided into two subgroups. First, it is the main producers, which represent agricultural enterprises of different types and sizes including family farms. The second subgroup is represented by farms of population. Nowadays, there is also the third group of the fodder market participants that it is not well developed, but is rather dynamically developing, i.e. intermediaries. They perform different functions depending on the position, they take in the chain of fodder delivery from producers to consumers. A particular role is played by wholesale markets. Each of the mentioned groups has some specific characteristics of demand and opportunities of their sale (Figure 1). The researches, conducted by the authors of the article, confirm that development of the forage grain and mixed fodder market is influenced by all mentioned categories of consumers. In contrast, at the market of roughage and succulent feed, demand is determined only by farming enterprises and large animal complexes that belong to agroholdings.

Group of consumers	**Demand characteristics**	**Ways of demand satisfaction**
Farms of population	Low demand for forage grain and mixed fodders	Individual purchase of fodders in small amounts
Agricultural enterprises, farming enterprises, family farms	Demand for all kinds of fodder depends on the farm size in terms of land use, structure of lands	Purchase at agricultural stocks, markets of agricultural products Personal production Production in cooperatives
Large animal complexes in the structure of agroholdings	Permanent and high demand for all kinds of fodder	Purchase at the market Production at one of the vertical levels of agroholdings

Fig. 1. Characteristics of consumers at the fodder market
Source: composed by the authors.

Production of concentrated fodders, i.e. forage grain, mixed fodder, coarse meal, seed cake, is the most developed constituent of commercial fodder production in the world and in Ukraine. Depending on the direction of animal husbandry, agricultural enterprises are engaged in, they create demand for some kinds of fodder products. Therefore, producers of milk and cattle meat generate the demand for green and coarse fodder, as well as hayage silage and mixed fodder for cattle. However, they are less interested to but forage grain. Producers of pork prefer mixed fodder and premixes for pig farming. Producers of eggs and poultry mostly buy forage grain and mixed fodder for poultry. However, it is worth noting that impact of all groups of consumer categories on the fodder market depends not on their quantity, but on the stock of agricultural animals and poultry they feed.

Intensive growth of the stock of pigs and poultry in 2012-2013 by all categories of agricultural producers (Figure 2) contributed to an active increase of the volume of fodder production in that period. Nowadays, fodder supply exceeds the demand at the free market. The main factor hindering development is the dynamics in animal husbandry, which is positive but still is not able to follow the rates, expected by investors, when they built new plants of fodder production for agricultural animals.

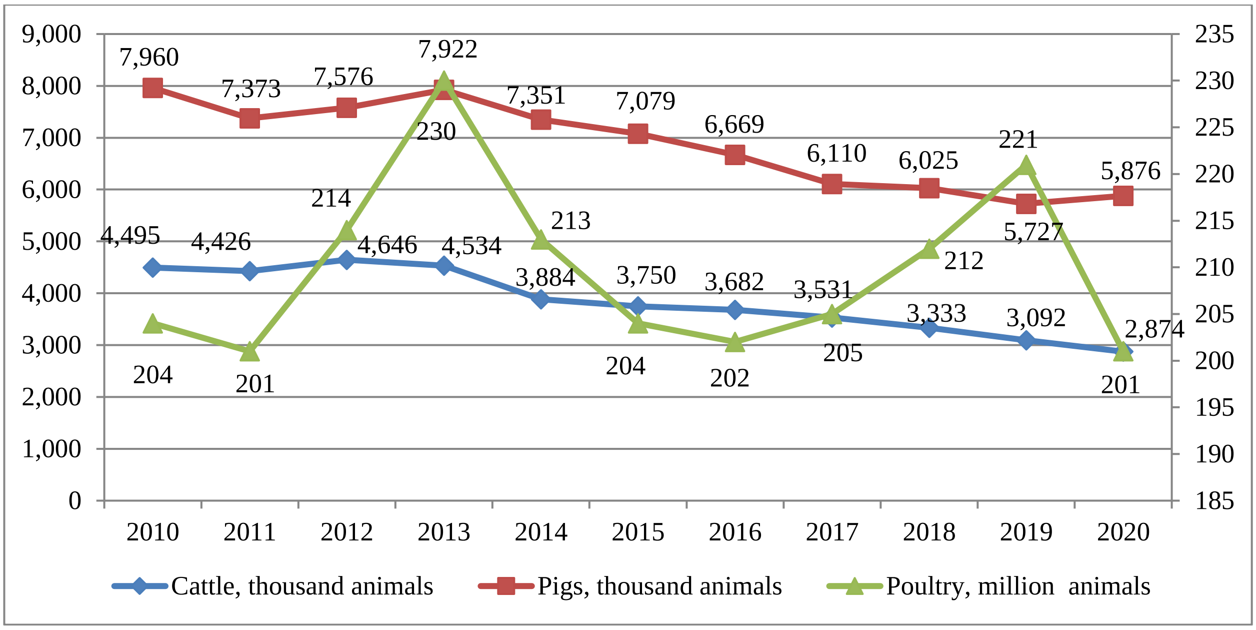

Fig. 2. Dynamics of the stock of agricultural animals and poultry, fed by all categories of agricultural commodity producers in Ukraine

Souse: composed according to [1, p. 124]

In Ukraine, producers of fodder for animal husbandry are divided into two subgroups, namely enterprises, specialized in commercial production of fodder, and agroholdings, which have units of fodder production for agricultural animals in their organizational structure. Specialized enterprises of fodder production create a group of the fodder market participants. Fodders are produced both by small and large enterprises, which are based on different forms of ownership. Farms, which have no their production of mixed fodders, are forced to buy them at market price. Deficit of current assets restricts opportunities of small farms to buy fodders. Therefore, farmers often use forage grain or simple mixtures of grain to feed animals. It causes reduction of the livestock productivity and fodder conversion and as a result, increase of production costs.

In Ukraine, the structure of mixed fodder production follows the trends of animal husbandry development. The most affordable products for population include chicken and eggs, because the effective demand of Ukrainians is currently not high enough to buy beef and pork. Because of such economic situation, the chicken stock shows a changeable dynamic, whereas the stock of pigs and cattle is steadily decreasing. As a result, outcome of mixed fodders for poultry increases, whereas production of fodders for pigs goes down (Table 1).

Table 1. Production of ready fodders for agricultural animals, thousand tons

Fodder kind	Year							2019 as compared to 2013, %
	2013	2014	2015	2016	2017	2018	2019	
Ready fodders (but for premixes) for pig feeding	1,789	1,391	1,402	1,210	1,226	1,232	1,236	69.1
Ready fodders (but for premixes) for cattle feeding	717	720	730	782	724	701	744	103.7
Ready fodders (but for premixes) for poultry feeding	4,235	3,937	3,895	3,899	4,091	4,534	4,322	102.1

Source: calculated according to [1, p. 64]

The stock of animals and poultry and the directions of animal husbandry development influence the volume of fodder production and its structure. According to the results of 2019, fodder production in Ukraine (but for premixes) accounted for 6.3 million tons. Such result is the lowest one for the last six years. In 2013, fodder production accounted for 6.7 million tons, whereas until 2019, it reduced by 6% or 402.7 thousand tons. It is worth noting that international production of fodders also reduced by 1.07% (up to 1.13 billion tons).

In 2013-2018, the volume of fodder production for poultry steadily increased. The growth happened along with the intensive development of commercial poultry husbandry and transition of small producers to advanced technologies in feeding: they started to use mixed fodders instead of unbalanced vegetable mixtures. However, in 2019, fall of fodder production was caused by reduction of demand for those products because of the radical reduction of the stock of poultry in that year, i.e. by 19.8 million animals as compared to 2018.

Agricultural products are used as raw materials for the further processing and production of fodders at specialized enterprises. Dynamics of the gross yield of cereals confirms the available powerful raw material base in Ukraine that is beneficial for the mixed fodder industry development. In 2020, the volume of grain production increased by 65.3% as compared to 2010. In 2010-2020, among the forage grain crops, the best results were shown by the gross yield of corn – 2.5 times. According to the export demands, along with the permanent growth of corn production, one observes a tendency to reduction of production of other forage grain crops that is forced by fall of domestic consumption. Thus, in the studied period, production of spring wheat reduced by 2.6%, rye – by 1.7%. barley – by 10.0% [1, p. 79, 90].

Among the enterprises, specialized in commercial fodder production but are not in the structure of agroholdings, the leading position is taken by Yednist Group, which has seven production enterprises in its structure. The last plant of the group of companies started its operation in autumn 2014 with the production capacity of 180 thousand tons of mixed fodder annually. Another powerful player at the market is Kyiv-Atlantik Ukraine PJSC – 90 thousand tons of granular mixed fodder annually. In addition, there are other players at the market, like Tsekhave Korm LLC, AVA Group and others.

In the structure of mixed fodder production, the largest share is taken by the products for poultry (almost 56%) and pigs - 20%, 11% of fodders is produced for cattle and 12% - for other animals. Considering the fact that almost half of all fodders are sold for poultry, the market is very sensitive to the situation in the industry. Nowadays, it experiences some deficit of growing birds because of shutdown of the enterprises in the east of Ukraine and logistic problems with the breeding poultry farms in the annexed Crimea. Some powerful producers of chicken eggs have radically reduced their stock of poultry due to such situation. Broiler direction performs only due to large operators, which have personal breeding herds [12, p. 13]. The branch of pig farming also experiences consolidation of the market that results in shutdown of small low-profitable farms and increased scales of pork production in the structure of large enterprises and agroholdings [3, p. 162].

Individual farms of population still are a promising and unfilled niche for fodder producers. Nowadays, they feed a lot of cattle, poultry and pigs using unbalanced diet. The negative factor, hindering development of that market is the low culture of mixed fodder use. Obtaining cereals as payment for their land and property shares, population feed poultry with the whole grain or meal the forage grain into the stock feed. Therefore, popularization of knowledge on composing diets for different groups of animals is the actual task to solve the problems of fodder production. It will contribute to an increased demand for the products of commercial fodder production. However, the authors of the research consider that it is rather risky for the entities of commercial fodder production to reckon only upon the market of the farms of population. Export of feed for agricultural animals is also limited. Currently, Ukraine exports fodders to Moldova, Georgia, Turkmenistan. Despite the competitiveness of fodders, European market is closed for Ukraine, because in the European countries with developed animal husbandry and poultry farming, there is a great number of local fodder producers. The developed infrastructure of modern foreign innovative productions secures high competitiveness of the products of fodder production. Therefore, at the foreign market, the competition is severe.

Nowadays, Ukrainian commercial fodder production is in stagnation. Besides the mentioned reasons, there are some other factors, which negatively influence the dynamic development of fodder market. In the last 8 years, costs of fodders in Ukraine increased five times [8]. A rapid rise of prices of the purchased fodder due to the rise of prices for grain will definitely result in unprofitable animal husbandry. Rates of increase of the sale prices for animal products do not cover the inflation growth of costs for their production even at the enterprises with high indices of animal productivity. Under such conditions, without significant reduction of the purchasing prices of beef and pork, animal husbandry will make loss. However, the prices of poultry products are dependent on the purchasing capacity of population, which is still low.

Such situation causes much concern of the medium-size and small agricultural enterprises, i.e. producers of chicken meet and pork. The rise of prices of grain and fodder forces them reconsider their business strategies with the focus on reduction of livestock and poultry, or total shutdown of the direction. Thus, it produces the situation when some Ukrainian agricultural enterprises, engaged in crop production, get permanent profit from grain export, whereas others are ready to wound up their production. Increased prices of grain due to a high demand at the foreign market, including forage one, which is used for fodder production, significantly influence the price of meat, eggs and many other food products, because the costs of mixed fodder take 65-70% in the structure of costs of the poultry and pig farming products [7]. Under the high demand for grain abroad, the domestic supply is reduced that is another reason for increase of grain price. Therefore, uncontrolled export of corn and grain is an indirect reason of stagnation in commercial fodder production and loss making of animal husbandry. In such situation, participants of the domestic grain market create artificial scarcity. Thus, it results in increased prices for exporters, producers and consumers of fodders.

In such conditions, small and medium-size producers of chicken meat and pork can hardly compete either at foreign markets or even with large companies inside the country. Every year, the number of agricultural enterprises, engaged in pig farming, reduces by 200-500 units. Small operators with the stock of less than 2 thousand animals leave the sector [3, p. 163]. It is primarily the agricultural enterprises, which run situational pig farming (e.g. waiting for favorable prices at the market), feel problems with current assets, do not invest in the measures on improvement of biosafety and efficiency of production and therefore, they are not competitive. Reduction of the industrial stock of pigs in the country may result in weaker supply of meat and higher prices, both purchasing and retail.

Nevertheless, due to a growth of personal herds as well as pig and poultry stock, almost all agroholdings have recently increased fodder production. Among agroholdings, the largest producers of mixed fodders in Ukraine are the enterprises, which belong to large animal husbandry complexes, particularly affiliate of Domestic complex of fodder production of Vinnytsia poultry plant LLC, Myronivskyi plant of cereals and mixed fodder production PJSC, APK-Invest PJSC, Yasensvit LLC. Agroholdings mostly develop that direction to supply their personal production with fodders. A significant share of mixed fodders (above 60%) is produced by large market operators, i.e. vertically integrated enterprises, which have mixed fodder production in their structure, e.g. MKhP, Agromars Complex LLC, Agro-Oven Corporation, Agrarian Holding Avangard Group, Inter-Agrosystems Group, Dniprovskyi poultry complex [11]. Almost total volume of fodder products, they produce, is used to satisfy personal needs. Therefore, mixed fodder production in their structure is stable and planned, and its volume depends on the scale of production of animal and poultry products inside the agroholding. The named companies possess large animal complexes, which need permanent and planned supply of fodders. It is economically beneficial to use mixed fodder of own production instead of buying them. It is particularly good for the enterprises with large volume of feed consumption. Moreover, use of own fodders provide guaranties of the raw material origin and quality of products.

The market of feed for agricultural animals is a local system of commodity-money relations, focused on production and sale of fodders for agricultural commodity producers to support reproduction of animal husbandry. However, one should remember that the fodder market covers the sphere of commodity exchange between agriculture and other entities of macro environment, i.e. enterprises, running commercial production of fodders. The local character of fodder market requires consideration of its regional features. It is primarily caused by geographic, climatic and economic peculiarities of different regions of Ukraine, in particular the regional character of animal husbandry and therefore, by the demand for certain kinds of fodders. The local nature of fodder production suggests the majority of produced fodders is consumed in the very region, where the corresponding infrastructure is created. Energy problems and significant transport costs contribute to some closeness of the regional fodder markets.

In the segment of mixed fodder and premix production, the majority of large producers is located in the Central Ukraine. Many of them are also placed in the Western Ukraine, but their share in total production is smaller. The main reason of such distribution is in traffic closeness to the largest animal breeding enterprises. The largest consumers of mixed fodders and premixes for pigs and cattle include enterprises and farms of the Western region. It can be explained by the geographic, climatic and industrial features, as in the Western Ukraine, industry is less developed.

Results of the conducted researches are shaped into a matrix of SWOT-analysis of the fodder market in Ukraine, demonstrating the market opportunities and threats, as well as strengths and weaknesses (Table 2). The matrix of SWOT-analysis shows that threats and weaknesses considerably exceed opportunities and strengths. To reduce the effect of threats and intensification of weaknesses of the further development of fodder market, agricultural enterprises should take more efforts to find reserves on reducing costs of the animal husbandry production due to cheaper feed diets, based on the use of by-products of processed corn, sunflower, rape,

brewing, flour milling and other food processing industries.
The most important property of the fodder market in Ukraine is that it is a sensitive regulator and coordinator of the system of commercial efforts of both agroholdings and entities of commercial fodder production, focused on production and sale of competitive fodder products.

Table 2. SWOT-analysis of the fodder market in Ukraine

	Strengths	Weaknesses
Internal environment	Available powerful raw material basis in Ukraine for development of the mixed fodder industry. Available own capacities for mixed fodder production due to such market entities as independent specialized mixed fodder enterprises; vertically integrated agroholdings; small and medium-size enterprises; feed preparation shops. Independent growing of fodder and grain crops by agricultural enterprises for the further processing and formation of cheap fodder supply.	Lack of fodder production cooperation in the environment of farming enterprises. Small agricultural enterprises and farms of population prefer using unbalanced fodder of personal production. Lack of the market of composed diets for animal husbandry. Reduction of the stock of animals and poultry. Concentration of fodder production in the vertically integrated agroholdings. Poor use of innovations in fodder production. Low competitiveness of fodder production. Circularity of the regional fodder markets and underdeveloped infrastructure.
	Opportunities	**Threats**
External environment	Maintenance of the current development tendencies at the market of mixed fodder and premixes in Ukraine in the medium-term prospect. Extension of the channels of meat and dairy product export. Growing demand for forage grain, products of soy bean processing, sunflower meal and mixed fodder at the global market. Development of the market of organic fodders. Growing demand for the products of commercial fodder production due to promotion of knowledge on the ways of animals and poultry feeding. Development of a chain of retail trade by specialized fodder producing enterprises and agroholdings.	Low purchasing capacity of farms of population and farming enterprises. Poor state support for animal husbandry enterprises and small fodder producers. Rise of the global grain prices and direct dependency of fodder costs on the world grain prices. Increased costs of energy sources. No arranged integration relations between fodder producers and agricultural enterprises. High competition at the foreign market and restrictions on fodder export. Uncontrolled export of forage cereals.

Source: own concept.

The analysis provides a reliable consumer assessment of produced or supplied fodder. Therefore, effective performance of fodder market is possible under sufficient effective consumer demand and coordination of supply by applying such instruments of impact as marketing, institutional supply, state support, cooperation and clusterization (Figure 3).
Institutional supply should primarily contribute to creation of the appropriate conditions for development of a full-fledged infrastructure of the fodder market and availability of significant mechanisms to execute the antimonopoly laws in order to secure equal conditions for all fodder market entities to compete and influence pricing of feed products. The mechanism of state support should maximum liquidate the effect of human factor in funds distribution.
Marketing information system of fodder production should be rearranged to satisfy demand of consumers under simultaneous effective activity of all structures of the fodder market and should be based on a deep analytical study of it. It should be characterized by availability of all necessary information on the fodder market with the following financial investments for its expansion. Cooperation and clusterization should be used as the additional instruments to increase efficiency of operation of all fodder market entities and to regulate

dependency between demand and supply. However, the best positions are taken by the enterprises of fodder production, which are able to rearrange their production depending on the customer needs and to produce a wide range of fodder with different receipts for different groups of animals and poultry. In the recent years, due to development of organic animal husbandry and increasing demand for organic products in Ukraine, the country experiences start of the market of organic fodder market. Transition to organic standards takes long time (minimum three planting seasons) and needs organic certification. Therefore, enterprises engaged in production of organic animal production use their own fodders, which are grown immediately at the farms, because they are absent at the market of Ukraine. Thus, Staryi Porytsk LLC company got the Organic Standard Certificate for their animal production. Nowadays, the enterprise produces cheese and dairy products. It has partnership agreement with the Swiss Research Institute of Organic Agriculture (FiNL). For organic animal production, it is important to provide the appropriate feeding base, because fodders should be organic. They include corn starch, haylage from grasses and legumes, hay. The enterprise makes concentrated fodders of grain and legumes. It is forbidden for organic farms to buy fodders and feeding additives, which are not certified for organic animal production. Therefore, the winter diet mainly consists of hay, silage, haylage, concentrated fodders, whereas in summer – it is grazing and green mass. The share of costs for buying fodders in the total costs of organic milk production accounts for 48.7% and in the last three years it has increased by 33.8%.

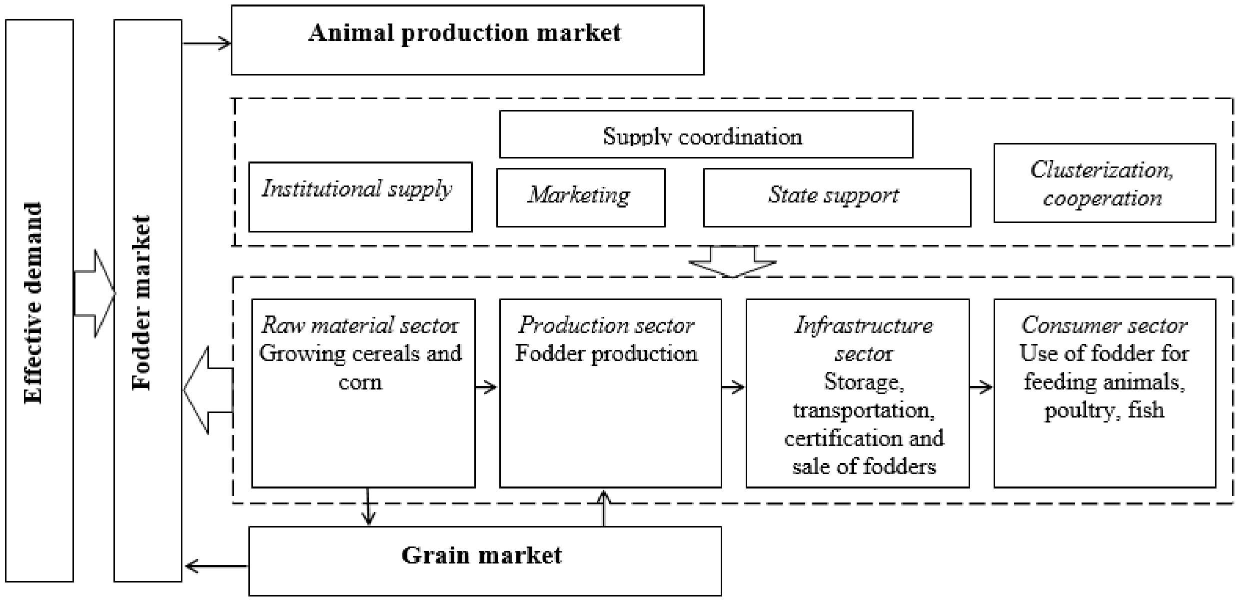

Fig. 3 Model of the fodder market performance in Ukraine
Source: composed by the authors.

CONCLUSIONS

Fodder market reflects the tendencies in development of animal husbandry and poultry farming and it influences pricing in the industry.

In Ukraine, the modern fodder market is characterized by fluctuating dependency between demand and supply. A relative balance of them will primarily depend on the general economic growth, rise of the level of effective consumer demand, active participation of market institutions and appropriate performance of the mechanisms of supply coordination. A regulated fodder market will effect reduction of the amplitude of changes of demand and supply dependencies, as well as stabilization of the stock of agricultural animals.

The focus on domestic demand and severe competition with agroholdings and local producers are the preconditions for inefficient use of the production potential of fodder market, reorientation and bankruptcy of specialized enterprises, reduction of tax revenues that does not meet the national interests and requires governmental regulation. The fodder market development is greatly influenced by direct (privileges for commercial producers of fodders, funding of equipment leasing for new fodder producing enterprises, etc.) and indirect impact of the state in the form of governmental support of animal husbandry. To cease the rise of fodder prices that happens due to the impact of the world grain prices, the government should introduce quoting of grain export.

Problems of fodder market are caused by application of inefficient technologies, obsolete machinery, significant losses of products and therefore, high costs of fodder production by feed preparation shops at agricultural enterprises. The deficit of land area for growing fodder crops, sometimes insignificant needs for fodders at agricultural enterprises, inexpediency of purchasing and servicing of expensive fodder-harvesting machinery and equipment for fodder production confirm consumers' interest in the fodder market development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

NATURAL FODDER LANDS OF UKRAINIAN STEPPE ZONE: CURRENT STATE AND MAIN WAYS OF PRODUCTIVITY RESTORATION

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Abstract

The results of scientific research on the current state of agro-landscapes of the Southern Steppe and the main agro-technological measures to reduce the manifestation of the mentioned negative phenomena are presented. The latter is achieved by creating high-yielding mono-species agrophytocenoses of perennial legumes and leguminous grass mixtures resistant to regional climate changes, which have been observed in recent years in the southern region. Systematic expansion of lands under cereals and industrial crops which are in demand on the international market, has led to the unstable state of agricultural lands in the steppe zone of Ukraine, their area at the beginning of the XXI century being one of the highest in the world and amounting to 90.2% in Kherson region. It was found that the plough land on the territory significantly exceeds the ecologically permissible limits, as a result of which the physical and chemical degradation of soils began to increase intensively, which leads to a significant reduction in the formation of high crop yields. The consequences of these changes were highly unfavorable for the development of agriculture in all regions of the Southern Steppe of Ukraine, which is due both to plowing up extensively the agricultural landscapes and changes in the sown area structure. The main way to reduce physical and chemical degradation of areas under crops under the natural moistening conditions is the creation of high-yielding mono-species agrophytocenoses of perennial legumes and poly-species leguminous - grass mixtures resistant to extreme weather conditions of southern steppes.

Key words: evaporation, precipitation, lack of moisture supply, land degradation, perennial grasses, grass mixtures, growth regulator, peat

INTRODUCTION

The creation of a reliable fodder base in the country allows the revival of the livestock industry. It is well known that the cheapest and most effective source of fodder is meadows and pastures. The area of meadows in the world is 313 billion hectares, or twice the area of arable land. In Ukraine, on the other hand, arable land area is almost five times larger than meadows. The area of plowed land in Ukraine makes about 82% of agricultural land. The most valuable productive lands of the Forest-Steppe and Steppe are plowed, in particular, in the Kherson region they amount to 90.2%, in Mykolaiv – to 83.6% [18]. This leads to the annual degradation of agricultural land and the loss of about 600 million tons of humus. For comparison: plowed lands in the United States make 16.9%; in Australia – 16.4%; in Great Britain – 25.8%; in Belarus – 27.9%; in Moldova – 53.7%; in Poland – 35.7%; in Germany – 34.0%; in France – 33.5%; in the Netherlands – 31.0% [17].

Effective development of the livestock industry of the Ukrainian Southern Steppe agro-industrial complex is possible only on finding a comprehensive solution to the problem of introducing scientifically sound systems of fodder production as well as agriculture in general. The system of fodder production as a set of organizational and economic, agronomic and zootechnical

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

measures aimed at maximizing the production of high quality fodder at the lowest labor expenditures and means of production per unit of fodder, is extremely difficult in the southern part of the steppe zone. The latter is related to the main direction of agricultural development in Ukraine, which underwent significant changes during 1991–2021. Irrational use of land resources in the southern part of the Steppe zone is primarily due to the significant changes in the structure of sown areas which has developed over the last 30 years in Ukraine (Table 1).

Table 1. Structure of sown lands in Ukraine in 2020 compared to 1990

Performances	1990		2020*	
	thous. ha	%	thous. ha	%
Sown area including:	32,218.0	100.00	27,973.0	100.00
1. Cereals and leguminous plants	14,583.0	45.26	15,364.7	54.92
including winter and spring wheat	5,480.0	17.01	6,571.3	23.49
Corn	1,200.0	3.72	5,451.3	19.49
winter and spring barley	3,003.0	9.32	2,384.9	8.52
other cereals and leguminous plants	4,900.0	15.21	957.2	3.42
2. Industrial crops	3,751.0	11.65	9,127.6	32.63
including sunflower	1,636.0	5.08	6,383.3	22.82
sugar beetroot	1,607.0	4.99	218.9	0.78
Soybean	93.0	0.29	1,340.5	4.79
winter and spring oilseed rape	90.0	0.28	1,115.2	3.99
other industrial crops	325.0	1.01	69.7	0.25
3. Potato, vegetables, melon and gourd	1,885.0	5.85	1,842.4	6.59
4. Forage crops	11,999.0	37.24	1,638.5	5.86

***** *Note: Excluding the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and parts of the lands in the area of the joint forces operation*
Source: the State Statistics Service of Ukraine [25].

Compared to 1990, the sown area of forage crops has significantly decreased. If the total area of forage crops in 1990 on the farms of all categories was 11,999.0 thousand hectares, in 2020 their sown area decreased to 1,638.5 thousand hectares, or by 10,360.5 thousand hectares, i.e. by 86.3%. Due to the reduction of forage crop sown areas, the main economic activity of agricultural enterprises and farms in recent years has been aimed at the cultivation of winter wheat, corn, sunflower and winter oilseed rape, which are in demand on the world market. As a result, the supply of fodder to farm animals, especially small and private farms, has become extremely low.

MATERIALS AND METHODS

In writing the article, data from the State Statistics Service of Ukraine, information from the agrometeorological station in Kherson and the results of the authors' own research were used. Empirical studies of the process of increasing the major crop yields were conducted using the methods of comparative, systematic and graphical analysis.

Field experiments on arable land alkalization were carried out in the KOPANI State Enterprise of the National Academy of Agrarian Sciences, Ukraine, in 2010-2019. The soil of the experimental plots was dark-chestnut, the topsoil containing humus (2.02-2.34% according to Tyurin), nitrate nitrogen ($N–NO_3$ – 8.00-12.30 mg kg^{-1}); mobile phosphorus (24.2-36.3% according to Machigin) and exchangeable potassium (330.00-413.00 mg kg^{-1} of soil).

The arable lands alkalinization was performed with cereals and leguminous perennial grasses as their biological features are best adapted to the natural and climatic conditions of the Southern Steppe. For a short period (not more than 2-3 years) the use of single-species crops of cereals and leguminous perennial grasses in grass mixtures included *Lolium multiflorum* Lam., Yaroslav variety and *Onobrychis arenaria* Kit., Ingulsky variety. *Festuca orientalis* (Hack.) V. Krecz., Domenica variety and *Medicago varia* T. Martyn, Veselka variety were used for medium-term restoration of soil fertility (3-4 years).

For long-term restoration of dark-chestnut soil fertility, *Medicago varia* T. Martyn), Veselka variety and *Bromopsis inermis* (Loyss.) Holub), Tavria variety were used. Sowing of cereals and leguminous perennial grasses in single-species crops and binary grass mixtures was carried out in early spring for three years (2016-2019). The sowing rate for short-term fertility restoration of degraded dark-chestnut arable lands, its economic suitability being 100%, in mono-species crops was: *Lolium multiflorum* Lam. – 24.0 kg ha^{-1}, *Festuca orientalis* – 24.0 kg ha^{-1}; *Onobrýchis arenária* – 80.0 kg ha^{-1}; in the composition of grass mixtures they were 12.0, 12.0 and 60.0 kg ha^{-1}, respectively.

In case of the long-term land fertility restoration, the sowing rate of *Medicago varia* seeds in single-species crops was 24.0 kg ha^{-1} and *Bromopsis inermis* – 28.0 kg ha^{-1}. As a part of binary grass mixes the rate of sowing made: *Medicago varia* + *Bromopsis inermis* – 12.0 + 14.0 kg ha^{-1}. The area of the sown area was 60 m^2, the discount area was 20 m^2. Yield recording was performed by cutting.

Dry matter content, grass stand density, change of species botanical composition, yield of fodder units, gross and metabolic energy were determined according to generally accepted methods [4]. Evaporation rate (Eo), moisture supply deficit (ΔEo) according to the years of research were determined by N.N. Ivanov [8]. Statistical analysis of the perennial grasses yield was performed by the method of variance analysis [27].

RESULTS AND DISCUSSIONS

The main forage crops are perennial grasses, which occupy about 50% of the total forage crops area. The fodder base is formed by those fodder crops that are characterized by the lowest cost of seeds, fuel, machinery and wages expenses which is of great importance in times of crisis but significantly worsens the fodder base [16]. One of the main reserves for increasing fodder production for the existing livestock industry is to increase the productivity of natural fodder lands, their total area in Ukraine amounting to 6,391.6 thousand hectares. However, the productivity of 1 ha of grassland is currently very low and does not exceed 1.0-1.2 t ha^{-1}, due to which they receive only 10-11% of the gross fodder harvest.

The main factor contributing to the high productivity of natural forage lands is a scientifically sound ratio of the arable land (arable land + perennial plantations) to the total area of agricultural land. In the US, this figure is 20.3%; Canada – 4.6%; the Netherlands – 24.3%; Germany – 32.0%; France – 34.7%, i.e. the structure of land use is optimized because up to 40.0-50.0% of the total land is occupied by nature-conservation areas, i.e. meadows and forests. The main factor that ensures the sustainable development of agro-ecological systems and the biosphere as a whole in these countries is the optimal ratio of arable land to the total agricultural area.

According to V.V. Dokuchaev [5], with intensive use of arable land, there must be an optimized ratio between the constituent parts of agricultural land. According to those time studies, the ratio of the perennial grasses lands to the total arable land, should be 20-25%, and the area of forest belts – 2.5-3.0%. Later scientific works by the Ukrzemproekt Land Management Institute gave a different ratio of agricultural land in the steppe zone: arable land – 55-60%, pastures and hayfields – 22-23%, perennial plantations and forest belts – 7.0-8.0%, recreational areas and water bodies – up to 6.0%. Depending on the territory distribution and the quality of the natural-climatic steppe zone soils, the above ratios may change slightly. On average, the optimal forest cover in Ukraine was recognized in the range of 19.0–20.0%, while in the Steppe zone it should reach 9.0%, Forest-Steppe – 18.0% and in Polissia – 32.0%.

Natural forage lands in the Steppe zone in 1980 occupied an area of 2,472.8 thousand hectares, their share in the total area of lands of all classes was 38.7%, in the natural-climatic zone of the Forest-Steppe – 1,674.0 and 26.2 and in zone of Polissia – 2,244.8 thousand hectares or 35.1%. At the same time, the total area of plain and gently sloping areas in the Steppe zone reaches 774.5 thousand hectares, steppe slopes – 960.3; non-saline

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

soils – 59.8; upland – 39.2; lowland – 129.5; floodplain of small rivers and gullies – 442.7; floodplain of large and medium rivers – 55.9; mountain – 9.5 and lowland swamp – 1.4 thousand hectares [4] (Table 2).

Table 2. Distribution of natural forage lands by classes and their area in various zones of Ukraine, thousand hectares

Zone	Plain and sloping	Steppe	Non-saline	Upland	Lowland	Small rivers floodplain	Large rivers floodplain	Mountain	Lowland swamp	Total
Steppe	774.5	960.3	59.8	39.2	129.5	442.7	55.9	9.5	1.4	2,472.8
Forest-steppe	25.5	438.8	0.6	91.9	196.1	512.6	248.6	22.7	137.2	1,674.0
Polissia	3.3	13.4	–	132.1	875.5	333.4	292.1	240.3	354.7	2,244.8
Total	803.3	1,412.5	60.4	263.2	1,201.1	1,288.7	596.6	272.5	493.3	6,391.6

Source: Resolution of the Government of Ukraine of March 21, 1980 "On measures to increase the productivity of natural forage lands in the collective and state farms of the Ukrainian SSR in 1980–1985"[19].

The instability of natural moisture in the steppe zone, especially in moderately dry (75%) and dry (95%) years, negatively affects the changes in species botanical composition of existing grasslands and the productivity of the most common species of cereals and leguminous perennials. Having a strong root system, xerophytes make good use of soil moisture and due to pubescence, wax plaque and pre-folding of leaves in droughts, they easily restore turgor with even a small amount of precipitation.

Among xerophytes are succulents which are characterized by moisture accumulation in succulent leaves and stems (cacti, agaves) and which dominate in deserts and semi-deserts and sclerophytes which are characterized by narrow leaves easily twisted in drought. Due to this, the evaporation from leaves is significantly reduced.

Sclerophytes in the natural-climatic zone of the Steppe include: *Festuca rupicola* Heuft., or *Festuca sulcata* Hack.; *Stipa capillata* L.; *Stipa lessingiana* Trin. et Rupr.; *Stipa borysthenica* Klok., as well as *Artemisia vulgaris* L.; *Artemisia austriaca* Jacg.; *Artemisia arenaria* DC. and others.

In relation to moisture in the arid conditions of the steppe zone southern part, special forms of plants germinate here, namely, ephemerals and ephemeroids. The biological feature of the most common ephemeral annual plant *Anisantha tectorum* Nevski in the Southern Steppe subzone and *Astragalus dasyanthus* Pall., *Astragalus dasyanthus* Pall., *Astragalus austriacus* Jacg. and other plants is thin delicate leaves and an accelerated plant growth and development.

Annual and perennial ephemeral plants in the steppe zone of Ukraine germinate intensively and form seed crops in the period of short and wet spring, while the onset of drought stops their growth and development until the onset of favorable moisture and temperature conditions. Perennial ephemeroids which are common in the natural climatic part of the steppe zone, include: *Poa bulbosa* L., *Poa stepposa* Kryl., *Poa compressa* L., and such annuals as *Poa annua* L. and the *Stellaria media* L.

On dry natural forage lands, the total area of which in the steppe zone reached 39.2 thousand hectares, *Onobrychis arenaria* DC., *Melilotus officinalis* Hall., *Elitrigia elongate* Nevski., *Agropiron desertorum* Schult., *Psathyrostachys juncea* (Fisch.) Nevski are growing. At the same time, transitional (intermediate) types from xerophytes to mesophytes are found on these forage lands: *Agropiron pectinatum* Beauv., *Agropiron lavrenkoanum* Procud., *Medicago falkata* L., *Galium verum* L. and a number of thin-legged species that belong to ephemeroids and grow in desert areas only in spring. Due to the supply of nutrients in the tubers, they form thin, tender leaves and withstand summer drought.

Along with this, a number of distinctive features are observed among mesophytes in terms of soil moisture requirement. On lowland natural forage lands, which covered an area of 129.5 thousand hectares in the steppe zone of Ukraine, and floodplains of small rivers and gullies – 442.7 thousand hectares, in natural meadow agrophytocenoses *Trifolium repens* L. and *Trifolium hybridum* L. predominate among leguminous perennial grasses. Of the perennial grasses, *Festuca pratensis* Huds., *Poa palustris* L., *Alopecurus pratensis* L., *Phalaroides arundinacea* Rausch., and *Agrostis maeotica* Klok. dominate on the indicated forage lands.

Due to the significant increase in the moisture supply deficit, perennial grasses are mostly represented by unproductive ephemeral and ephemeroid species on the natural forage lands of the southern part of the Steppe zone: *Poa bulbosa* L., *Poa angustifolia* L., *Calamagrostis epigeios* (L.) Roth., *Cynodon dactylon* (L.) Pers., *Elytrigia repens* (L.) Nevski.

Of the legume species, monotype phytocenoses are dominant: *Lathyrus tuberosus* L., *Vicia cracca* L., *Medicago falcata* L., *Lotus ucrainicus* Klok. However, in conditions of natural moistening (without irrigation) in late May – early June, most cereal ephemeral and ephemeral species of grass stop growing and developing and die completely, thus they do not have a significant impact on the existing livestock industry feed supply, especially in average dry (75%) and dry (95%) years.

The most common annual ephemeral cereal grasses are: *Anisanta tectorum* Nevski, *Bromus mollis* L., *Bromus secalinus* L., *Vulpia ciliata* Dumort, *Aegilops cylindrica* Host., *Hordeum murinum* L., *Eremopyrum triticeum* (Gaerth) Nevski, *Setaria glauca* L., *Setaria viridis* L.

Due to the above, the available phytocenoses of natural forage lands revealed a very limited amount of high-yielding meadow vegetation, the range of annual and perennial grasses includes only 35 species, including 23 species of annual, 5 biennial and only 7 perennial grasses.

In most areas of the southern part of the steppe zone, especially on large-scale sunflower fields a mass appearance of atypical for the region weeds was found in recent years: *Lactuca tatarica* L., *Anisantha tectorum* Nevski, *Cyclachaena xantifolia* L., *Ambrosia artemisifolia* L., etc.

The spread of *Ambrosia artemisifolia* L. in the southern regions of Ukraine is associated with the high competitiveness of this species, due to which it began to occupy a dominant position in the agrophytocenoses.

However, due to the lack of sufficient seeds of alfalfa (*Medicago sativa L.*) and drought-resistant species of perennial grasses, primarily *Bromopsis inermis* (Leyss.) Holub, *Bromopsis erecta* (Huds.) Holub, *Dactylis glomerata* L., *Elytrigia intermedia* (Host Nevski), etc re-alkalinization of forage lands of different classes in the steppe zone was not carried out in recent years as a result of which a shortage of green and roughage yields annually amounts to 9.5-12.0 million tons of fodder units and to 1.8-2.0 million tons of digestible protein.

Along with the significant impact of extremely high plowing of plains and sloping natural forage lands, as well as agricultural lands of the southern steppe zone as a whole, in recent years there has been a significant impact of regional climate changes on the formation of their productivity, causing the intensive changes in the structures of existing agrolandscapes.

The increase in the average monthly air temperature during the growing season of 2018-2020 by 1.7-2.8 °C, compared with the average long-term figures for 65 years (1945-2010), significantly affected the changes in water regime of forage crops grown under non-irrigated agriculture conditions in the subzone of the Southern Steppe.

In general, during the growing season (April-September) in the dry year of 2020 (95%) the rainfall only amounted to 163.6 mm, the evaporation reached 947.5 mm and the deficit of moisture supply (ΔEo) – 783.9 mm and, compared to the average long-term figures for 65 years (1945-2010), was higher by 290.1 mm, or 58.7% (Figure 1).

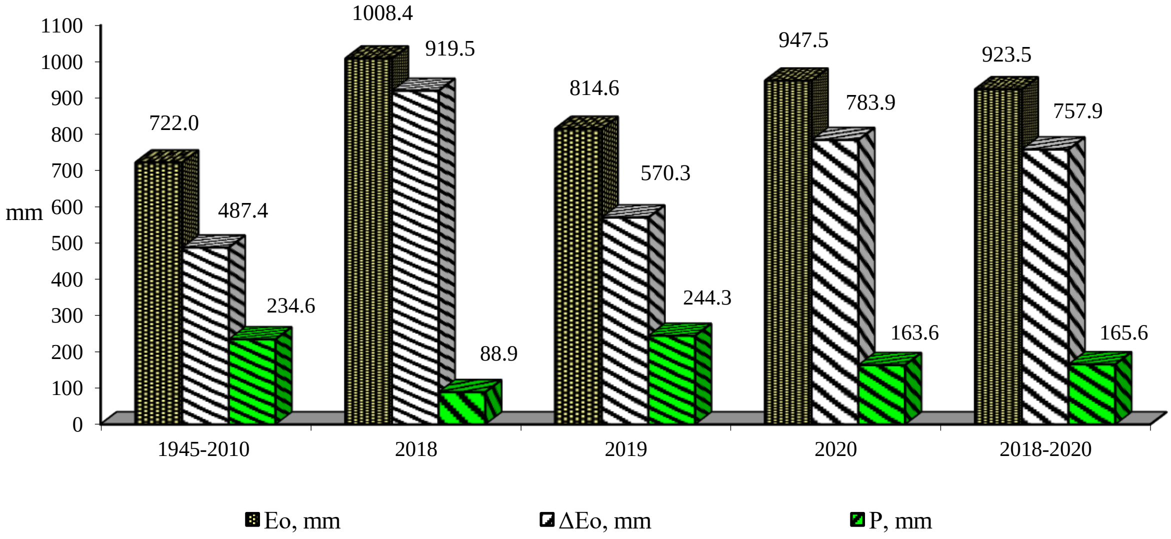

Fig. 1. Evaporation (Eo), deficit of moisture supply (ΔEo) and the amount of precipitation (P) during the growing season in the Southern Steppe of Ukraine
Source: The Meteorological Station of Kherson [26].

The degree of cultivated forage crops moisture supply during their growing season, established by the moisture coefficient, shows that in April it was 0.03; in May – 0.29; in June – 0.13; in July – 0.29; in August – 0.12 and in September - 0.15 (Figure 2).

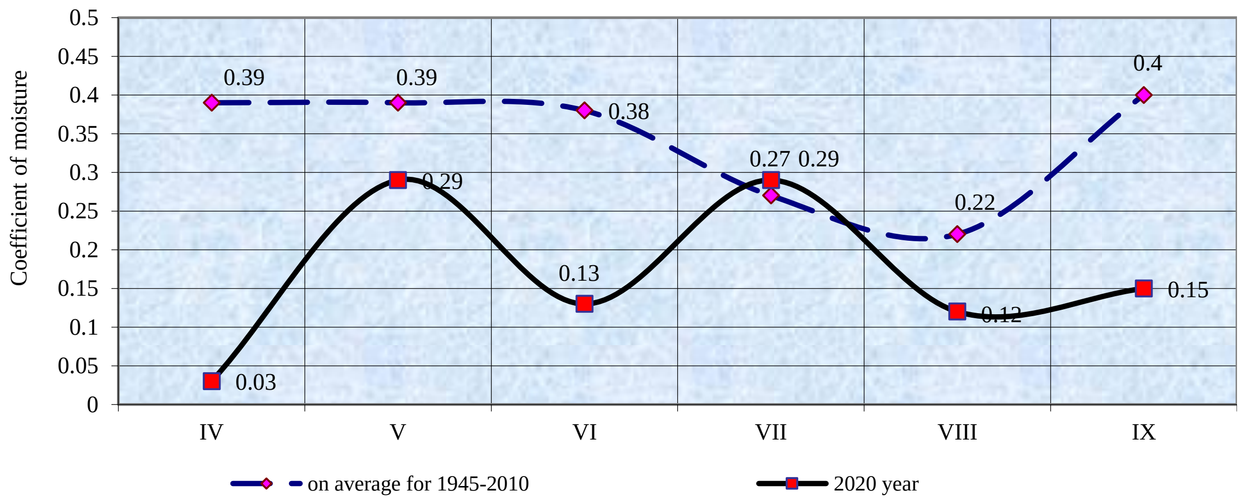

Fig. 2. Coefficient of moisture supply during the forage crops growing season in the dry year of 2020 (95%)
Source: The Meteorological Station of Kherson [26].

However, the disadvantage of energy-saving technology aimed at improving natural forage lands was the uneven germination of sown grasses and those that are already growing because of the plants mutual shading [15].

Due to the fact that the potential of natural hayfields and pastures in Ukraine is used very poorly, cultivated pastures can play a special role as a factor in significant savings of material, technical and energy resources [21, 23, 24, 29]. In addition, cultivated pastures are also of great economic and agronomic importance: their creation on the slopes stops water and wind erosion and helps to restore soil structure and, consequently, increase its fertility [2, 3, 11, 22].

In Western European countries cultivated pastures occupy 70-85% of all land under perennial grasses. In Denmark, 80% of fodder is obtained from such pastures. In England and the Netherlands the proportion of pasture feed in the annual cattle diet makes 35-50%

[6]. Much attention is paid to the creation of cultivated pastures in Latin America and Africa [9, 7, 10], which helps to solve not only forage production problems but also the problems of soil conservation [1].

However, when creating a cultivated pasture, it should be treated it with no less attention than wheat or any other field, it should be provided with necessary fertilizers and equipment, with the optimal set of perennial grass seeds for each zone [12, 13, 14, 30]. The solution to this problem can be achieved only owing to the state support of long-term cultivated pastures for beef cattle by funding targeted local programs specifically aimed at improving pastures for grazing and private farms in particular [28, 20].

In our research on non-saline natural forage land surface improvement, the yield of absolutely dry matter of *Medicago* variety Unitro in the first year averaged 3.30-3.32 t ha^{-1} in the three years of research with natural moistening (without irrigation), while that of *Elytrigia intermedia* (Host.) Nevski – 3.24-3.44 and binary grass mixture *Elytrigia* + *Medicago* – 3.33-3.50 t ha^{-1} (Table 3).

Table 3. Yields of absolutely dry matter of perennial grasses with surface improvement of non-saline natural forage lands in the Southern Steppe of Ukraine (*on average for 3 years of research*)

Agrophytocenosis composition (A)	Year of application					
	first		second		third	
	Yield, t ha^{-1}	Energy consumption, MJ t^{-1}	Yield, t ha^{-1}	Energy consumption, MJ t^{-1}	Yield, t ha^{-1}	Energy consumption, MJ t^{-1}
Top-dressing with Plantafol 30.10.10 (B)						
No Plantafol 30.10.10 application (B_1)						
Elytrigia intermedia (Host.) Nevski. (E)	3.24	6,427.5	2.70	7,713.0	1.86	10,360.7
Medicago (M)	3.30	2,841.2	2.49	3,765.5	1.67	4,883.3
E+M	3.33	5,473.0	2.88	6,328.1	1.81	9,642.8
Onobrychis arenaria (O)	3.39	2,990.8	2.73	3,713.9	1.65	5,205.1
E+O	3.64	5,111.8	2.78	6,693.2	1.78	9,303.5
E+M+O	3.70	4,996.2	2.79	6,625.8	1.82	9,243.0
With Plantafol 30.10.10 application (B_2)						
Elytrigia intermedia (Host.) Nevski. (E)	3.44	6,253.2	2.71	7,937.6	1.91	10,755.5
Medicago (M)	3.32	3,030.4	2.63	3,825.5	1.70	5,380.2
E+M	3.50	5,403.1	2.88	6,566.3	1.88	9,798.4
Onobrychis arenaria (O)	3.67	2,949.6	2.73	3,965.2	1.73	5,494.9
E+O	3.77	5,117.5	2.91	6,629.9	1.88	9,695.0
E+M+O	3.81	5,031.8	2.87	6,679.8	1.89	9,585.5
Assessment of the partial differences significance:						
SSD_{05}, t ha^{-1} – (A)	0.40		0.09		0.08	
SSD_{05}, t ha^{-1} – (B)	0.30		0.09		0.05	

Source: own research.

Therefore, one of the most effective ways to increase the productivity of natural forage lands, which is currently underutilized by small-scale farms in the Southern Steppe, is to expand the sown areas of the most drought-resistant cereals and leguminous perennials and, above all, alfalfa and sainfoin.

Energy consumption of 1 ton of absolutely dry matter of binary wheatgrass medium + alfalfa grass mixture regardless of the use of Plantafol 30.10.10 growth regulator, the first year of use, for surface improvement of non-saline natural forage lands, was 5,403.1-5,473.0 MJ, the second – 6,328.1-6,566.3 and the third – 9,642.8-9,798.4 MJ, respectively.

On the thinned natural forage lands with the predominance of low-yielding plants of the herbaceous group, a radical improvement of natural forage lands is carried out. In general, radical improvement is the main method of cultivating natural forage lands of all classes, as its implementation contributes to the creation of optimized water, nutrient and air regimes of the soil.

In carrying out a radical improvement of the natural forage lands of the Lower Dnieper Sands (Oleshky Arena), we used the method of soil reclamation consisting in layer-by-layer application of peat as an organic fertilizer. The sands of the experimental field were characterized by extremely low fertility (humus content – 0.08%, mobile phosphorus P_2O_5 – 0.95-1.0; exchangeable potassium K_2O – 2.5-3.0 mg 100 g^{-1} of soil) and the predominance of coarse and fine sand particles in the granulometric composition (39.56–51.71%).

Layered application of peat solved one of the main problems, namely, the increase of the sand fertility. For this purpose, local organic peat fertilizer was applied in two layers up to 500 t ha^{-1}. For this, a tracklaying tractor rammed a rut for wheeled transport, the previously planned field was rammed with a tracked tractor to spread peat (RUN–15B) up to 300 t ha^{-1}, turned it under with a plow to the depth of the topsoil. The second fertile layer was created by applying peat (up to 200 t ha^{-1}) and mineral fertilizers ($N_{60}P_{60}K_{100}$) by sifting and mixing them with disc harrows BDNT-2.2 in two tracks in the upper layer to a depth of 0-10 cm. Immediately after the application of mineral fertilizers, the soil was rolled by ring rollers, which contributed to obtaining uniform seedlings of cereals and leguminous perennials.

The proposed method solves several pressing problems of agricultural production: development of low-yielding lands for irrigated cultivated hayfields, increasing their fertility, protection of sandy lands from wind erosion, preservation of the environment. Its application on irrigated lands allowed to obtain 50.0–60.0 t ha^{-1} of green mass of alfalfa-cereal grass mixtures for several years.

Under the irrigation, the most productive were grass mixtures of blue hybrid alfalfa, foxglove, grasshopper and perennial fenugreek. The yield of absolutely dry matter of these types of grasses and their grass mixtures, on average for five years of research, was 12.9-14.0 t ha^{-1}, respectively, feed units – 8.9-9.4 t ha^{-1}; digestible protein – 1.9-2.1 t ha^{-1} and metabolic energy – 135.1-146.3 GJ ha^{-1}. The yield of absolutely dry matter from single-species crops of foxglove was 12.92 t/ha, respectively, fodder units – 8.66; digestible protein – 1.51 t ha^{-1} and metabolic energy – 135.1 GJ ha^{-1} (Table 4).

Table 4. Productivity of single-species crops of *Bromus inermis* and *Medicago-Bromus* grass mixtures when grown on reclaimed sands under irrigation in the Southern Steppe of Ukraine *(average over five years)*

Grasses and grass mixtures	Yield from 1 ha			
	Absolutely dry matter, tons	Fodder units, tons	Digestible protein, tons	Metabolizable energy, GJ
Bromus inermis (Bi)	12.92	8.66	1.51	135.1
(Medicago Khersons'ka 1)+Bi+LpD+D+Lp	12.89	8.76	1.99	135.7
(Medicago Khersons'ka 7)+Bi+LpD+D+Lp	13.52	9.19	1.99	142.8
Medicago (B-3504)+Bi+LpD+D+Lp	13.51	9.05	1.90	140.9
Medicago (B-3521)+Bi+LpD+D+Lp	13.30	8.91	1.94	140.4
Medicago (B-3521)+Bi+LpD+D+Lp	13.06	8.88	1.98	137.1
Medicago (B-480)+Bi+LpD+D+Lp	13.61	9.39	2.03	143.7
Medicago (B-426)+Bi+LpD+D+Lp	13.97	9.36	2.06	146.3
LSD_{05}, t ha^{-1} (GJ)	0.30	0.22	0.14	3.25

Note: Bi – *Bromis inermis*; LpD - *Lolium pratense* (Huds.) Darbysh.; D – *Dactylis glomerata*; Lp - *Lolium perenne*.
Source: own research.

The most productive were grass mixtures with different varieties of *Medicago, Bromis inermis*; *Lolium pratense* (Huds.) Darbysh.; *Dactylis glomerata* and *Lolium perenne*. The yield of absolutely dry matter of these types of grasses and their grass mixtures from 1 ha on average for 5 years was 12.89–13.97 t ha^{-1}; fodder units – 8.76–9.39; digestible protein – 1.99–2.06 t ha^{-1} and metabolic energy – 135.7–146.3 GJ ha^{-1}.

Inclusion of different varieties and cultivars of alfalfa and cereal perennial grasses in the composition of grass mixtures contributed to a significant increase in the essential nutrient content: fodder units – by 0.67–0.70 t ha^{-1} (8.1–8.4%), digestible protein – by 0.55–0.57

t ha^{-1} (36.4–44.5%) and exchange energy – by 7.4–10.6 GJ ha^{-1} (6.0–7.8%). The content of basic organic nutrients (crude protein, crude fiber and crude fat) corresponded to the zootechnical cattle feeding standards and made: crude protein – 19.28–21.66%; crude fiber – 26.77–29.80; crude fat – 2.99–3.36% in absolutely dry matter. The content of mineral elements in the crude ash was within the zootechnical cattle feeding standards and made: nitrogen – 3.12–3.46%, phosphorus - 0.60–0.65 and potassium – 2.64–3.13% in absolutely dry matter.

CONCLUSIONS

Under natural moistening, the formation of absolutely dry matter of single-species alfalfa and sainfoin, as well as wheatgrass and wheatgrass-alfalfa and wheatgrass-sainfoin grass mixtures with surface improvement of non-saline soils of the Southern Steppe depended significantly on rainfalls and changes in the species botanical composition, species of grasses and grass mixtures during the years of their use.

Growing single-species crops of drought-resistant legumes of perennial grasses and wheatgrass during the first year of use in non-irrigated agriculture contributed to the yield of absolutely dry alfalfa – 3.30–3.32 t ha^{-1}, sainfoin – 3.39–3,67 and wheatgrass – 3.24–3.44 t ha^{-1}. During the second year of use, the yield of absolutely dry matter of wheatgrass was 2.70–2.71 t ha^{-1}, alfalfa – 2.49–2.63 and sainfoin – 2.73 t ha^{-1}, respectively, the third year of use – 1.86–1.91 t ha^{-1}, 1.67–1.70 and 1.65–1.73 t ha^{-1}, respectively.

Under irrigation, the most productive were grass mixtures of alfalfa (*Medicago x varia* Martyn), *Bromus inermis*, *Dactylis glomerata* L. and *Lolium perenne.* The yield of absolutely dry matter of these grasses and their mixtures, on average for five years was 12.9–14.0 t ha^{-1}, fodder units – 8.9–9.4 t ha^{-1}; digestible protein – 1.9–2.1 t ha^{-1} and metabolic energy – 135.1–146.3 GJ ha^{-1}.

ACKNOWLEDGEMENTS

The research was performed in accordance with the State Research Program №14 of the National Academy of Agrarian Sciences of Ukraine "Feed production" under assignments 13.03-007 "To develop a technology for creating and using pastures on land withdrawn from cultivation and natural forage lands through surface and radical improvement in the conditions of southern Ukraine" (State registration number 0106U006146) and 14.03.03.13.P "To develop adaptive technological methods for creating perennial feed agrophytocenoses in the conditions of rainfall feed production in the Southern steppe of Ukraine" (State registration number 0114U002000).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STUDY ON THE NEW MANAGEMENT STRATEGY FOR AGRICULTURAL FARMS IN ROMANIA, AS A RESULT OF THE ENERGY CRISIS FROM 2021-2022

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Abstract

In Romania, in 2020-2022, a series of events took place which led to the need to rethink and adapt the management of agricultural farms to the new conditions. It is about the health crisis caused by the Covid-19 pandemic, which overlapped with one of the driest agricultural years (2019-2020), but also about the energy crisis, that for agriculture meant the unprecedented price increase for inputs and technologies. Under these conditions, the cost of food has increased from the very first stage of the production process, namely obtaining the raw material. Analyzing the data provided by the Romanian Commodities Exchange, the upward trend in prices starting with January 2020 and lasted until February 2022 can be observed. For the main crops in Romania, namely wheat, corn and sunflower, trading prices increased with 26-73%. At the same time, there are significant increases in inputs, which in turn are caused by higher prices in the energy sector – 443% for natural gas and 194% for electricity. Petroleum products were no exception, with a doubling of the price between the beginning of 2020 and February 2022. All these have led farmers to look for new solutions in order to ensure, at least partially, the necessary fertilizers from natural sources, through crops that are able to bring nitrogen into the soil. Reducing costs per hectare by introducing legumes (especially soy) into crop rotation and merging technological works are only the first proposed solutions, and in the coming years more innovations will be implemented in agricultural management.

Key words**:** *energy crisis, inputs, yields, technologies, agricultural management*

INTRODUCTION

Agricultural production has been and will continue to be dependent on a number of basic inputs, such as soil, labor, capital and technology. Of these, the soil is the most limited resource, because of the anthropogenic activities the fertile areas being constantly decreasing [5].

Despite all the progress made in this domain, there are still many farmers in Romania without technical knowledge, who don't use agricultural management tools and who don't know how to orient themselves to the market [6]. Due to the lack of technologies, most small farmers obtain minimum yields, being on the verge of subsistence [2].

On the other hand, [15] states that in the United States the main raw material of modern agriculture is fossil fuel, the labor force being relatively low. The study highlighted that as fuel prices increase, production costs will automatically increase, noting that a yield of 2.8 kcal of corn per 1 kcal of used fuel may be uneconomical.

Worldwide, in the period 2000-2018, the total index of food prices increased by about 121%, and specifically by 108% for cereals and 72.8% for meat [20].

Incrising food prices have been translated into concerns about food security and food accessibility for a large number of people.

Current statistics show that obtaining agricultural production consumes about 70% of freshwater resources and 25-30% of energy currently available on Earth. All agricultural activities are consuming energy – germination bed preparation, sowing, fertilizing, treatments, harvesting, processing, storage and sale [9].

Finding new ways to optimize the activities carried out in agriculture, to obtain food, has strong implications in the agricultural field and related economic branches, which can lead to reduced costs, increased income and/or increased average yields [21].

With the modernization of industry and agriculture, energy consumption has also increased (Figure 1). This massive technology, based of which record yields were obtained, was considered the best element of sustainable development. Then, against the background of environmental protection, integrated agriculture has improved energy efficiency by reducing energy input without affecting production [11].

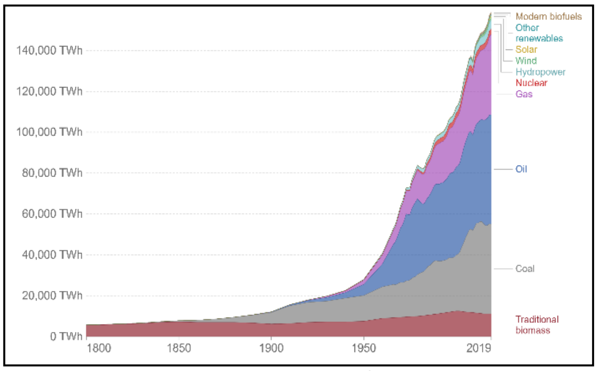

Fig. 1. The evolution over time of energy consumption and the quantities related to each type
Source: [17].

From the point of view of energy consumption, the most demanding activities in the entire food production and distribution system include [8]:

-chemical production of fertilizers and plant protection products;

-production of machinery and equipment necessary for food processing;

-mechanical works in the field;

-transport of products;

-industrial food processing.

It's becoming obvious that agricultural production is sensitive to changes in energy prices, either through direct consumption or through inputs that cannot be eliminated, and here the main category is fertilizers. In addition, measures taken to limit climate change, by taxing emissions, lead to increases in energy prices [19], whether it's about natural gas, electricity or fuel.

On the other hand, the agricultural sector can be a source of renewable energy, such as biomass or biofuels, and by using sustainable energy sources can help reduce the impact on the environment [16].

Where this isn't done, for various reasons, the negative effects of the energy crisis on the well-being of farmers, especially small and medium-sized ones, with limited resources, have already been reported [1, 10, 12, 13].

The four main crops, which account for 70% of world food production, are rice, wheat, corn and soybeans. Of these, rice production requires the most energy, especially through irrigation. At the other end of the spectrum are soybeans and legumes (peas, chickpeas etc.), which have the ability to fix nitrogen directly from the atmosphere, requiring a smaller amount of synthetic fertilizers [4, 18].

The aim of this paper is to present the main sources of energy that are found in nature and that can be accessed through various agricultural practices, especially as the price of conventional energy (fossils) continues to rise, causing food production to involve increasing costs.

MATERIALS AND METHODS

Considering the changes we feel at the economic level, we structured the economic analysis on three of the basic crops in Romania – wheat, corn and sunflower. In line with them, we followed the dynamics of prices for natural gas and electricity. For data collection we accessed the online platforms of the National Institute of Statistics (NIS, Tempo-online database), Romanian Commodity Exchange (BRM) and the National Energy Regulatory Authority (ANRE).

Based on the obtained results, we performed an analysis of the costs involved in agrotechnical works, to see which are the technological links where changes can be made. We also proposed a crop rotation to help the nitrogen fixation into the soil, which would also reduce input costs.

RESULTS AND DISCUSSIONS

The digital era, which began in the 1970s, has logarithmically led to the optimization of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

economic processes, including agriculture. We point out that, now, almost all manufacturers of tractors and agricultural machinery have launched fully electronic tillage, sowing and maintenance equipment. The adjustment of the machines according to their technological parameters (density and depth of sowing, depth of application of fertilizers, doses of fertilizers and pesticides, speed of machines and combines according to the working conditions) is carried out automatically, computerized.

The energy used in the synthesis required by nitrogen fertilizers was represented by oil or gas, i.e. extremely polluting hydrocarbons, especially since they were forced to achieve reaction temperatures above 1,000°C. Soon, the so-called Green Revolution began to show its weaknesses. People had something to eat, but they could no longer breathe and they had no water to drink, as a result of the reaction shown schematically in Figure 2.

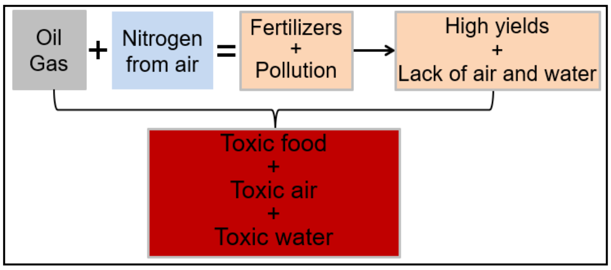

Fig. 2. The consequences of the transition to intensive agriculture – schematic presentation
Source: Original.

This leads to the Jevons Paradox, which states that "the advancement of technology increases the efficiency of the use of a resource, but nevertheless doesn’t decrease the consumption of resources, but increases it" [22].

Taking into account the above, but also the overlap of other events, among which we mention the Covid-19 health pandemic, with all the imposed restrictions and limitations, the extreme drought of the agricultural year 2019-2020, followed by the liberalization of the energy market, started in 2021, but also by the armed conflict on Romania's borders, the rules began to change, and the economy was unbalanced on several fronts. Energy consumption increased significantly in the period 2020-2022, which generated additional costs in many sectors (Table 1).

Analyzing the data in the table, we find that the prices of unprocessed food had non-homogeneous increases, from 26% for maize, to 54% for wheat and 73% for sunflower. It is true that the dynamics of prices was accentuated especially at the end of 2021 and the beginning of 2022. We also note that previously, in the period 2016-2019, although there was an increasing trend, it was insignificant.

On the other hand, the years 2021 and 2022 were marked by unprecedented increases in natural gas (+443.55%) and electricity (+194.14%), all these additional costs will be reflected on the food market in the following months. From an agricultural point of view, the growth will be felt in the summer-autumn of 2022, when the yield of the current year will be marketed and when farmers will have to cover, from sales, the expenses made over the year with the establishment and maintenance of the crop.

Table 1. Average prices in agriculture and energy fields in 2016-2022 and their dynamics

Crop/ Energy	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022***	**2022/ 2020**
	lei/ton							**(%)**
Wheat	640	660	690	730	800	980	1230	153.75
Maize	760	690	730	740	830	920	1050	126.50
Sunflower	1,530	1,380	1,330	1,310	1,520	1,790	2,630	173.03
	lei/MWh							%
Natural gas	82	74	89	102	124	412	674	543.55
Electric energy	423	434	472	468	478	562	1,406	294.14

*average price for January and February 2022
Source: ANRE, BRM, NIS [3, 7, 14].

What can be done about it in the years to come? How can we make sure that the price of wheat, for example, is not going to increase 5 times, in order to keep up with all the other inputs needed to obtain the yield? The answer seems to be as simple as possible, namely to look back at natural models and use them, based on the knowledge we have today.

Specifically, a first step is to comply with the technologies, first by avoiding crop rotations consisting of less than 4 crops, one of which is legumes (soybeans, peas, chickpeas etc.). Already in the regions of Romania with higher rainfall, experienced farmers have begun to grow soybeans on very large areas.

In Figure 3 we present a model of evolution of soil preparation works, starting from classical agriculture to the current one, minimally invasive and, in addition, much more economical.

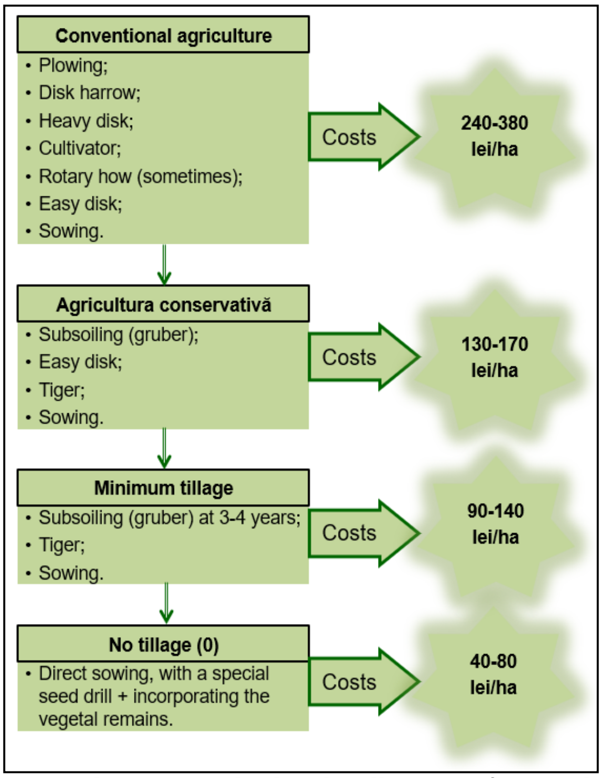

Fig. 3. The costs involved in the tillage specific to each type of agriculture
Source: Own calculation.

Thus, we see how we can save 200-300 lei/ha only by merging the soil works. However, in order to do this, it’s necessary to prepare the soil in advance by incorporating the remains. Permanent ground cover is slowly but surely transforming the ecosystem into its original, natural form of existence, which will no longer require relocation (plowing) and, consequently, the conservation of humus and structure will be achieved naturally, correlated with the biological restoration of the soil.

The second step is concerning plant nutrition, which in the last 50 years has been influenced by chemical syntheses that have provided agriculture with large amounts of nitrogen taken from the air with an unnatural pattern (the Haber-Bosch process), which consumes a lot of energy, in the same time being a pollution generator. The synthesis of nitrogen fertilizers, doubled by the plant protection products (pesticides), has generated tremendous progress in food production, as well as in the demographic dynamics of the world – they have brought a certain food satiety to a good part of the world's population, but not a long-term safety of life.

If we think of a general index of comfort of human society according to the two models of development (natural vs intensive), for agriculture they could look like in Figure 4. It is not justified at all, from a logical point of view and human wisdom, to accept intensive model. Natural development would have led to the partial or even total avoidance of crises and would have ensured the sustainability of society.

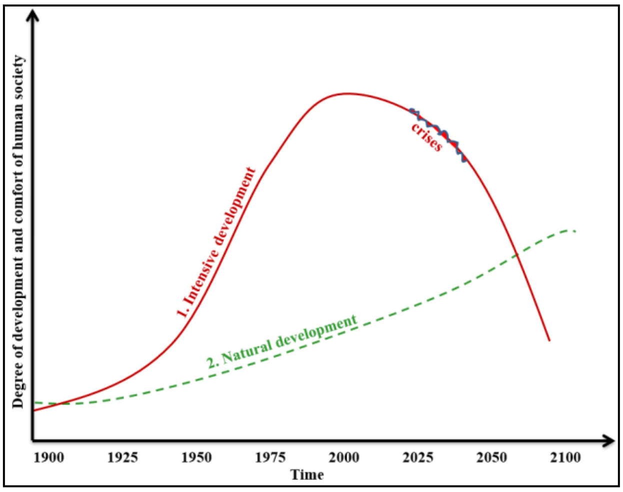

Fig. 4. The effect of agricultural development models on the comfort and well-being of human society
Source: Original.

Microorganisms are those small organisms that populate the Earth's ecosystems, which are extremely industrious and specialized, and which create, through biochemical reactions, products that no human synthetic technology could create. The biological fixation of nitrogen by them is carried out according to very precise natural laws, genetically coordinated, but insufficiently known. The following 4 categories of nitrogen-fixing microorganisms (mainly species of bacteria) live in terrestrial ecosystems and especially in soil (Figure 5).

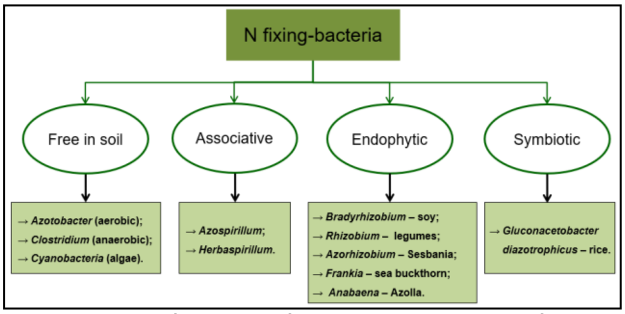

Fig. 5. Classification of the main nitrogen-fixing microorganisms (bacteria)
Source: Original.

The working model of associative bacteria is the following: starting with 4°C in the soil, the bacteria, very present, including in Romania, are close to the root zone. As the temperature rises, so does their hunger. They send chemical enzymatic signals to the plants, requesting food (elaborate photosynthesis products – glucose or glutamate). If there isn't enough nitrogen in the soil, then the plant accepts the collaboration with the bacteria and the association begins to work.

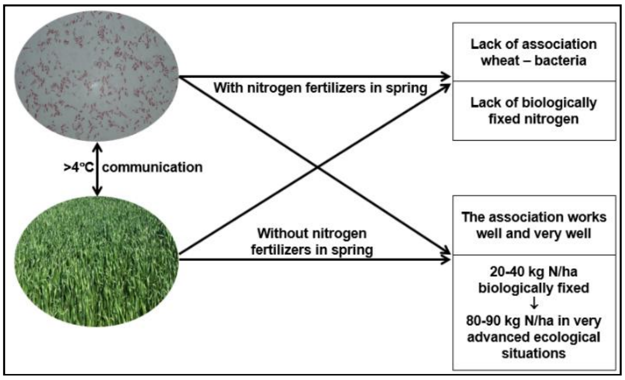

Fig. 6. Diagram of the association between *Azospirillum* and wheat
Source: Original.

The most numerous researches were done on wheat, where the association fixed, on average, 20-40 kg N/ha, with peaks of up to 90 kg N/ha. The application of chemical fertilizers with nitrogen in early spring interrupts the operation of the association, as the plant is an extremely economical system, which doesn't release energy in the form of glucose or glutamate if nitrogen is already in the soil (Figure 6).

CONCLUSIONS

Some of the technological processes currently in use will become impossible in the years to come, amid the impending economic crises. In order to be more cost-effective, but also to be able to achieve consistent long-term agricultural production, the management of the farm will have to take into account some basic criteria, which we can't neglect, although it clearly requires more effort than application of synthesis inputs:

-the most adapted crops for the respective region will be chosen, which will make the best use of the existing natural resources and will not assume the risks of the area (drought in soil and atmosphere, soil specificity, biotic and abiotic factors etc.);

-the crop rotations will not have less than 3 crops and will contain up to 25% breeding plants, such as perennial and annual legumes (alfalfa, clover, other fodder legumes, peas, soybeans, beans, chickpeas);

-maize, sunflower, cereals and oil crops will hold the remaining 75%;

-aggressive soil works (plowing, milling, disc, etc.) will not be allowed, which are high energy consuming – they will be replaced with non-aggressive works, on minimum or 0 tillage;

-green crops, consisting of grasses and legumes, will play a major role in protecting the soil, on the surface and inside it (as green organic fertilizers).

A good soil structure, obtained through reduced tillage, incorporation of straw and green manure, will lead to the elimination of waste of water, energy and other inputs. Thus, when the crop is established, the plants will find in the soil all the necessary conditions for their development in good conditions. Human intervention will be kept to a minimum, as well as the maintenance and fertilization works that will have to be carried out.

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CONSUMERS' PERCEPTIONS OF FOOD SUSTAINABLE DESIGN PACKAGING: A SYSTEMATIC LITERATURE REVIEW

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Abstract

Packaging plays an essential role in ensuring that goods are delivered safely and in good condition to the final consumer within supply chains. Packaging also has many potentials to help with the long-term development of food products. This review paper investigates consumer perceptions and understanding of design food packaging and how design packaging can help the environmental pillar of sustainable development. A literature analysis was conducted using the search strategy in Web of Science as well as other suitable international databases based on their global accessibility and researchers' library access. The result indicates that, from the consumer's standpoint, the essential aspect of sustainable packaging is represented by packing materials, and the packaging design must contain information about recycling actions. Considering the current issues, such as plastic waste and plastic packaging, the consumers believe that sustainable packaging is not as available on the food market as expected.

Key words*: *consumer perceptions, design packaging, food packaging, packaging materials, sustainable packaging

INTRODUCTION

Nowadays, the stakeholders involved in the food industry, from entrepreneurs, corporations, governments, non-profit organizations to the final consumers, grant increasingly more attention to sustainable food packages [18, 7, 65].

In this context, more and more consumers believe they are responsible for making environmentally friendly purchases [43, 3, 53, 47].

On the one hand, sustainability initiatives are being enforced by food companies mainly in response to consumers' needs and demands [38, 40, 57].

On the other hand, consumers' and corporations' focus on sustainability tends to vary. As producers bring on the market food products with sustainable packages, consumers do not show a willingness to purchase and pay for food products that have sustainable packaging and a high degree of recyclability [46, 54].

One of the reasons for this fact is that consumers face several issues, one of which is a deficiency of diagnostic information on the food market, and therefore they do not comprehend the usefulness and the benefit they could have from acquiring food products with sustainable packaging [35, 48, 53, 23].

In the outlined context, the aim of this review paper is to investigate consumer perceptions and understanding of design food packaging and how design packaging can help the environmental pillar of sustainable development.

The next section displays the materials and methods, followed by exhibiting the results and discussions. The paper is completed with the final section containing conclusions, practical implications, limitations, and future research directions.

MATERIALS AND METHODS

This present review aims to determine and analyse consumers' perceptions of food sustainable design packaging. In fulfilling this purpose, a search strategy, also reported by [10, 17, 15] was employed.

The period examined in this review was 2007-2021.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

A thorough and systematic search of the literature using specific keywords (Figure 1) was performed. In order to obtain results from a range of disciplinary study areas, the most relevant databases were employed. The 49 reviewed papers (Appendix) belong to the following databases: Web of Science, Scopus, Science Direct.

After the studies had been analysed and interpreted, the authors set up three identified directions based on the paper's reported results: how sustainability influences consumers' packaging commitment; associations between age, education, willingness to pay, and the recognized value of sustainable packaging, as well as the impact of COVID-19 on the consumer perceptions regarding food packages.

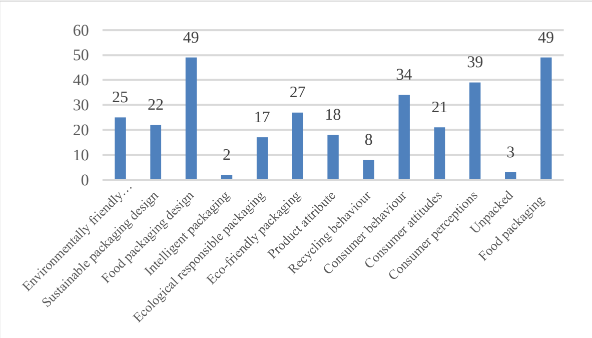

Fig. 1. Keywords and number of reviewed studies containing them
Source: Own development.

The distribution by year of the reviewed literature is illustrated below (Figure 2).

The lack of publications before 2013 indicates that consumer' perceptions of food sustainable design packaging was not a prevalent research issue.

Nevertheless, there is registered significant growth in publications after 2013, implying an increasing interest in this topic.

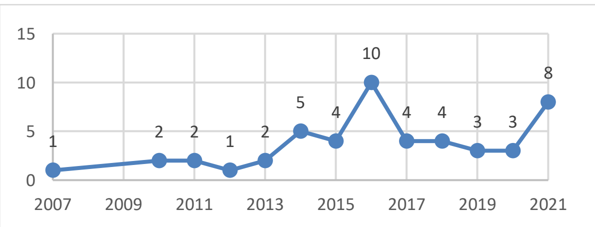

Fig. 2. The reviewed literature distributed by year
Source: Own development.

The publication journals of the revised articles can be viewed below (Figure 3). The numeral in Figure 3 indicate the number of articles that have been published in each of the journals mentioned in the figure. Articles following aspects regarding consumers' perceptions of food sustainable design packaging have been published in numerous journals, from different domains, like marketing, environment, sustainability, food quality, recycling behaviours. This aspect implies a widespread interest and a priority in investigating consumer perceptions regarding sustainable food packaging.

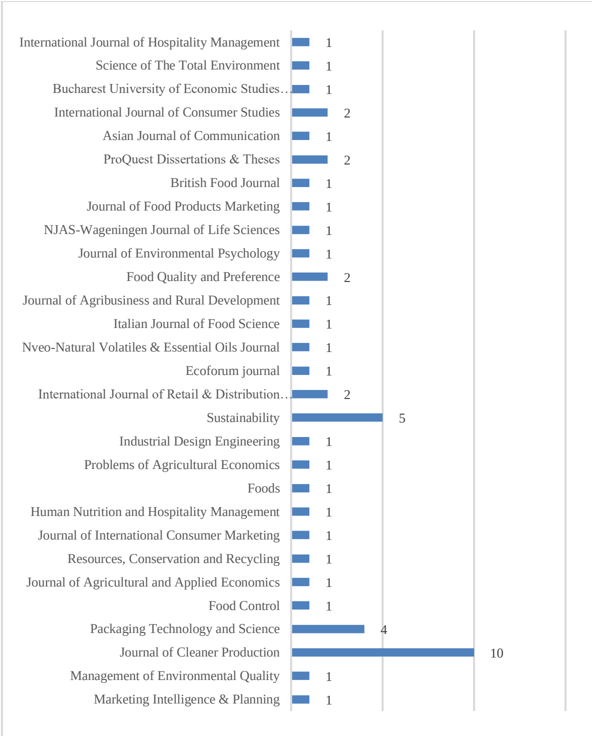

Fig. 3. The journals of publication of the reviewed literature
Source: Own development.

Seventeen articles focus on how sustainability influences consumers' packaging commitment regarding food waste, package sorting, and recycling.

Twenty-eight papers study the acknowledged value of sustainable packaging, and four articles highlight the impact of COVID-19 on consumer perceptions regarding food packages.

RESULTS AND DISCUSSIONS

How does sustainability influences consumers' food packaging commitment regarding food waste, sorting and recycling?

The figure below (Figure 4) illustrates the distribution of the revised literature according to the incentives to which consumers were exposed to. The most investigated topic was sustainable packaging (bio-based and biodegradable). They have also investigated the attitudes and commitment of consumers in terms of environmentally friendly packaging, recycling behaviour, and the intention of consumers to buy food products with little or no packaging at all.

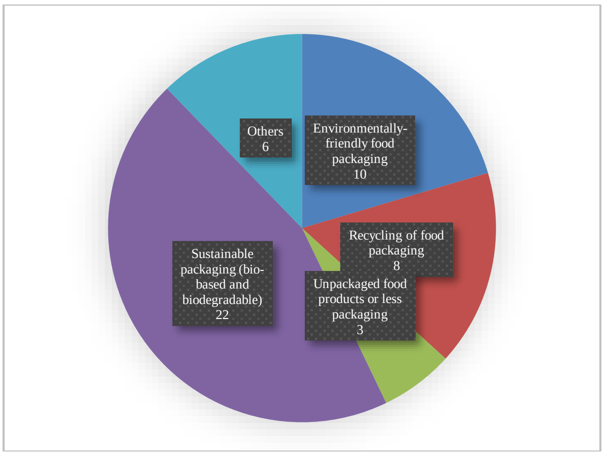

Fig. 4. The consumer incentives content
Source: Own development.

At the level of food packaging, there is an evolution towards more sustainable and healthier packaging. In this context, the implications of the design of food packages are examined and their role in the recycling measures completed by the final consumers. [25, 26, 4, 41].

Also, the role of the shape of food packages is examined in specialized literature [8, 30, 64, 2, 6].

Therefore, [6] extrapolate consumers' belief regarding the need for focused approaches targeting food packaging. This particular aspect will lead to the diminution of food waste at household level.

Consumers maintain an essential part in the market insight of sustainable food packaging given that the decision-making role on the purchase of food products is mainly at the level of final consumers. [62, 44].

Simultaneously, consumers require guidance in recognizing sustainable packaging [16, 34]. Although they mostly assume the materials themselves, recycling symbols, and certain eco-certification, they also believe that other packaging elements, such as colors and images, can be misleading [28, 11, 49, 55, 56, 53, 23].

When it comes to purchasing food with sustainable packaging, consumers face various barriers, such as misperception of quality, lack of availability of products with sustainable packaging, and sometimes too high prices [32, 33, 59, 44].

Contrary to this findings, other studies [61, 1, 22, 13, 56, 48] identify that final consumers understand the consequences of packaging production and the non-recycling aspect on the environment. Nevertheless, consumers lack information when it comes to how to reuse food packaging or how recyclable it is [1, 39].

In a study led by [21], young consumers' viewpoints on sustainable packaging are related to issues such as recyclability, while other significant considerations include safety for human health and reuse of recycled materials.

Associations between age, education, willingness to pay, and the recognized value of sustainable packaging

When we consider how consumers can recall sustainable food packaging, labels, logos, and the type of packaging material, it is clear that these are the most important features in identifying and buying food products with sustainable packaging.

In contrast to the findings which report that a large proportion of final consumers succeed relatively well in identifying sustainable food packaging [50, 32, 31, 5, 42], an investigation led in Italy by [35] discovered that those consumers with an average level of education find it very difficult to perceive the symbolism of the various elements of sustainable food packaging design, such as logos or symbols.

[19] pinpoint disparities between the participants' insights in the United States of America (USA), Germany and France.

Consumers with different education and income levels were invited to mention aspects that make packaging more sustainable. Opinions were divided: German consumers were focused more on those characteristics from the beginning of the production process, such as the raw material. Consumers participating in the study in the USA and France are mainly concerned about those attributes at the end of the production process, such as reuse, recycling, and biodegradability). In a similar qualitative study performed in five countries from Europe, it is apparent that participating consumers have different views on sustainable food packaging. On the one hand, those consumers who are aware of the importance of sustainability and have positive feelings about this issue also show a higher willingness to pay for sustainable and intelligent packaging [27, 20].

On the other hand, consumers who do not consider sustainability a key issue or do not have extensive knowledge about it consider this situation an advantage that marketers use in promotion [52].

For instance, a study conducted by [51] in South Korea highlights how sustainable food packaging and natural food ingredients influence consumers' availability of payment. Conclusions relate to the fact that consumers are willing to pay a higher amount for sustainable food packaging. Following the same direction, a study conducted by [25] in the USA, explored how consumers are willing to pay and buy food with recycled packaging. The authors found that participants demonstrated an increased willingness to pay when it comes to recycled materials (glass or plastic) [25].

These aspects are also revealed in the investigation led by [12], where consumers state that they are willing to purchase food products with sustainable packaging and easy recyclable packages, like glass, aluminium, and paper.

[58] conclude that adult Indian consumers are concerned about the influence of packaging on the environment and therefore tend to choose sustainable food packaging. Going in the same direction, [22] identifies those consumers who, with a caring attitude towards the environment, declare that they avoid purchasing food products that have packaging made of materials such as paper or plastic. Other results cast a new light on the age of consumers in terms of preference for sustainable food packaging.

[29 and 63] reveals that age is a factor that determines the preference of food with recycled packaging. Thus, consumers of the second and third ages are identified as those who purchase food with recycled packaging.

In a study conducted by [25], the age of consumers is also the determining factor influencing the availability of payment for recycled packaging. Regarding consumers' gender, [22] found that when it comes to recycling and degradation of packaging in the environment, women in this study are more concerned than men. As such, they express their preference for sustainable packaging that does not have as much impact on the environment when compared to standard food packaging. [45] concludes that women are more worried about the environment and therefore buy food with sustainable packages. Conversely, [37 and 66] found that environmental matters directly related to food products packaging stand more significant for men than women.

The impact of the pandemic caused by COVID-19 on consumer perceptions regarding food packages

Literature regarding the impact of the current pandemic caused by COVID-19 on consumer' perceptions of food packaging is making an appearance. These perceptions were affected during the COVID-19 pandemic. Food packaging impacts consumer perceptions caused by new food security concerns throughout the pandemic [24]. According to the Global Buying Green Report (2021) [14] when questioned about their perceptions and attitudes of sustainable packaging, almost one in three consumers from South America, USA and Europe said that COVID-19 led them to increase the importance of sustainable packaging. These results are in line with the fact that food security and hygiene have become extremely important for many consumers during 2020. However, it is anticipated that apprehensions about environmentally friendly packages and the use of more sustainable packaging will be a priority for the post-pandemic society [36]. A study performed in the USA by [9] reveals that more than a half of the participants perceive food packaging in restaurants as a source of contracting COVID-19 and live more worried about the infection with COVID-19 from restaurant food than from supermarket food products. A recent study on consumer perceptions of food packaging during the pandemic shows that customers are more careful about food safety and have become more conscious of sustainable packaging when buying food [24]. There is also a need to reduce the production of plastic food packaging and promote sustainable technologies for the management and recycling of plastics [60], along with the desire of consumers to pay for biodegradable alternatives; thus, these two factors can constitute a potential for innovation in the food packaging sector [42].

CONCLUSIONS

Our results demonstrate a significant barrier when it comes to sustainable packaging. The main aspects of these barriers resend in its price, availability, and the perceived quality of sustainable packaging versus standard packaging. This isn't the only significant barrier these types of packaging encounter, as there is another. This is the lack of supermarkets advertising. Supermarkets have shortcomings in promoting sustainable packaging that could help the current situation of worldwide waste by reducing food waste and creating better packaging that offers an easy and economical way to recycle the packaging materials.

It is believed that an element that should be present on all the food packaging is the symbol or icon that illustrates the package recycling level. As many companies have stringent brand guidelines such as colours, font, and illustrations, recycling symbols should be highlighted. The colour factor isn't relevant when speaking about packaging recycling because many people have visual disabilities, which prevents them from correctly identifying the colours.

Our findings show mixed feelings between consumers' responses worldwide and between genders.

The feminine gender and the people with more positive feelings towards the environment have a more frequent intention in purchasing products with sustainable packaging.

The discrepancy between the results of the studies is given by the lack of advertising of products with sustainable packaging.

As these results show, starting with 2020, the year that COVID-19 led to a global crisis, hygiene has become the main objective when speaking about food security and consumption.

The COVID-19 psychological impact on the consumers led to new concerns about food security. During COVID-19, product packaging has become one of the most important factors when purchasing food products.

The pandemic leads consumers to rethink the importance of sustainable packaging and to choose safer and healthier alternatives.

Furthermore, there is an urgent need for information campaigns to educate the consumers about the implications of their purchase decision regarding their packaging choice and its impact on the environment.

Our review does have certain limitations. The search approach may have overlooked relevant data, which could affect our conclusions to a specific degree.

The impact of the pandemic caused by the new COVID-19 on consumer' behaviour towards sustainable food packaging is a topic of novelty in the literature.

Because of this, a complete picture of how final consumers relate to sustainable packaging in a pandemic context could not be presented.

For this reason, it is believed that additional studies are needed to capture and study consumer insights regarding sustainable food packaging under the influence of the pandemic context.

ACKNOWLEDGEMENTS

This work has no external funding.

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Appendix

Title	Journal name	Year
Consumers' willingness to pay for ethical attributes	Marketing Intelligence & Planning	2014
The role of labels in directing consumer packaging waste	Management of Environmental Quality: an international journal	2010
Reasons for household food waste with special attention to packaging	Journal of Cleaner Production	2012
Attributes of packaging and influences on waste	Packaging Technology and Science	2011
Perceived barriers to food packaging recycling: Evidence from a choice experiment of US consumers	Food Control	2017
Consumer preference for alternative milk packaging: The case of an inferred environmental attribute	Journal of Agricultural and Applied Economics	2016
Consumer preferences and demand for packaging material and recyclability	Resources, Conservation and Recycling	2016
How consumers react to environmental information: an experimental study	Journal of International Consumer Marketing	2017
Consumer Perceptions of Plastic-Free Food Packaging	Human Nutrition and Hospitality Management	2021
The influence of packaging attributes on consumer behaviour in food-packaging life cycle assessment studies-a neglected topic	Journal of Cleaner Production	2014
Sustainable paper-based packaging: A consumer's perspective	Foods	2021
Social aspect of sustainable packaging	Packaging Technology and Science	2010
The role of packaging in fighting food waste: A systematised review of consumer perceptions of packaging	Journal of Cleaner Production	2021
Consumer perception of active intelligent food packaging	Problems of Agricultural Economics	2016
The influence of packaging design features on consumers' purchasing & recycling behaviour	Industrial Design Engineering	2018
The role of food packaging design in consumer recycling behavior—A literature review	Sustainability	2019
Consumer considerations for the implementation of sustainable packaging: A review	Sustainability	2020
Framework for sustainable food packaging design	Packaging Technology and Science	2013
The importance of packaging design for own-label food brands	International Journal of Retail & Distribution Management	2007
The role and impact of the packaging effect on consumer buying behaviour	Ecoforum journal	2015
Sustainable Packaging: A Study on Consumer Perception on Sustainable Packaging Options in E-Commerce Industry	Nveo-Natural Volatiles & Essential Oils Journal	2021
Role and function of food packaging: What consumers prefer	Italian Journal of Food Science	2011
Consumers' behaviours related to packaging and their attitudes towards environment	Journal of Agribusiness and Rural Development	2015
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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC EFFICIENCY OF THE TABLE GRAPES SECTOR

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Abstract

The paper addresses the concept of economic development and efficiency which is most comprehensively expressed in an economic activity, evaluated in terms of resources consumed to carry out these activities. Viticulture has a well-defined place in the agricultural economy and national economy, the importance of which can be appreciated from several points of view. Currently, in the Republic of Moldova are planted approximately 126 thousand ha of vineyards, of which 18.9 thousand ha are planted with table varieties. Viticulture is an intensive sector in agriculture characterized by a high coefficient of land use. It has been calculated that the economic efficiency of viticulture is 10 times higher than that of field crops. The value of production obtained from one hectare, cultivated with vines is equivalent to 7 ha of cereal crops. The research was conducted based on data provided by the National Bureau of Statistics through methods of analysis, synthesis, tabulation and graphics.

Key words: *economic efficiency, viticulture, vineyards, table grapes*

INTRODUCTION

In agriculture, including *viticulture*, economic efficiency expresses the degree of use of the main factors, which are: intensification of production, improved use of investment, production funds, land, labor resources, perfecting of the planning, of the stimulation of methods, new forms of work organization. [5, 10, 17, 22, 23].

Due to the fact that in agriculture the land is the main means of production, which fulfills a dual function, means of labor and object of labor, it is one of the main terms for reporting indicators of economic efficiency. From this point of view, the economic efficiency of the production activity in agriculture presents an economic category that expresses the characteristic of producing maximum economic effects, with optimal living and materialized labor costs [9, 20].

The essence of the efficiency of agricultural production consists in the formation of a complex of requirements and conditions necessary for the enlarged reproduction, in the conditions of the competitive economy, which will allow the branch not only to satisfy the food needs of society but also to develop in harmony and to ensure the sustainable development of agriculture [21].

Following the analysis, we can conclude that economic efficiency is a complex economic category that most comprehensively expresses the results obtained in an economic activity, evaluated in terms of resources consumed to carry out an activity. Efficiency is that element, which allows the economic unit to obtain as much material goods and services as possible from land, labor, technical and material resources [23].

Table grape viticulture is a branch of the agro-industrial complex, which has a high adaptability to environmental conditions, relatively simple care and increased economic efficiency, etc. This is due to the centuries-old experience of winegrowers in several countries, such as Italy, France, Spain, Germany, and especially the rapid development of viticulture in recent times in the USA, China, South Africa, Latin America, Australia, etc.

Because table grapes, having curative-therapeutic qualities, through their ability to remove heavy metals from the human body, they are welcome to exist in human nutrition all year round. Producers have seen the need to extend the period of consumption of fresh grapes, which can be ensured in two ways: by cultivating varieties with a mid late or late maturation period, and by adjusting agrotechnical processes and cultivation and storage technologies of the table grapes.

Table grape varieties are distinguished by different characteristics (aroma, color, shape / size of the grain and the maturation period), which allows the organization of plantations in the conveyor [6].

Because the maturation of table grape varieties is done in stages, in this way consumers have access to fresh production for a longer period of about 3-4 months. At the same time, the delivery of table grape production can be done over a longer period of time and involves a more balanced staggering of revenues. Depending on the market demand for table grapes, the cultivation of grapes differs and is profitable, and largely depends on several factors, such as: maturation period; grape quality; the cost of the products.

Market demand and increased efficacy in the cultivation of table grape varieties are given much less attention compared to the cultivation of wine varieties. This state is observed in many countries of the world, including the Republic of Moldova. This phenomenon is explained through the economic interest of which potential producers are still unaware, as well as the difficulties dictated by the specifics of the technology of cultivation of table varieties - more manual work care, harvesting, sorting, transporting, storage and commercialization of grapes [16].

The development of the cultivation of table grape varieties at the level of current and future requirements cannot be conceived without knowing their agrobiological and productive potential and how they react to different climatic factors and agrotechnical procedures (driving system, cutting length, grapevine trunk load, green operations, etc.). Therefore, the study of existing and new local varieties is a current issue [6, 9].

The productivity of the vineyards and the sustainability of their exploitation depend on the biological value of the planting material, on the correctness of the establishment of the plantation and on the level of care in the first 3-4 years after planting. According to the Government Decision no. 418 of July 9, 2009 (2) [8], the establishment of viticultural plantations is carried out with the devirusated viticultural planting material of authorized biological category and not only of the "standard" category under the conditions of the Vine and Wine Law no. 57-XVII of March 10, 2006 (Article 8, paragraph 3) [12].

MATERIALS AND METHODS

In order to analyze the evolution of the viticultural sector and, namely of the table grape sector, the following indicators were used, such as the total area of vines (ha), the area of vines of table grapes (ha), the global harvest and average grape harvest (tonnes), export of table grapes (tonnes). At the same time, the technological data sheets for growing table grapes and input prices were analyzed. The period analyzed in this article was the years 2010 - 2019. The data collected from the National Bureau of Statistics, the Ministry of Agriculture and Regional Development and other institutions, were processed and interpreted statistically, building the trend line. At the same time, the necessary investments were determined for the vines from planting to fruiting. Were determined the profitability of the viticultural sector, namely for table grapes, the investment payback period.

The following research methods were applied in the scientific research process: the comparison method, the table method and the graphical presentation of the studied phenomena, the average size method, the relative size method, etc.

RESULTS AND DISCUSSIONS

The vitivinicultural sector is and will remain an important one, where viticulture accounts for 3% of the country's GDP, but also that this branch represents 7% of total exports. High quality grapes and wine are the business card of our country, internationally recognized. The vitivinicultural industry in the Republic of Moldova is one of the main branches of the country's economy, being an important source of income for the state budget. At the same time, the vitivinicultural sector in the country remains a job creator in rural areas, and the number of economic agents working in this field and registered in the Vitivinicultural Register has reached 39,182, which includes natural persons, peasant farms, limited liability companies, joint stock companies, agricultural cooperatives.

The viticultural heritage in 2019 (in all categories of households) amounted to 126 thousand ha. The share of viticultural plantations on fruit varies between 92-95%. Wine varieties account for 80% [18].

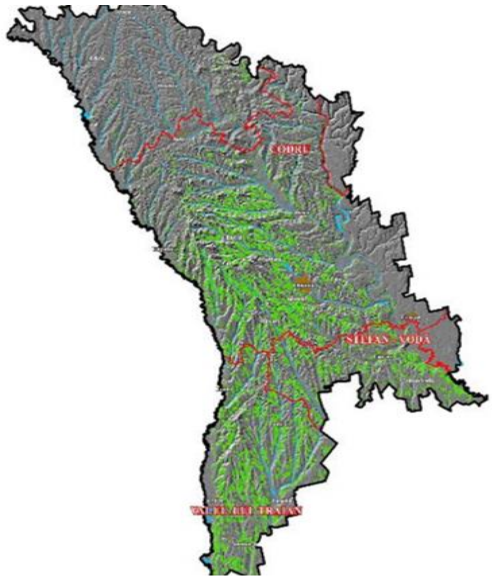

Fig. 1. Map of Vitivinicultural sector in Republic of Moldova
Source: Google search [7].

In 2019, the total area of vines in Moldova was 126,000 ha, of which the surface of table grape varieties accounted for 18,900 ha, representing 15%.

The total grape harvest accounted for 659 thousand tonnes, of which table grapes 120 thousand tonnes, that is 18.2%.

The area registered in VVR was 34,000 ha (+ 13%), and the area of technical varieties 70,200 ha.

The vineyards with table grapes, in the last years, register a stability constituting on average 19.5 thousand ha. The share of vineyards for the table in total vineyards in 2019 was 15%. In recent years, there has been a slowdown in vine planting, but this trend does not apply to table grape plantations.

This is conditioned by the high demand for table grape consumption in regional markets. At the same time, it was due to the support policy of the state, in terms of support for both planting and post-harvest infrastructure.

In 2019, according to the data of the National Bureau of Statistics, the area of vineyards of mass varieties is about 19 thousand ha.

In the Register of Plant Varieties of the Republic of Moldova are registered 73 table grape varieties. The share of table grape production in the total grape harvest is 17%.

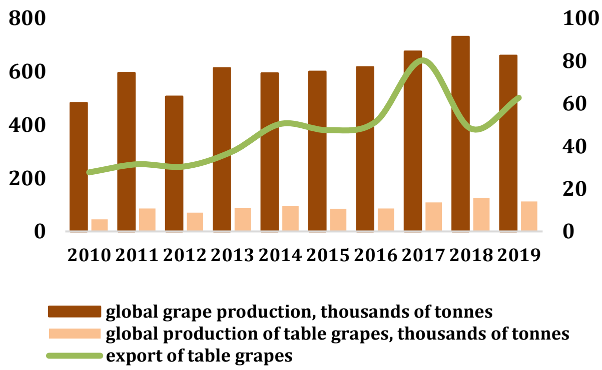

Fig. 2 Evolution of indicators for assessing the economic growth of the vitivinicultural sector in the Republic of Moldova (in all types of households)
Source: National Bureau of Statistics [15].

The conducted research and the data analysis indicate that, on average, in dynamics, in the period of the years 2010-2019, the harvest of table grapes is increasing by 5.6%. The total quantity of grape production was relatively stable, remaining at a level of about 600 thousand tonnes per year, and the production of table grapes increased from 66.3 thousand tonnes in 2010 to 120 thousand tonnes in 2019.

In the Republic of Moldova, the global production of table grapes is 120 thousand tonnes with an average productivity of 5 t / ha of table grapes and exports about 60% of them.

Our country has begun to make progress in the export of table grapes, which are now in demand in over 30 countries around the world. Exports of table grapes are growing steadily to the EU, accounting for 30% of the volume.

The export of table grapes has doubled from 27.7 thousand tonnes in 2010 to 62.7 thousand tonnes in 2019. The Russian Federation has the largest share in total grape exports, namely about 41%, Ukraine has a share of 12.4%.

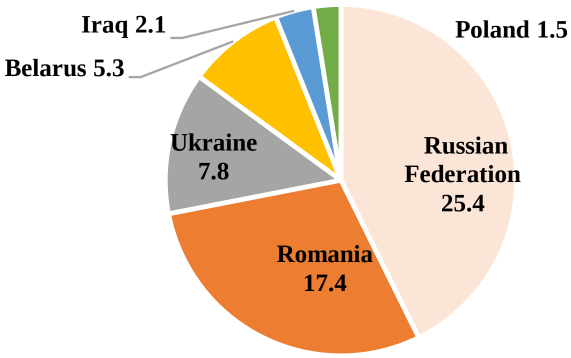

Fig. 3. The main destinations of table grapes, thousands of tonnes
Source: East Fruit, 2020, [4].

Within the EU, the main market is Romania, where approx. 17.4 thousand tonnes were exported or about 28% of the total volume, followed by Poland with a share of 2.4% of the total volume, Latvia.

Other table grape importing countries include Iraq and Belarus. Exports of table grapes to both EU and CIS markets are growing.

In order to maintain this positive trend and the stability of export deliveries, it is important to continue to diversify markets and develop the efficiency of the table grape sector. And this is explained by the increased interest in quality production.

Producers and exporters of table grapes must constantly diversify their markets in order to be able to identify the markets with the best prices and minimize the risks in international trade [19].

According to *East-Fruit* estimates and data from *statistica.com*, in terms of the world's largest exporters of table grapes, worldwide, the Republic of Moldova ranks 15th, by the volume of fresh grapes exported.

At the same time, according to the volume exported per capita, the Republic of Moldova is included in the TOP 3 world exporters of table grapes (East-Fruit, 2020) [4, 13].

In addition to this, the Republic of Moldova offers the most competitive prices from the top 25 exporters in the world, reaching to the control of 15% of the Russian table grape market.

Moreover, in recent years there have been significant successes in EU markets. Table grapes have even reached the market in the USA, Croatia, Great Britain.

In 2019, according to *World's Top Exports*, the Republic of Moldova, according to the value of grape exports (dollars), ranked 19th place. The value of exported grapes amounted to 48.2 million US dollars [14, 24].

Following the analysis of the structure of vineyards that are fruiting and the production obtained, we notice that the highest share belongs to the Southern Development Region - more than 47%, followed by ATU Gagauzia (24%), Center (23%), Chisinau municipality (6%), and in the northern region there are no climatic conditions regarding the cultivation of vineyards.

This is explained by the fact that in this area (South development region), table grapes are able to mature well and obtain better organoleptic qualities. In the case of table varieties, a high quality crop is obtained on well-heated terrains, with fertile and light soils, well aerated, with a high content of humus and nitrogen.

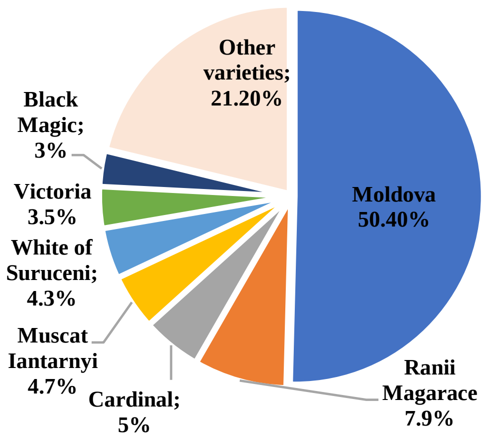

Fig. 4. The most widespread varieties cultivated in the Republic of Moldova
Source: Table grapes marketing a vital need for market development and guaranteed access [19].

The trends of recent years are characterized by the establishment of vineyards with table varieties, which could be competitive in European markets.

Although the list of table varieties is quite varied, the assortment structure of the existing plantations is substantially unbalanced in favor of the *Moldova variety*, elaborated by Moldovan scientists over 30 years ago.

It is this that has largely contributed to the reputation of the Republic of Moldova abroad. *The Moldova variety*, taken as a whole by republic, occupies more than 50% and has 85% of all the structures of the variety in the country.

Also, it is a new oppotunity for organic viticulture in Moldova [1, 3].

An important factor in the production of table grapes are the refrigerated spaces, which allow the storage of grapes. For example, we can keep *Moldova variety grapes* for up to 180 days. The technologies that are already implemented and the experience that Moldovan farmers have gives the possibility to keep the grapes harvested from September-October for a period of 6 months, at the same time their commercialization lasts an even longer period, because in the cold period of the year grapes have a high demand and enjoy advantageous prices.

In 2020, the market prices of table grapes are 10-15% higher compared to the same period of the previous year. This is due to the smaller grape harvest, following the spring calamities, but also to the summer drought, this year. Table grapes are sold in all markets in the Republic of Moldova, and the highest value of the average selling price was recorded in the central and northern areas of the country. The average price of a kilogram of white table grapes varies between 6-12 lei, and red table grapes sell for 10-13 lei / kg.

This business is considered profitable, even if we consider the increase in costs and lower yields due to factors such as: climatic conditions, varieties, applied technologies, grape quality, etc.

Establishment of plantations. When setting up vineyards that are oriented towards the production of table grapes, it is necessary to plant a wide range of varieties with a different ripening period. The productivity of the vineyards and the sustainability of their exploitation depend on the biological value of the planting material, on the correctness of the establishment of the plantation and on the level of care in the first 3-4 years after planting. When planting vines, planting material from highly productive virus-free clones is used.

In our case, for the establishment of the vineyard with table grapes and its care until fruiting (first 4 years) with a plantation area of 10 ha, are required capital investments in the amount of about 1.8 million lei (Table 1) [11]. The budget for the investments in the care of the vines until full fruiting (first 4 years), the investments are indicated (for each year) and are taken into consideration both the number and the market prices of the planting material necessary for the establishment and for the filling of post-planting gaps, as well as the costs (obviously in the form of market prices) of mineral or (where applicable) organic fertilizers, agricultural machinery, the composition and cost of plantation planting and care work during the period until fruiting etc., were carried out according to the indications from the Cost tariffs in agriculture [2].

Table 1. Investments for planting and care of vines 10 ha (thousand lei)

Cost items	**Planting / 1 year of vegetation**	**Year II / total cost, lei**	**Year III / total cost, lei**	**Year IV / total cost, lei**
Total material consumption	908,975	438,950.10	24,284.10	67,679.50
Total cost of mechanized operations	28,108	37,428.50	36,386.00	52,144.20
Total cost of manual operations, lei	10,887.3	5,095.94	8,485.54	8,536.74
c. Constant consumption: Duties and taxes	*	1,060.00	1,060.00	1,060.00
d. Direct consumption - total, lei	947,970.3	482,534.54	70,215.64	129,420.44
e. Indirect costs, lei	*	96,506.91	14,043.13	25,884.09
f. Total maintenance costs, lei	947,970.3	579,041.45	84,258.77	155,304.53

Source: Iațișin T. Timofti E., 2021, [11].

The optimal term of exploitation of the vineyards is conditioned by several variables, including, varieties, conditions of exploitation of the vineyards, soil quality. In most cases, this period is 15-20 years. The budget for the cultivation of table grapes (year V of vegetation, year I of harvest), constituted 419,374.2 lei (Table 2).

Table 2. Table grape growing budget (year V of vegetation, year I of harvest), calculation per 10 ha

Cost itesm	*Year V*	
	harvest of 9 t / ha	
	Units per 10 ha	Total cost yearly, lei
Net sales, lei	x	720,000
Table grapes, 8 lei / kg	90,000	720,000
Total material costs		59,853.40
Total cost of mechanized operations		55,337.63
Total cost of manual operations		15,533.09
C. Constant consumption		119,797.42
D. Direct costs - total, lei		250,521.54
E. Indirect costs, lei		50,104.31
F. Total maintenance costs, lei		300,625.85
F. Total net income, lei		419,374.15

Source: Iațișin T. Timofti E., 2021, [11].

According to Table 2, the average harvest of table grapes per hectare was 9 tonnes, the average selling price of grape production directly from the field being 8 lei/kg. According to the present calculations, we notice that the sum of sales revenues is about 720,000 lei and the total maintenance cost of the 10 ha vineyard is 300,625.85 lei. Following the calculations performed, *the annual profit obtained* from a vineyard of 10 ha *can reach a value* of 419,374.15 lei.
Important from the point of view of economic analysis for any capital investment, is the indicator the term of the investment return. The amount of investment required for the planting of 10 hectares of vineyards with table varieties and its maintenance for a period of 4 years until fruiting is 1,766,575 lei.
Based on the total amount of investments and the planned annual level of net profit, the term of their recovery will be 4.2 years (from the beginning of fruiting or 8 years after planting the vineyard) for the entrepreneur, which is of practical interest for diversification of activities and income in rural areas.

Table 3. Main indicators, viticultural sector, table grapes

		1 ha
1	Total investments, lei	176,657.5
2	Production costs, lei	30,062.6
3	Harvest, tonnes / ha	9
4	Unit cost, per tonne, lei	3,340.28
5	Unit price, per tonne, lei	8,000
6	Net sales, lei	72,000
7	Gross income, lei	41,937.4
8	Return on investment, years	4.2

Source: Iațișin T. Timofti E., 2021, [11].

The quality of a product, from an economic point of view, is conditioned by the costs related to the qualitative side of satisfying the needs of the consumers, by the degree of utility of the consumption value, etc. The economic aspect of quality as a category reflects the need to record costs not only in the production process, but also in the sphere of consumption (processing, exploitation).

CONCLUSIONS

The vitivinicultural sector is and will remain an important one, demonstrated by the fact that viticulture accounts for 3% of the country's GDP, but also that this branch represents 7% of total exports. High quality grapes and wine are the business card of our country, internationally recognized.
The comparative approach of some indicators of the level of development and economic growth of the vitivinicultural sector allows us to find that the performance of the sector in the Republic of Moldova, in dynamics, in the years 2010-2018, registered an average annual growth of 6.2% - productivity of the vineyard on fruit; 8.4% - table grape harvest; 7.1% - export of table grapes;
The highest pressure, in terms of costs, is attested during the establishment of the vineyard (year I-IV). Only for the planting of vines on an area of 10 ha, the costs represent 947,970.3 lei, so that, subsequently, until year V (the first year of harvest), the total value of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

the expenses will reach the amount of 1,766,575 lei. Thus, the future entrepreneur, who has decided to start a business in the given sphere, must be sure that he owns or can obtain the *necessary investments.*

In order to maintain the performance of the sector, it is recommended that entrepreneurs growing table grapes do the following:

-set up plantations with competitive varieties;

-making investments in processing infrastructure and post-harvest operations by creating refrigerated warehouses, thus creating conditions for the sale of grapes in the cold period and obtaining an advantageous price;

-specialization of table grape producers in this crop;

-application and use of specialized technologies for the production of table grapes;

-the use of fertilizers (mineral fertilizers and microelements for foliar fertilization), which contribute considerably to increasing the harvest and quality of grapes; the traceability of grapes and the strict record of phytosanitary preparations and fertilizers (correct record in the Register of Evidence);

-the association of farmers producing table grapes in associations in order to promote / defend their interests and their cooperation for the commercialization of grapes under more advantageous conditions.

The creation of an efficient and competitive vitivinicultural sector in the Republic of Moldova involves the support of economic agents in this sector through various *economic and financial instruments and levers.*

ACKNOWLEDGEMENTS

The research woek was elaborated within the State Program *"Elaboration of new economic instruments for evaluation and stimulation of competitiveness of agriculture of the Republic of Moldova for the years 2020 - 2023"* (chifer - 20.80009.0807.16).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

NEW DIMENSIONS OF RURAL COMMUNITIES' DEVELOPMENT IN ROMANIA – SMART VILLAGE CONCEPT

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Abstract

Preserving the rural identity by establishing communities that develop through intelligent use of local resources and technology, represent new challenges regarding the increase of the living standard in the rural environment. The development of smart villages supposes, first, economic and social development with a direct impact on the quality of life of the members of the rural community as well as on their expectations in relationship to the actions of the public authorities. In this sense, the ability to meet social, educational, economic and environmental challenges, using the strengths and opportunities of a community, but also the involvement of local authorities, are an integral part of the new concept of Smart Villages. Current paper concentrates on defining this novel concept for the Romanian rural area and highlights the implications of its implementation and oversees the structural availability of resources required for optimal fit. The applicability of the concept results from the fund absorption analysis and its implementation is structured in a multi-stage action proposal. Using the financial performance of past projects through various measures to observe the historical trends and indicate future opportunities and introducing the applicable plan as the main research methods, the smart village emergence in rural Romania could directly impact socio-economic development. As the main results present, the ICT infrastructure is tuned in and ready to support various encouraging projects therefore, the Romanian digital rural society is becoming closer to reality. For the Romanian rural communities to be compliant with the international standards, the smart village approach represents a viable action plan.

Key words*: *smart village, rural development, Local Action Group, sustainability, digitalization, EU funds

INTRODUCTION

This specific term was primarily introduced by the European Commission as part of the novel rural development policy through the EU Action for Smart Villages [7] that is focusing on connecting rural Europe, amplifying the existing strengths, assets and opportunities of rural areas and communities. This concept is not pushing a unique general solution that fits all communities but rather one that is socio-geo-economically sensitive based on existing requirements and potentials of a specific territorial strategy [5].

Can the LEADER approach continue to create the conditions for smart and higher investment in rural development programs - NRDPs, cohesion funds or at national public and private level?

Sustainable rural development is the general consideration when it is discussed about development policies at national and European level, emphasizing more often that the recognition of the multiple functions of agriculture in today's society, as well as the vital function of rural space, which guarantees the existence and efficiency of agriculture. In the appreciation of the factors of decision at the EU level, the Romanian villages and communes need revitalization and development through new economic and social flows.

Today's society is undergoing unprecedented changes, both socially, culturally and technologically, which can lead to a redefinition of relationships between people, new technologies, science and creativity.

Communities that create viable villages are those that continue, regardless of context, to learn to perceive, use the benefits of rural areas and promote the values of rural space. Digital technologies and innovations help to ensure a better quality of life, better public services and a more efficient and economical use of local resources. The links between traditions and the latest technologies allow the creation of new value chains in rural areas.

For almost half of Romania's population, the countryside is simply home - a place where they live, work, raise and educate their children. Romanian rural communities need new jobs, basic services, connectivity and intelligent transport solutions, as well as a climate conductive to entrepreneurship. This means an increased awareness that new types of business models will continue to emerge.

Globalization was expected to increase employment opportunities with a positive impact on labour force from remote rural areas that would migrate to economically growing urban centres [20].

Assisting rural enterprises to better connect, integrate and cooperate with urban businesses are the new challenges that Romanian village residents face with.

The importance of appropriating new technologies in agriculture by farmers will be one of the major criteria in assessing the proposed success.

However, it should not be omitted the problems and provocative factors that affect the Romanian rural population in acquiring new technologies in and out of their agricultural practices. These include the lack of adequate knowledge of new technologies, the small size of farms, lack of investment capital, education, experience in agriculture, land ownership, lack of membership in various agricultural organizations and finally, the use of agricultural inputs.

A new perspective that includes the development of the Romanian rural space is the concept of smart villages. Building communities that use local resources and technology in a smart way, but at the same time preserve their rural identity are key features of this concept. The ability to meet social, economic and environmental challenges, building on the strengths of rural communities, including local authorities, and local opportunities, using innovative solutions, incorporates the concept of smart villages.

The economic and social impact, as well as ensuring the success of the Smart Village initiative on rural communities, will take place only by realizing the need to identify all stakeholders, regardless of social and economic conditions, and the main actors that are an integral part of each rural community. The initiation and implementation of smart village strategies can be based on existing initiatives as well as on support measures already underway.

An important role in this context lies with the local action groups (LAGs), that can directly contribute to the mobilization of locals, to facilitate the exchange of views on the challenges and opportunities that arise in merging the local community to a Smart Village, to support technical studies and pilot projects as well as small-scale investment financing. This can create the conditions for greater investment in rural development programs, cohesion funds or at national public and private level.

As a starting point, the authors of this paper view smart villages to advance human development, moreover, they analyse quality of life indicators and technological infrastructure as key factors that represent the structural base for smart village development.

For the Romanian rural communities, the coverage or accessibility of digital technology will not be the main barrier in the development of the Smart Village concept, but rather the low level of qualification, the size of farms, the high percentage of rural aging and its conservatism.

Particular attention will need to be paid to the digital growth and literacy of the rural population.

The major role in the economic development of the villages by outlining the profile of the local economy and identifying future directions of development is played by the local public administration.

The management of human, financial, material and information resources through which they can support local / regional entrepreneurship is the responsibility of local authorities. The development of smart villages can only be achieved by developing an economic dimension and implicitly by developing new jobs, reducing unemployment, increasing the purchasing power of the local population, increasing revenues from local taxes and fees, reducing the number of social aids granted and, at the same time, improving living conditions [21, 5].

The administrative dimension (governance) comprises three areas covering public services, transparency and policy.

In Romania, institutional transparency is regulated by Law 52/2003, which includes the provisions of European legislation. The administrative dimension also includes the extremely important, even decisive, role that the mayor plays in creating the Smart Village [13].

The mayor is the main decision-maker in almost all issues regarding the implementation of strategies that lead the community to achieve Smart Village, including links with other institutions. As a manager and community leader, he or she should encourage community interaction through the direct participation of community members in making decisions about strategies and policies applied at the community level to achieve Smart Village.

To present the economic dimension in relation to the concept of smart village, the community should group a series of productive economic activities, services, as well as elements of infrastructure. The basic objective of the economic dimension is to remove obstacles in the development process of the local economy and to improve the mechanisms for the efficient functioning of the market.

Other objectives are to focus efforts on assisting the existing business sector, encouraging the opening of new businesses by identifying new people's needs, attracting local investment and raising the level of infrastructure development. To achieve these objectives, it is necessary to operate strictly in the directions of economic development of the respective local community, having as perspectives the economic growth and the improvement of the quality of life of the inhabitants of the given territory.

The adjacent economic dimension of a smart village includes: the integration of economic processes with those on environmental protection, the development of trade and industry, alternatives on financing development as well as behavioral changes of community members.

The quality of the services provided and the degree of social satisfaction that they manage to determine are two of the main indicators of the smart village concept. The growing importance of services in the economy and their spectacular diversification in recent times have broadened concerns for knowledge of this sector of activity, as well as the impact generated in rural areas.

An extremely important role in creating the necessary premises for the transition to the level of economic and social development that characterizes a Smart Village is played by the information and communication technology (ICT), due to the fact that the Smart Village is a management concept that to achieve its objectives is based on the extensive and efficient use of technology information and communications to maximize results. In the construction process of a Smart Village, ICT directly contributes to the local development of business, the improvement of human resources, the growth of the potential of the community, etc.

In order to be applied at the level of small communities, ICT must be affordable, efficient, sustainable, easy to use and maintain. Using ICT can ensure the optimal use of resources, which can contribute to the sustainable development of villages. The technological dimension must also cover the characteristic requirements of the rural environment. Technologies like sensor-based sensors specific to agriculture, animal husbandry, etc., as well as the possibility of creating remote server networks that can store, manage and process data (cloud computing).

There are already many IoT (Internet of Things) applications in agriculture. IoT means the operation of physical devices that have network connectivity via the Internet, which allows the collection and exchange of data between each other. IoT is a huge opportunity for farmers to monitor their crops and increase productivity.

Satellites, drones, wireless sensor networks, agricultural analytical device systems, farm management systems, big data (long-term statistical series) applied to the farm and the food management chain are all examples of IoT and smart agriculture that is collecting data on temperature, precipitation, humidity, wind speed, pest infestation and soil content.

This data can be used to automate agricultural techniques, make informed decisions to improve quality and quantity, minimize risk and waste, and reduce the effort required to manage crops.

For example, farmers can now monitor soil temperature and moisture remotely and apply precision fertilization based on IoT data [28].

Human resources are key to creating a Smart Village and that is why the education of community members requires special attention.

A qualified human resource can directly influence the attraction of capital and economic organizations that can create added value in the local economy.

Development of services at the local community level, both essential for health and education, and those that can contribute to the development of entrepreneurship, such as infrastructure (transport, energy, water, etc.) and the logistics part that aims to combine factors of production and distribution (raw materials, materials, installations, people, information, etc.) can significantly contribute to ensuring the conditions that allow the achievement of a smart village.

The standard of living in a smart village is related to the living conditions that this paper oversees.

Smart villages are an approach to the local development of the village, which reflects the contemporary dynamics and direction of development processes and the challenges of civilization [2].

Based on the elements analyzed, it can be concluded that this concept, Smart Village, was developed to provide solutions to the many problems faced by localities in rural areas, both economically and socially.

In this context, the purpose of the paper is to highlight the full potential and opportunities resulted from effective conceptual adaptation in the Romanian rural side.

MATERIALS AND METHODS

Several quantitative approaches have been considered in this present paper in order to reveal the importance of the novel smart village concept in Romania.

The first research method is the analytical review of the financial measures of implementation through diverse measures, axes and sub-measures;

Second, a three-staged proposal of applicable action plan for autochthonous actors followed by a quantitative analysis for the existing rural smart infrastructure that represents the structural applicability base.

The smart village model involves rural development that fully utilizes the Information and communications technology to achieve rural sustainable development through proper clarification of rural needs and characteristics.

The smart village focus is on enhancing strategic systems through regulated controls, guides and subsystems that drives digital economic and social transformation and improves local infrastructure enabling rural areas potential of sustainable developing [28].

The participatory approach is reflected through meeting the need to develop a holistic strategy at the local level, focusing on technological innovation (digitization), on social innovation, on local communities rather than at local administrative unit level all of them creating added value to local communities.

The main branches of the implementation of the Smart Village concept for rural communities are described in Table 1.

They are including: public administration sector and administrative services, technology (internet access, technologies specific to the rural environment, etc.), resources (natural economic and human resources), healthy services, standard of living, environmental changes, social, historical, cultural and religious particularities, tourist potential, etc.

Table 1. Smart village implementation initiative

Administration	Efficiency of administrative services	Technology	Socio-historical, cultural and religious peculiarities
Transparency of financial and government information Leadership Improvement Policy(s) Public Services	Use of ICT to provide services to the community;	ICT – Internet access IT infrastructure Technologies specific to the rural environment Sensor used in agriculture and animal husbandry Cloud computing IOT	Tourist potential Village identity Tourist destinations Local brand Village promotion platform Village culture and traditions
Public Services	**Standard of Living Safety and effort**	**Resources**	
Economic services Entrepreneurship Access to work Economic institutions Logistic facilities	Waste management Environmental protection Public safety Disaster management Access to public services Sports field Green facilities Banks/Banking services Road and bridge infrastructure	Natural resources – State of the land, access to running water, energy supply Economic resources Agriculture, fishing, animal farms Human resources Rural communications Education level Openness to new Essential services: health services, education services	

Source: Authors' conceptualization.

RESULTS AND DISCUSSIONS

National Rural Development Program (NRDP) contribution to the Smart Village concept implementation

Discussing the implementation of NRDP in our country, we can look at some examples of specific measures that have supported and continue to support the development of a smart village strategy.

Since the 2007-2013 programming period, Ministry of Agriculture and rural Development (MARD) [14] has used part of the amount available under Measure 322: "Renovation, development of villages, improvement of basic services for the economy and rural population and enhancement of rural heritage", from NRDP, allocated through the European Economic Recovery Plan, amounting of approximately EUR 20.38 million, to make the necessary investments for the development of broadband infrastructure in rural areas that had not previously benefited from access to such infrastructure.

This was achieved by implementing sub-measure 322e): "Investments in broadband infrastructure in rural areas". Sub-measure 322e) supported investment in rural areas in the creation or modernization of the last mile access segment of fixed-point electronic broadband networks and the creation or modernization of the backhaul of broadband electronic communications networks, where this segment does not exist or does not fit into broadband parameters. Regarding the technical and financial implementation of this sub-measure, we specify the fact that 12 financing contracts were concluded, with payments amounting up to EUR 1.6 million, of which 9 contracts were finalized.

Also, in the period 2007-2013 [16], it was implemented Measure 125: "Improvement and development of infrastructure related to the development and adaptation of agriculture and forestry". The aim was to adapt the agricultural and forestry infrastructure to the new property structures that have emerged as a result of the property restitution process in order to increase the competitiveness of the agricultural and forestry sector. For the public beneficiaries of this measure, the public aid (EAFRD + national public contribution) was 100%. Under measure 125, a total of 673 financing contracts were concluded with a value of EUR 527 million [1, 22].

For the period 2014-2020, through NRDP [17], a series of public utility measures were implemented, respectively, Sub-measure 4.3 "Investments for the development, modernization and adaptation of agricultural and forestry infrastructure", Sub-measure 7.2 "Investments in the creation and modernization of basic infrastructure at small scale and Sub-measure 7.6 "Investments associated with the protection of cultural heritage". Regarding the contracts concluded related to sub-measure 4.3 to date, there are 1,403 contracts with a total allocated value of EUR 677.7 million, the payments made so far reaching EUR 431.7 million. sM 7.2, has concluded 1,403 contracts, with a total allocated value of EUR 1.1 billion, the payments made so far being EUR 887.58 million. For sM 7.6, 699 projects were contracted, with a total allocated value of EUR 206.28 million, the payments made so far being EUR 144.44 million [1, 10].

Through the specific "bottom-up" approach, the implementation of the LEADER tool in Romania has led to important results in many rural areas and could play a significant role in helping the rural environment to adapt to contemporary realities that are constantly changing. LEADER [15] has played a significant role in encouraging joint initiatives in rural areas by discovering new solutions to traditional problems. The very creation of LAGs can be considered an innovative element that supports the phenomenon of local governance [5, 26, 24].

In Romania, the NRDP 2014-2020 continues to use the LEADER instrument, as an independent measure with an allocation of over EUR 560 million, representing 7% of the total value of the program.

During this period, 239 local development strategies were selected, implemented by LAGs, with an almost total coverage of the eligible territory (over 92%).

Within the strategies, based on the needs identified at local level, a series of measures have been proposed aimed at local economic and social development, focusing on areas of interest especially in rural areas, such as: promoting local products by adhering to producers' schemes European quality, encouraging association, supporting young people, the issue of vulnerable groups [15].

As a novelty factor, during this programming period, a complementarity mechanism was established between NRDP and POCU to solve rural social problems.

LEADER funding provides the infrastructure part, and the POCU provides social, educational and health services to vulnerable groups in the LAG territories [25].

It can be observed that this mechanism has a character of social innovation, through the 163 projects that received funding worth over EUR 11 million, it contributes to solving the social problems in the local communities.

LEADER has also paid special attention to digitization issues.

Broadband infrastructure has a relative presence in rural areas, and people and institutions do not have the technical support and knowledge to use IT technology.

The LAGs made it possible to finance 28 projects, with a value of over EUR 655 thousand, which aim at setting up a broadband network, the acquisition of IT&C equipment, the development of e-government solutions and digital literacy actions [18].

The elements of social innovation and digitalization in the context of specific cooperation LEADER creates the right framework for the development of "smart villages". ”Smart villages are essentially about people - they are about rural communities taking initiatives to find practical solutions to problems and trying to take full advantage of new opportunities.

Digital solutions can support many of these new opportunities, but smart also means cooperation and the development of new alliances - free thinking and paving the way for prosperity and sustainability. Phil Hogan, European Commissioner for Agriculture and Rural Development” [5].

The strategic documents of the future Common Agricultural Policy and Cohesion Policy indicate that the LEADER approach and support for smart village-specific elements will continue to be funded in the next programming period.

New models regarding the implementation of the concept of smart villages in Romania

Table 2. Stage 1 – Implementation action plan

STAGE 1	*Actions planned*
Training Social Abilities	Identify the main actors in each community; Workshops and actions on motivating the inhabitants of the rural area; Digital literacy Change of mentality Awareness of the importance of implementing Smart Villages initiatives; New opportunities offered by direct contact of the inhabitants of a community with experts in order to gain the best possible understanding.
Periods: Weekly / monthly for different groups, depending on age / education, social level, etc.	

Source: Authors' conceptualization.

Table 3. Stage 2 – Implementation action plan

STAGE 2	*Actions planned*
Development Smart Villages	Identification of social and political organizations, identification of support measures for the development of rural and agricultural infrastructure, logistics, information technology (ICT), telecommunications services linking businesses to other communities, including urban environment, resources, etc. Continuation of the workshops from Stage 1, of the planned actions, by including the following topics: 1. Education 2. Social (presentation of examples of good practices on the standard of living of certain developed rural communities) 3. SMEs 4. Community welfare 5. Promoting and marketing local products / ideas for arranging local markets and supplying them 6. New employment opportunities 7. Interconnected rural communities **Building participation and the role of key actors and stakeholders** 1. Government Agencies and Local Public Authorities 2. Farmers' communities (cooperatives, producer groups, associations, agricultural and non-agricultural enterprises, etc.) 3. Schools and other educational institutions 4. Hospitals and other public health institutions 5. SMEs, Banking Services 6. Community agencies and programs implemented in local community development 7. Social and political organization
Results: Development of new expertise and new references Training of rural residents through workshops and later, development of local communities in the network based on communication through internet technology.	

Source: Authors' conceptualization.

Table 4. Stage 3 – Implementation action plan

STAGE 3	*Actions planned*
Socio-economic impact Abilities	% increase in the promotion and awareness of citizens % increase in production and marketing of local products Increasing social e-inclusion activities Communication Network Development New established ICT industries and mobile entrepreneurs

Source: Authors' conceptualization.

The ways of identifying the main actors in each community on the one hand, as well as identifying all stakeholders, on the other hand, ensure the success of the concept of Smart Villages in Romanian agriculture.

These issues are extremely important, because not all the actors of rural communities, are prepared to be part of this new initiative for a number of reasons, namely, on the one hand, because they are not involved in agriculture and related activities, age, low motivation, disinterest due to very low digital literacy of the rural population.

However, in as far as, more time is devoted to implementing all smart villages initiatives, changing the mindset and attitude that is necessary for all communities means ensuring that all kinds of projects and incentives are attracted, they will be well received and successful.

The implementation of these initiatives can be staged in three time periods, as shown in Tables 2, 3 and 4.

Romanian rural digital society

The Romanian information society faces several essential problems but is also characterized by a good level of training of specialists in the field. We will be able to develop the regions if we create national and regional development networks, virtual organizations of different levels and in different branches of activity [4].

The study on "Implementation of Digital Governance in Romania", conducted by PricewaterhouseCoopers Management Consultants SRL in 2018, shows that Romania is among the last countries in the rankings, ranked 67th out of 193, according to the UN study, but last in the countries EU Member States, ranked 28th out of 28, according to the DESI report, and ranked 54th out of 63, according to the IMD World report, being the penultimate place among EU member states [23].

In 2014, some of the objectives set by the first digital agenda for Europe 2010-2020 were taken over and adapted to the Romanian context. The purpose of this strategy was to ensure the development of Romania's ICT at the level of the other member states and to establish the premises for Romania's integration, from the ICT point of view, in the digital single market of Europe [8].

Regarding this initiative of our country, most of the measures taken have not been started, the rest being in an early stage of implementation.

The efficiency, effectiveness and quality of services provided by healthcare systems can be greatly improved through digitization. The concrete digital economy is one in which businesses can take full advantage of the possibilities and benefits of digital technologies, both to improve efficiency and productivity, and to achieve sales and reach end customers.

An important aspect in the development of the digital economy is the "quality of economic data" - which is important for building an economic information infrastructure, especially in a changing environment [3].

The 2020 Country Report for Romania, according to Pillar II, PNRR Digital Transformation [19], shows that the digitalization of the economy has lagged, although efforts have been made in this regard. Public services lag those in other EU member states, even though Romania has one of the highest shares of e-government users (7th place in the EU). In addition, in terms of digital technology integration, Romanian companies are well below the EU average.

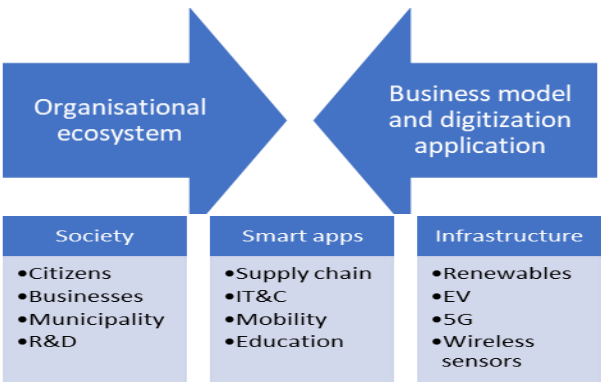

Fig. 1. Digital ecosystem for a smart village
Source: Adapted from [12].

The digital ecosystem required for a smart village highlighted at Figure 1 is pointing out the relevant types of digital service present in rural areas and presents how the pillars of societal well-being can become smart through finetuning of the organisational ecosystem enhancing actors from the civil society, services providers and infrastructure through technological advance.

The digitalization can be achieved at all levels and the immediate effects can improve the rural communities' quality of life.

Romania ranks last Member State in the 2021 ranking of Digital Economy and Society Index as presented in the figure below. On human capital, Romania ranks 26th, Romania ranks 7th on Connectivity thanks to broadband services and this strength could be used to further diminish urban-rural digital divide fully supporting Smart Village implementation (Figure 2).

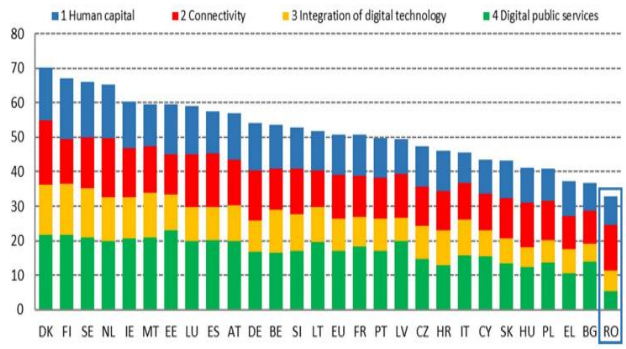

Fig. 2. Digital economy and Society Index (DESI) 2021 ranking
Source: European Commission, Digital Economy and Society Index (DESI) 2021 – Romania [6].

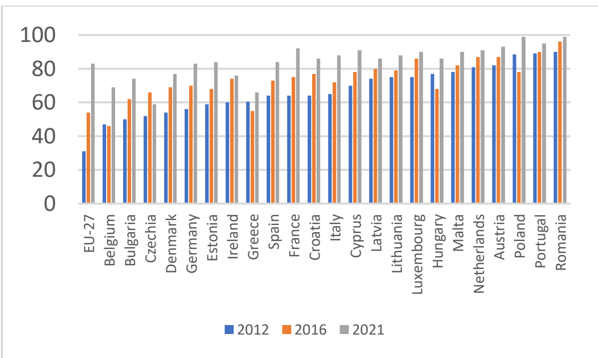

Fig. 3. Last internet use in the past 12 months as % of individuals living in rural areas
Source: Eurostat, Digital society statistics at regional level [9, 11].

Romania ranks among the top 5 countries in internet usage in the last 12 months of rural citizens, reaching almost 100% in 2021 (99%) indicating that rural population is interested in accessing the Web with a growth of 10% in 2021 compared to 2012; the EU-27 average marks a 168% increase in 2021 compared to

2012. This internet accessing ease could represent real opportunities for information access of rural citizens (Figure 3).

While Romania marks last in rural individuals that have never used the internet in 2012, in 2021 it sits on the 21st position with an 76% decrease in 2021 compared to 2012 reaching 16% of the rural population never accessing the internet, similar to the EU-27 average. Such a significant improvement marks rural broadband expansion and general public increased interest in using internet (Figure 4).

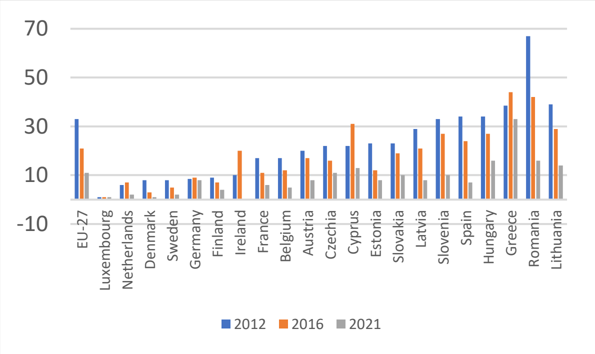

Fig. 4. Percentage of individuals in rural areas that have never used the internet
Source: Eurostat, Digital society statistics at regional level [9, 11].

CONCLUSIONS

The implementation of the Smart Villages initiative in Romania through the 3 stages presented is closely related to the social capacity, the development of eco-systems regarding smart villages and the economic capacity of each rural community. If we refer to the main barriers that could hinder the development of an action plan on the concept of Smart Villages in our country, these would be the large number of small farms, limited knowledge of the use of innovative technologies and techniques and conservatism of the rural population.

The sustainable rural development of a community to be multifunctional must be in line with local conditions, so it will be different depending on the region and the potential of the area. Focus on development and new mechanisms of change will lead to economic revitalization of rural areas.

All actions to implement a smart village should be taken over by both local organizations and residents of a community, to build relationships between partners, using modern ICT.

In a vibrant, European Romania, the strategies will have to be designed in such a way that they no longer meet the "needs of yesterday". Agriculture, in the next programming period, needs strategies to meet future needs, so that the challenges and risks, or the vulnerabilities that may arise, have concrete measures of intervention and correction. Thus, the investment schemes in the new National Strategic Plan will be directed towards the performance and economic viability of the investment, this leading step by step to the road leading to the Smart Villages also in our country.

Moreover, in order to comply with European standards, the Smart Village concept in Romania should focus on how digitalization supports the efficiency and performance at the farm level. Strategic advice on digitalization and e-infrastructure is needed, as it is linked to knowledge exchange, communication, dissemination and operation.

Further, the LAG's that implements the Local Development Strategies, can support the concept of "Smart Villages", which involves the development of smart projects aimed at capitalizing on the knowledge of local communities.

The concept of "Smart Villages" must be translated into strategies that integrate social, economic, health aspects and propose tools to improve local governance. The Local Development Strategies implemented by the LAGs create the optimal framework for the coordinated implementation of Smart Villages type interventions and provide funding opportunities for them. Through the LAG's, it can be identified solutions using technology and innovation, to improve the quality of life in rural areas, in the field of depopulation and demographic handicaps, improving the quality of local services in the field of health and safety of citizens, and the digitalization of social/administrative/educational sectors. [34, 25, 26].

The advantages of implementing Smart Villages through LAGs are that they consider the needs of the community and the potential for local development and, finally, create links between public authorities, the business community and civil society acting at the local level.

ACKNOWLEDGEMENTS

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVALUATION OF BULL-BREEDERS ACCORDING TO THE LONGEVITY INDICATORS OF THEIR DAUGHTERS

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Abstract

Assessment studies of sires by indicators of lifelong performance of their daughters were performed in the herd of the raising Ukrainian Red-and-White dairy breed of the Mayak agricultural company, Zolotonosha district, Cherkasy region in Ukraine. The significant influence of bull-breeders on the lifespan, rates of productive use and lifelong performance of offspring, which was determined by personal inheritance of breeders, has been established. Changeability of daughters' lifespan of estimated breeders differed over a wide range – 3.005-3.462 days, terms of productive use – 2.188-2.626 days, and number of used lactations from 2.5 to 5.6. By the best rates of lifelong dairy productivity was differed the progeny of breeders with higher lifespan and productive use. The highest yield for one day of life and productive use was obtained by offspring of sires, which had higher rates of milk production during the first lactation and shorter longevity. The level of relationship between the yields for 305 days and lifespan indicators of sire's offspring differed by significant variability from moderate negative with longevity (r=-0.244) to positive with productive use (r=0.259). Obtained correlations between milk yield value for the first lactation and lifelong productivity of the offspring of evaluated breeders by the degree (r=0.055–0.659) and reliability (P<0.05–0.001) were characterized by positive and reliable values. This was certifying the possibility of milk yield during the first lactation to be a predictor of cows' lifelong production. The high productivity of daughters of the estimated breeders during the first lactation did not provide a similar growth in their economic use, but will guarantee lifelong milk productivity. The offspring of sires of domestic selection were not inferior by the productive longevity indicators to the offspring of purebred Holstein breeders.

Key words: *Holstein, Ukrainian Red-and-White dairy, sires, duration of use, lifelong productivity, milk yield, milk fat*

INTRODUCTION

The created Ukrainian specialized dairy breeds have been improved for a long time in the direction of increasing the traits of milk productivity. This did not take into account the functional state of the organism, especially indicators of longevity. High indicators of lifelong productivity are the result of good development and functioning of all organs and vital systems of the whole organism of cows [5]. Since lifetime productivity was not only a selection trait but also one of the main factors influencing the economic development of the dairy cattle industry. [6, 8], conducting research in this area was relevant and motivated. Therefore, studies on this issue have testified great interest by significant number of scientists, especially in countries with developed dairy farming [1, 14, 22].

The problem has long been covered in the domestic literature [10, 23, 25].

Lifetime productivity indicators were controlled by a large number of factors, both genotypic and paratypic.

Given the low indicators of the strength of impact on the duration use and cow's lifetime productivity and their low hereditability, [7, 8, 16, 27] affirmed that the effectiveness of breeding in mass selection to improve productive longevity traits won't be significant. Therefore, the most effective method in the breeding system was the selection of bull-sires, which are characterized by productive longevity of their daughters. For example, about it was reported [5]. [5]. [3] that the variability of lifetime indicators of sire's daughters was significantly reliable. By the life expectancy within 1,422–3,057 days and by lifetime milk yield 8,551–46,530 kg.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Given that the genetic improvement of breeds in dairy farming depending on the sires heredity by 90-95% [4], the aim of these studies was to examine their impact on the their daughter's longevity traits with definition of improvers.

MATERIALS AND METHODS

The experimental base was a farm for breeding Ukrainian Red-and-White dairy breed (URWD) in the agricultural enterprise "Mayak" of Zolotonosha district of Cherkasy region of Ukraine.

Assessment of duration and effectiveness indicators of lifetime use was performed by the method of [26], taking into account the date of birth (D_b), first calving (D_{fc}) and withdrawal (D_w). For each lactation $(i = n)$ its duration (D_{li}), milk yield (MY_i), content $(\% F_l)$ and milk fat yield (MF_i) for the whole lactation. Indicators of duration and selection efficiency of cows lifetime use were calculated by the following formulas: life expectancy (days) – $L_e = D_w - D_b$; duration of economic use (days) – $D_{eu} = D_w - D_{fc}$; lifetime milk yield (kg) – $MY_l = \sum MY_i$; lifetime milk fat yield (kg) – $MF_l = \sum MF_i$; average lifetime fat content in milk (%) – $\% F_l = MF_l \times 100 / MY_l$; average milk yield per one day of life (kg) – $MY_{dl} = MY_l / L_e$; average yield per one day of economic use (kg) – $Y_{deu} = MY_l / D_{eu}$; number of used lactations (pcs.) – $N_{ul} = \sum N_{ul}$. Coefficient of economic use (C_{eu},%) was determined according to the formula given by [24] – $C_{eu} = (C_{le} - C_{afc})/C_{le} \times 100$, where: C_{le} – cow's life expectancy, days; C_{afc} – cow's age at the first calving, days.

Statistical processing of experimental data was carried out according to the formulas given by [21].

RESULTS AND DISCUSSIONS

The study of the traits characterizing the productivity, life expectancy and economic use of the daughter offspring of Holstein (Hol.) and Ukrainian Red-and-White dairy breeds testified a reliable variability of the estimated traits under the impact of their inheritance. (Table 1).

Table 1. Indicators of performance and length of use of offspring sires, x ± S.E.

Sire	Breed	n	Milk yield of the first lactation, kg	Duration:		C_{eu},%	Number lactations, pcs.
				life, days	economic use, days		
Inhibitor 402151	Hol.	115	7,956±128.2	2,247±57.9	1,417±59.0	63.2±1.13	3.1±0.13
Intul 401806	Hol.	62	7,844±229.4	2,299±97.3	1,465±99.3	62.3±2.04	3.0±0.21
Banff 920375	Hol.	131	6,791±97.0	2,130±30.5	1,342±30.9	64.1±0.79	3.1±0.07
Bovak 506089211	Hol.	162	8,041±115.1	2,149±34.8	1,299±34.4	55.2±0.94	2.7±0.07
Wilson 400720	Hol.	62	7,911±169.2	1,996±50.9	1,155±52.9	51.1±1.71	2.5±0.11
Vice 10910993	Hol.	59	6,599±142.4	2,264±51.4	1,465±50.8	64.4±1.53	3.6±0.12
Volt 5839901	Hol.	104	8,088±177.3	2,202±46.2	1,387±47.4	60.4±1.15	2.9±0.11
Diplomat 401497	Hol.	72	7,982±113.3	3,005±56.0	2,192±56.7	79.9±0.68	4.8±0.16
Kerry 5634653	Hol.	59	6,853±107.6	2,487±54.4	1,383±54.8	71.7±1.05	3.9±0.14
Sapphire 401799	Hol.	54	7,559±154.5	3,462±71.5	2,626±71.2	82.7±0.69	5.6±0.20
May 5573 (3/4 Hol.)	UBR	76	7,165±116.3	3,025±77.8	2,188±78.7	77.1±0.97	4.9±0.17
Start 5151 (3/4 Hol.)	UBR	55	6,536±161.2	3,263±88.6	2,427±88.3	80.1±0.98	5.2±0.21
Average for the herd		1011	7,521±36,8	2,427±15.4	1,606±11.5	65.7±0.23	3.6±0.07

Source: Own calculations.

By the lifespan evaluation, the advantage was on the side of daughters of Holstein breeders Diplomat and Sapphire and Ukrainian Red-and-White dairy May and Start, that amounted to 3,005-3,462 days. The statistically significant difference between daughters of these sires compared to the average value by herd varied from 578 to 1,035 days (P

<0.001). Among the breeders which have the highest lifespan, with the exception for two purebred Holsteins (Diplomat and Sapphire), there were two representatives of Ukrainian Red-and-White dairy breed (May and Start), indicating on the high genetic potential of the productivity of sires of Ukrainian selection crossed after Holstein breed. The term of economic use, which is represented by both absolute and relative numerical values, was indirectly related to the lifespan of animals. By the interval of economic use (***I_{eu}***) and coefficient of economic use (***C_{eu}***), the daughter offspring of bull-breeders Diplomat, Sapphire, May and Start with variability of research results within 2,188-2,626 days and 77.1-82.7% prevailed the average of experimental herd by 582-1,020 days and 11, 4-17.0%, with high reliability (P <0.001). The period of economic use was supplemented by a feature - the total number of lactations used by animals. In our studies, the variability of this indicator varied significantly, from 2.5 to 5.6 lactations. The advantage by total number of used lactations remained for daughters of Holstein breeder Sapphire. Reliable difference of the daughters of the best breeders on this trait in comparison with the average value by herd was 1.2-2.0 lactations (P <0.001). Milk production of the daughter offspring of estimated bull-breeders by the data of the first lactation showed that its indicator, especially the highest rates, did not always correlate with longevity. Among the best rated breeders, only daughters of Sapphire 401.799 had the highest yield (7.559 kg) by data of the first lactation. Studies report that milk production for the first lactation has a high repeatability with subsequent lactations, serving as an indicator of determining the breeding value of animals at an early age [11, 12, 15, 20, 25]. The evaluation of sires in terms of offspring quality was also based on the milk productivity of first-calf cows.

Table 2. Lifelong productivity of daughter progeny of bull-breeders Ukrainian Red-and-White dairy breed, x ± S.E.

Sire	n	Lifetime:			Milk yield for one:	
		milk yield, kg	yield of milk fat, kg	fat content in milk, %	day of life, kg	economic use, kg
Inhibitor	115	27,992±896.2	1,052.5±29.82	3.76±0.013	12.5±0.28	19.9±0.45
Intul	62	28,549±1440.4	1,087.7±47.27	3.81±0.023	12.4±0.46	19.5±0.65
Banff	131	25,009±404.8	932.8±13.59	3.73±0.012	11.7±0.13	18.6±0.18
Bovak	162	24,582±604.9	929.2±19.55	3.78±0.011	11.4±0.22	18.9±0.39
Wilson	62	21,719±1001.9	801.4±33.14	3.69±0.019	10.9±0.36	18.8±0.67
Vice	59	19,407±646.8	727.7±22.46	3.75±0.031	8.6±0.25	13.2±0.41
Volt	104	24,782±852.1	936.8±28.23	3.78±0.017	11.2±0.29	17.9±0.48
Diplomat	72	35,715±877.8	1,328.6±29.54	3.72±0.015	11.9±0.21	16.3±0.27
Kerry	59	26,974±850.1	1,006.1±28.47	3.73±0.020	10.8±0.26	19.5±0.34
Sapphire	54	38,811±1167.0	1,455.4±34.34	3.75±0.016	11.2±0.23	14.8±0.29
May	76	33,588±1012.7	1,289.8±33.19	3.84±0.016	11.1±0.19	15.3±0.28
Start	55	36,044±1128.8	1,376.9±36.72	3.82±0.023	11.0±0.18	14.8±0.24
Herd average	1,011	27,918±321.5	1,050.7±9.54	3.76±0.007	11.4±0.06	17.7±0.08

Source: Own calculations.

However, in our studies, the relatively high milk yields of a large number daughters of Holstein breed sires Volt (8,088 kg), Bovak (8,041 kg), Inhibitor (7,956 kg), Wilson (7,911 kg) and Intul (7,844 kg) didn't provide the appropriate indicators both in terms of length of use and lifelong production (Table 2). The highest lifelong dairy productivity was distinguished by the offspring of sires with higher indicators of life expectancy and economic use while maintaining the priority of positions. Daughters of the Holstein sire Sapphire were characterized by the highest lifetime milk yield, from which 38,811 kg of milk and 1,455.4 kg of milk fat. The next place in the ranking belonged to the daughters of the bull Start of Ukrainian Red-and-White dairy cattle. During 5.2 used lactations,

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

lifelong milk yield of his daughters averaged 36,044 kg and milk fat 1,376.9 kg. In the third place were daughters of the Diplomat – a sire of Holstein selection, and in the fourth place – the sire' offspring of domestic origin May, from which for 4.8 and 4.9 lactations received lifetime milk yield – 35,715 and 33,588 kg and milk fat – 1,328.6 and 1,289.8 kg., respectively. The highly reliable difference in lifetime milk yield and milk fat in the daughter offspring of these sires compared to the average indicators for the herd was 6,400-11,611 and 219.7-366.4 kg, respectively (P <0.001). The hereditary influence of sires on the fat content of daughters' milk was evidenced by a highly reliable difference of 0.15% (P <0.001) between the highest rate of 3.84% (May's daughter) and the lowest – 3.69% (Wilson's daughter). Analyzing the traits that also characterize lifelong productivity - milk production for one day of life and economic use, there is a pattern, which is that much higher yield for one day of life and productive use characterized breeding bulls in which daughter offspring differed in higher milk yields for 305 days of the first lactation, lower periods of life and economic use. These are Holstein breeders: Inhibitor, Intul, Banff, Bovak, Wilson and Kerry.

The level of coefficients of phenotypic correlations between the level of milk yield during the first lactation and type traits of longevity were presented in (Table 3).

Table 3. Relationship between milk amount for the first lactation and longevity traits of bull-breeders daughters

Sire	Breed	n	Duration: life, days	Duration: economic use, days	C_{eu},%	Number lactations, pcs.
Inhibitor 402151	Hol.	115	-0.033	-0.044	0.033	-0,046
Intul 401806	Hol.	62	-0.081	-0.053	-0.125	-0,142
Banff 920375	Hol.	131	0.132	0.122	0.093	0,074
Bovak 506089211	Hol.	162	-0.009	-0.036	-0.044	-0,102
Wilson 400720	Hol.	62	0.184	0.213	0.197	0,095
Vice 10910993	Hol.	59	0.155	0.162	0.185	0,121
Volt 5839901	Hol.	104	0.113	0.122	0.156	-0,107
Diplomat 401497	Hol.	72	-0.233**	-0.227**	-0.194*	-0,224**
Kerry 5634653	Hol.	59	0.088	0.034	0.041	0,057
Sapphire 401799	Hol.	54	-0.074	-0.045	-0.077	-0,111*
May 5573 (3/4 Hol.)	UBR	76	-0.244**	-0.217**	-0.119	-0,163*
Start 5151 (3/4 Hol.)	UBR	55	0.212**	0.259**	0.225**	0,185***
Average for the herd		1,011	-0,187***	-0.216***	-0.198***	-0.145***

Source: Own calculations.

The correlation coefficients between milk yield for the first lactation and indicators of the duration of use of the offspring of sires differed in significant variability from moderate negative with life expectancy (r=-0.244; May's daughters) to positive with economic use (r=0.259; Start's daughters).

Correlation coefficients for the herd as a whole testified with a high degree of reliability that with an increase in milk yield of cows for 305 days of the first lactation, their life expectancy, duration ***(D_{eu})*** and coefficient of economic use ***(C_{eu})***, and the number of used lactations decrease by 18.7; 21.6; 19.8 and 14.5%, respectively.

The findings that high first lactation productivity led to a decrease in duration of use and didn't always guarantee high lifetime productivity was consistent with other studies on this issue [2, 8, 19]. This was also reported by studies of Holstein cattle from Serbia [17] with a correlation between first lactation and lifelong yield (r = -0.088), productive life (r = 0.0023); brown Swiss breed in Slovenia in which correlation between yield for the first lactation and productive life was moderate and negative (-0.41 ± 0.052) [15]. It was reported [13, 18, 20] that the established positive and reliable correlation coefficients between milk amount for the first lactation and longevity traits in the daughters of estimated bull-breeders allow to use the yield of cows for the first lactation as a predictor of lifelong productivity, (Table 4).

Table 4. Relationship(r) between milk amount for the first lactation and lifelong productivity indicators of sires offspring

Sire	Breed	n	Lifetime:			Milk yield for one:	
			milk yield, kg	yield of milk fat, kg	fat content in milk, %	day of life, kg	day of economic use, days
Inhibitor	Hol.	115	0.306***	0.267*	0.045	0.441***	0,527***
Intul	Hol.	62	0.444***	0.249*	0.235	0.622***	0,659***
Banff	Hol.	131	0.356***	0.273**	-0.095	0.371***	0,596***
Bovak	Hol.	162	0.394***	0.324***	0.221**	0.442***	0,555***
Wilson	Hol.	62	0.537***	0.345**	0.373**	0.569***	0,563***
Vice	Hol.	59	0.390***	0.395**	0.126	0.369***	0,392***
Volt	Hol.	104	0.401***	0.324**	0.098	0.439***	0,432***
Diplomat	Hol.	72	0.442***	0.374**	0.107	0.337**	0,564***
Kerry	Hol.	59	0.442***	0.378**	-0.161	0.378**	0,513***
Sapphire	Hol.	54	0.498***	0.396**	0.059	0.244*	0,482***
May	UBR	76	0.403***	0.427***	0.029	0.286**	0,441***
Start	UBR	55	0.444***	0.468***	0.279*	0.285*	0,466***
Average for the herd		1,011	0,488***	0.401***	0.088	0.384***	0.421***

Source: Own calculations.

About the relationship between first lactation traits and productive longevity traits was confirmed by studies of Holsteins in North Carolina herds, according to which the genetic correlation between milk production of the first lactation and lifelong was 0.85 [9]. Canadian Holstein cows were closely correlated with the first lactation yield and most of the longevity indicators - from 0.64 to 0.92 [11]. A weaker correlation was obtained in the study of Brown cattle in Slovenia with coefficients of 0.26 ± 0.057 [15].

CONCLUSIONS

Evaluating the longevity rates of the offspring of estimated bull-breeders of different origins, we can generalize that to improve the dairy breeds of Ukraine the best genetic resources of domestic producers should be used. When using bulls from the world gene pool in the breeding process, it is advisable to take into account their longevity assessment indicators.

The high level of milk yield of the first-born cows of evaluated bulls didn't provide an increase in the indicators of the length of economic use in them, however, it will guarantee higher lifelong milk productivity.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE INFLUENCE OF MAIN FACTORS ON STRENGTHENING COMPETITIVENESS AND ENTERPRISE FINANCIAL POSITION

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Abstract

Entrepreneurship development is a powerful factor in reforming the economy: creating a socially oriented market mechanism, overcoming the current crisis decline in production and providing the preconditions for economic growth in the region. Entrepreneurship is recognized as one of the main factors of political and social stability of society. Therefore, the effective functioning of business entities is a prerequisite for the economic well-being of the country`s citizens, and hence national security. The main source of data for the study was the State Statistics Service of Ukraine, which publishes a set of indicators that characterize various aspects of business. In particular, data from the section `Activities of enterprises` on the official website of the State Statistics Service of Ukraine and official data on the websites of its regional offices, as well as information from the collections `Activities of economic entities` and `Activities of large, medium, small and micro enterprises` were used. The development of entrepreneurship for the period of 2016–2020 has been analyzed in the article. The analysis of the dynamic changes in the development of entrepreneurship in the context of enterprises and individuals-entrepreneurs has been conducted. The quantitative data of the State Statistics Service of Ukraine, illustrating the distribution of subjects of Ukrainian entrepreneurship by size, types of economic activity, volumes of sold products, works and services, and financial results of entrepreneurial activity have been considered and analyzed. It is important to monitor the financial performance of enterprises continuously. It promotes response and the efficiency of their activities increase, optimizing the use of resources and management potential.

Key words: *entrepreneurship, factor, business entity, enterprise, economic activities, trends of development*

INTRODUCTION

The problem of competitiveness is one of the most important problems in the current conditions of economic development, which is characterized by deepening integration processes, liberalization of trade conditions, increased attention to product quality [1]. The urgency of the problem of strengthening the competitiveness of enterprises is growing as a result of Ukraine's integration into international organizations and the further development of a market economy.

In order to identify ways to increase competitiveness, it is first necessary to define the interpretation of the term "competitiveness". According to the classical definition, competitiveness is a position of a producer in domestic and foreign markets determined by a set of factors, reflected through a set of indicators (Porter, 2000) [9]. In modern conditions, competitiveness should be interpreted as the level of competence of the company compared to other competitors in such parameters as technology, practical skills and professional knowledge of staff, level of strategic and current planning, sales policy, management, communication, quality management systems, production, etc. (Ponomarova et al., 2019) [8]. In a market economy, competition is a struggle, competition between producers of goods and services for more economically favourable economic conditions, for better conditions for production and sale of the product (Kostyuk., 2019) [6].

Competitiveness is one of the important indicators in the economy on which the development, efficiency and stability of all participants in competitive relations depend. Modern entrepreneurial activity depends on the level of research of the main factors influencing competitiveness. To strengthen competitiveness, it is important to identify, justify and classify the factors of competitiveness and explore the reserves of its increase [10].

The study of the impact of key factors on strengthening competitiveness is becoming urgent for entrepreneurs, as the crisis has exacerbated the difficult economic situation in the competition of enterprises. In the absence of identification and analysis of factors directly affecting the competitive position of the enterprise, its management makes it impossible to develop and implement a strategy for the existence and operation of the organization in the future.

MATERIALS AND METHODS

The main source of data for the study was the State Statistics Service of Ukraine, which publishes a set of indicators that characterize various aspects of business. In particular, data from the section "Activities of enterprises" on the official website of the State Statistics Service of Ukraine and official data on the websites of its regional offices, as well as information from the collections "Activities of economic entities" and "Activities of large, medium, small and micro enterprises" [11]. were used».

The article analyses the development of entrepreneurship for the period 2016-2020. The study pays special attention to the analysis of dynamic changes in the development of entrepreneurship in terms of enterprises and individuals - entrepreneurs. Particular attention is paid to the quantitative analysis of data of the State Statistics Service of Ukraine, which characterizes the distribution of business entities by size, type of economic activity, sales, types of works and services, financial results of business activities. The statistical and economic analysis of the structure of entrepreneurial activity is carried out and the main factors influencing the development of entrepreneurship are determined.

The theoretical and methodological basis of the study were the works of domestic and foreign scientists, statistics and general scientific research methods: abstract logic, content analysis, synthesis, statistical and comparative analysis.

RESULTS AND DISCUSSIONS

A study of the level of competitiveness of the region is not possible without a detailed analysis of factors whose impact may increase and decrease its overall level.

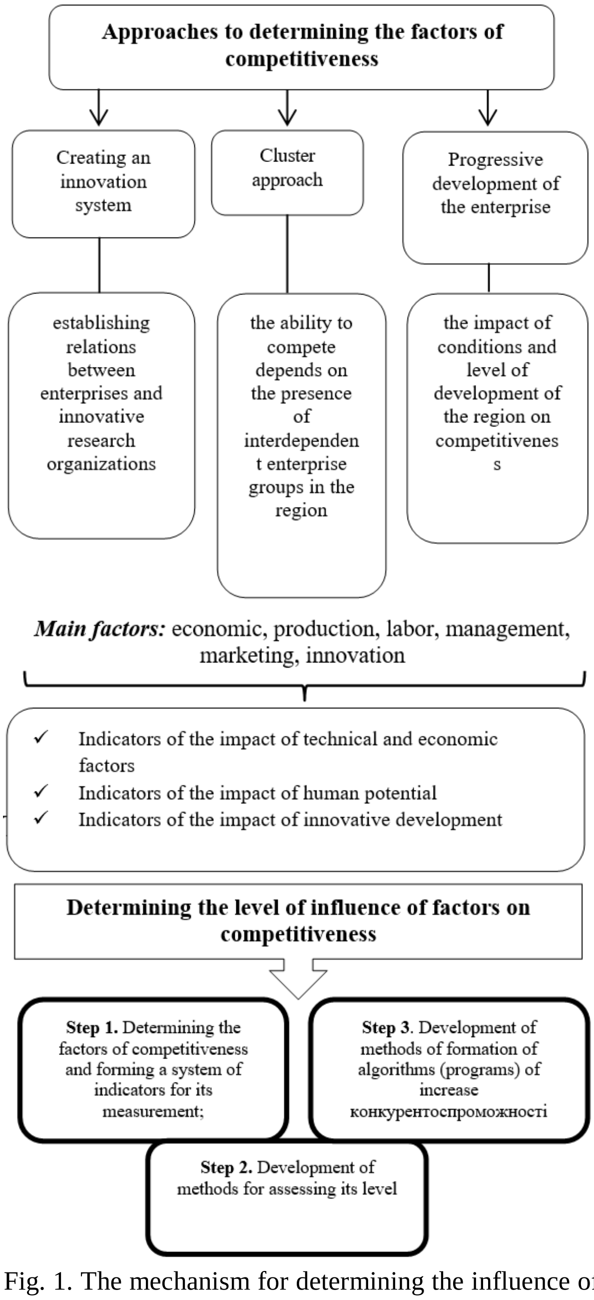

Fig. 1. The mechanism for determining the influence of factors on the competitiveness of the enterprise and the algorithm for its strengthening
Source: Authors' conception.

Factors affecting competitiveness have a significant impact on the economy and can be used in the formation of state regional policy, so it is advisable to develop a mechanism for determining the impact of factors on the competitiveness of the enterprise and the algorithm for strengthening it (Figure 1).

Factors that can enhance competitiveness are considered by experts from three main approaches: cluster, innovation and progressive development [7].

According to the cluster concept, competitiveness depends on the presence of a cluster of interdependent industries. Clusters are geographically concentrated groups of interdependent enterprises, specialized service providers, as well as non-profit organizations and institutions related to their activities in certain competing industries. Therefore, one of the tasks in the algorithm to increase competitiveness is to identify the potential for clustering [2].

The second group of views combines competitiveness with innovation. The development and implementation of innovations includes the relationship of research organizations with manufacturers, the formation of innovation structures such as business incubators, technology parks, training centers. Accumulation of knowledge and creation of institutions that promote innovation, enhancing competitiveness.

The third group of factors characterizes the progressive development of the enterprise and is related to the conditions and pace of development of entrepreneurship, includes the following economic and geographical provisions: image, labor resources, management skills.

Having identified the main factors influencing the competitiveness of the enterprise, it is advisable to determine the level of influence of factors on the competitiveness of the enterprise. Determining the level of influence of factors on competitiveness should be carried out by mathematical methods based on statistical indicators. First of all, it is advisable to determine the indicators that characterize the impact of technical and economic factors on competitiveness (production and financial activities). The next step is to investigate the indicators that characterize the impact of human potential factors on competitiveness (education, culture, health and public safety; the level and quality of life and the state of the environment). At the last stage it is expedient to determine the indicators that characterize the impact of factors of innovative development on the competitiveness of the region (innovation and investment activities) [3].

Determining the level of influence of factors on competitiveness should be carried out objectively, ie on the basis of reliable and verified information that really reflects reality, and conclusions should be based on accurate analytical calculations.

The mechanism of strengthening the competitiveness of the enterprise involves the use of an integrated approach to the main functions of management (analysis, planning, organization, motivation, control, regulation) and is carried out in three stages: determining the factors of competitiveness and forming a system of indicators; development of evaluation methods; development of methods of formation of algorithms (programs) of strengthening of competitiveness. The mechanism of strengthening competitiveness should affect all areas of the enterprise: staffing, information, materials, finance, investment, energy, advertising, sales, etc.

Factors affect both increasing the competitiveness of the enterprise and decreasing. Gaining competitive advantage based on factors depends on how effectively they are used. Analysis of factors helps to identify strengths and weaknesses of the company and the industry and develop measures to strengthen competitiveness, so in our opinion it is advisable to analyze the impact of factors on business. These factors are interrelated and interdependent, so this economic category should be considered as a system with all its inherent properties, such as: the complexity of the system structure, continuity of operation and development, system integrity, synergy, interdependence of system and environment [4].

According to the statistics of the State Statistics Service of Ukraine (Figure 2) on the territory of Ukraine in 2020 there are 1,973,652 units of economic entities, of which large business entities 512 units, medium - 17,602 units, small - 355 708 units, individual entrepreneurs - 1,599,755 units, so it can be observed that in Ukraine the majority of business entities are small enterprises in the context of enterprises and individual entrepreneurs. In particular, during 2016-2020 there is a tendency to increase the number of economic entities in all categories, so the number of large enterprises increased by 33.7%, medium-sized enterprises by 18.3% and small by 22.2%, which is generally a positive trend. However, there is a sharp decrease in the number of enterprises in the period 2019-2020, so the number of large enterprises decreased by 1.2% compared to 2020, medium-sized enterprises by 0.9%, and small, respectively, by 1.8%, which in our opinion is only the beginning of a negative trend resulting from the COVID-19 pandemic, exacerbation of economic problems (including a 1.4-fold increase in electricity and gas tariffs by 5 times), and hostilities.

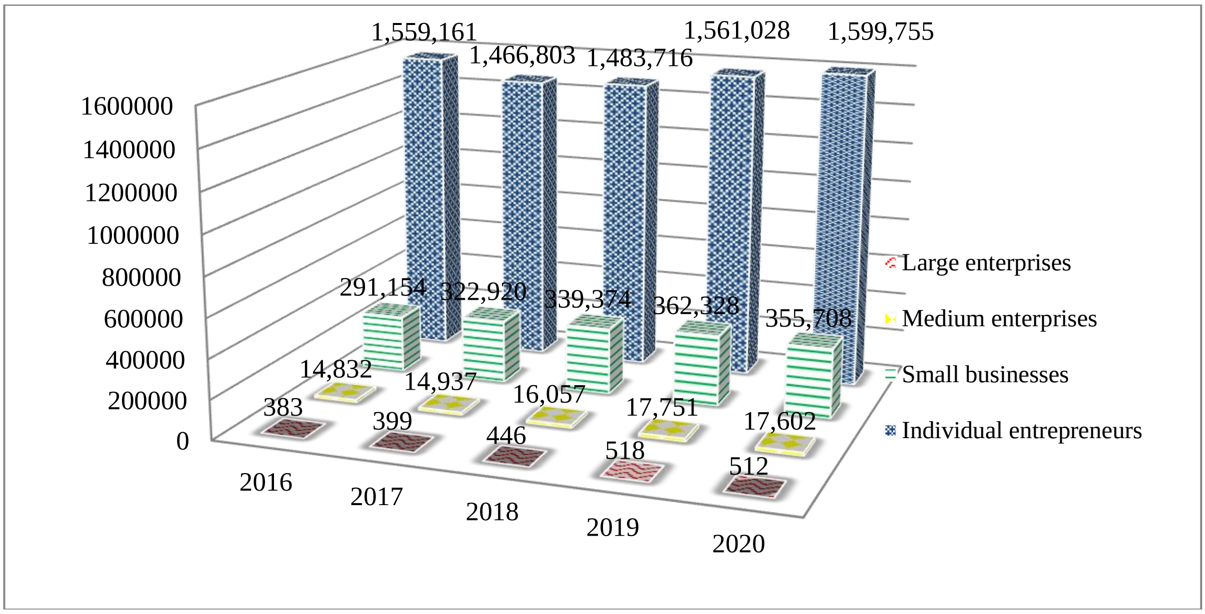

Fig. 2. Distribution of the number of business entities in Ukraine by size
Source: Own design based on the data from [11].

Usually, under difficult business conditions, large and medium-sized enterprises are crushed and transferred to the group of small businesses, which is not the case in Ukraine in this situation, as the reduction in the number of enterprises occurs in all groups of businesses. However, it can be argued that some of the companies that have ceased to exist have moved to the group of individual entrepreneurs, because this link since 2019 has increased by 2.5%.

For a detailed study of the dependence of the factor of the number of economic entities on the efficiency of their activities, consider Table 1. In our opinion, the main factors that characterize the efficiency of economic entities are the number of employees and the volume of products sold. In general, during the study period, the number of employees in business entities increased by 11.9% and in 2020 amounted to 7,379.5 thousand people against 6,597.6 thousand people, of which the number of employees at the company increased by 9.6% and is 6,413.5 thousand people, and individual entrepreneurs by 29.1% and is 966.0 thousand people.

The volume of sold products of economic entities in Ukraine increased by 64.1% and in 2020 amounted to UAH 11,285,578.9 million. from it at the enterprises 10,273,152.5 million UAH, and physical persons-entrepreneurs 1,012,426.4 million UAH.Thus, it can be argued that in Ukraine, out of the total number of business entities, on average 20% belong to enterprises, and 80% to natural persons are entrepreneurs. However, exactly 20% of enterprises employ an average of 85% of all employees in Ukraine, who produce 90% of all sales in the country.

Table 1. The main indicators of entrepreneurship in Ukraine

Indicator	Years					Deviation
	2016	2017	2018	2019	2020	2020 in% until 2016
Number of business entities, thousand units	1,865.6	1,805.1	1,839.7	1,941.7	1,973.6	105.8
Number of enterprises	306.5	338.3	355.9	380.6	373.8	122.0
in% to the total	16.4	18.7	19.3	19.6	18.9	115.3
individual entrepreneurs	1,559.1	1,466.8	1,483.8	1,561.1	1,599.8	102.6
in% to the total number of business entities	83.6	81.3	80.7	80.4	81.1	97.0
Number of employees in business entities, thousand people	6,597.6	6,706.2	7,088.7	7,418.8	7,379.5	111.9
including enterprises	5,849.6	5,844.9	5,999.5	6,369.6	6,413.5	109.6
in% to the total	88.7	87.2	84.6	85.9	86.9	98.0
individual entrepreneurs	748.0	861.3	1,089.2	1,049.2	966.0	129.1
in% to the total	11.3	12.8	15.4	14.1	13.1	115.5
Volume of sold products of business entities, UAH million	6,877,077.4	8,467,031.9	10,148,847.2	10,725,442.9	11,285,578.9	164.1
including enterprises	6,387,872.8	7,862,695.2	9,388,092.1	9,841,060.7	10,273,152.5	160.8
in% to the total	92.9	92.9	92.5	91.8	91.0	98.0
individual entrepreneurs	489,204.6	604,336.7	760,755.1	884,382.2	1,012,426.4	207.0
in% to the total	7.1	7.1	7.5	8.2	9.0	126.1

Source: Own calculation based on the data from [11].

The distribution of the number of registered enterprises and the volume of sales by type of economic activity in the structure of enterprises are presented in Table 2, according to this factor there is a tendency to reduce the number of business entities, so in 2020 the largest number of them was registered in the field of wholesale and retail trade 826.1 thousand units, during the study period their number was reduced by 84.3 thousand. units, of which the number of enterprises was reduced from 2019 by 3.0 thousand units, the number of natural persons entrepreneurs was reduced to 100.4 thousand units, considering the number of sold products of wholesale and retail trade, we see a tendency to increase its volume, so in total, this figure was increased by UAH 1,890,852.7 million. and in 2020 amounts to UAH 4,068,233.3 million. of them, enterprises increased sales by UAH 1,682,541.8 million, ie from UAH 2,385,691.5 million. to UAH 4,068,233.3 million, individual entrepreneurs, despite the larger number, worked worse and increased sales by UAH 208,310.5 million. In agriculture, the number of economic entities did not decrease significantly, but a negative trend is present, a total decrease of 1.3 thousand units. and is 73.3 thousand units, the volume of sales increased from 414,799.9 million UAH. up to UAH 624,070.1 million, ie by UAH 205,270.2 million.

Production relations are reflected in the financial results, certain necessary types of resources of the enterprise can be obtained if they have sufficient financial resources. The state, dynamics and structures of financial support of enterprises depend on the potential for their development [5].

From the point of view of development of economy of Ukraine, replenishment of the budget and definition of the basic statistical reference points at carrying out audit of the financial reporting and control of activity of the enterprises it is expedient to carry out the analysis of aggregate factors on groups of the enterprises. It is advisable to determine the level of influence of the main factors of formation, distribution and use of financial results of entrepreneurship before taxation.

Table 2. Characteristics of enterprises by type of economic activity

Types of economic activity	Years	Number of business entities, thousand units			Volumes of sold products, UAH million		
		Total	Enterprises	Individual entrepreneurs	Enterprises	Individual entrepreneurs	Individual entrepreneurs
All of them:	**2016**	1,865.6	306.5	1,559.1	6,726,739.8	6,237,535.2	489,204.6
	2019	1,941.7	380.7	1,561.0	10,524,112.8	9,639,730.6	884,382.2
	2020	1,973.7	373.9	1,599.8	11,062,297.1	10,049,870.8	1,012,426.3
Agriculture, forestry and fisheries	**2016**	74.6	45.0	29.6	414,799.9	403,645.8	11,154.1
	2019	75.4	50.2	25.2	572,748.3	556,325.9	16,422.4
	2020	73.3	49.4	23.9	624,070.1	605,483.1	18,587.0
Industry	2016	127.0	38.5	88.5	2,343,000.4	2,305,695.9	37,304.5
	2019	130.3	47.7	82.6	3,289,388.9	3,230,045.0	59,343.9
	2020	126.3	47.8	78.5	3,524,673.6	3,460,666.5	64,007.1
Construction	**2016**	50.2	24.3	25.9	180,966.5	169,705.3	11,261.2
	2019	56.9	31.9	25.0	394,919.4	370,760.6	24,158.8
	2020	56.9	31.6	25.3	444,753.9	420,084.3	24,669.5
Wholesale and retail trade	**2016**	910.4	82.2	828.2	2,628,672.0	2,385,691.5	242,980.5
	2019	834.2	101.4	732.7	4,345,851.2	3,958,371.1	387,480.1
	2020	826.1	98.4	727.8	4,519,524.7	4,068,233.3	451,291.4
Transport	**2016**	109.3	13.7	95.6	398,913.7	365,332.7	33,581.0
	2019	96.2	17.5	78.7	603,015.8	542,968.2	60,047.6
	2020	98.3	17.6	80.7	558,433.9	498,243.6	60,190.2
Information and telecommunications	**2016**	129.7	11.9	117.8	175,050.9	117,407.2	57,643.7
	2019	206.1	15.9	190.2	334,865.3	198,276.7	136,588.6
	2020	234.2	16.1	218.1	395,417.1	218,144.9	177,272.2
Financial and insurance activities	**2016**	11.9	3.9	8.0	64,092.6	61,162.3	2,930.3
	2019	10.1	4.2	5.9	105,622.1	101,088.8	4,533.3
	2020	10.2	4.2	6.1	118,454.1	113,496.6	4,957.5
Real estate transactions	**2016**	90.9	30.9	60.0	103,770.5	85,497.3	18,273.2
	2019	98.4	39.0	59.4	166,359.9	135,127.9	31,232.0
	2020	95.8	36.8	59.0	159,090.1	127,075.0	32,015.1
Professional, scientific and technical activities	**2016**	125.1	24.9	100.3	274,279.9	241,869.5	32,410.4
	2019	134.8	30.7	104.1	395,448.2	330,127.3	65,320.9
	2020	140.4	29.8	110.6	343,195.1	268,661.3	74,533.8
Education	**2016**	11.1	1.9	9.2	3,891.5	2,253.0	1,638.5
	2019	15.4	2.6	12.8	9,905.6	5,104.2	4,801.3
	2020	16.7	2.7	14.0	11,357.0	5,458.9	5,898.1
Healthcare	**2016**	21.6	3.9	17.6	16,803.1	13,805.0	2,998.1
	2019	31.0	6.9	24.1	58,517.3	51,090.8	7,426.5
	2020	37.6	7.4	30.2	130,559.0	120,838.4	9,720.6
Provision of other types of services	**2016**	203.7	25.3	178.4	122,498.8	85,469.7	37,029.1
	2019	252.9	32.6	220.3	247,470.8	160,444.1	87,026.8
	2020	257.7	32.1	225.6	232,768.5	143,484.9	89,283.8

Source: Own representation based on the data from [11].

Analysis of pre-tax financial results as a factor of competitiveness provides information on the positive or negative dynamics of economic development, as well as allows to determine the trend of enterprise development, which is the subject of interest of a wide range of stakeholders.

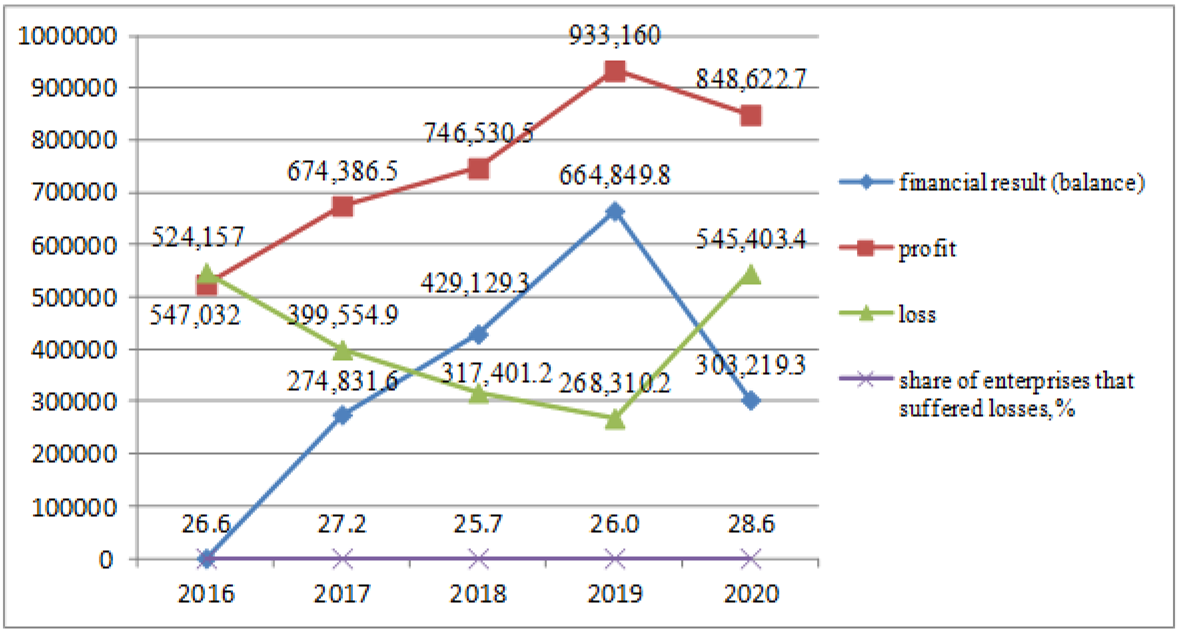

Fig. 3. Financial results of enterprise before taxation
Source: Own results based on the data from [11].

The financial result (balance) from the unprofitable UAH 22,875 million was reduced to the profitable UAH 303,219.3 million in 2020, although the highest level of the balance for the study period was observed in 2019 at UAH 664,849.0 million. Profit in 2016 amounted to UAH 524,157.0 million in 2020 increased to UAH 848,622.7 million, but in 2019 the profit amounted to UAH 933,160.0 million, which is 10% more. The loss by 2019 tended to decrease and if in 2016 this figure was 547,032.0 million UAH in 2019 decreased to 268,310.2 million UAH, ie the loss decreased by almost 50%, but in 2020 this figure reaches 545.0 UAH 403.4 million, ie the amount of damage returned to the level of 2016. If we examine the share of enterprises that suffered a loss, we can say that from 2016 to 2019, this figure remained almost at the same level of 26.0%, but in 2020 there was an increase of 2.6%. In general, it can be argued that with the overall positivedynamics, there is a significant decrease in key indicators in 2020. These results indicate the negative impact caused by political events and the pandemic, the results of which Ukrainian companies failed to offset with profits (Figure 3).
Let's highlight the main factors that hinder the development of modern entrepreneurship in Ukraine: military action, which is actively conducted in eastern Ukraine, which led to the deterioration of the business environment; reducing the investment attractiveness of the economy; saving significant amounts of costs associated with the liquidation of enterprises; reduction of the solvency of the population, which has a negative effect on the decline in consumer demand; imperfect legal framework in the field of entrepreneurial activity; inefficient financial and credit policy of business development; low level of qualification of entrepreneurs.

CONCLUSIONS

After conducting the analysis, it can be stated that business entities today operate in unfavourable external and internal environments. The rapid depreciation of the national currency and, as a result, a sharp decline in the investment attractiveness of the Ukrainian economy, hostilities in the east of our country, and other destabilizing factors have negatively affected the activities of businesses, pose additional threats to their business.
Economic recovery and gradual growth should be based on building a high-tech business sector and increasing its

competitiveness in European and global markets. The priority should be to study the impact of key factors on strengthening competitiveness and their role in the innovation activity of the business sector, the formation of a favourable regulatory environment and innovation and investment climate.

The competitiveness of the enterprise should be considered taking into account the factors of product competitiveness, the potential of the enterprise, industries, regions and the country as a whole. Competitiveness factors for each level have their own specifics. Depending on the combination of influencing factors, a particular enterprise is characterized by the achieved level and the special nature of the formation of competitiveness. In addition, a specific combination of factors is an objective prerequisite for the formation of stable competitive positions of the enterprise, which in turn enhances competitiveness. The proposed mechanism for determining the impact of factors on the competitiveness of the enterprise and the algorithm for its strengthening allows to develop a system of indicators of competitiveness and methods of its evaluation, to direct them to neutralize the existing problems of the enterprise. This system of factors allows you to create and maintain the appropriate level of competitive advantage of the object of study, as well as to determine the strategic, current and operational measures to manage the competitiveness of the enterprise.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SOCIAL STATUS AND STANDARD OF LIVING OF THE RURAL POPULATION AS PREREQUISITES TO CHANGE THE SOCIAL PARADIGM OF THE DEVELOPMENT OF RURAL TERRITORIES IN RUSSIA

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Abstract

The purpose of the study In preparing the article, data from the Federal State Statistics Service of the Russian Federation, materials collected as a result of a survey of residents of rural areas, scientific works of Russian and foreign scientists were used. The study was based on the works of T. Kuhn and the theory of structural functionalism of T. Parsons and R. Merton. To determine the social status and standard of living of the population of rural areas, a questionnaire survey was conducted, during which the following were determined: the level of education, pension and social security, the amount of income from labor activity, wages of residents, as well as infrastructure provision of villages. The results of such a study showed that the current socio-economic situation in the countryside is characterized by a high level of unemployment, poverty, and negative trends in the social sphere.

Key words: *social status, standard of living, rural population, social paradigm, Russia*

INTRODUCTION

The modern development of the agro-industrial complex of Russia began with the adoption in 2006 of the priority national project "Development of the agro-industrial complex", where, as part of the support of rural areas, it was envisaged to provide affordable housing for young specialists in rural areas. In continuation of this document, the State Program for the Development of Agriculture was adopted, in which a separate subprogram was developed to support rural areas. However, as the current state and level of socio-economic development of rural areas in Russia shows, support programs for 15 years have not yielded tangible results – there is a decrease in the quality of life, an increase in unemployment, a demographic crisis, and an increase in social stratification between urban and rural populations [7]. The continuation of the current trend will lead to a loss of food security and the impossibility of import substitution of basic food products. Changing the social paradigm of sustainable development of rural areas of the region will change the socio-economic situation, which will reduce social tension, increase the attractiveness of rural life, change migration flows and become a catalyst for the development of agriculture in the region.

The concept of paradigm was introduced into the philosophy of science by G. Bergmann [2] to define methodological standards (he considered the paradigm "general criteria and patterns of methodological research"), but T. S. Kuhn revealed the concept most deeply in his works [12].

A number of domestic and foreign scientists were engaged in research and substantiation of scientific paradigms in relation to rural territories: A.I. Kostyaev [10], Z.I. Kalugina, O.P. Fadeeva [9], S.G. Bylina [4], F. Ellis, S. Biggs [5], D. Byerlee, A. Janvry, E. Sadoulet [3], M. Ambrosio-Albalá, J. Bastiaensen [1], E. Guinjoan, A. Badia, A. F. Tulla [8], J. D. Ploeg [18], Kudriashova et al., 2021 [11], Novikov et al., 2021 [14] etc.

The experience of developing issues of sustainable development of rural areas has been accumulated by I.G. Ushachev, L.V. Bondarenko [19], A.V. Petrikov [17], A.I. Kostyaev [10].

The need to change the existing paradigm of rural development to improve the quality of life of the population, as well as the high scientific and practical importance of developing a social paradigm for rural development, served as the basis for the study.

In this context, the purpose of the paper is to assess the social status and standard of living of the rural population in order to determine the prerequisites for changing the social paradigm of the development of rural areas in Russia.

MATERIALS AND METHODS

As part of our research, we will rely on the theory of the disciplinary matrix of T. Kuhn and the theory of structural functionalism proposed by T. Parsons [16], developed and refined by R. Merton [13].

The concept of a scientific paradigm was first formulated by Thomas Kuhn [12]. The transformation of paradigms, in his opinion, occurs in the process of scientific revolutions, and the sequential transition from one paradigm to another through revolution is a common model of the development of science. Despite the fact that the author believes that paradigms change in the process of scientific revolutions, which proceed from the solution of anomalies arising in old paradigms, due to the evolution of science in particular and human society as a whole, he also points out that every even the most minimal scientific achievement has an impact on the existing scientific paradigm, thereby modifying it. Can a modified paradigm be considered a new paradigm? Kuhn does not give a clear answer to this question. Under the influence of criticism on his work, he supplemented and reformulated the definitions of the paradigm. Later, to separate the concepts of the paradigm and the scientific community, he introduces the concept of "disciplinary matrix", structuring the paradigm into 4 components "symbolic generalizations", "metaphysical paradigms", "values" and " exemplars".

T. Parsons studied social phenomena as a system, the main property of which he considered the restoration of equilibrium after a destructive impact. The actions of a socially correctly motivated person are aimed at maintaining the social system in balance. However, Parsons believes that the system cannot be in a state of complete equilibrium, because it is constantly affected by destructive factors. He uses not only the concept of "system", but also the concept of "structure" – a certain scheme of stable elements of an integral system extracted from it. The author uses the concept of structure in the analysis of social objects, calling it structural and functional analysis, suggesting a set of functional problems for its implementation: adaptation, goal-attainment, reproduction of structure, stress relief and system integration.

R. Merton studied middle-level theories – the directions of development of sociology between theoretical and empirical research. He believed that sociology would be delayed in the development of universal sociological systems, and its advancement depended on the development of middle-level theories. Merton refutes the three main postulates of functional analysis, putting forward his paradigm showing the essence of his concepts, procedures and challenges, the main purpose of which is to define a preliminary codified guideline for functional analysis, it should also lead to the postulates underlying functional analysis and make the sociologist realize political and ideological conclusions.

To evaluate the social situation and the living standard of the rural population, it was chosen a sample of the residents from Saratov region, Russian Federation.

The field survey was conducted in 5 districts using a sample of respondents with a different social status and age.

A questionnaire was set up consisting of 4 parts: education and social status; pension and social security; income from work and wages; infrastructure support.

The answer have been processed and expressed in percentage for each studied criterion, illustrated in Tables and graphics, and correspondingly interpreted.

RESULTS AND DISCUSSIONS

The socio-economic situation of the Russian Federation is currently characterized by a decrease in real incomes of the population, a decline in production, an increase in unemployment, negative demographic trends, and an increase in poverty. All social indicators are aggravated by the epidemiological situation of COVID-19. The main socio-economic indicators of Russia are practically not increasing or decreasing in dynamics (Table 1), the average monthly salary in 2020 was 589.6 euros, the pension was 180.8 euros, the growth of these indicators in dynamics is lower than the real value of inflation in the country.

Table 1. The main socio-economic indicators of the Russian Federation

	2020	2020/2019 %
Industrial production index, %	100.0	97.9
Agricultural products, billion euros	74.3	101.3
including:		
crop production	41.5	100.7
livestock production	32.8	101.9
Investments in fixed assets, billion euros	231.0	98.6
Retail trade turnover, billion euros	389.0	96.8
Catering turnover, billion euros	16.6	77.4
The volume of paid services to the population, billion euros.	103.4	85.2
Average monthly nominal accrued salary of one employee, euro	589.6	107.3
The real salary of one employee, %		103.8
Average monthly pensions, euro	180.8	105.6
Consumer Price Index, %		104.9
The number of officially registered unemployed, thousand people	2,773.1	99.7
The number of permanent population, million people	146.2	99.6
The coefficient of natural attrition per 1,000 people of the population	–4.8	218.2

Source: Compiled according to [6].

The socioeconomic characteristics of the sample of respondents questioned in the 5 districts of Saratov region are as presented below.

The average age of the respondents was 42 years (the study was conducted in the group from 18 to 83 years). Of the respondents, 33% indicated the status of their main activity as "Employed"; "Working pensioner" - 18%; "Non-working pensioner" - 22%; "Student/student" - 19%. One person worked at his own company and seven were engaged in household chores.

As for education, the largest share among the respondents is occupied by people with secondary vocational education – 32%, most of them are employed or working pensioners aged 54 to 68 years. Secondary (full) general education was noted in the questionnaire by 28% of respondents, all of them are students. 24% of respondents indicated higher education, mostly people under 35 years of age, all of them are employed. 10% of respondents have basic general education, 6% have incomplete higher education.

According to the study, 20% of respondents cannot afford to regularly relax outside the home (sports, theater, cinema, etc.) and have lunch with friends/relatives at least once a month; 30% do not have the opportunity to spend a certain amount of money weekly without coordinating with anyone (Figure 1).

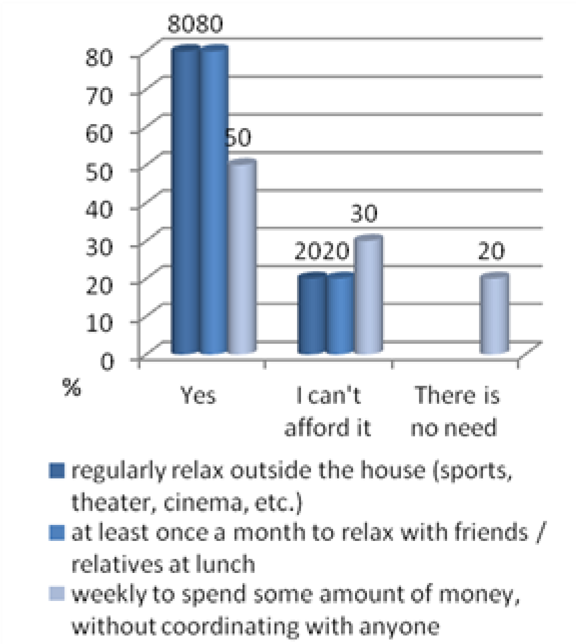

Fig. 1. Respondents' answers to the question "Do you have the opportunity to afford?"
Source: Compiled based on the results of the survey.

Of all the respondents, 42% received a pension. The average old-age pension indicated by the respondents was 136.15

euros, which is lower than the regional average of 165.81 euros. Below the subsistence minimum, 7% of pensioners received pension provision, in accordance with this, they received an additional payment up to the amount of 110.06 euros.

During the analyzed period, 55% of respondents had a paid job, of which 7.3% the employer did not provide uninterrupted work experience, the break in the length of service averaged 2.5 months. According to the questionnaire processing data (Table 2), it can be concluded that the average salary of the respondents ranges from 180-265 euros, which is much lower than the official regional average of 385.19 euros.

Table 2. Respondents' estimate of the approximate amount of monthly earnings

Approximate amount, Euro	Respondents, %
Less than 140	12.7
140–170	14.5
170–230	5.5
230–290	14.5
290–350	5.5
350–400	3.5
400 and more	3.6

Source: Compiled based on the results of the survey.

Only 18% of respondents have the opportunity to receive additional income. Employees have the opportunity to receive an additional approximately 60-170 euros per month, pensioners - 60-110 euros per month, students up to 60 euros.

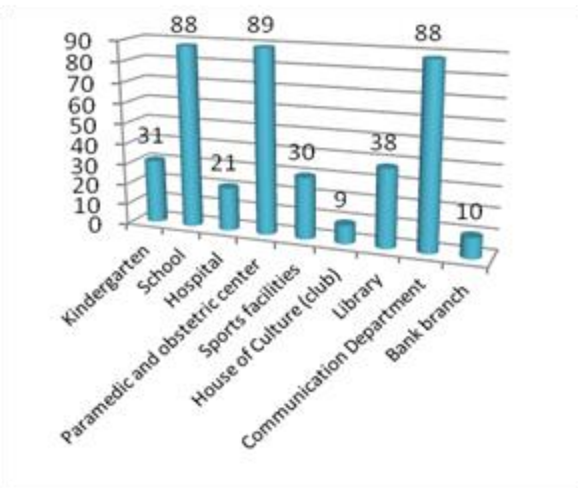

Fig. 2. Structure of respondents' responses about the availability of infrastructure facilities in their places of residence, %

Source: Compiled based on the results of the survey.

The structure of respondents' responses about the availability of infrastructure facilities in their places of residence is shown in Figure 2.

All interviewed residents of rural areas were asked to choose the objects of improvement of their place of residence from the proposed list. Based on the answers, it can be concluded that the entire population of the region is provided with gas, a little more than 30% have water supply and sewerage. 7% of respondents have an unsatisfactory assessment of their living conditions, 18% of respondents are completely satisfied with their living conditions; 48% - want to improve the existing housing; 10% - expand the housing area; 20% - purchase their own housing.

Sustainable development of rural areas is the most important goal of modern state agrarian policy, different points of view on the problem under study indicate the need for deeper scientific study and concretization of practical measures for its implementation. The current socio-economic situation in rural areas is characterized by high unemployment, poverty, negative trends in the social sphere: the deterioration of the demographic situation, the destruction of social infrastructure, the processes of outflow and decline in the quality of labor. The change in the qualitative characteristics of the life of the rural population negatively affects the reproduction of labor resources as the basis for sustainable socio-economic development of rural areas. The development of a social paradigm for the sustainable development of rural areas in the region is one of the necessary strategic goals of agricultural, demographic and social policy, the achievement of which will ensure food security, competitiveness of the national economy and improvement of the quality of life of the population. To achieve it, based on the theory of the disciplinary matrix T. Kuhn the prerequisites for the formation of a social paradigm of sustainable rural development have been developed:

1. The emergence of new goals and values. The emergence of the term "sustainable development" within the framework of the UN activities, meaning economic and social changes that allow the modern generation of people to meet their needs without prejudice

to the future generation. This approach has caused the need to revise concepts and principles, focusing on the social component and a harmonious attitude to the environment.
2. Dissonance of social processes in rural areas. The social stratification between rural and urban populations, social tension due to high levels of poverty and unemployment prove that the current direction of development and support of rural residents does not allow achieving the necessary quality of life to solve these problems. Thus, there was a need to change the paradigm of rural development.
3. Formulation of a hypothesis for the development of a social paradigm for the sustainable development of rural areas in the region.
4. Development of the matrix of the social paradigm of sustainable development of rural areas of the region, including 4 components (Figure 3): methods; theories; symbolic designations; values.

Methods	**Theories**
Symbolic designations	**Values**

Fig. 3. Matrix of the social paradigm of sustainable development of rural areas of the region
Source: Compiled by the author.

The study of the theoretical and methodological foundations of the subject under study, as well as the development of prerequisites for the formation of a social paradigm for the sustainable development of rural areas, made it possible to clarify the content of this concept, namely, "a set of theories, methods, symbolic designations and values of society, the correlated action of which involves the transformation of rural development processes for the coordinated functioning of social, economic and natural aspects of the population's activities".

CONCLUSIONS

The study of the social situation and standard of living of the rural population of Russia reflect the objective need to develop prerequisites for a paradigm shift in the development of rural areas of the country.
The study revealed that the old-age pension indicated by the respondents, as well as the average wage level is lower than the national average, that is, employers pay lower wages to rural residents. Also, rural residents are not fully provided with social infrastructure facilities, in many localities there are no bank branches and sports facilities, in some there are schools, kindergartens and communication offices. Water supply and sewerage are inaccessible to most villagers, and only 10% of respondents have hot water and central heating in the house. The gap in the standard of living of rural and urban populations entails an outflow of rural residents to cities, as well as high social tension.
The theoretical aspects of the development of the social paradigm of rural development were studied and the prerequisites for its formation were substantiated: the emergence of new goals and values; the dissonance of social processes in rural areas; the formulation of a hypothesis for its development and the development of a matrix of the social paradigm of sustainable development of rural areas of the region, including 4 components (methods, theories, symbolic designations and values). The content of the concept of "social paradigm of sustainable development of rural areas" is clarified – it is a set of theories, methods, symbolic designations and values of society, the correlated action of which involves the transformation of rural development processes for the coordinated functioning of social, economic and natural aspects of the population.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EXPLORING ROMANIAN AGRI-FOOD COOPERATIVISM AS A WAY OF CONSOLIDATING SUSTAINABLE RURAL DEVELOPMENT

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Abstract

European agriculture is a sector that is in a decisive moment of transformation. The transition from small farms to viable and sustainable businesses is difficult and often traumatic. One of the ways to face these changes is through the grouping of farmers creating agri-food cooperatives. This model has proven successful in Sweden or Finland but has not been developed equally in all territories. Romania is a country with no deep-rooted cooperative tradition. However, it has exciting and promising initiatives that may represent an alternative development path, especially in rural areas. This paper addresses the current situation of agri-food cooperatives in Romania, analysing its immediate past and exploring the opportunities that arise in the future through a scientific literature review. Results help to better address future actions on cooperative promotion.

Key words*: *associationism, agri-food sector, cooperativism

INTRODUCTION

Cooperativism is an associative movement that seeks, based on synergies, to provide services and value to the members of this type of entity. This movement, which emerged in England at the end of the 19th century, rapidly expanded internationally and now represents a significant presence in the economy. It is estimated that around 12% of the world's population is a member of one of the three million cooperatives globally [15]. Today it is possible to find cooperatives of various types: housing, consumer, fisheries, transports, labor or agri-food [2]. Agrarian cooperatives represent the autonomous association of private individuals or legal entities, having a private law juridical status, established upon free consent of the parties with the purpose of promoting the interests of the cooperative members [18].

In Europe, the cooperative movement has had a particularly significant presence in the agri-food sector. In most cases, cooperatives have provided access to factors of production, technology, or markets for farmers and growers. The association has proven to be especially beneficial in the case of small farms that do not have sufficient production volume to maintain a strong negotiating position vis-à-vis suppliers or large customers.

In countries such as Denmark or France, the market share achieved by agri-food cooperatives is very high, even leading the market. In Italy, Spain, or Italy, there is a high number of cooperatives [7] because their existence makes land exploitation viable and allows joint commercialization

Romania has a very high production potential in the agri-food sector. Its more modern history, the end of a socialist era, and the transition to capitalist economies has led it to define the business model that can best develop this potential. It is a territory of contrasts, with many subsistence farms [19], which need to increase their productivity to generate surpluses. At the same time, a small number of holdings agglutinate a vast extension of land [27]. However, in the last decades, there have been some successful experiences in creating and developing associations or cooperatives that allow progress in knowledge, management, and market vision [2].

This paper explores the most recent research on agri-food cooperatives in Romania. In this way, it will be possible to identify weaknesses, strengths, threats, or opportunities for this sector. It will additionally help the sustainable development, especially in rural areas [5].

MATERIALS AND METHODS

To this end, a systematic review was carried out [8]. This methodology is characterized by a precise definition of the purpose of the work, a comprehensive search with a relevant selection of information using of explicit criteria, a critical evaluation of the results obtained, and reproducible decisions regarding relevance, selection, and methodological rigor. This method, conceived for the field of natural sciences, is nevertheless discouraged by some authors [14], for example) for use in the social sciences, due to its positive epistemological nature.

According to the methodology proposed by [10], the approach adopted for the review is that of narrative synthesis. The advantage is that it accommodates diverse works and studies, the review process is flexible and allows the exploration of novel topics, and the identification of different approaches to the mainstream.

The search was carried out in January 2022 using the Web of Science database of scientific papers, identifying papers that combined the terms "Agri-food cooperative", "Agricultural cooperative" with "Romania", "Romanian", in the title or as keywords. The only results considered were scientific articles in English or Spanish. Only publications from 2000 to 2021 were considered. The results obtained in Web of Science were 43 papers. After discarding those duplicated or that were not directly link to the topic, 37 papers made the sample that has been analysed.

RESULTS AND DISCUSSIONS

The growing interest in agri-food cooperatives in Romania is also reflected at the academic level in the number of publications in high impact journals indexed in the Web of Science (Figure 1). Specially from 2015 a remarkable number of scientific publications have studied different aspects about agricultural cooperatives in Romania. This might be linked to what [27] recognized as early signs of a change in the perception and treatment of agricultural cooperatives.

Topics covered a wide range of angles, from the contribution to rural development [4, 19, 16] to the determinating factors for farmers to join a cooperative, being the reluctance from farmers to associate one the most frequent comments that is present in almost every contribution. Another claim in most of the papers refers to government support and guidance in promoting these entities [11, 24, 26].

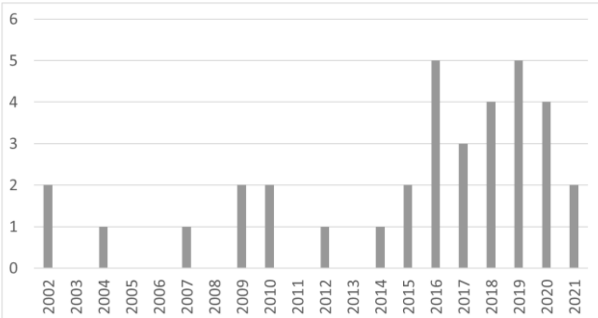

Fig. 1. Number of academic papers annually published in WoS journals related to agricultural cooperatives in Romania
Source: WoS journals.

[25] stated at an early point the urge for undertaking associative processes to help farmers to join forces and help them overcome financial constraints and structural problems. They provide some guidelines as to help the development of rural areas based on the constitution of associative forms, recommending public administrations to take active part in this transition [21].

A survey among agricultural cooperatives was conducted and documented in the work of [4]. Results from a sample of 284 organizations showed differences in the educational level of farmers in cooperatives according to regions.

In North-Eastern region, the majority had completed primary education while in South, South-Western, North-Western and Centre regions, the top position is occupied by farmers that completed high school. Regarding the existence of employees, only 36% had permanent workers and 53% had no employees. Referring to the most constraints in their activity, they pointed out the lack of funding, market problems and lack of information as their most pressing problems at the time. On the bright side, they confirmed the youth of the new generation of cooperativists, being the group aged 31-40 the most numerous.

Advantages and disadvantages from the point of view of the farmer were analysed in [18]. Among the pros, the reduction of the number of agents in the supply chain, the increase in influence, the improvement in negotiating supply terms or the easiness for adopting technology. On the other side, distrust, lack of vision, insufficient education or lack of financial sources were stated as difficulties to overcome to create a cooperative. In similar terms, a SWOT analysis identifying the most relevant aspects for a Romanian farmer to join a cooperative is contributed by [7]. The work also remarks the difference in number and in size that Romanian cooperatives hold in comparison to some of the Western cooperatives, such as the ones of Germany or Netherlands, appointing the way these entities can help develop rural areas in a sustainable way.

This long way ahead as also noticed by [18 and 4]-this latter, based on a study on the agricultural cooperatives at the moment- urges for a training program aimed at cooperative managers so they can lead the process. Leadership is a key element in any process involving an organization. [13] studied the impact of hiring professionals as directors, linking the absence of them to the risk of failure at the cooperative. They also include the need of transparency and education as well as the group, the existence of facilities and the member support. Over a sample of 20 second order Romanian cooperatives they applied qualitative and quantitative analysis, concluding that all five elements were significant in the survival of the organization.

Another question that arises from some of the works is the legal frame under which cooperatives are developing their activity.

[4] highlights the access to funding as the biggest problem, due to legal restrictions related to the definition of the legal form.

[12] stress the need to increase transparency and dissemination of information about cooperatives as well as the dissolution of cooperatives at their request.

A practical proposal involving NGOs as catalysts for the implementation of agricultural cooperatives is explained in [19]. Following some prior experience in a similar context in Nepal, it is suggested to promote organic farming through cooperatives as a way to ensure income to farmers with the aid of NGOs.

The poor formation of farmers as the slow structure of their commercial behavior are factors appointed by [14] as contributors to the difficult situation of contracts among the agrarian supply chain. It is also one of the most aspects that can benefit the most from the cooperation/association, according to authors.

Another interesting point is the one of trust. *Lack of trust seems to be one of the most important factors of influence why formal organizations did not emerge after the change of regime*, appoint [26]. However, these authors also add that instead of formal organizations, farmers cooperate in informal ways, they usually group according to vicinity or family ties and help each other or share key resources. [22] coined this informal groups as *family societies*. Although these groups need coordination and they are becoming more, and more frequent, their lack of registration makes it impossible to quantify its importance.

[1] conducted an extensive study about several of those groups and express serious doubts about the trust issue, arguing that *people feel cooperation is more difficult now, it is expressed in terms of changes in values and perspectives rather than a lack of trust.*

One of the most recent and complete works was based on key informant interviews. Carried out by [27], it describes the evolution of agriculture in Romania, starting from the XIX century and stating the main consequences that the various political situations have had into the Romanian agricultural structure. Nowadays a dual pattern of farms exists, where there is a large number of small and semi-subsistence farms (54.1% had less than 1ha in 2016), whilst a small number of large farms account for almost half of the utilized agricultural area (INSSE, 2018). Wolz's work concludes that a change of sign might have happened in the past years (appointing reasons such a better legal frame or improvements in taxes). They remark that cooperatives have been increasing its number and that they have found mainly two gaps to fill in the market: associations aiming at the information exchange and others, more complex, that also provide services to the members [27].

This growing interest is also corroborated by [12] in their work. They explain it also from the legal point of view, due to the improvement in tax conditions that started in 2019; also in the coverage that national organizations have linked farmers and government and in the establishment of the National Register of Agricultural Cooperatives from Romania. Also, [23] detects an increase in consultation, education at a national level to consider the mechanism of association as a whole. This mentioned change is visible for example, through the increase in the overall turnover of cooperatives, which doubled from 2015 to 2018. [17] quantify this change through a survey conducted in 19 counties where they found out that 82.1% of the farmer were willing to join an associative form of organization in the near future. In addition to this, [20] studied a sample made of farmers from the South-East region and concluded that 64.2% of respondents to the survey considered that the development of social agricultural cooperatives would greatly influence the economic development of local communities.

Nevertheless, [9] lists legal changes from 1989 and expresses the need to continue improving the legal situation so cooperatives can solve their problems accessing to European funding, the land fund problem or some tax barriers. And, those precisely the factors appointed by [6] as the dynamic ones that encourage farmers to form cooperatives.

Finally, some research related to the impact of COVID-19 pandemic has analysed the social resilience in rural areas in relation to social economy organizations. [24] remarks the consideration of cooperatives as one of the main vectors in following social and economic goals.

Advantages of agricultural cooperatives

As stated by [27], cooperatives can help farmers to overcome the high transaction costs of their small holdings. They can improve access to credit when allowing acting as a financial entity, they funnel investments and resources from EU [14]; they can provide access to technology and training [16] and reduce barriers of entry into market by improving bargaining power. [7] adds economies of scale because of the possibility of joint purchases, with effects on quality, cost and conditions. This all leads to improvements in quality that finally make it possible to enter into premium markets [3, 4].

As stated by [11], cooperatives also help to adjust to the European systems and protocols. They also increase accessibility of farmers to technical, legal, economic expertise by creating cooperative service. In this line, [14] appoint the opportunity to increase training (understood as education).

CONCLUSIONS

The presence of agricultural cooperatives in Romania has its roots in the XIX century although political regimes and continuous changes have limited the continuance of the entities. Current cooperatives, although facing some limitations and many challenges in their beginnings, are called to be one real alternative for those small Romanian farms that –as it happens in many other European countries with structural problems in their agricultural holdings- need to gain size.

The impulse from Europe and a new generation of young and more prepared farmers can be the turning point to definitely enable this legal form as a real option for farms to increase their productivity.

Some demands have been attended and the sector seems to respond well to recent improvements. Further support is needed to continue in this path.

At an academic level, it is possible to see an evolution in the existing knowledge about agricultural Romanian cooperatives. Descriptive papers and contributions written in conditional have led to analytical studies and documents that deal with complex problems of ongoing businesses. That can only be a sign of progress for the Romanian agrarian cooperativism.

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FIXED ASSETS AS AN ELEMENT OF THE PRODUCTION POTENTIAL OF THE AGRICULTURAL SECTOR IN REGIONS

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Abstract

The purpose of the study is to assess the current state of fixed assets of the agricultural sector in the Penza region and their use. The information resources were the results of scientific research by leading scientists in the field of the use of fixed assets, as well as data generated by the authors on the basis of official statistical materials for the Penza region. For analytical data processing, methods of scientific generalization, systematization and statistical groupings were used. In the course of the current research, indicators of the provision of agricultural organizations with fixed assets were calculated and systematized, and trends in their change were determined. For the period from 2014 to 2020, the indicators of capital ratio and capital-labor ratio of agricultural organizations in the region increased by more than 4 times. In order to identify the influence of factors on the capital ratio per 100 hectares of agricultural land, 125 agricultural organizations of the Penza region were examined and grouped. In the group with the highest capital ratio (5 million rubles or more of fixed assets per 100 hectares of agricultural land), the maximum return on fixed assets is 5.5% and the profitability of production is 17.9%. The article identifies strengths and weaknesses in the use of fixed assets, opportunities and threats. Opportunities to improve the efficiency of the use of fixed assets by agricultural organizations of the Penza region can be achieved through the technical improvement of machinery and equipment, production technologies; focus on the high technical level of fixed production assets; fuller use of available fixed assets.

Key words: *production potential, fixed assets, capital ratio, efficiency*

INTRODUCTION

The problem of efficient use of the production potential of the agricultural sector of the economy is currently the most important part of the country's economic development strategy [2].
In the scientific papers under the term "potential" refers to the ability to produce a certain volume of products over a period of time, subject to the full use of available land, material and technical, labor, biological and financial resources. The development of the agricultural sector is defined by a combination of the main factors used in production, on which the quantity and scale of crop and livestock production, which are the main sectors of the agricultural sector, depend to a certain extent. The main factors of production in the agricultural sector are: land, labor, animals and plants, material and technical base, organizational and managerial activity of business leaders [1, 10].
The effective use of the production potential of agriculture in the region and organizations provides for the rational use of resources included in its composition [5].
The effectiveness of the production potential of participants in the agricultural business depends on the effectiveness of the use of its constituent elements. In conditions of limited available resources, economic entities are faced with the need to improve the efficiency of the use of production potential. To a greater extent, this applies to the fixed assets of organizations that require significant investments in their renewal and maintenance.
Fixed assets are the most significant element of the production potential of economic entities, providing the material and technical base and conditions for production activities.
The most complete and rational use of fixed assets contributes to the improvement of all technical, economic and financial performance indicators of agricultural organizations and the agricultural sector of the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

region as a whole. The current importance of the identified problem proves the necessity to assess the current state of fixed assets of the agricultural sector of the Penza region and their rational use. In the current research, indicators of the effectiveness of the use of fixed assets were calculated and systematized, trends in their change and renewal were identified, strengths and weaknesses in the use of fixed assets, opportunities and threats were identified. Based on the results of the research, recommendations were developed to improve the efficiency of the use of fixed assets in the agricultural sector of the regions.

The purpose of the study is to assess the current state of fixed assets of the agricultural sector in the Penza region and their use.

MATERIALS AND METHODS

For a detailed study of the identified problem, the performance indicators of agricultural organizations of the Penza region for the period from 2012 to 2020 were used.

Within the current research the main emphasis was placed on the analysis of the provision indicators of agricultural organizations in the Penza region with fixed assets (capital and capital-labor ratio). The capital ratio is calculated as the ratio of the average annual value of fixed assets to the area of agricultural land, multiplied by 100. This indicator characterizes the size of fixed assets in value terms per 100 hectares of agricultural land.

The capital-labor ratio characterizes the provision of labor resources with fixed assets and is calculated as the ratio of the average annual cost of fixed assets to the average annual number of employees.

The theoretical and methodological basis of the study was the works of the classics of agrarian economics, the work of modern domestic and foreign economists.

When writing the article, data from the Territorial Authority of the Federal State Statistics Service for the Penza Region, the Ministry of Agriculture of the Penza Region were used.

The research was carried out using general scientific methods (dialectical, analysis and synthesis, comparison and analogy), as well as special methods of economic science (system analysis, comparative analysis, economic and mathematical methods).

RESULTS AND DISCUSSIONS

Fixed assets are one of the most essential elements of the production potential, as they together provide the material and technical base and conditions for production activities. The fixed assets of the agrarian sector are the basis of the country's food security [9]. The most complete and rational use of fixed assets makes it possible to increase labor productivity, increase production volumes, improve product quality and, ultimately, contribute to the improvement of all technical, economic and financial performance indicators of agricultural organizations.

In the process of research, it is important to assess the availability, condition and degree of use of fixed assets that form a significant part of the production potential of enterprises in the agricultural sector of the economy.

The Penza Region is located in the center of the European part of Russia and is part of the Volga Federal District. Agriculture plays a special role in the region's economy. This sector of the economy accounts for about 15% of the gross regional product.

In the period from 2012 to 2020, there was a trend of active development of agriculture in the Penza region. In 2020, compared to 2011, the production volumes of this industry increased by 72.9%, including crop production by 89.0%, livestock products - by 58.4%.

In 2020, the region produced agricultural products in actual prices in the amount of 129.1 billion rubles, including crop production - 73.8 billion rubles, livestock products - 55.3 billion rubles. In a comparable assessment, the increase compared to 2019 was 14.4%.

The volume of agricultural production and the value of the result indicators of agricultural organizations depends on the extent to which the main production assets are involved in the production process, how agricultural organizations are provided with them, what is the structure of the main production assets [3].

An important factor in the growth of the efficiency of the agrarian sector of the region is the growth of capital ratio and capital-labor ratio (Figure 1).

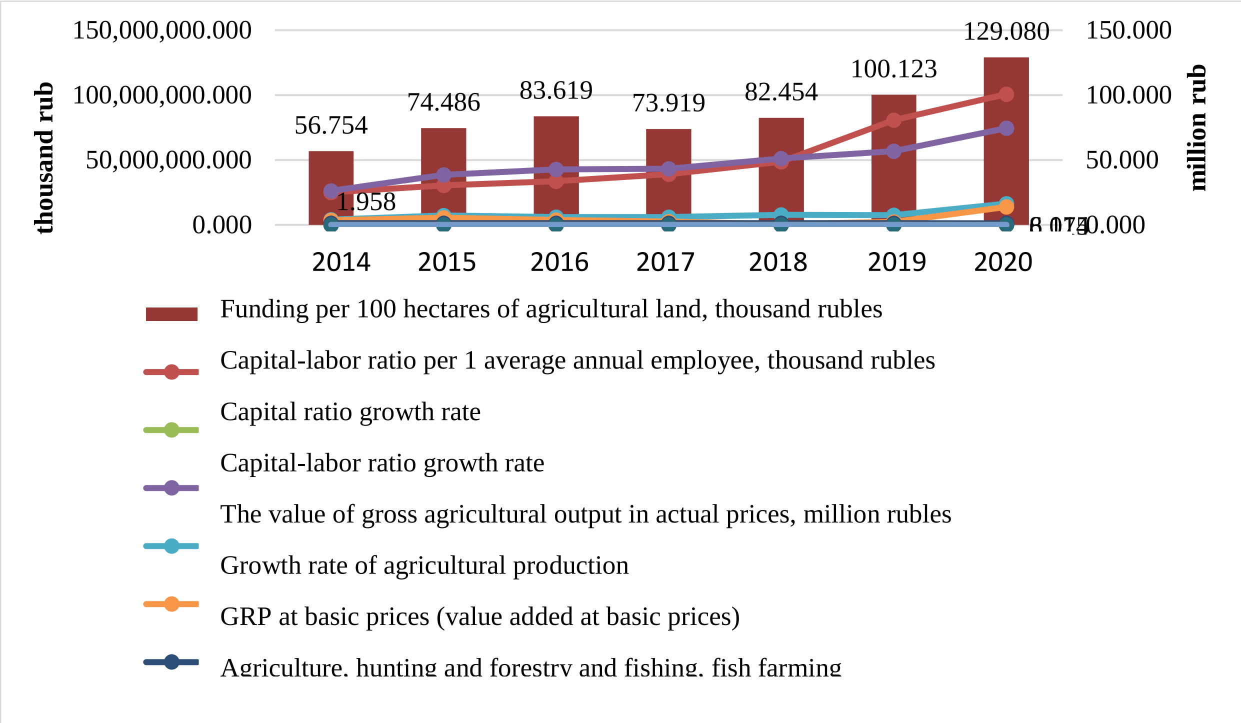

Fig. 1. Dynamics of gross agricultural output and provision of fixed assets of agricultural producers
Source: Compiled by the authors based on data from the Territorial Authority of the Federal State Statistics Service in the Penza Region [12].

The dynamics of gross agricultural output corresponds to the trends in the change in capital ratio in value terms. In the period from 2018 to 2020, when there is the most active increase in capital ratio and capital-labor ratio, there is an intensive increase in the volume of agricultural production.

In 2014, the value of gross agricultural output in the Penza region amounted to 56,754 million rubles, then in 2020 - 129,080 million rubles, or 2.3 times more.

And if at the beginning of the period under review there were 1,479 thousand rubles per 1 agricultural worker of fixed assets, then in 2020 the number reached up to 6,114 thousand rubles, or 4.1 times more. Correlation of fixed assets with land resources of agriculture makes it possible to obtain and analyze such an indicator as capital security. In terms of 100 hectares of agricultural land in the region, there were 1,958 thousand rubles of fixed assets in 2014, and in 2020 - 8,075 thousand rubles (growth rate 4.1 times).

Consider the structure of fixed assets of agricultural enterprises in the Penza region (Figure 2).

The share of the passive part of fixed assets, which includes buildings and structures, increased from 37.2% in 2014 to 49.2% in 2020.

The cost of land plots practically did not change during the analyzed period. However, against the background of an increase in the total cost of fixed assets, their share decreased from 11.9% to 4.8%.

The share of machinery, equipment and vehicles that make up the energy potential decreased in the analyzed period - from 44% in 2014 to 42.0% in 2020.

According to the latest annual review of the situation in the agro-industrial complex published by Rosstat, as of December 31, 2012, agricultural producers in the Penza region had 3,391 tractors, 885 grain harvesters and 96 forage harvesters.

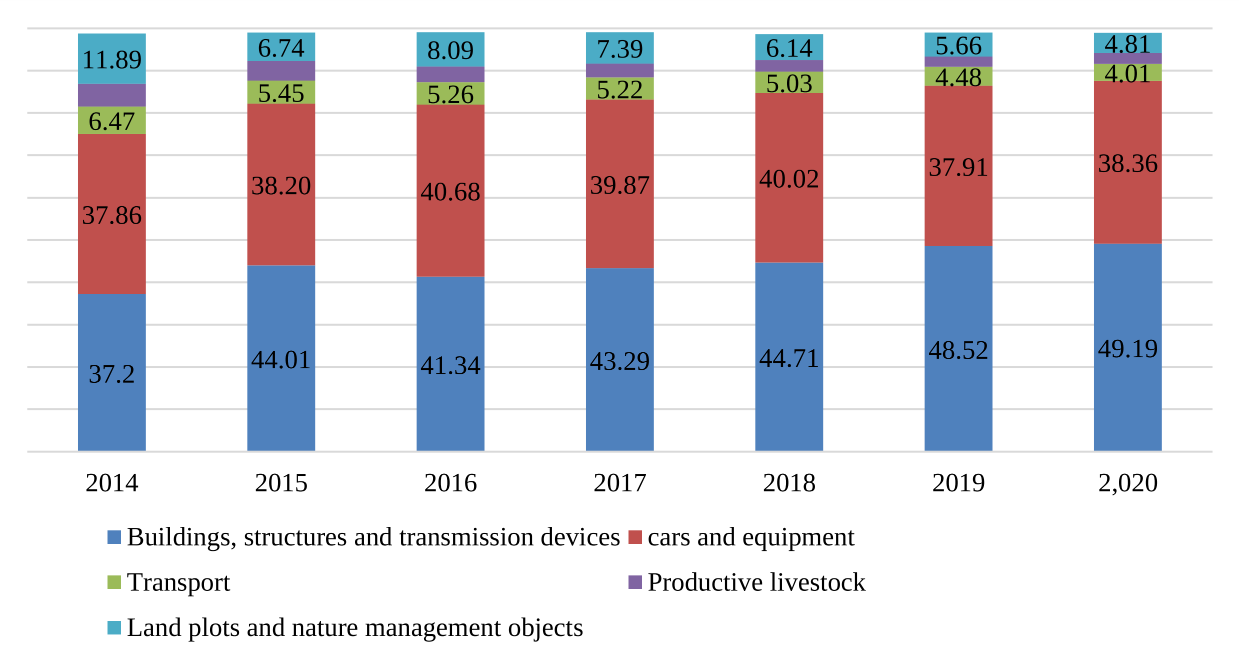

Fig. 2. Structure of fixed assets of agricultural enterprises in the Penza region
Source: Compiled by the authors based on data from the Territorial Authority of the Federal State Statistics Service in the Penza Region [12].

Since December 31, 2020, all regional agricultural producers had in general 2,720 tractors (80.2% compared to the corresponding date of 2012), 741 combine harvesters (83.7%) and 207 forage harvesters (46.3%) (Table 1).

Table 1. Types of the main equipment in agriculture of the Penza region

Type of equipment	2012	2014	2016	2017	2018	2019	2020
Tractors	3,391	2,959	2,787	2,847	2,643	2,625	2,720
Plows	728	628	669	662	731	657	606
Cultivators	1,669	1,461	1,389	1,418	1,362	1,301	1,188
Seeders	1,317	1,083	1,061	1,068	1,224	1,213	880
Mowers	440	364	337	331	336	311	301
Balers	281	246	224	211	209	192	181
Windrowers	270	223	215	230	226	260	227
Combines:							
grain harvesters	885	718	704	764	731	771	741
potato harvesters	16	20	17	17	18	19	14
forage harvesters	207	166	154	136	118	101	96
Beet harvesters	84	62	62	74	74	84	80

Source: Compiled by the authors based on data from the Territorial Authority of the Federal State Statistics Service in the Penza Region [12].

A common characteristic of the agricultural machinery fleet is that for a long period there has been a pronounced tendency to reduce it, affecting almost all major types of equipment. As we can see from Table 1, this trend continues up to the present.

A decrease in the total stock of agricultural machinery could have an objective positive character when it is explained by an increase in the productivity of machinery, or a reduction in the area of arable land. As for the last factor, in 2020 the area of arable land in the Penza region was estimated at 2,263.5 thousand hectares. In 2012, the same indicator was equal to 2,259.3 thousand hectares. Since at least 2012, there has been no reduction in arable land.

Thus, against the background of a relatively stable area of arable land and a reduction in the agricultural machinery available in the park, there is a natural decrease in the provision of agricultural machinery in terms of 1,000 hectares of arable land. This is clearly shown in Table 2.

Table 2. Machinery and energy capacities of agriculture in the Penza region

Indicator	2012	2014	2016	2017	2018	2019	2020
There are energy capacities per 100 hectares of sown area, l, s.	181	151	135	142	140	130	139
Arable land per tractor, ha	296	483	522	503	544	548	578
Grain crops per grain harvester, ha	507	477	716	645	667	718	742
Accounts for 100 tractors, pieces:							
plows	21	21	24	23	28	25	24
cultivators	49	49	50	50	52	50	48
seeders	39	37	38	38	37	37	35
mower	13	12	12	12	13	12	12

Source: Compiled by the authors based on data from the Territorial Authority of the Federal State Statistics Service in the Penza Region [12].

A direct consequence of the increase in the load of arable land per unit of equipment is the delay in the implementation of the main field work, which leads to a decrease in crop yields and an increase in losses during harvesting. Low technical equipment is one of the main obstacles to the development of innovative technologies by agricultural producers [6].

This is a clear confirmation of the fact that the reduction in the number of agricultural machines in the region was not associated with a change in the turnover of agricultural land.

Another expression of the same trend is the indicator of arable land load per tractor, monitored and published by Rosstat [8].

As part of the study of the efficiency of the use of fixed assets as the most important element of production potential, a grouping of agricultural organizations of the Penza region was carried out according to the capital ratio (Table 3).

125 agricultural organizations were examined, characterized by different scales of production, specialization and economic conditions. The grouping did not include holding-type agricultural enterprises.

The absence of a clearly defined relationship between capital ratio and return on assets confirms the fact that the cost expression of fixed assets of an enterprise does not quite objectively reflect the availability and quality of available resources.

There may be several reasons for this. One of the main reasons is the high and disproportionate growth in prices for industrial groups of goods and agricultural products [11].

Given the rate of inflation and the long period of use of fixed assets, there is a disparity in cost indicators.

So, for example, a tractor purchased in 2015 (or even earlier) continues to be used at the present time, and its accounting value in the financial statements often does not correspond to the market valuation.

In addition, involved legal entities and individuals can take part in the production of agricultural products, which, having their own machine and tractor fleet, provide services for an agricultural enterprise.

Therefore, the volume of fixed assets used for the production of the final product is not fully reflected in the statistical and annual reports of agricultural organizations.

For example, the first group included 30 enterprises with a minimum level of capital productivity. And it is in this group that the maximum return on assets in terms of revenue and gross income was obtained. The low cost of fixed assets played a decisive role here. But the profitability of fixed assets in this group has a minimum level and a negative value.

Maximum profitability of funds in the group of enterprises with the highest capital ratio.

In addition to the absolute availability of fixed assets, production efficiency is influenced by

the movement of fixed assets, that is, the speed of their replacement with new objects. This is especially true for the active part of fixed assets - machinery and equipment.
The analysis made it possible to reveal one more dependence on the capital ratio: the higher the level of equipment with fixed assets, the more taxes the company pays to the budget. This fact should be taken into account in the formation and development of regional strategies for investing in the agro-industrial complex.

Table 3. The impact of the capital ratio of agricultural enterprises on the efficiency of the use of fixed assets and financial indicators, 2020

Indicator	Groups of enterprises by capital ratio per 100 hectares of agricultural land, thousand rubles				Total and average
	up to 1,000	1,001-2,500	2,501 - 5,000	5,001 and more	
Number of enterprises in the group	30	46	36	13	125
Average annual cost of fixed assets, million rubles	1,888.19	8,158.72	10,631.91	13,959.62	34,638.44
Capital security per 100 hectares of agricultural land, thousand rubles	714.67	1,778.53	3,570.80	10,414.83	2,905.72
There are machines and equipment per 100 hectares of arable land, thousand rubles	555.42	1,166.31	2,282.32	3,909.32	1,581.53
Capital-labor ratio, thousand rubles	1,290.63	2,625.92	3,010.17	6,779.81	3,409.00
Growth rate of fixed assets, %	35.61	13.46	27.71	11.67	18.02
Renewal coefficient, %: fixed assets - total	27.26	18.01	21.60	15.82	18.83
including machinery and equipment	28.62	11.75	16.51	10.80	14.52
Wear coefficient, %: fixed assets - total	0.43	1.86	1.93	2.04	1.85
including machinery and equipment	50.27	49.76	37.26	29.49	37.86
Return on assets (in terms of revenue), thousand rubles	56.15	63.52	49.11	52.54	54.70
Return on assets in terms of gross income, thousand rubles	1.78	1.00	0.86	0.52	0.80
Return on funds, %	-38.94	-10.95	9.70	5.55	0.51
Production profitability level, %	1.17	10.38	14.84	17.96	10.24
Received budgetary funds - total for the group, million rubles.	74.65	118.76	141.27	609.17	943.86
per 1 enterprise, thousand rubles	2,488.44	2,581.63	3,924.27	46,859.52	7,550.85
Taxes and fees paid – total for the group, million rubles	221.84	547.67	605.65	538.51	1913.66
per 1 enterprise, thousand rubles	7,394.50	11,905.87	16,823.58	41,423.46	15,309.27

Source: Compiled by the authors based on the annual accounting (financial) statements of agricultural organizations in the Penza region.

CONCLUSIONS

Weak sides of the use of fixed assets are: a rather high level of capital intensity of the industry, associated with the acquisition of expensive machines, the construction of elevators, grain storage, potatoes and vegetables; decrease in indicators of capital productivity and capital profitability; underdeveloped service maintenance of agricultural machinery [7].
The main threats to the use of fixed assets are: depreciation of a piece of equipment, lack of qualified engineering and technical personnel to work with new high-tech equipment; insufficiently stable financial condition of individual agricultural organizations, which may prevent the acquisition of new fixed

assets.

Opportunities to improve the efficiency of the use of fixed assets by agricultural organizations of the region could be achieved through the technical improvement of labor tools and production technologies; focus on the high technical level of fixed production assets; more complete use of fixed assets and a reduction in the need for new production capacities when the volume of production changes [4]; increasing the degree of utilization of fixed assets per unit of time by determining the optimal mode of operation [13].

Thus, the rational use of fixed assets in order to increase the efficiency of production potential is one of the main tasks for ensuring sustainable development of both the region as a whole and agricultural organizations.

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METHODOLOGICAL APPROACHES TO THE DEVELOPMENT OF MECHANISMS FOR THE SYSTEM INTEGRATION OF AGRICULTURAL, PROCESSING AND MARKETING ENTERPRISES

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Abstract

System integration can be an economically advantageous tool for increasing the competitiveness of the regional agro-industrial complex. The article substantiates a methodological approach to the development of mechanisms for the system integration of agricultural, processing and marketing enterprises, reflecting the views of international and national standards of the Russian Federation. This is a three-stage structured algorithm for constructing elements of functional, informational, organizational and resource subsystems and the relationships between them. At the first stage, the system integration of internal functions and processes of the enterprise is carried out. At the second stage, elements are allocated for the formation of subsystems in the process of combining objects. At the third stage, mechanisms for the functioning of subsystems are built on the basis of mutual interest in the development of integrated objects. The mechanisms form and provide both internal and external inter-economic interaction, movement and synchronization of the flows of the totality of information and resources of the organizations under study. A comprehensive methodology for evaluating system integration performance indicators is presented, including quantitative and qualitative characteristics of five hierarchical levels.

Key words: *integration in agribusiness, levels, mechanism, efficiency, system*

INTRODUCTION

Modern levels of business and information technology development have led to the formation of the concept and development of system integration tools – a new in-demand approach to improving the management of all processes of organizations. And if for large industrial, banking, transport and other enterprises that successfully implement automation in their business processes, system integration has become an effective way to optimize and improve the quality of all spheres of activity, then for the vast majority of agricultural enterprises this direction opens up new opportunities for growth. And since it is advisable for the producer of raw materials to strengthen ties with processing and marketing organizations in order to increase competitiveness, the tasks of forming mechanisms for system integration are becoming more complicated.

The theoretical foundation for the study of the concentration of production and integration processes in the economy was laid by A. Smith [28] and further developed by D. Riccardo, K. Marx, [2], D. Mill [5] and other scientists. The author's vision of the essence of modern integration and its conceptual directions of development was presented in their works by B. Balassa [3], I.N. Buzdalov [6], E.S. Gvozdeva [12], A.G. Granberg [11], N.V. Ermalinskaya [9], F. Kanhert [15], O.A. Rodionova [26], O. Williamson [29]. The fundamental contribution to the theory of economic mechanisms was made by L. Hurwitz, R. Myerson and E. Maskin [24], the works of L.I. Abalkin [1], A.N. Bychkova [7], S.B. Izmalkov, K.I. Sonin and M.M. Yudkevich [14], A. Kulman [17], N.V. Sirotkina [27] deserve attention. The systematic approach as a methodology is revealed in the works of Y.M. Biryukov [4], G.B. Kleiner [16], V.I. Loiko [21], A.V. Ovchinnikova [25], E.Y. Chicherova and P.M. Titov [8].

The transformation of factors of the internal environment and economic relations of enterprises due to the introduction of digital technologies is of scientific interest from a theoretical and practical point of view within the framework of the studied topic of modern integration processes [23, 30]. These include specialization, concentration and methods of farming, forms of organization of production and labor, availability of resources, methods of regulation and interaction. The high level of competition combined with scientific and technological progress stimulate market participants to abandon standard single-circuit management strategies and introduce modern digital solutions into business processes [18, 19, 20]. Therefore, at the first stage, the development of mechanisms for the system integration of functions and processes within individual enterprises of the industry is in demand, at the second stage – the unification of a group of enterprises.

In this context, the purpose of the paper is to substantiate a methodological approach to the development of mechanisms for the system integration of agricultural, processing and marketing enterprises, reflecting the views of international and national standards of the Russian Federation.

MATERIALS AND METHODS

The theoretical, methodological and informational base of the research was made up of the works of classics and modern scientists, materials of the Federal State Statistics Service of the Russian Federation (Rosstat), regional agricultural management bodies, Internet resources and other sources. The normative basis was the international standard ISO 19439:2006 «Enterprise integration - Framework for enterprise modeling» (IDT) [13], the national standard of the Russian Federation GOST R ISO 15746-1-2016 «Industrial automation systems and integration. Integration of advanced process control and optimization capabilities for production systems. Part 1. Structure and functional model» [10]. A set of general scientific (system and process approaches, structural, analysis, generalization, modeling, comparison, formalization) and interdisciplinary (functional approach, statistical, normative, morphological, etc.) research methods were used.

RESULTS AND DISCUSSIONS

In accordance with the international standard ISO 19439:2006 ISO 19439:2006 «Enterprise integration – Framework for enterprise modeling» (IDT) [13], the nature of the enterprise is characterized by four representations of the model, grouping and expressing in various ways its functional, informational, organizational and resource content. According to this concept, we consider it expedient to develop these four mechanisms. They represent a set of structures and ongoing purposeful processes of different levels and properties. To do this, it is necessary to build optimal schemes of interaction within functional, informational, organizational and resource subsystems and between them in the association of organizations for the production and processing of agricultural products and the sale of raw materials and finished food products based on digitalization, automation and intelligent information platforms that contribute to effective working methods and sustainable development of the participants of the association and the system as a whole.

The proposed theoretical and methodological approach to the development of system integration mechanisms (Figure 1) reflects the concepts of the standard adapted to the specifics of agricultural, processing and marketing enterprises, based on the ordering of elements of functional, informational, organizational and resource subsystems and the construction of relationships between them. The sequence of events is structured in three stages.

At the first stage, an autonomous object is investigated and described as a system, its comprehensive analysis is carried out, models of various types are formed for the characteristics of the functions used and the processes taking place, their system integration is carried out through the capabilities of digital business and intelligent information systems. At the second stage, taking into account the principle of compatibility of the selected higher-level elements or their combinations, the design of subsystems is carried out at the level of combining objects into an interacting structure. At the third stage, mechanisms are being built and the connections between them are being improved, allowing to implement the tasks of optimization, development and forecasting of the state of the integrated system.

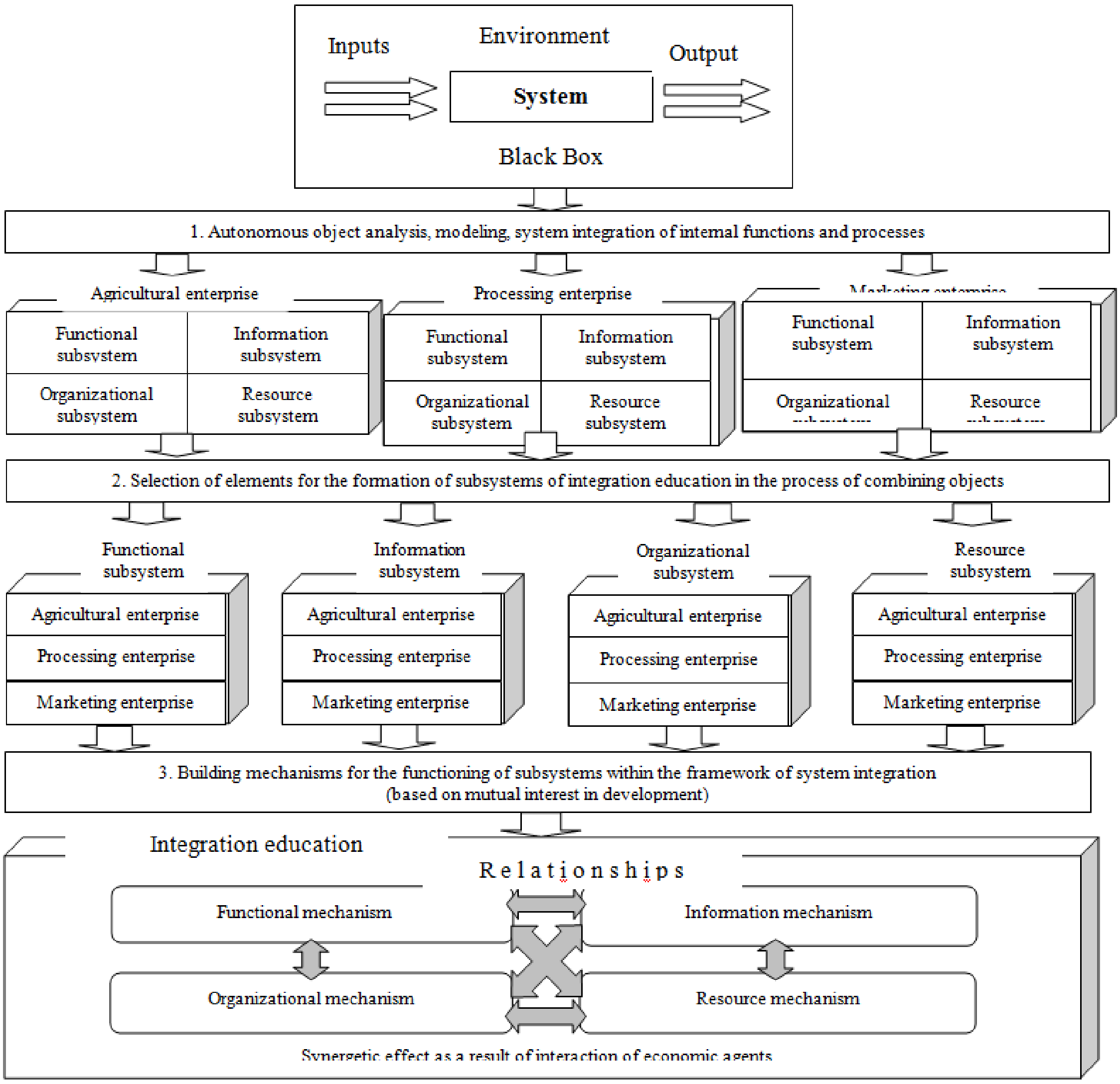

Fig. 1. Methodological approach to the development of mechanisms for the system integration of agricultural, processing and marketing enterprises
Source: Developed by the author.

Modern authors investigate the systems or subsystems of interest to us mainly at the level of business process management of individual enterprises. Within the framework of the research topic, the concept of "subsystem" is considered as an integral component of the formation of mechanisms for the management system of a set of integrated enterprises of various areas of specialization (areas of production, processing, sale of agricultural products). We believe that the mechanisms of functioning of these subsystems form and provide both internal and external inter-economic interaction, movement and synchronization of the flows of a set of information and resources (labor, material, financial) of the organizations under study.

The identified basic elements for the construction of mechanisms for the functioning of subsystems of integration education are presented in Table 1.

Table 1. Matrix of elements for building system integration mechanisms

Complex of system integration subsystems	Levels of system integration	Agricultural enterprise	Processing enterprise	Marketing enterprises
Functional subsystem	the level of integration association	- combined elements of modules: «Planning», Enterprise Resource Planning (ERP), management systems based on data mining; - control with forecasting and optimization in steady-state modes		
	private enterprise level	systems for accounting of works and agricultural operations, monitoring, scouting, control, reporting and analytics	programmable process control systems, automatic regulation and control, automated process control systems	electronic customer profiles, clustering, business rules management systems, Customer Relationship Management (CRM)
Information subsystem	the level of integration association	- combined components of the modules «Operational planning in production», «Address storage», «Mobile Client», ERP, digital management systems based on an intelligent approach to data storage, analysis and processing (interaction through technical elements based on the Internet); - providing subsystem of movement and interaction of resources of enterprises on the basis of legal, technical, regulatory documentation, means of information transformation of economic and clerical order		
	private enterprise level	enterprise management system based on the «1C: Enterprise 8» platform, including through the application solution «Ear: Grain Accounting and processing», application software solutions for storing, analyzing and processing data on the enterprise personal computers, tools for information conversion	enterprise management systems based on the «1C: Enterprise 8» platform, applied software solutions for storing, analyzing and processing data on personal computers of the enterprise, tools for information conversion	enterprise management systems based on the 1C: Enterprise 8 platform, applied software solutions for storing, analyzing and processing data on personal computers of the enterprise, tools for information conversion
Organiza-tional subsystem	the level of integration association	- decisions of general meetings; - strategic plans; - consolidated budgets (cash flows, income and expenses, forecast balance, purchase and payment limits, planned profitability); - general regulations, instructions		
	private enterprise level	charter, accounting policy, staffing, job descriptions, internal regulations	charter, accounting policy, staffing, job descriptions, internal regulations	charter, accounting policy, staffing, job descriptions, internal regulations
Resource subsystem	the level of integration association	- Supply Chain Planning and Management Systems (ERP), Supply Chain Planning (SCP), Supply Chain Management (SCP), Supply Chain Event Management (SCM); - Customer relationship management systems (BPM – Business Process Management), BSC/KPI (Balanced Scorecard / Key Performance Indicators), CRM (Customer Relationship Management); - Supplier relationship management systems (SRM); - Collaborative planning, forecasting and Resupply (CPFR); - Integrated Sales and Operations planning (S&OP)		
	private enterprise level	«Lean Production» + «Six Sigma», Material Requirements Planning (MRP I), Distribution Resource Planning (DRP /DRP II), Customer Synchronized Resource Planning (CSRP), Manufacturing Execution System (MES)	«Lean Production» + «Six Sigma», Material Requirements Planning (MRP I), Distribution Resource Planning (DRP /DRP II), Customer Synchronized Resource Planning (CSRP), Manufacturing Execution System (MES), Product Lifecycle Management (PLM)	Customer Synchronized Resource Planning (CSRP), Manufacturing Execution System (MES), Product Lifecycle Management (PLM)

Source: Developed by the author.

The internal functions and processes of individual enterprises can be modified based on the capabilities of software services and technologies proposed for the private levels of each of the subsystems. For example, an agricultural producer, by implementing systems for accounting for work and agricultural operations, monitoring, scouting, control, reporting and analytics, improves and optimizes the implementation of management functions by automating individual operations, and also minimizes subjectivity in the work of managers and specialists. Using management systems based on the «1C: Enterprise 8» platform, including applied software solutions «Ear: Grain Accounting and processing», services for storing, analyzing and processing data on personal computers of employees, means for information conversion, the organization builds a basis for reliable and timely reflection of all events in quantitative and qualitative parameters.

By updating the charter, accounting policy, staffing, job descriptions, internal regulations in a timely manner due to changing requirements, the administrative and managerial staff ensures a clear uninterrupted operation of all structural divisions and individual members of the team.

Using the capabilities of individual «Lean Manufacturing» systems most suited to the specifics of production in combination with «Six Sigma» (Lean Production + Six Sigma), material demand planning (MRP I), resource planning in distribution (DRP/DRP II-technologies), resource planning synchronized with the consumer (MES, CFM, CSRP) or their combined modules, the enterprise forms a modern resource subsystem with the characteristics of rationality and continuity.

The mechanisms of system integration of enterprises in the region are based on the capabilities of software services and technologies proposed for their combined levels within each of the subsystems. In particular, the combined elements of the modules «Planning», ERP systems, information management systems based on data mining, management method with forecasting and optimization in steady-state modes will allow to form elements and organize the work of the functional subsystem of the studied agricultural, processing and marketing business units. Similarly, mechanisms are being developed for the integration of information (based on the components of the modules «Operational planning in Production», «Address storage», «Mobile Client», ERP systems, digital management systems based on an intelligent approach to data storage, analysis and processing, providing subsystems for the movement and interaction of resources), organizational (based on decisions of general meetings, strategic plans, consolidated budgets, general regulations, instructions) and resource (based on planning systems and supply chain management, relationships with customers and suppliers, joint planning, forecasting and restocking, integrated sales and operations planning) subsystems.

Approaches to the integration of advanced process control capabilities and optimization of production systems served as the basis for the implementation of the tasks in the functional sphere. For the information sphere – means of modern electronic and material document management and ERP systems. For the organizational sphere – methods of constructing matrix management structures. For the resource sphere – building relationships and structures based on the platform approach.

According to the materials of the National Research University «Higher School of Economics» [22], in 2019, only 57.2% of the total number of organizations in the business sector of the Russian Federation used software to solve managerial and economic problems, 31.2% worked with databases through global information networks, 23.3% used ERP systems for enterprise resource planning, 18.6% – customer relationship management systems (CRM), 10.6% – supply chain management systems (SCM).Among the types of activities presented by the Institute for Statistical Research, there is no information on the branches of agriculture and the food processing industry, which is due to the lag in the development of adapted system products and their implementation due to the complexity of management. The available data on wholesale and retail trade facilities are significantly higher than the national average: the use of software tools for solving managerial and economic tasks – by 4, the use of databases – by 10.3, ERP systems – by 14.2, CRM systems – by 14.6, SCM systems – by 13.1 percentage points. The current situation suggests that marketing enterprises focused on final demand can be conduits and stimulators of accelerated implementation of the principles and tools of system integration among processing and agricultural partners.

The proposed methodology for a comprehensive assessment of the effectiveness of the system integration of agricultural, processing and marketing enterprises (Figure 2) allows us to judge the effectiveness of improving functional, informational, organizational and resource mechanisms. The approach is based on the analysis of quantitative and qualitative characteristics of key parameters characterizing the internal processes of organizations and their associations on five hierarchical levels.

The first level (performance indicators of individual elements of the management system) includes assessments of production processes (services) in accordance with specialization.

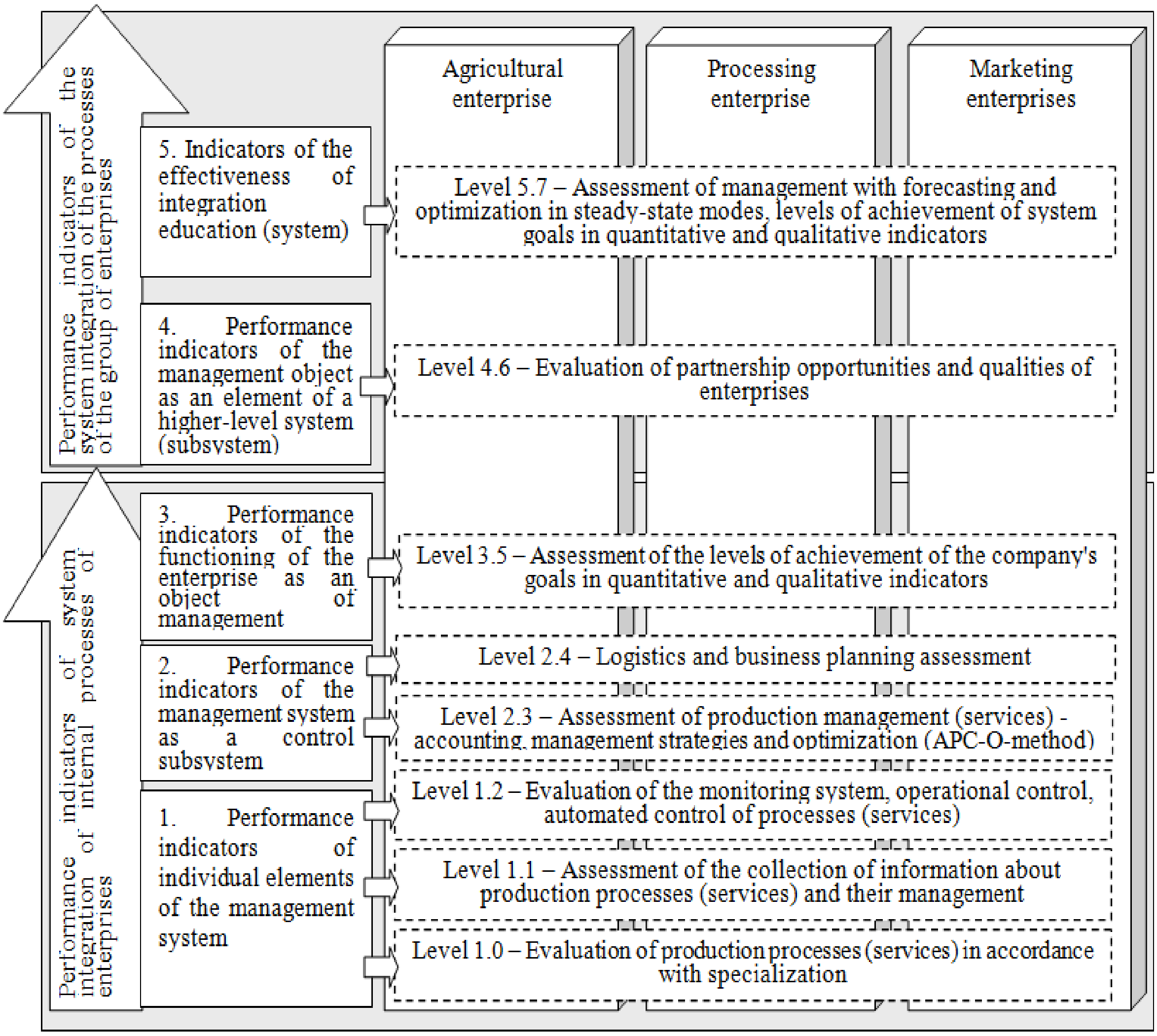

Fig. 2. Methodology for the comprehensive assessment of the effectiveness of the system integration of enterprises
Source: Developed by the author.

These include analysis of the cost of the process and its products, functional and cost analysis, the proportion of defects, errors during orders, the structure of industry according to the method of M. Porter, benchmarking, frequency analysis, causal diagram K. Ishikawa. Also, this level includes the collection of information about production processes (services) and their management, these are the timing and reliability of obtaining information, methods of analyzing statistical materials. The first level also includes an assessment of the monitoring system, operational and automated control of processes (services). It is possible by such indicators as security, critical control points, execution time, operation without failures, measurement accuracy, checklists, maps, matrices, coefficients of controllability of business processes, resource intensity.

The second level (performance indicators of the management system as a control subsystem) consists of assessments of production (services) management, accounting, optimization, APC-O-method. Estimates are carried out using the following tools: a system of cost accounting and cost calculation methods; analysis of manipulated, controlled variables, disturbing parameters; dynamic models; achievement of the objective function. The second level also includes the assessment of business planning and logistics by analyzing the quality of business planning, the overall performance of the business system, discounting cash flows, costs in the supply chain management, the duration of processes, the level of service quality.

The third level (indicators of the effectiveness of the functioning of the enterprise as an object of management) is an assessment of the levels of achievement of goals in quantitative and qualitative indicators. Here, the effectiveness of the strategy, economic, financial indicators, labor savings and cost reduction in the field of business process management, the time duration of management cycles as a result of the introduction of information technology, methods of expert and heuristic assessments are applicable, indicators of the social efficiency of business process management (increasing the degree of scientific and technical management, the level of integration of management processes, manageability of the system, job satisfaction, increasing the degree of validity of decisions).

The fourth level (indicators of the effectiveness of the management object as an element of a higher-level system (subsystem)) is an assessment of partnership opportunities and qualities of enterprises. The analysis is carried out according to a set of criteria for the level of significance of a group of partner enterprises, the partner's share in the total volume of the group; points are determined based on estimates of durability, depth, possibility of duplication, reliability of dynamics, efficiency; scales of assessments of the organization, development, and effectiveness of partnerships are introduced.

The fifth level (indicators of the effectiveness of integration education (system)) is designed to assess management with forecasting and optimization in steady-state regimes, the levels of achievement of the goals of the system in quantitative and qualitative indicators. Expert forecasting methods, SWOT analysis of business processes, identification of problem areas, indicators of social efficiency are used from the group of qualitative indicators. Among the quantitative ones, formalized forecasting methods, statistical and structural models, product and process indicators, consumer satisfaction levels (external and internal), performance indicators (complexity, processability, controllability, resource intensity, controllability of business processes) are applicable.

CONCLUSIONS

A methodology has been developed for constructing mechanisms for the system integration of agricultural, processing and marketing enterprises based on the ordering of elements of functional, informational, organizational and resource subsystems of the association of economic agents and building relationships between them. The proposed concept complies with ISO 19439:2006 «Enterprise integration – Framework for enterprise modeling» (IDT), is based on the principles of a systematic approach, reflects the nature of enterprises and their economic mechanism with four standard representations of the model.

The methodology of a comprehensive assessment of the effectiveness of the system integration of enterprises after improving the functional, informational, organizational and resource mechanisms of interaction, including groups of indicators of quantitative and qualitative characteristics of the parameters of internal processes of organizations and their associations, is recommended. The first group allows you to judge the effectiveness of production processes (services) in accordance with specialization, assesses information collection and management, monitoring system, operational and automated control, accounting and optimization, APC-O-method, business planning and logistics, levels of achievement of the organization's goals. The second group is an analysis of partnership opportunities and qualities, management with forecasting and optimization in steady-state modes, levels of achievement of the system's goals.

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FACTORS EVALUATION AFFECTING SUNFLOWER OIL PRICES IN UKRAINE

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Abstract

In the article were evaluated factors that influence on Ukrainian sunflower oil prices. There was made price analysis, where domestic sunflower seed prices and European sunflower oil prices were taken into account. The research results showed that nowadays the sunflower oil production increased twofold compare to 2010. It could be explained by using modern processing technologies and growth demand for vegetable oils on the world market. Thus, it leads to increase Ukrainian export of sunflower oil more than twofold worldwide in 2021. Our research has shown Granger causality between the series of Ukrainian sunflower oil and European sunflower oil using VAR modeling. Indeed, European sunflower oil prices Granger-causes Ukrainian sunflower oil price at 0.01 significance level. In turn, it means that the past changes in European sunflower oil prices make it possible to forecast current changes of Ukrainian sunflower oil prices. Opposite interactions are also significant. However, there was not confirmed causality between the series of Ukrainian sunflower oil and Ukrainian sunflower seed. The absence of causality between Ukrainian sunflower oil and Ukrainian sunflower seeds could be explained due to the fact that sunflower seed prices domestically more influenced by the conjucture formed at vegetable oil market and not vice versa.

Key words: *sunflower oil, sunflower seeds, market, price analysis, VAR modeling, linkage*

INTRODUCTION

Sunflower oil production is one of the important branches of the agricultural complex in Ukraine. The main its competitive advantages include innovative technologies of enterprises, developed infrastructure of the industry, elevator logistics and sea ports [1]. All these factors contributed to the increase in production in the country and enhance export capacities of sunflower oil. Prior to COVID-19, the domestic market was relatively stable; the oil producers used a price leadership strategy and a differentiation strategy. One of the areas of implementation of the differentiation strategy in both domestic and foreign markets was the production of unique products (the high oleic oil, organic sunflower oil and produced sunflower oil using environmentally friendly technologies) [14].
In recent years, the oil industry companies have been operating under quarantine restrictions related to COVID-19 pandemic and the influence of the price situation in the world and domestic markets [2; 9].
In 2021, the world market showed low dynamics of supply of sunflower oil due to poor yields of sunflower seeds in the Black Sea producers. The 2020-2021 harvest in Ukraine, Romania, Bulgaria and Moldova was restrained by arid conditions during the growing season, resulting in lower yields and oil content in the seeds [13]. At the same time, there is forecasted until 2030 a further increase in prices for oilseeds (sunflower, rapeseed) in the European market in accordance with growing demand [4].
In the domestic market in 2020/21 MY, there was an increase in oil prices, which was due to a sharp rise in commodity prices and its deficit. The cost of growing sunflower seeds was about $250-280, but selling price of seeds was getting to $350-360. So it leaded to price change of sunflower oil in during the season to $950-980. In Ukrainian market, there was a restraint in the sale of sunflower seeds by agricultural producers and a failure to supply

this raw material under previously concluded forward contracts with processing enterprises [16]. Thereby, sunflower oil producers were forced to buy seeds at the rising price. At the same time, the supply of sunflower oil for export under previously concluded forward contracts was carried out at lower prices than supplied to the domestic market in some periods.

At the beginning of 2022, Ukrainian and foreign analysts predicted a significant increase in sunflower oil production in Ukraine (over 7.2 million tons). This was primarily due to the level of sunflower seed harvest in Ukraine in 2021, which amounted to 16.5 million tons that is higher on 20% compare to 2020. Active supply was in line with growing demand as global economic growth resumed after the COVID-19 crisis. The opening of hotels, restaurants and catering establishments has been favorable for sunflower oil demand [17].

Ukrainian sunflower oil market is integrated to the world market that is emphasized by its export orientation. The market integration analysis is covered in many articles. Agricultural producers, processing enterprises and traders are concerned about the price shocks of different markets [5]. This interest is connecting with the development trade in agricultural commodities on financial markets.

Traditionally, market integration is characterized by the level of price transfer between vertical or spatial markets. Hamulczuk et al. observed the integration of the agricultural market between the Ukrainian (UA) and European (EU) markets. The results show a direct and indirect integration of these markets through the physical trade flows of rapeseed, cake and oil, which indicates that Ukrainian and European rapeseed prices are integrated [8].

The existence of integration between the sunflower oil markets in Ukraine, the European Union and United States was researched by Kuts and Makarchuk, where their findings provided evidence of high price transmission between the UA and EU markets, conversely lower price transmission was observed between the UA and US [11].

Undoubtedly, the formation of prices for vegetable oils, including sunflower oil, will be affected by rising energy prices and demand for biofuels purposes.

Many researchers indicate the following trends in the sunflower oil market in Ukraine over the past 10 years: growing demand for sunflower oil worldwide; and increase in production and export of sunflower oil, which is determined by favourable price conjuncture on the vegetable oil market [14].

In such circumstances, we can observe a stable demand for sunflower seeds from processing plants. Indeed, special attention in the article will be paid to the price analysis of UA sunflower oil market with UA domestic sunflowerseed and EU sunflower oil markets. Getting linkages gives possibilities to conclude which factors are dominating in UA sunflower oil price changes and therefore influence on its competitiveness worldwide since approximately 90% goes for export. The evaluation of factors influencing sunflower oil prices in Ukraine was taken into account in the paper because it is actual subject in terms of narrow connection the market from domestic factors as well as foreign market.

The paper is constructed as follows: Section 2 highlights the main materials and empirical investigation methods; Section 3 consist the results and discussions; and Section 4 shows the conclusions of research.

MATERIALS AND METHODS

The aim of this paper is to study the possible linkage between domestic sunflower oil prices and European sunflower oil market; and evaluation of domestic sunflower oil prices and domestic sunflower seeds prices. On one hand the sunflower oil market is high integrated to the world market, it highlighted the fact that Ukraine exports 90% of sunflower oil, where approximately 56% of UA sunflower oil consists in the world export. Therefore, there is expected to be close connection between markets. On the other hand, UA sunflower seed as a domestic factor could influence on sunflower oil prices due its high share (approximately 70%) in production cost. In these regards, we will consider which

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

factors (internal or external) leads to fluctuations of UA sunflower oil price.

In the article is used weekly series from January 2021 to January 2022 that was taken from the source of APK inform to analyze the linkage between Ukrainian sunflower oil prices and European sunflower oil prices; Ukrainian sunflower oil prices and Ukrainian sunflower seeds prices. All prices are expressed in US dollar per tonne. Figure 1 shows price series that were mentioned in the period from January 2021 to January 2022.

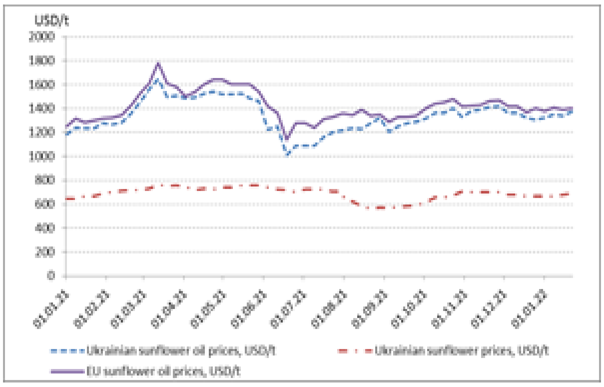

Figure 1. UA sunflower oil prices (USD/tonne), UA sunflower seeds prices (USD/tonne) and EU sunflower oil prices (USD/tonne)

Source: Built based on APK-inform data [2].

From Fig. 1 we can see the prices show how UA sunflower oil prices are close follow EU sunflower oil prices. There is observed also UA sunflower seeds prices repeat fluctuations of UA sunflower oil prices. However, in some period of time could be not stable paths, i.e. from August 2021 to October 2021 was observed decrease in UA sunflower seeds prices and at the same time favorable situation on the world market of sunflower oil leads to increase UA sunflower oil prices.

In Fig. 1 we can see how the UA sunflower oil prices are close to the prices of sunflower oil in the EU. There is also a recurrence of fluctuations in sunflower oil prices in Ukraine. However, in some period of time there may have been an unstable path, i.e. from August 2021 to October 2021 there was a decrease in prices for sunflower seeds in Ukraine, and at the same time a favorable situation on the world market of sunflower oil lead to higher prices for sunflower oil in Ukraine.

To evaluate the closeness of price relationship between UA sunflower oil and EU sunflower oil, UA sunflower oil and UA sunflower seed several methods were used. In order to test stationarity of each series the Augmented Dickey-Fuller unit root test (ADF) was used. The null hypothesis of this test is that time series are not stationary, i.e. has unit root. Opposite to the null hypothesis, alternative states that time series are stationary. ADF test is based on tau-statistics of coefficient φ from OLS estimation. There is used the following formula [3]:

$$\Delta y_t = \alpha_t + \varphi y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

where: y_t – the analyzed price rows; α_t – deterministic term (constant, trend); p – number of lags that ensure white noise properties of random component;

ε_t, δ_i – coefficients that describe the short-run persistence of Δy_t.

In the case of a linear combination of time series is stationary I(0) then non-stationary of time series are co-integrated. Thus, the Engle-Granger cointegration test (E-G) was applied to check the existence of long-term relationship between series that is based on the regression [3]:

$$y_t = \beta_0 + \beta_1 t + \beta_2 x_t + \varepsilon_t \qquad (2)$$

where:

x_t, y_t – variables tested for existence of cointegration; β_0, β_1, β_2 – structural parameters; ε_t – residuals.

When the residuals ε_t are stationary, there is could be conclude about existence of co-integration between variables x_t and y_t.

Next step of the analysis was performed using a Vector Autoregressive Model (VAR). The VAR model has the following form [6]:

$$x_t = A^0 d_t + \sum_{i=1}^{r} A_i x_{t-i} + e_t, \qquad (3)$$

where: $x_t = x_{1t},\ldots.x_{mt}^T$ is a vector of observation on the current values of the variables; $d_t = d_{ot},\ldots.d_{kt}^T$ – is a vector k + 1 of deterministic components of equation; A_0 – is a matrix of parameters in the d_t, vector variables; A_i – is a matrix of parameters in the delayed variables of a vector x_t, where maximum lag order is equal to r; ε_t =

$\varepsilon_{1t},\ldots\varepsilon_{mt}^{T}$ – vectors of the model equation residuals [3].

Vector of the model equation residuals should satisfy assumption (zero mean, constant variance, absence of autocorrelation), while covariance between residuals of the individual equations can be different from zero. The lag order (r) was chosen using AIC criterion.

RESULTS AND DISCUSSIONS

Market analysis of Ukrainian sunflower oil. Sunflower oil production in Ukraine is very dynamic develop and profitable agricultural sector. Enterprises for the production of sunflower oil are strategically important for national economy because traditionally UA population consume sunflower oil, thus it is one of important product for food safety. However, in average 10% of produced sunflower oil consume domestically and the rest of it goes for the export. In this context UA is one of the leaders in the processing and exporting of sunflower oil worldwide.

Until 1999 UA exported only sunflower seeds and from early 2000s began to process it inside the country. In this regard policy regulation was played a crucial role. According to the Law of Ukraine “On export rates (export) duties on seeds of certain types of oilseeds cultures” that was enforced from 10.09.1999 (No. 1033-XI) in 1999 there was introduced export duty for sunflower seeds in the amount 23% from the customs value. Indeed, the rates of export duty on sunflower seeds in 2001 were decreased to 17% in accordance with the amendments to this law. When Ukraine entered to the World Trade Organization (WTO) in 2008, the country committed from 2013 decrease annually export duty by 1% to reach the amount of 10% that exists now [12].

Such measures allowed to reorient the structure of exports of oil and fat complex from raw materials to final food products and make Ukraine a world leader in the production and export of sunflower oil.

According to the Deep and Comprehensive Free Trade Area (DCFTA), Ukraine has agreed to reduce the export duty on sunflower seeds to all EU member states to zero by 2027. For other countries, the requirements adopted by Ukraine upon accession to the WTO in 2008 apply, in particular the reduction of export duties on sunflower seeds to 10%, no additional reduction under WTO conditions is required.

Thus, the development trends of UA oil and fat complex demonstrate a fairly deep integration into the world trade space, which allows our country to influence the world market situation in this segment and increase the export potential of sunflower oil.

Dynamics of UA sunflower oil production demonstrates that UA share in the world sunflower oil production is high and in 2021/2022 was equaled to 33%. As we can see the share of UA export of sunflower oil in the world export was approximately 50% over the last years (Fig. 2).

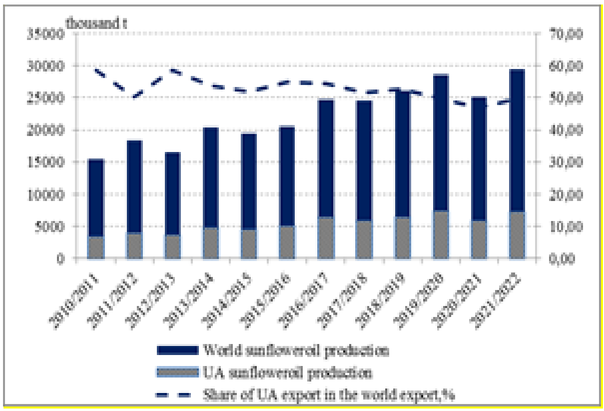

Fig. 2. Dynamics of UA sunflower oil production in the world production, thousand MT

Source: Own calculation based on USDA-FAS (2022) [18].

Analyzing the sunflower oil balance in Ukraine, it should be noted that its production grew every year due to the profitability. In 2021/22 MY 7.3 million tons of sunflower oil were produced, where 6.7 million tons were exported (91%) (Table 1).

At the same time, the largest importers of UA sunflower oil remain EU countries, i.e. approximately 30% of total exports. The coefficient of self-sufficiency is growing every year, which indicates the coverage of domestic consumption. In 2021/22 MY self-sufficiency ration was equaled to 13.

Table. 1 Sunflower oil balance sheet for Ukraine, thousand MT

Indices	2010/ 2011	2012/ 2013	2015/ 2016	2018/ 2019	2021/ 2022
Beginning Stocks	144	462	344	279	264
Production	3,335	3,638	5,010	6,364	7,289
Imports	1	1	1	0	0
Total Supply	3,480	4,101	5,355	6,643	7,553
Exports	2,652	3,245	4,500	6,063	6,650
Industrial Dom. Cons.	30	30	30	30	40
Food Use Dom. Cons.	500	520	520	515	535
Domestic Consump.	530	550	550	545	575
Ending Stocks	298	306	305	35	328
Total Distribution	3,480	4,101	5,355	6,643	7,553
Self-sufficiency ratio	6.3	6.6	9.1	11.7	12.7

Source: Own representation based on USDA-FAS (2022) [18].

In Figure 3 could be observed the increase as in production and total supply that confirm growing demand on the world market for sunflower oil.

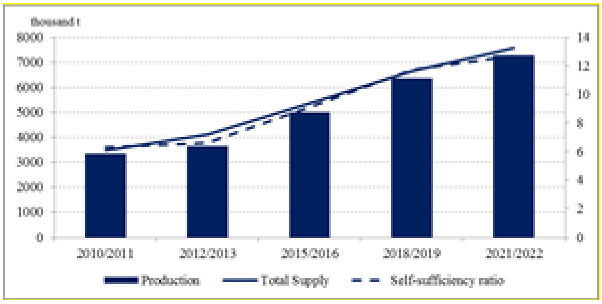

Fig. 3. Dynamics of sunflower oil production, total supply and self-sufficiency
Source: Own calculation based on the State Statistics Service of Ukraine (2022) [15].

Consider the influence of the price factor on the supply and demand of sunflower oil. Many specialized experts in the field of vegetable market agreed that at the world market will continue a tendency to increase sunflower oil and vegetable fats prices. In general, there are both internal reasons that encourage price growth and external factors that seriously determine the price situation in the country. In fig. 1 visible occur the following of UA sunflower oil prices EU prices. It is worth noting that the domestic price is directly related to the world. Thus, the production of sunflower oil is about 7.3 million tons, where at the domestic market we consume approximately 575 thousand tons, i.e. exports account for more than 90% of domestic production. Therefore, oil producers will not sell sunflower oil to the domestic market cheaper than they sell to the foreign market, which may further affect domestic demand.

In turn, due to the pandemic and the decline in the total harvest of oilseeds on world markets, the conditions for price growth have objectively been formed. In addition, China has entered the world market with great demand, which is now sharply increasing its domestic food reserves. Thus, according to the FAO, the price of vegetable oils has increased by 45% [18].

Also among the reasons for rising prices, experts call the rise in energy prices. However, according to expert forecasts, further increase in the price of sunflower oil in the domestic market will not occur.

Thus, the supply of sunflower oil will only increase due to favorable price conditions (capacity will increase depending on the gross sunflower harvest), and demand (especially domestic) will fall due to insolvency if prices rise.

To evaluate how Ukrainian sunflower oil market linkage to the world and UA raw materials (sunflower seeds), the price analysis was done in the following part.

Price analysis. In order to analyze price series of UA sunflower oil, UA sunflower seeds and EU sunflower oil, price series were transformed into logarithmic data. ADF test was used to check stationarity of price series. Getting results of this test are presented in the Table 2.

ADF test results showed that log levels are not stationary because tau values for all variables are lower than critical value tau, which is equaled to 3.398. Therefore, there is accepted the null hypothesis about non-stationary of price series. In contrast to it, first differences are stationary due to the tau statistics of the models for first differences with a constant are higher than the critical value tau.

Table 2. ADF test results

Variable	ADF		
	tau	p-value	lag
l_UAsunfloweroil	-2.4136	0.1379	2
dl_UAsunfloweroil	-3.8731	0.0023	1
l_UAsunflower	-2.4057	0.1401	2
dl_UAsunflower	-3.4620	0.0090	4
l_EUsunfloweroil	-2.3064	0.1699	0
dl_EUsunfloweroil	-7.6606	4,807e-012	0

Source: authors' calculation.

In turn, it means that the null hypothesis should be rejected for the first differences of price series and accepted the alternative hypothesis about existence of price series stationarity. Indeed, investigated price series are integrated in order one I(1).
At the next stage we evaluated the existence of the long-run equilibrium relationship between UA sunflower oil prices and UA sunflower seeds prices; UA sunflower oil prices and EU sunflower oil prices using the E-G co-integration test (Table 3).

Table 3. Engle-Granger co-integration test results

Specification	Values
Cointegration equation UA sunfloweroil-UA sunflowerseeds: l_UA_Sunflower oil=4.23+0.45*l_UA_Sunflowerseeds$_t$+ε_t	
Estimated φ	-0.3720
Tau-value	-2.4245
P-value	0.3132
Cointegration equation UA sunfloweroil-EU sunfloweroil: l_UA_Sunflower oil=-0.97+1.12*l_EU_Sunfloweroil$_t$+ε_t	
Estimated φ	-0.3518
Tau-value	-1.7353
P-value	0.6617

Source: authors' calculation.

The results obtained for both models with a constant allow us reject the null hypothesis about the existence of co-integration. P-values are higher than the critical value 0.05 or 0.1. It means that in the long run period, there is no significant force to push prices towards a common path.
Similar results were obtained for Ukraine by Hamulczuk and Makarchuk [7].

The absence of co-integration between Ukrainian sunflower oil and Ukrainian sunflower seeds might be caused due to the fact that sunflower seeds prices domestically more influenced by the conjucture formed at vegetable oil market and not vice versa. In both models the lack of co-integration may be also caused by the fact that the magnitude of interaction varies over time.
VAR modeling. Stationarity and cointegration test results indicate integration of variables in order one, however they are not co-integrated. Hence, for the further analysis was based on the VAR model estimated on the first differences. In the table 4 are presented estimated models.

Table 4. VAR estimated results (based on first differences of natural logs – ld)

Variable	Cofficient	P-value
Model for Ukrainian sunflower oil (1)		
dl_UA sunfloweroil_1	0.069	0.363
dl_EU sunfloweroil_1	0.935	2.61e-015 ***
Model for Ukrainian sunflower oil (2)		
dl_UA sunfloweroil_1	-0.184	0.183
dl_UA sunflowerseed_1	0.381	0.150
Model for European sunflower oil		
dl_EU sunfloweroil_1	-0.051	0.493
dl_UA sunfloweroil_1	0.748	1.96e-015 ***

Source: authors' calculation.

Getting results showed Granger causality between Ukrainian sunflower oil and European sunflower oil price series. EU sunflower oil prices Granger causes UA sunflower oil price at the 0.01 significance level. In turn, this means that past changes in sunflower oil prices in the EU make it possible to forecast current changes in Ukrainian sunflower oil prices. Opposite interactions are also significant.

CONCLUSIONS

Sunflower oil production is one of the key branches of the agricultural complex in Ukraine. Over the past 15 years it has become a powerful industry, whose profitability is constantly increasing.

Essential to emphasize that Ukraine's oil industry is one of the few that is developing rapidly even in the context of the global financial and economic crisis and is a budget-generating sector of the agro-industrial complex with a strong export potential. Oil and fat industry of Ukraine includes 64 processing plants, 48 oil extraction plants, exports to more than 120 countries and 350 million US dollar in investments.

It worth noting that the Ukrainian sunflower oil production in 2021/2022 MY was about 7.3 million tons, where at the domestic market consumed approximately 10% of the total production, and 90% was exported. In this context domestic sunflower oil prices are directly related to the world. Indeed, oil producers get profits due to the favorable vegetable oil prices on the world market.

Since 70% in cost production of sunflower oil is UA sunflower seeds, in our research were taken into account domestic sunflower seed prices and EU sunflower oil prices as external factor, which could influence on UA sunflower oil prices and find linkages between them.

The long-run equilibrium linkage between UA sunflower oil, UA sunflower seeds and EU sunflower oil prices was not confirmed by the Engle-Granger co-integration test. This means that in the long run period there is no significant force that would push prices in the same way.

Applied stationarity and co-integration tests indicated that variables are integrated in order one, however they were not co-integrated. In these circumstances the VAR model was used. Received results state about Granger causality between UA sunflower oil and EU sunflower oil price series at 0.01 significance level. It can be explained that past changes in sunflower oil prices in the EU allow us to forecast current changes in sunflower oil prices in Ukraine and vice versa.

Model for UA sunflower oil and UA sunflower seeds prices showed that UA sunflower seeds prices are not significantly influence UA sunflower oil prices. The lack of a causal link between these factors can be explained by the fact that the prices of sunflower seeds in the country depend more on the situation that is formed at the vegetable oil market, and not opposite.

Further uncertainties on sunflower oil market could be related to the war in Ukraine. After the start of the war in Ukraine, the sunflower production forecast for world remained at 57.2 million tons, however sharply reduced the estimation of sunflower oil exports. After Russia's invasion, almost all Ukraine's oil refineries and ports have suspended operations, and Western countries have imposed sanctions that have stopped exports from the aggressor country. The share of the Black Sea region in world exports of sunflower oil is 80%., but the share of sunflower oil in the world consumption of food oils is only 12%, and in total consumption of vegetable oils (including biofuels and other industrial uses) - 9%. In the world trade in vegetable oils, the share of sunflower oil is 14%, as well as soybean. Indeed, due to the lack of supplies from Ukraine and Russia vegetable oil prices have increased significantly on the world market [10].

Further research could be related to consequences as from COVID-19 and the war in Ukraine on the world vegetable oil markets; the further development of Ukrainian sunflower oil market in the context of rebuilt after the war.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FINANCIAL MANAGEMENT OF EUROPEAN FUNDS FOR ROMANIAN AGRICULTURE

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Abstract

The goal of this study is to look into how to finance the agricultural sector in Romania. The study emphasizes public institutions and their contribution in financing Romanian agriculture, as well as the results obtained by analyzing the effects of public funding on the agricultural sector, which are critical to the economy. In this regard, we present the functionality and involvement of two important national public institutions, APIA and AFIR. The research methodology is based on qualitative methods that employ both inductive and deductive reasoning. The study's main conclusion is that European funding leads to higher in the number of new farmers as well as an increase in agricultural entrepreneurial income. Moreover, the findings of the study can help public decision-makers understand the agricultural sector's financial needs as well as its importance to the economy.

Key words**:** *European funds, farmers, investments, revenues, agriculture, Romania*

INTRODUCTION

Financial private firms are widely regarded as having a poor understanding of farming operations.

Many companies are lacked of specialized agriculture, financing strategies, products, or personnel.

Furthermore, their presence in rural regions is restricted, and they are not positioned near prospective clients. Furthermore, the provision of limited-amount loans is thought to indicate greater costs due to the larger effect of fixed costs for application screening and management, thus reducing the availability of credit to the farm sector. This has a significant impact on small farms that require minor loan amounts [1].

The higher interest rates charged for agricultural loans as compared to other industries is a manifestation of these circumstances [8].

Thus, public institutions are the essential chance for farmers to receive the desired funding.

The impact of public funding on the development of Romanian agriculture is a research topic for both decision makers or economists, as well as for researchers, because it is essential to finance companies in the agricultural sector, in the medium and long term given the vital importance of this sector of basic goods to citizens [9].

Many governments and international financial institutions have tried to address the issues related to barriers to SME (Small and Medium Enterprises) financing through the development of support programs of small entrepreneurs [2]. This is also the case of the Romanian government, which, since the country's entry into European Union has supported the creation of financial instrument packages (guarantee, credit products, etc.) aimed at facilitating the access of SMEs to funding, in line with European best practices. Initiatives in this field, carried out so far, have sought to strengthen the capacity of financial intermediaries (microcredit institutions, banks, venture capital funds, etc.) to support, at the level national and regional, private sector investments [5].

In addition to membership of European Union ensures Romania the right to benefit from targeted financial transfers to facilitate access to knowledge and innovation, increase the clarity and predictability of the environment business education and training [9].

Direct payments are perceived as the most important grant for farmers (support for their income, intended to compensate for the gap of income from other economic activities), therefore, in future negotiations, one of the "battles" with important stakes will be around the way they will be divide the amounts allocated to this form of support between Member States [1,6].

Although, at least at the declarative level, it was wanted to rebalance the value of direct payments between Member States, the European Commission had to make a proposal feasible and balanced budget and policy, taking into account elements that exceed the rigors of European agricultural policy, being closer to maintaining a balance between predominantly contributing and net beneficiary Member States [3].

The access of agricultural companies to financing is inextricably linked to the cost of the methods of funding and the financial structure of the applicant. Often, however, financial intermediaries question the ability of farms to present viable projects in which they can invest.

Sources of financing for agricultural enterprises differ from country to country due to their characteristics the level of development of the financial system and the environment governing institution [7].

At the country level, differences in the method of financing the activity of micro, small and medium enterprises are more prominent in reasons that are largely related to company-specific factors such as profitability, tangibility of assets, sales volume, development opportunities, bankruptcy costs and so on understanding the financing models for small and medium-sized agricultural enterprises and how they change with institutional development and have important political implications [10].

The CAP is a real financial support for the new member states from the Central and Eastern Europe. Because Romania has large agricultural areas, a high share of population working in agriculture, but the productivity is still low, specialization is a solution for attracting direct aids funds, destined to production performance using modern techniques [11].

The process of accessing the European funds has had a positive impact on the economic and social development of agriculture and rural areas, as proved for example by the analysis of the project portofolio of the Călărași county [4].

The EU funds should continue to favour investments in the creation and modernization of small-scale basic infrastructure, processing/marketing units, and also on the creation of non-agricultural units [12].

In this context, the purpose of the paper is to demonstrate the role of public institutions in financing agricultural holdings and highlighting the effects that public funding has on the development of Romanian agriculture.

MATERIALS AND METHODS

In order to analyse the way in which the public funds destined for the development of the agricultural sector in Romania are managed, the coordinates of the topic proposed for debate were taken into account and they were corroborated with various methods that allow to substantiate the hypotheses. Thus, the nature of the present research is based on an interpretation of the institutional data on the financing and evolution of Romanian agriculture.

The study is focused on:

1.Analysis on the level of investment in agriculture.

2. Presentation of the main public institutions that finance Romanian agriculture.

3. Analysis on the amount of European funds allocated by EAFRD in 2018.

RESULTS AND DISCUSSIONS

The level of investment in agriculture

Investments in the Romanian agricultural sector are and have been declining in recent years, both in absolute value terms and as a percentage of GVA (Gross Value Added) (Figure 1).

In absolute terms, Gross Fixed Capital Formation (GFCF) was EUR 970 million in 2018, which was 35% below the level of 2011.
The decrease in investment is uniform more striking in terms of its share of the GVA of agriculture. In 2011, its share was 18.5%, while in 2018 its share was only 11.7% [10]. This compares with a weighting of 30.7% for the EU 28 average. All GFCF components, including machinery and other production equipment (-40%), transport (-28%) and buildings (-26%) decreased since 2013, except for investments in the plant and animal husbandry sector (+ 45%). For 2018, however, investments in the plant and animal husbandry sector fell by more than 56% compared to 2017 (Figure 1).

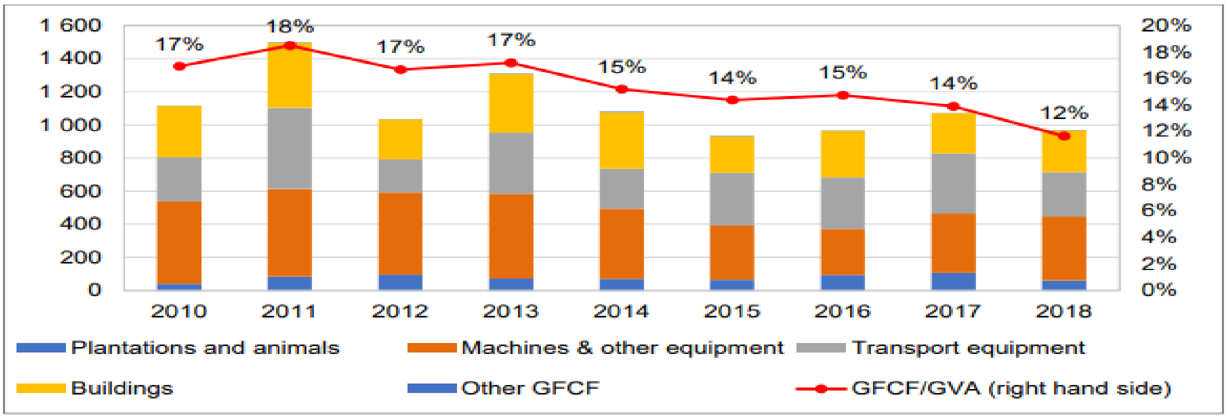

Fig. 1. Gross Fixed Capital Formation (GFCF) in the Romanian agriculture sector 2010 - 2018, EUR million
Source: European Commission [5].

The decrease in the investments must be attributed, in part, to the economic and financial crisis which is expected to have started in 2012.

Public institutions that finance Romanian agriculture

In Romania, the Ministry of Agriculture and Rural Development (MADR) also includes subordinate agencies whose primary responsibility is to finance agricultural operations. APIA and AFIR are the two most important institutions.
The Ministry of Agriculture and Rural Development develops the National Rural Development Program in compliance with the Common Agricultural Policy (CAP). Beginning in 2007, the agricultural intervention system was built around two pillars:
• Pillar I Represents direct payments through APIA:
• Pillar II Rural Development through AFIR

Pillar I. Agricultural Payments and Intervention Agency (APIA)

The Payments and Intervention Agency for Agriculture (APIA) is a government agency that functions under the Ministry of Agriculture, Forests, and Rural Development and is based on Law 1/2004, with later revisions and completions. APIA's organizational structure consists of a central apparatus, 42 county offices, and 266 local offices. APIA has been managing European monies for the implementation of assistance measures funded by the European Agricultural Guarantee Fund since January 1st, 2007.
APIA's tasks are extremely complex, ranging from the management of public funds allocated to agricultural entities, to the verification of payment requests received from beneficiaries, to the administration of the agricultural import-export certification system, to ensuring all conditions of public information on activities, and so on.

Pillar II: Agency for Rural Investment Financing (AFIR)

Given Romania's obligation to designate an accredited payment authority for each rural development program and the need to absorb the aforementioned funds, it is necessary to establish the institutional framework of the

Agency for Financing Rural Investments, a public institution with legal personality subordinated to the Ministry of Agriculture and Rural Development. The Agency's mission is to oversee the technical and financial execution of the European Fund for Agriculture and Rural Development, abbreviated as the EAFRD.

Agency for Financing Rural Investments, AFIR, is responsible of informing the farmers how to access European funds granted through the National Rural Development Plan for the period of 2014-2020. The agreements existing between the European Community and Romania provides measures and submeasures and also specify the amounts granted and the advantages that the applicants could obtain by accessing EU funds [7].

The amount of European funds allocated by the EAFRD in 2018

The table below shows the breakdown by Member State and by the reporting period of the amounts paid by the European Commission in the 2018 budget year (Table 1).

The financing of agriculture from public funds is made taking into account the objectives of the Common Agricultural Policy, which was designed to provide food for the population.

Table 1. Payments allocated by the European Commission for each Member State, in 2018

Payments actually made between 01.01.2018 and 31.12.2018							
FEADR 2014-2020							*(in EUR)*
Member state	Prefinancing	Before T4 2017	T4 2017	T1 2018	T2 2018	T3 2018	**Total**
BE			14,769,727	15,140,622	25,364,796	13,820,384	**69,095,529**
BG			23,123,216	51,560,230	90,811,734	40,188,138	**205,683,318**
CZ			51,401,899	99,910,206	121,404,790	51,930,327	**324,647,223**
DK			25,150,543	23,743,732	24,203,641	16,589,239	**89,687,155**
DE			518,178,026	282,762,184	166,020,708	150,707,971	**1,117,668,890**
EE			26,393,744	62,414,101	21,516,515	17,779,705	**128,104,065**
IE		9,957	140,312,902	37,845,485	30,944,655	109,596,149	**318,709,149**
GR			379,215,655	54,885,586	53,542,080	92,301,511	**579,944,832**
ES			416,008,619	96,475,713	187,940,300	199,301,454	**899,726,086**
FR	16,198,977		796,540,026	373,403,181	173,535,226	365,371,103	**1,725,048,512**
HR			28,786,041	34,672,812	97,924,640	44,766,900	**206,150,392**
IT			165,429,113	257,078,670	263,057,102	360,192,154	**1,045,757,040**
CY		28,200	4,935,917	958,689	1,518,427	7,088,938	**14,530,171**
LV			100,480,707	34,413,859	23,541,015	34,228,519	**192,664,101**
LT	1,502,340		92,618,423	49,513,684	40,021,563	35,815,191	**219,471,201**
LU			4,472,366	5,509,319	1,591,621	2,957,429	**14,530,735**
HU			126,974,681	78,165,237	78,248,639	102,540,987	**385,929,544**
ML			1,664,858	773,245	404,825	6,548,266	**9,391,195**
NL	1,800,000		14,461,718	48,496,359	3,301,137	12,613,164	**80,672,378**
AT			297,250,603	42,654,465	129,876,825	43,022,265	**512,804,158**
PL			188,299,185	290,179,630	284,299,863	181,791,044	**944,569,722**
PT		440,121	298,337,459	95,012,944	65,110,741	44,132,058	**503,033,323**
RO		5,775,526	291,226,430	322,544,208	206,914,475	319,691,776	**1,146,152,415**
SI			32,016,502	14,193,563	52,304,883	12,428,401	**110,943,349**
SK			55,560,398	43,342,784	53,662,898	47,630,789	**200,196,868**
FI			139,384,686	24,270,973	60,320,920	127,811,352	**351,787,931**
SE			126,607,330	25,820,902	19,873,752	23,340,897	**195,642,880**
UK			101,215,145	150,380,307	125,030,443	204,372,633	**580,998,528**
Total	**19,501,317**	**6,253,804**	**4,460,815,920**	**2,616,122,689**	**2,402,288,216**	**2,668,558,754**	**12,173,540,691**

Source: European Commission [5].

Table 1 shows that Romania benefited from a European funding of over 1.1 billion Euros in 2018, being among the EU member states that benefited from high allocations of funds. Apart from Romania, only Germany, France and Italy received over one billion euros in 2018.

Given the situation of the agricultural sector in our country, we can say that it was one of the privileged countries, in terms of funding.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CONCLUSIONS

Public funding can be the "cornerstone" for the proper functioning of business in Romanian agriculture, and institutions such as APIA and AFIR, directly involved in this process must work as well as possible. Following the analysis of the level of investment in agriculture, it was found that in recent years the agricultural sector is the only sector that has seen an increase in investment, compared to other areas such as real estate, transport or others. The research highlights a high level of public funding in Romania, our country being among the countries that benefited from the highest amounts of money in 2018. Future research pathways can focus on the financial evolution of small and medium enterprises with agricultural profile that benefit of public funds but also on the sustainability of enterprises according to the financing stage and the way of applying a correct financial management.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DECLINING RURAL AREAS - DEMOGRAPHIC IMPLICATIONS

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Abstract

The rural area is of particular importance from a socio-economic point of view, whose economic activities are closely linked to the specific nature of the area. Rural localities are at different stages of development, depending on their specific characteristics. The aim of this paper is to identify the demographic effects of the poor economic development of rural localities, with particular emphasis on those in the South-Muntenia development region, which is known for its predominantly agricultural economic activities. In order to carry out the work, the main demographic indicators were qualitatively and quantitatively analysed and the main location and dispersion indicators were determined. The social outlook is not at all positive, both at national level and especially in rural areas. The population tends to decrease, influenced by the existing lifestyle, to which various factors contribute, such as the COVID-19 pandemic, but also the military conflicts in the area, which generate concerns.

Key words**:** *rural areas, rural development, demography*

INTRODUCTION

The rural space is a complex concept, which has generated different opinions on its definition, scope and components. In the view of several authors, 'the countryside' is seen as the totality of activities taking place outside the urban area, characterised by the fact that communities are made up of a relatively small number of members (with mutual relations), a dispersed population, and agriculture and forestry play a particularly important economic role [9, 10, 5]. Thus, 'countryside' can be defined in its simplest form as 'everything that is not urban', but it creates a great deal of confusion between the notions of rural and agricultural [17, 20, 6].

However, a slightly more complete definition is identified in European Council Recommendation 1296/1996 (European Charter), where rural area is defined as an inland or coastal area containing villages and small towns, and where much of the existing land is used for agriculture, forestry, aquaculture, fisheries. Economic and cultural activities, such as crafts, are also present [5, 18, 7].

The rural area is of particular importance from a socio-economic point of view, whose economic activities are closely linked to the specific nature of the area. Rural localities show different stages of development, influenced by their geographical location (close to large urban centres or close to the border, especially in the western part of Romania) and the importance of agriculture in the economic activities carried out in the localities. According to the study "A Difficult Pattern to Change in Romania, the Perspective of Socio-Economic Development" [9, 14, 2, 1], the authors state that it is not necessarily the low number of non-agricultural activities that is the main reason for the poor development of rural areas, but rather the quality of economic activities, which cannot generate a sufficient number of jobs for the local population. This pattern can be broken by local and national decision-makers, who through fiscal measures can encourage the development of quality non-agricultural activities [1, 8, 16].

With the depopulation of rural areas, in addition to the loss of cultural heritage, food security is affected and endangered, where

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

even the United Nations considers that food security must be seen from an international, national and local point of view (Figure 1) [9, 19, 13].

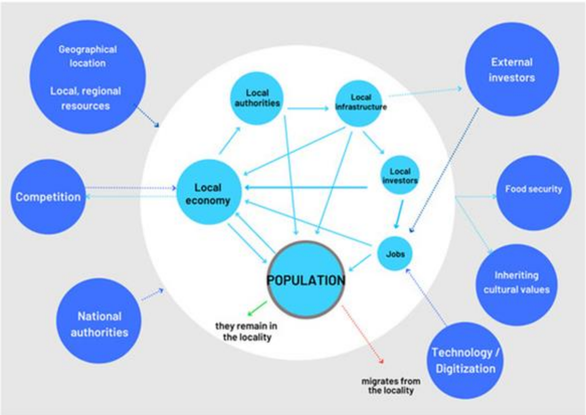

Fig. 1. Interdependence of internal and external factors on localities
Source: [9].

The gap in living standards between urban and rural areas has led young people to migrate to other regions and to stay in these areas, especially the older population. At the same time, the ageing population can no longer carry out normal agricultural activities, preferring to rent out their small agricultural land. The large number of inhabitants in a locality leads to a large number of economic agents in order to satisfy their needs, but the reciprocal is also valid (Figure 1) [9, 15].
The aim of this paper is to identify the demographic effects caused by the poor economic development of rural localities, especially those in the South-Muntenia development region, known for its predominantly agricultural economic activities.

MATERIALS AND METHODS

In order to carry out the work, the main demographic indicator studied in this research work is population at the national level but mainly in the South Muntenia region of development and its 7 counties.
The following indicators were qualitatively and quantitatively analysed: resident population, resident population by age, birth rate, mortality and natural increase.
The information source used to collect the data is National Institute of Statistics.
For all the indicators taken into consideration the empirical data were statistically processed in terms of: arithmetic mean, geometric mean, quadratic mean, harmonic mean, median, modal value, quartiles) and the main dispersion indicators (relative amplitude, linear mean deviation, coefficient of variation, and confidence limits - lower and upper) were determined.
For this purpose, the Excel facilities have been utilized.

RESULTS AND DISCUSSIONS

Romania's population in 2021 reached 19.19 million inhabitants, a decrease of 4.% compared to 2012, which is also the lowest value recorded in the period under analysis (Figure 2).
The South-Muntenia Region had, at the level of 2021, a 14.9% share of the total population registered at the Romanian level, of which Prahova and Argeș counties present the highest shares referred to the total population of the South-Muntenia Region, of 24.5% and 19.8% respectively (Figure 2).

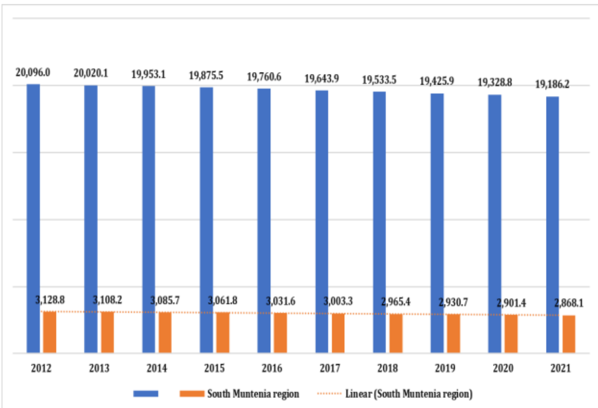

Fig. 2. Population evolution in Romania, 2012-2021 (thousands of inhabitants)
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Both at national level and in the case of the South-Muntenia region there is a decreasing trend in terms of the number of inhabitants, which is caused both by the decreasing birth rate and increasing mortality (ageing population) and by the migration of the population to European countries in search of better paid jobs (Figure 2).
Analysing the total population in the South-Muntenia development region and in the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

counties of the region, the main location indicators were determined for the period 2012-2021. The arithmetic mean of the analysed data set for the total population was 19.68 million inhabitants, and for the South-Muntenia region it was about 3 million inhabitants. The calculated median value of the analysed data set shows a value of 19.70 million or 3.01 million inhabitants (Table 1).

Table 1. Analysis of location indicators related to population

Location indicators								
						QUARTILE		
Crt.	Count	Arithmetic mean	Geometric mean	Harmonic mean	Median	Q1	Q2	Q3
Total	10	19,682.4	19,680.2	19,678.0	19,702.3	19,452.8	19,588.7	19,741.0
Reg.	10	3,008.5	3,007.3	3,006.0	3,017.4	2,939.4	2,984.4	3,025.8
1	10	591.7	591.5	591.4	593.1	581.4	588.1	594.7
2	10	292.8	292.7	292.5	294.2	285.3	290.5	294.8
3	10	502.0	501.8	501.7	503.2	492.6	498.7	504.4
4	10	272.7	272.6	272.5	274.3	267.0	271.6	274.4
5	10	262.9	262.9	262.8	263.5	257.2	260.7	264.3
6	10	735.1	734.9	734.6	736.7	720.0	729.2	739.1
7	10	351.3	350.8	350.4	352.5	336.0	345.5	354.3

Legend: 1 - Argeș, 2 - Călărași, 3 - Dâmbovița, 4 - Giurgiu, 5 - Ialomița, 6 - Prahova, 7 – Teleorman
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Table 2. Analysis of population-related dispersal indicators

Crt.	Min.	Max.	Abs. Ampl.	Rel. Ampl.	Variance	Std. dev.	C.V.	Std. error	Risk 5%	Lower limit	Upper limit	Rhythm %
Total	19,186.2	20,096.0	909.8	4.6	95,828.4	309.6	1.6	97.9	2.3	19,460.9	19,903.8	-0.5
Reg.	2,868.1	3,128.8	260.7	8.7	8,096.6	90.0	3.0	28.5	2.3	2,944.1	3,072.9	-1.0
1	567.7	611.0	43.3	7.3	208.6	14.4	2.4	4.6	2.3	581.4	602.0	-0.8
2	277.5	305.8	28.3	9.7	99.1	10.0	3.4	3.1	2.3	285.7	300.0	-1.1
3	483.0	517.7	34.7	6.9	149.4	12.2	2.4	3.9	2.3	493.2	510.7	-0.8
4	261.0	282.0	21.0	7.7	55.0	7.4	2.7	2.3	2.3	267.4	278.0	-0.8
5	251.5	273.3	21.8	8.3	55.1	7.4	2.8	2.3	2.3	257.6	268.3	-0.9
6	703.4	761.7	58.3	7.9	395.5	19.9	2.7	6.3	2.3	720.9	749.4	-0.9
7	324.0	378.0	54.0	15.4	351.7	18.8	5.3	5.9	2.3	337.8	364.7	-1.7

Legend: 1 - Argeș, 2 - Călărași, 3 - Dâmbovița, 4 - Giurgiu, 5 - Ialomița, 6 - Prahova, 7 – Teleorman
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

As regards the analysis of the dispersion indicators for the period analysed, we identify the minimum values for the period in 2021, of 19.19 million inhabitants (at the national level) and 2.87 million inhabitants (at the level of the South-Muntenia region). Also, the maximum value was recorded in 2012, being 20.1 million inhabitants (at national level) and 3.13 million inhabitants (at the level of the South-Muntenia region) (Table 2). The coefficient of variation shows low values, varying for the criteria analysed between 1.6% (C.V. at population level) and 5.3% (Teleorman county), indicating the homogeneous nature of the data analysed. The rate also shows negative values, which indicates a general trend of population decrease in all the areas analysed (Table 2).

Romania's rural population in 2021 reached 8.9 million, down 3.7% from 2012 (Figure 3). However, there is a slight increase in the rural population in 2021 compared to the previous

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

year (0.31%), due to the migration of the population from urban centres to peri-urban regions (near large cities) as a result of restrictions imposed by the authorities to limit the spread of the COVID-19 pandemic (Figure 3).

The South-Muntenia Region had, as of 2021, a 19.55% share of the total rural population registered in Romania, of which Prahova and Dâmbovița counties have the highest shares in relation to the total rural population (South-Muntenia Region), 20.9% and 19.9% respectively (Figure 3).

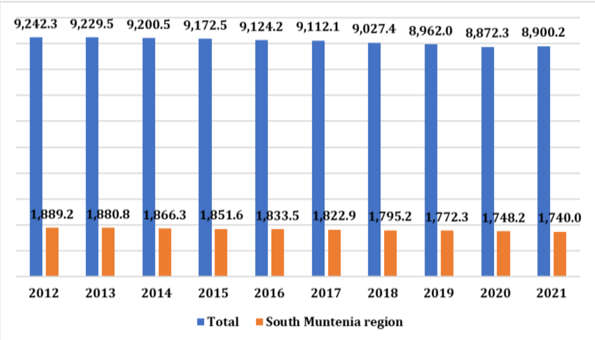

Fig. 3. Population evolution in rural Romania (thousands of inhabitants)
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Analysing the total population in rural areas and in the South-Muntenia development region, as well as in the counties of the region, the main location indicators were determined for the period 2012-2021.

The arithmetic mean of the analysed data set for the total rural population was 9.08 million inhabitants and for the South-Muntenia region was approximately 1.82 million inhabitants.

The calculated median value of the analysed data set shows a value of 9.12 million and 1.82 million inhabitants respectively (Table 3).

As regards the analysis of the dispersion indicators for the period analysed, we identify the minimum values of the period in 2020, of 8.87 million inhabitants (at national level - rural environment), respectively 1.74 million inhabitants (at South-Muntenia region level - rural environment in 2021). The maximum value was also recorded in 2012, being 9.24 million inhabitants (at national level - rural environment) and 1.89 million inhabitants (at the level of the South-Muntenia region - rural environment) (Table 4).

Table 3. Analysis of location indicators for the rural population

Location indicators								
Crt.	Count	Arithmetic mean	Geometric mean	Harmonic mean	Median	QUARTILE Q1	Q2	Q3
Total	10	9,084.3	9,083.4	9,082.5	9,118.1	8,978.3	9,069.8	9,121.2
Reg.	10	1,820.0	1,819.3	1,818.5	1,828.2	1,778.0	1,809.0	1,830.9
1	10	319.7	319.6	319.5	321.2	313.8	318.4	321.7
2	10	187.0	186.9	186.8	188.1	182.0	185.7	188.4
3	10	359.1	359.0	359.0	360.5	353.8	357.9	361.0
4	10	193.6	193.6	193.5	195.1	189.2	192.9	195.4
5	10	146.7	146.6	146.5	147.3	142.8	145.5	147.6
6	10	376.3	376.2	376.2	377.1	369.8	374.3	377.8
7	10	237.6	237.2	236.9	238.7	226.6	234.0	239.5

Legend: 1 - Argeș, 2 - Călărași, 3 - Dâmbovița, 4 - Giurgiu, 5 - Ialomița, 6 - Prahova, 7 – Teleorman
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

The coefficient of variation shows low values, varying for the criteria analysed between 1.5% (C.V. at rural population level) and 5.5% (Teleorman county - rural), indicating the homogeneous nature of the data analysed. The rate also shows negative values, which indicates a general trend of population decrease in all the areas analysed (Table 4).

Table 4. Analysis of dispersion indicators for the rural population

Crt.	Min.	Max.	Abs. Ampl.	Rel. Ampl.	Variance	Std. dev.	C.V.	Std. error	Risk	Lower limit	Upper limit	Rhythm %
Total	8,872.3	9,242.3	369.9	4.1	18,520.9	136.1	1.5	43.0	2.3	8,986.9	9,181.7	-0.4
Reg.	1,740.0	1,889.2	149.2	8.2	2,919.5	54.0	3.0	17.1	2.3	1,781.4	1,858.7	-0.9
1	307.0	329.9	22.9	7.2	64.9	8.1	2.5	2.5	2.3	313.9	325.4	-0.8
2	177.4	195.1	17.7	9.5	42.5	6.5	3.5	2.1	2.3	182.4	191.7	-1.0
3	346.9	368.0	21.1	5.9	59.2	7.7	2.1	2.4	2.3	353.6	364.6	-0.7
4	186.4	200.8	14.4	7.5	27.0	5.2	2.7	1.6	2.3	189.9	197.4	-0.7
5	139.3	153.4	14.1	9.6	24.8	5.0	3.4	1.6	2.3	143.1	150.2	-1.1
6	363.2	387.7	24.5	6.5	74.9	8.7	2.3	2.7	2.3	370.1	382.5	-0.7
7	219.8	255.7	36.0	15.1	171.4	13.1	5.5	4.1	2.3	228.2	246.9	-1.7

Legend: 1 - Argeș, 2 - Călărași, 3 - Dâmbovița, 4 - Giurgiu, 5 - Ialomița, 6 - Prahova, 7 – Teleorman
Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Analysing the evolution of the urban population, in the age ranges 0-4 years and 5-9 years, there were significant decreases of 11.7% and 10.3% respectively. in 2021 compared to 2012. However, the most significant increases were recorded for the population aged 65-69, and people over 85. On the one hand, these increases in the older population indicate an increase in life expectancy, but on the other hand they require early action to avoid economic bottlenecks when the inactive population outnumbers the active population (Table 5).

Table 5. Evolution of the urban population by age (thousands of persons)

Specification (years)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2021/2012
0- 4	59.9	57.5	55.5	54.6	54.1	54.8	55.8	56.5	55.5	52.9	-11.7
5- 9	60.2	61.5	61.9	62.3	61.6	59.3	57.3	55.5	55	54	-10.3
10-14	59.4	58.2	57.5	57.4	57.9	58.8	59.9	60.4	61	60.1	1.2
15-19	62.2	62.8	61.1	59.9	59.2	57.8	56	55.4	55.5	55.7	-10.5
20-24	77.4	69.3	64.3	60.8	59.2	58.5	58.3	56.3	54.8	53.4	-31
25-29	81.7	81.8	83.3	81.7	75.3	67.8	60.3	55.6	52.9	51.1	-37.4
30-34	95.8	90	84.7	80.1	76.2	73.8	73.6	74.3	73.8	67.8	-29.2
35-39	98	98.8	99.7	97.7	95.2	91	85.5	79.5	76.1	72.3	-26.2
40-44	124.8	112.3	101.4	97.3	95.4	94.2	95.2	95.4	94.3	91.4	-26.8
45-49	74.5	88.7	101.6	109.6	115.4	119.7	107.3	96.7	93.2	91	22.1
50-54	94.1	88.1	82.4	77.7	73.6	70.1	84.4	96.4	104.3	108.9	15.8
55-59	102.9	102.3	101.5	97.9	93	86.8	81.8	76.3	72.2	67.7	-34.2
60-64	81	85.2	89.3	90.4	92.4	93.4	93.4	92.4	89.2	83.4	2.9
65-69	49.5	52.1	55.7	61.9	68.5	72.2	76.3	79.5	80.7	80.9	63.5
70-74	47	44.8	42.9	42	41	42.5	45.1	48.2	53.8	58.4	24.2
75-79	36.9	37.4	38.4	39	38.6	37.5	35.9	34.5	33.7	32.3	-12.5
80-84	21.9	23.2	23.7	24.4	24.9	25.7	26.1	26.8	27.6	26.7	22.1
Over 85	12.4	13.3	14.4	15.3	16.3	16.8	17.9	18.6	19.7	20.1	62.7

Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

In the case of the evolution of the rural population according to age, the trend recorded at national level continues.

Also the extremes of the age intervals show higher values than in the case of the urban population, in the sense that the population aged 0-4 years and 5-9 years, respectively, at the level of 2021 were 75.6 thousand people, respectively 77.3 thousand people, compared to the urban population which was 52.9 thousand people, respectively 54 thousand people (Table 6).

Comparing the year 2021 to the reference year, the highest share was recorded among the 45-49 years old segment, where compared to 2012 there was an increase of 58.2% of the population (Table 6).

Analysing the evolution of the birth rate in the South-Muntenia Region, it can be seen that in 2020 the number of newborns decreased by 22.5% compared to 2007.

This phenomenon was recorded in both urban and rural areas, but was more intense in urban areas (Table 7).

Table 6. Evolution of the rural population by age (thousands)

Specification	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2021/2012
0- 4	93.5	89.6	85.1	81.4	78.5	77.9	77.8	78.2	76.6	75.6	-19.1
5- 9	100.8	99.6	98.9	98.6	97	93.7	89.8	84.9	80	77.3	-23.4
10-14	110	108.5	106.6	104.5	102.6	101.7	100.3	99.1	98.1	96.5	-12.2
15-19	109	109.9	109.9	109.8	109.6	108.9	106.3	103.4	100.1	98.7	-9.5
20-24	115.5	108.3	103.8	101	100.3	100.4	100.3	99.1	97.8	97.8	-15.3
25-29	104.5	109.1	114.2	116	110.9	104.3	95.4	89.8	85.9	86	-17.7
30-34	124.7	118.2	110.7	104.7	100.9	100.6	102.7	105.9	106.6	103.5	-17
35-39	141.6	141	140.6	135.8	130.7	124.9	117.2	108.1	101.7	99.1	-30
40-44	165.9	157	147.8	145.3	143	141.6	140	139.1	134.1	130.3	-21.4
45-49	89.3	109.4	127.5	141.2	153.9	165.5	154.8	145	142.5	141.3	58.2
50-54	104.3	100.9	95.7	92	89.8	89.2	107.7	125.5	138.2	151.3	45
55-59	117.3	115.7	113.7	111.1	106.7	103.2	98	92.9	88.7	87.4	-25.5
60-64	121.6	123	122.7	116.6	115.4	114.5	110.2	108.5	105.7	102.7	-15.5
65-69	99.4	101.9	102.5	107.4	112.5	114.1	113.5	113.5	107.6	107.6	8.3
70-74	107.3	101	94.5	91.3	86.3	87.8	89.2	90	95	99.9	-6.8
75-79	93.6	91.6	92.6	92.4	90.9	86.6	81.5	76.5	74.1	69.8	-25.5
80-84	58	61	61.3	62.6	62.6	64.7	63.5	64.8	64.7	63.5	9.5
Over 85	33	35.2	38.2	39.9	42.1	43.2	46.8	48	50.7	51.7	56.8

Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Thus, in the case of the birth rate registered in urban areas, there was a decrease of approximately 30% in 2020 compared to 2007, while in the case of the rural population the decrease registered in the same period was 16.95%. The considerable difference between these two residence environments can be attributed to the fact that the urban population prioritises career (professional development), and as a rule the number of children in families living in this environment is somewhat lower (Table 7).

Due to religious factors and customs, which are still observed in rural areas, the birth rate in rural areas is somewhat lower than in urban areas (Table 7).

Table 7. Evolution of the urban population by age (thousands of persons)

Specification	2007	2013	2014	2015	2016	2017	2018	2019	2020
Total	30.7	28.9	27.5	28.1	28.2	28.3	28	26.5	23.8
Urban	13.1	12.5	11.5	11.8	11.9	11.8	11.7	10.8	9.2
Rural	17.6	16.4	16	16.2	16.4	16.5	16.3	15.7	14.6
Location indicators									
							QUARTILE		
Crt.		**Count**	**Arithmetic mean**	**Geometric mean**	**Harmonic mean**	**Median**	**Q1**	**Q2**	**Q3**
Total		14	28.6	28.6	28.5	28.2	28	28.2	29.3
Urban		14	12	11.9	11.9	11.8	11.6	11.8	13.1
Rural		14	16.7	16.6	16.6	16.4	16.2	16.4	16.9
Dispersion indicators									
Specification	**Min.**	**Max.**	**Abs. Ampl.**	**Rel. Ampl.**	**Variance**	**Std. dev.**	**C.V.**	**Std. error**	**Rhythm %**
Total	23.8	32.4	8.6	30.1	4.8	2.2	7.6	0.6	-1.9
Urban	9.2	13.6	4.4	36.8	1.3	1.2	9.6	0.3	-2.7
Rural	14.6	18.8	4.2	25.2	1.1	1.1	6.3	0.3	-1.4

Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

The arithmetic average of the data analysed for the birth rate in the South-Muntenia Region was 28.6 thousand births. The calculated median value of the analysed data set shows a value of 28.2 thousand newborns (Table 7).

Regarding the analysis of the dispersion indicators for the period analysed, we identify the minimum value of the period in 2020, of 23.8 thousand newborns, and the maximum value was recorded in 2009, being 32.4 thousand newborns (Table 7).

The coefficient of variation shows low values, varying for the criteria analysed between 7.6% (birth rate - general) and 9.6% (birth rate - urban), indicating the homogeneous nature of the data analysed. The rate also shows negative values, indicating a general trend of decreasing birth rates (Table 7).

Analysing the evolution of mortality in the South-Muntenia Region, it can be seen that in 2020 the number of deaths increased by 18% compared to 2007. This phenomenon was recorded in both urban and rural areas, but in urban areas it was more intense. On the one hand, the stress of large urban agglomerations contributes to a somewhat lower life expectancy than in rural areas, and on the other hand, elderly people in rural areas who experienced difficulties in travelling and caring for themselves were brought to urban areas by their legal guardians in order to be properly cared for (Table 8).

Thus, in the case of urban mortality, there was a decrease of about 29% in 2020 compared to 2007, while in the case of the rural population the decrease over the same period was 8.8% (Table 8).

The arithmetic average of the data series analyzed for mortality registered in the South-Muntenia Region was 260.2 thousand deaths. The calculated median value of the analyzed data set is 258.1 thousand deaths (Table 8).

Table 8. Mortality analysis in the South-Muntenia Region by residence (thousands of deaths)

Specificare	2007	2013	2014	2015	2016	2017	2018	2019	2020
Total	252.0	250.5	255.6	263.0	258.9	262.8	265.5	260.4	297.3
Urban	114.6	116.4	119.4	123.7	123.0	124.9	127.0	125.4	147.9
Rural	137.4	134.1	136.2	139.3	135.9	137.9	138.5	135.0	149.5
Location indicators									
							QUARTILE		
Crt.		**Count**	**Arithmetic mean**	**Geometric mean**	**Harmonic mean**	**Median**	**Q1**	**Q2**	**Q3**
Total		14	260.2	260.0	259.8	258.1	253.8	257.2	261.0
Urban		14	121.6	121.4	121.1	118.5	116.2	117.7	124.0
Rural		14	138.6	138.5	138.5	137.9	136.3	137.9	139.0
Dispersion indicators									
Specification	**Min.**	**Max.**	**Abs. Ampl.**	**Rel. Ampl.**	**Variance**	**Std. dev.**	**C.V.**	**Std. error**	**Rhythm %**
Total	250.5	297.3	46.9	18.0	135.7	11.6	4.5	3.1	1.3
Urban	114.4	147.9	33.5	27.6	76.5	8.7	7.2	2.3	2.0
Rural	134.1	149.5	15.4	11.1	14.6	3.8	2.8	1.0	0.6

Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Regarding the analysis of the dispersion indicators for the period analyzed, we identify the minimum value of the period in 2013, of 250.5 thousand deaths, and the maximum value was recorded in 2020, being 297.3 thousand deaths (Table 8).

The coefficient of variation shows low values, varying for the criteria analyzed between 2.8% (mortality - rural) and 7.2% (mortality - urban), indicating the homogeneous nature of the data analyzed. The rate also shows positive values, which indicates a general trend of increasing mortality among the population of the South-Muntenia region (Table 8).

Table 9. Analysis of the natural increase at the level of the South-Muntenia Region, according to the area of residence (thousands of persons)

Specificare	2007	2013	2014	2015	2016	2017	2018	2019	2020
Total	-37.2	-35.5	-53.1	-56.8	-49.3	-47.9	-50.9	-57.2	-118.7
Urban	1.8	1.7	-9.0	-10.1	-7.9	-6.1	-7.8	-13.6	-52.7
Rural	-39.0	-37.2	-44.1	-46.7	-41.3	-41.8	-43.0	-43.7	-66.0
Location indicators									
								QUARTILE	
Crt.		**Count**	**Arithmetic mean**	**Geometric mean**	**Harmonic mean**	**Median**	**Q1**	**Q2**	**Q3**
Total		14	-52.1	-	-	-50.1	-55.0	-49.3	-36.8
Urban		14	-7.7	-	-	-7.9	-9.2	-7.8	1.7
Rural		14	-44.4	-	-	-43.4	-46.3	-43.0	-40.2
Dispersion indicators									
Specification		**Min.**	**Max.**	**Abs. Ampl.**	**Rel. Ampl.**	**Variance**	**Std. dev.**	**C.V.**	**Std. error**
Total		-118.7	-31.3	87.4	-167.7	444.6	21.1	-40.4	5.6
Urban		-52.7	7.2	59.9	-777.3	208.7	14.4	-187.6	3.9
Rural		-66.0	-37.2	28.8	-64.8	49.4	7.0	-15.8	1.9

Source: statistical data processing National Institute of Statistics, Accessed 08.04.2022 [12].

Analysing the evolution of the natural increase in the South-Muntenia Region, it can be observed that, in general, it shows negative values, both in urban and rural areas, with the exception of the period 2007-2010 and 2013, when positive values were recorded in urban areas (Table 9).

CONCLUSIONS

The social outlook is not at all positive, both nationally and especially in rural areas. Romania's population is tending to decline, influenced by the existing lifestyle, to which various factors contribute, such as the COVID-19 pandemic, but also the military conflicts in the area, which are causing concern [9, 4, 3].

However, there are cities that are experiencing population declines, with people preferring to relocate to peri-urban areas, while benefiting from many of the facilities offered by the city. Truly rural areas have a predominantly ageing population, which is common both in Romania and in the South-Muntenia region, where agriculture is the main activity [10, 21]. They are no longer able to work the land as they used to, preferring to rent it out to the large farmers in the area. In practice, small-scale farming, based mainly on self-consumption, is beginning to disappear, and food is largely purchased from village shops.

A viable solution that can effectively focus investment in rural areas could be a rural monitoring platform that identifies the problems and needs of rural communities in a timely manner in order to truly develop rural areas [5, 11].

ACKNOWLEDGEMENTS

This paper is part of the project "Studies on resilience strategies and increasing the competitiveness of family farms by joining associative forms" - project code: code 2021-0017/14.07.2021, funded under internal projects carried out by USAMV Bucharest, Romania.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE AGROECONOMIC VALUE OF *RUBUS LOGANOBACCUS* L.H. BAILEY CULTIVATED IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

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Abstract

The introduced Rubus loganobaccus cultivars 'Lincoln Logan', 'Tayberry Buckingham', 'Tayberry Medana' were studied under the conditions of the Republic of Moldova. The experiments were conducted in the National Botanical Garden (Institute), Republic of Moldova. It has been found that the plant of studied cultivars produces 65 - 75 fruits per floricane, with an average weight of 4.37-6.20 g, their sugar concentration was 9.6 - 11.8 % and the vitamin C 21.1 – 26.2 mg/100 g. The antioxidant value of the leaves constitutes IC_{50} = 53-56 mg/ml. The leaf dry matter of the researched cultivars contained 15.2 - 18.7% crude protein, 81-13.6 % ash, 7.9-12.5 % cellulose, 12.7-13.9 % hemicellulose and can be used to feed animals or as organic fertilizer in the hybrid berry plantations. When pruning the floricanes after harvest, the wood biomass obtained contained 48.5 % cellulose, 25.4 % hemicellulose with energy value of 18.5 MJ/kg and theoretical ethanol potential 557 L/t, *it can be used to produce renewable energy. In the Republic of Moldova, the studied Rubus loganobaccus cultivars have agroeconomic value as a food, medicinal plants, also as fodder and energy biomass.*

Key words: *agroeconomic value, cultivars, floricanes, fruits, leaves, Rubus loganobaccus*

INTRODUCTION

Agriculture has been a worldwide engine that has allowed overcoming critical states of food shortage, poverty and unemployment, especially in developing countries.

Economic activities in the Republic of Moldova based on agriculture contributed 10.7% to the gross economic production in 2019. Horticulture, traditionally, is one of the priority directions of agriculture in the Republic of Moldova meant to provide products with added value, with a considerable share in exports. Currently, the horticultural sector is growing both in terms of production and exports, provides jobs and wages in rural areas, and is an attractive business area for agricultural producers. Thus, according to the data of the National Bureau of Statistics, over 1,000 companies are directly involved in the primary production and subsequent processing of horticultural production.

The genus *Rubus* L. belongs to the tribe *Rubeae* Dumort., subfamily *Rosoideae*, family Rosaceae Juss. *Rubus* is recognized as one of the largest genera with over 1,350 species, Flora Europaea lists 75 species; in the spontaneous flora of the Republic of Moldova, 8 species have been identified [17]. It includes deciduous or semi-evergreen perennial herbs or shrubs, which are often spiny with a characteristic fruit, formed of a head of one-seeded drupelets. Raspberries, blackberries and dewberries are common, widely distributed members of the *Rubus* genus. The cultivation of berry plants is one of the most important areas of the agricultural industry worldwide. Berries are a rich source of various biologically active compounds, which make them popular both in the food and pharmaceutical industries [4, 5, 2, 3].

Growing berries is an increasingly important driving force for the development of the horticultural sector and agricultural economic growth in the Republic of Moldova due to their high added value. Traditionally, berries were grown on small plots in private gardens for personal use and only a small amount was grown for sale. Due to the increase in the demand for berries on the domestic market, since 2012, the production areas of berries in Moldova has quadrupled, reaching 4,000 hectares in 2019, as compared with 1,000 hectares in 2010. The berry production in 2020 has reached about 16,000 metric tonnes. Although the berries can be sold as a fresh finished product, they can be processed as freshly squeezed blackberry juice, raspberry and chokeberry juice, blackberry wine, sublimated berry candies, frozen berries and fruit rolls, all of which have great potential for success in both the domestic and export markets.

A general advantage of Moldovan berries is that the harvest starts a few weeks earlier than in competing countries, such as Poland. In addition, Moldovan raspberries taste sweeter and have a higher sugar concentration. The productivity of berry crops in Moldova is lower than in neighbouring countries, with most farmers being small farmers with limited access to machinery, irrigation systems and fertilizers. The vast majority of farmers do not plant approved berry cultivars (certified and approved) that are in higher demand.

Domestic berry products could be more competitive internationally by expanding the range of species and cultivars, implementing progressive technologies in the field of planting material production, founding and maintaining industrial plantations, harvesting, transporting, post-harvest storage and agricultural marketing.

The most cultivated berries in the Republic of Moldova are strawberry, raspberry, black and red currant. Measures are being taken to expand the areas with goji and blackberries.

The purpose of scientific investigations was to assess the agroeconomic value of *Rubus loganobaccus: 'Lincoln Logan', 'Tayberry Buckingham', 'Tayberry Medana'* under the conditions of the Republic of Moldova according to fruit quality indices, amounts of antioxidants and value as animal feed, and also evaluating the potential of using the floricanes pruned after harvest as energy biomass.

MATERIALS AND METHODS

The *Rubus loganobaccus* cultivars 'Lincoln Logan', 'Tayberry Buckingham', 'Tayberry Medana' (Photo 1) served as the subjects of study and were cultivated in experimental plot of the “Alexandru Ciubotaru” National Botanical Garden (Institute) Chişinău, Republic of Moldova, N 46°97′32.0″ latitude and E 28°88′77.4″ longitude. The cultivars represented hybrid berry cultivars bred in the USA 'Lincoln Logan', in Scotland 'Tayberry Buckingham', 'Tayberry Medana', which we received as cuttings by exchange of vegetative material from National Clonal Germplasm Repository Corvallis, Oregon, USA and from *In Vitro* Culture Laboratory, Fruit Research Station Cluj-Napoca, Romania.

The experiment started in the spring of 2016. The trial included blackberries as well as hybrid berries. The planting of plantlets and the maintenance of the plants were carried out according to the agrotechnical procedures described in the previous works [12].

The plant growth, development and productivity were assessed according to methodical indications accepted by NBGI.

Photo 1. *Rubus loganobaccus* experimental plot
Source: Original.

Fresh fruits were collected from each cultivar, weighed and prepared for investigation. The concentration of sugar and vitamin C in fruits was determined in accordance with standard laboratory procedures [19].

The leaves for the determination of phytochemical compounds for medicinal purposes were taken from primocanes. The 1,1-diphenyl-2-picrylhydrazyl radical (DPPH), which is a stable one, was used for the determination of free radical-scavenging activity of the extracts. The IC_{50} value was calculated graphically and it denoted the sample concentration, which was required to collect 50% of DPPH free radicals [4].

For biochemical analyses and fodder value, leaf samples were collected from both primocanes and floricanes, dried in a forced air oven at 60 °C, milled in a beater mill equipped with a sieve with diameter of holes of 1 mm and some assessments of the main parameters, such as crude protein (CP), crude fibre (CF), ash, acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL) and total soluble sugars (TSS), have been determined by near infrared spectroscopy (NIRS) technique using PERTEN DA 7200 NIR Analyzer. The concentration of hemicellulose (HC) and cellulose (Cel), the digestible energy (DE), the metabolizable energy (ME), the net energy for lactation (NEl) and the relative feed value (RFV) were calculated according to standard procedures. The carbon content of the substrates was obtained using an empirical equation according to [1]. The physical properties of energy dry biomass from pruning *Rubus loganobaccus* floricanes were determined according to the standards: the moisture content of the plant material was determined by SM EN ISO 18134 in an automatic hot air oven MEMMERT100-800; the content of ash was determined at 550 ºC in a muffle furnace HT40AL according to SM EN ISO 18122; the automatic calorimeter LAGET MS-10A with accessories was used for the determination of the calorific value, according to SM EN ISO 18125. To determine the cell wall components in the dry mass of floricanes, the amounts of neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were assessed using the PERTEN DA 7200 NIR Analyzer. The amount of cellulose was calculated as ADF minus ADL and hemicelluloses – NDF minus ADF. The Theoretical Ethanol Potential (TEP) was calculated according to the equations of Goff et al., 2010 based on conversion of hexose (H) and pentose (P):

$$H = [\%Cel+(\%HC \times 0.07)] \times 172.82$$

$$P = [\%HC \times 0.93] \times 176.87$$

$$TEP = [H + P] \times 4.17$$

Data were expressed as the mean of three replicates and standard error (SE). The statistical significance ($P<0.05$) was evaluated by the Student's test. AII analyses were performed using GraphPad Prism; version 6.01, 2012.

RESULTS AND DISCUSSIONS

Analyzing the results of the assessment of morfo-biological peculiarities under the conditions of the Republic of Moldova, it can be noted that ***Rubus loganobaccus* 'Lincoln Logan'** develop cilindrical canes, without spikes; imparipinnate compound leaves, 5-foliate, linear hair-like stipels; canaliculated rachis, slightly tomentose, leaflets – wide elliptical to subround, subsessile to sessile, irregular double serrated, lower leaflets prone to lobbing, with cordate or rounded base, obtuse tip. The surface of the leaflets is obviously embossed; the adaxial side soft glabrescent, abaxial – slightly tomentose, mostly with ribs; terminal leaflet 10.5x11.5 cm, lateral leaflets 9.5x10.5 cm; the leaflets partially overlap. Cylindrical floricanes with ternate leaves, stipelate; few-flowered inflorescence, corymbated, leafy; erect pedicels, slightly tomentose; sepals (5-7) narrow elliptical, green tomentose, white-edged.

Photo 2. Lincoln Logan with fruits
Source: Original.

When flowering, the flowers are placed horizontally, having 5-7 white petals of an elliptical shape, (0.5-0.8 cm) nail-shaped; flowers 2.5-2.8 cm in diameter, stamens shorter than stigmas, pubescent ovary.

An average floricane produces 65 fruits. The fruits are large (5-6 g), red, elongated, representing a cluster of big drupelets, located close together and attached to the receptacle. The average weight of the fruit is 6.20 g, of which 0.30 g is the weight of the seeds. The wood dry matter of the floricanes is 358.2 g and – of leaves is 629.7 g.

***Rubus loganobaccus* 'Tayberry Buckingham'** grows curbed canes, glaucescent, without spikes; the leaves are pinnate, 3-5 foliate, linear hair-like stipels; deep canaliculated rachis, soft-glabrescent, without spikes, ovated leaflets, green on both sides, the adaxial side glabrescent, abaxial – pubescent, on the edges imperfect crenate (the terminal macro-leaflet wide ovate – to rhomboidal (6 x 7.5 cm), petiolated, lateral ones subsessile, obtuse tip, rounded base; cylindrical floricanes, soft-pubescent; elongated inflorescence, leafy, with a soft-pubescent axe, without spikes, few-flowered; pedicellate flowers, thin pedicels, with short soft hair, ternate in the leaf axilla; ovate-lanceolated sepals, acuminated, soft hairy, whitish on edges, reflect when flowering; petals (7 x 15 mm), wide ovate to wide elliptical, white, unguicular with rounded tip; subequal stamens with stigma; white anthers; glabrescent ovary; ternate leaves with lanceolate stipels (Photo 3).

Photo 3. Tayberry Buckingham with flowers
Source: Original.

The fruit is larger than that of raspberry, at maturity cherry-red, sweet-sour, very fragrant, sums up the qualities of blackberry and raspberry, containing an increased amount of pectin, soluble fibre, antioxidants and other biologically active substances which provide many health benefits (Photo 4).

The average weight of a fruit is 5.33g, of which 0.22g is the weight of the seeds. An average floricane produces 70 fruits.

The wood dry matter of the floricanes is 605.4 g and the dry matter of leaves is 291.1 g per plant.

Photo 4. Tayberry Buckingham with fruits
Source: Original.

***Rubus loganobaccus* 'Tayberry Medana'** under the conditions of the Republic of Moldova is characterized by cylindrical canes, straight spikes; linear-narrow stipels; imparipinnate compound leaves, 5-foliate; canaliculated rachis, short and scattered, pubescent with straight, cylindrical spines; short-petiolate ovate leaflets, on the adaxial side glabrescent, on the abaxial side slightly tomentose, on the edges imperfectly biserrate; the terminal leaflet 5.5-6 cm long, petiolate cordate. The leaves of the floricanes are ternate; the inflorescence – few-flowered corymb; the pedicels long, slightly tomentose, with fine spines, slightly falcate; sepals 5, triangular, long acuminate, with white-tomentose indument, after flowering deflect; petals 5-7, white, wide-elliptical to subround; stamens do not overcome stigmas; pubescent ovary (Photo 5).

Photo 5. Tayberry Medana with flower
Source: Original.

The average weight of a fruit is 4.37 g, of which 0.15g is the weight of the seeds. An average floricane produces 75 fruits.

The wood dry matter of the floricanes of a plant is 826.63 g per plant. The dry matter of the leaves is 424.8 g per plant.

Photo 6. Tayberry Medana with fruits
Source: Original.

Table 1. Comparative fruit and dry matter production by variety of ***Rubus loganobaccus***

Variety	Average weight of a fruit, g/fruit	of which, average weight of seeds, g/fruit	Average number of fruits per floricane, No./ Floricane	Average weight of fruits per floricane, g/Floricane	Average dry matter,	
					Canes after harvest, g/plant	Leaves, g/plant
Lincoln Logan	6.20	0.30	65	403	358.2	629.7
Tayberry Buckingham	5.33	0.22	70	373.1	605.4	291.1
Tayberry Medana	4.53	0.15	75	339.75	826.63	424.8

Source: Own determination.

Table 1 shows that Lincoln Logan produces 403 g fruits per floricane, being the most productive variety. On the 2nd position is Tayberry Buckingham which produces 373.1 g fruits in average per floricane, and finally on the 3rd position comes Tayberry Medana with only 339.75 g fruits per floricane.

Regarding dry matter of the canes after harvest, the highest amount is produced by Tayberry Medana, followed by Tayberry Buckingham and on the last position is Lincoln Logan.

The highest average dry matter in leaves per plant is carried out by Lincoln Logan, then comes Tayberry Medana and finally Lincoln Logan is ranked the 3rd (Table 1).

The composition of fruits largely determines their sensory properties, their nutritional value, and hence, consumer preference and the final profit for fruit growers. Among other compounds, vitamins and carbohydrates are one of the major determinants of the fleshy fruit quality. Vitamin C, also known as L-ascorbic acid, is a water-soluble vitamin that is naturally present in some foods, added to others, and available as a dietary supplement, it plays an important role in the normal functioning of the immune system, in controlling infections and healing wounds, and is a powerful antioxidant that can neutralize harmful free radicals. Humans, unlike most animals, are unable to synthesize vitamin C endogenously, so it is an essential dietary component [5, 11].

The results regarding the concentration of vitamin C and soluble sugar in *Rubus loganobaccus* fruits are presented in Figure 1 and 2. It was found that the content of vitamin C in *Rubus loganobaccus* fruits ranged from 21.1 mg/100g in *'Tayberry Medana'* to 26.2

mg/100 g in *'Tayberry Buckingham'* (Figure 1).

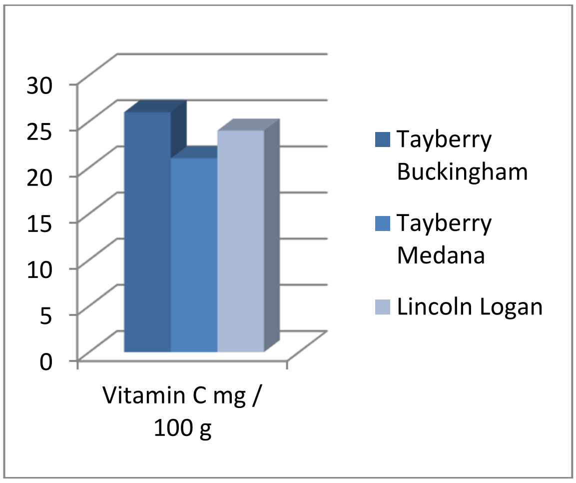

Fig. 1. The vitamin C content of *Rubus loganobaccus* fruits, mg/ 100g
Source: Original graphic based on the data from Pantelidis et al.(2007).

The soluble sugar concentration in fruit dry matter varied from 9.6% in *'Tayberry Buckingham'* to 11.8 % *'Tayberry Medana'* [14]. (Figure 2).

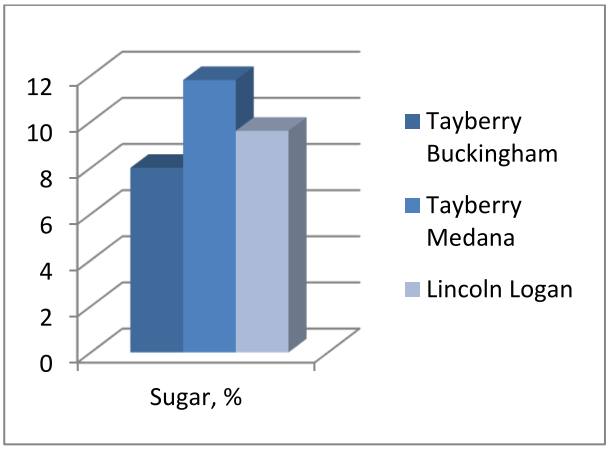

Fig. 2. The sugar content of *Rubus loganobaccus* fruits, %
Source: Original graphic based on the data from Pantelidis et al. (2007).

Flavonoids, phenolic acids, tannins and stilbenes are the main categories of phenolic compounds found in the berries. Antioxidants can exert large spectra of biological and physiological functions, including anti-allergic, anti-atherogenic, anti-inflammatory, antimicrobial, antioxidant, anti-thrombotic, cardioprotective effects. In the specialized literature, it has been mentioned that DPPH is a stable free radical and accepts an electron or hydrogen radical to become a stable diamagnetic molecule. A commonly used parameter to measure the antioxidant activity is the IC_{50}, which stands for concentration of antioxidant needed to decrease the initial DPPH concentration by 50%. The higher antioxidant power has the extract, the lower value IC_{50} have. The results on DPPH radical scavenging of *Rubus loganobaccus* leaf extracts are shown in Figure 3.

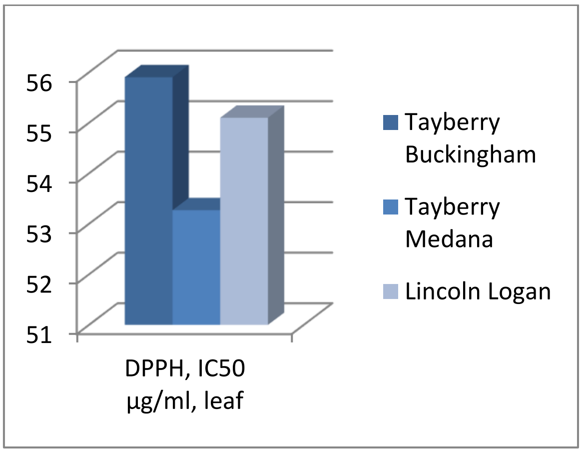

Fig. 3. The antioxidant activity of *Rubus loganobaccus* leaf extracts, DPPH, IC_{50} µg/ml
Source: Original graphic.

In general, in all assays, the leaf extracts of studied cultivars *of Rubus loganobaccus* showed higher values of antioxidant activity. It was determined that, the leaf extracts of *Rubus loganobaccus* 'Tayberry Medana' showed a higher level of free-radical sequestering.
The industrial plantations and the anti-erosion protection belts of species of the genus Rubus can serve as habitat and food source for various species of animals and birds, both in the growing season and in the winter-spring dormancy period; the leaves have a higher feed value for animals.
The results of the research on the biochemical composition and economic value of the leaves of the investigated *Rubus loganobaccus* cultivars are shown in Table 2.
We have found that *Rubus loganobaccus* leaves are characterized by higher crude protein content and a lower structural carbohydrate and lignin concentration as compared with the traditional forage crop

Trifolium pratense. This has had a positive effect on the nutritional value and the supply of metabolizable energy and net energy for lactation of the feed for livestock. The leaves of 'Tayberry Buckingham' and ′Tayberry Medana′ cultivars as fodder have a very low content of ADF, cellulose, hemicellulose and lignin and a high supply of crude protein, metabolizable energy and net energy for lactation, which would allow their use as feed for livestock [15]. The esteemed biochemical indices of *Rubus loganobaccus* leaves have a favorable ratio of C/N = 17-19, thus it can be used as organic fertilizer in the hybrid berry plantations.

Table 2. The biochemical composition and fodder value of the leaves of studied *Rubus loganobaccus cultivars*

Indices	*Rubus loganobaccus*			*Trifolium pratense*
	Lincoln Logan	Tayberry Buckingham	Tayberry Medana	
Crude protein, g/kg DM	152	181	187	169
Ash, g/kg DM	88	97	93	89
Acid detergent fibre, g/kg DM ,	136	96	81	252
Neutral detergent fibre, g/kg DM	263	231	22	422
Acid detergent lignin, g/kg DM	11	8	2	31
Total soluble sugars, g/kg DM	201	228	229	222
Cellulose, g/kg DM	125	88	79	221
Hemicellulose, g/kg DM	127	135	139	170
Digestible dry matter, g/kg DM	814	888	879	811
Digestible organic matter, g/kg DM	655	732	732	763
Relative feed value	277	328	349	153
Digestible energy, MJ/ kg	15.15	15.71	15.91	13.52
Metabolizable energy, MJ/ kg	12.44	12.90	13.07	11.10
Net energy for lactation, MJ/ kg	8.45	8.91	9.08	7.12

Source: Own determination.

Several studies have evaluated the fodder potential of *Rubus* species. According to Drożdż, *In vitro organic matter digestibility* of the leaves of *Rubus* sp. during the growing season decrease from 69.2% in May to 48.3% in November [6]. White, mentioned that senescent leaves of the woody biennial blackberry contained 2.14 % nitrogen, 75.5 % acid detergent soluble material, 5.3 % lignin, 19.2 % cellulose [18]. Grace, reported 12.46% crude protein concentration in fodder from *Rubus* spp. [8]. Filley's laboratory tests for nutritive value mentioned that Himalaya blackberry *Rubus armeniacus* had a content of 15-16% crude protein, 62-64% TDN, 0.5-0.67 %Ca, 0.18-0.26% P, but grass hay and alfalfa hay 8-22% CP, 51-57%TDN [7], respectively. Ryu, in 2013, established that forage qualities of leave from the mutant lines of *Rubus fructicosus* were: 5.86 % crude fat, 13.88 % crude fiber, 5.77% crude ash, 16.61% crude protein, 26.04% NDF, 15.51 % ADF, 76.65 %TDN and RFV=298, but forage qualities of stems 1.68 % crude fat, 42.57 % crude fiber, 3.48% crude ash, 7.39% crude protein, 58.80% NDF, 49.18 % ADF, 50.05%TDN and RFV=82.31, respectively [15].

Horrell, remarked that the foliage of *Rubus argutus* and *Rubus trivialis* contained 7.9- 9 % CP and of *Rubus armeniacus* 8.09-8.31% crude protein [10].

Ever year, growers burn raspberry stalks after pruning bushes in order to limit diseases that could contribute to the reduction of crops or plantation diseases. Therefore, the best solution may be to promote the use of waste biomass for energy production in order to prevent competitiveness of both sectors, therefore the use of raspberry stems for energy purposes could be a profitable solution for the renewable energy market [16].

The production of energy from vegetable biomass constitutes an important component, initially making use of the already existing forest, agricultural and agro-industrial residues and subsequently giving more importance to the production of biomass for energy purposes. Agricultural residues such as lignocellulosic biomass present extensive possibilities for research and use in the production of renewable energy and as a raw material for biorefineries that can be used in various applications and in obtaining other chemicals important to the national economy. Analyzing the quality of pruned wood biomass of *Rubus loganobaccus*, Table 3, we could mention that the ash content and calorific value are optimal; the concentrations of structural carbohydrates and acid detergent lignin in *Rubus loganobaccus* stem substrate are much higher in comparison with *Malus domestica* pruning residue substrates.

The estimated content of fermentable sugars in *Rubus loganobaccus* stems: 86.89 g/kg pentoses and 41.68 g/kg hexoses, but in *Malus domestica* pruning residues – 78.17 g/kg and 36.02 g/kg, respectively.

The esteemed theoretical ethanol yield from structural carbohydrates averaged 557 L/t in *Rubus loganobaccus* substrate, as compared to 476 L/t in *Malus domestica* pruning residue substrates.

Table 3. Some energy properties, the cell wall composition and theoretical ethanol potential of pruned wood biomass from *Rubus loganobaccus*

Indices	*Rubus loganobaccus*	*Malus domestica*
Ash content of biomass, %	3.5	4.7
Calorific value, MJ/kg	18.5	18.3
Acid detergent fibre, g/kg	592	547
Neutral detergent fibre, g/kg	847	760
Acid detergent lignin, g/kg	111	92
Cellulose, g/kg	485	437
Hemicellulose, g/kg	254	219
Hexose sugars, g/kg	86.89	78.17
Pentose sugars, g/kg	41.68	36.02
Theoretical ethanol potential, L/t	557	476

Source: Own determination.

Some authors mentioned various findings about the pruning residues. White, stated that the blackberry canes contained 0.44 % nitrogen, 28.5 % acid detergent soluble material, 19.4 % lignin, 52.1 % cellulose [18].

According to Mustelier, in Latvia, *Rubus ulmifolius* pruned canes contained 50.71 % moisture, 3.4 % ash, 74.99 % volatile matter, 21.57 % fixed carbon, 17.82 MJ/kg gross calorific value, the quality indices of produced pellets were 4.14 % moisture, 2.71 % ash, 16.40 MJ/kg gross calorific value, 1252.7 kg/m^3 density and 98.50% durability [13].

Gudîma, reported that the calorific value of the biomass resulted from pruning apples trees was 18.98 MJ/kg and from technical varieties of vine canes – 18.34 MJ/kg [9]. Słupska, noted that briquettes obtained from raspberry stalks achieved satisfactory parameters to be used as an alternative source for the production of energy, the average heat of combustion of the produced briquettes was 17.3 MJ/·kg [16].

CONCLUSIONS

As a result of scientific investigations, it has been established that *Rubus loganobaccus* cultivars 'Lincoln Logan', 'Tayberry Buckingham', 'Tayberry Medana' the can be used to create industrial plantations for the production of berries, but also for the foundation of agroforestry protection strips.

The leaves have antioxidant potential and can be used in the production of herbs and in the pharmaceutical industry. For medicinal purposes, it is recommended to collect the leaves from the primocanes.

If planted in protection belts, these cultivars can be recommended for the nutrition of wild animals and the increase of the hunting fund.

Floricanes are recommended for use as energy biomass for the production of various types of biofuels as renewable energy sources.

ACKNOWLEDGEMENTS

The study has been carried out in the framework of the projects: 20.80009.7007.19 *“Introduction and elaboration of technologies for multiplication and cultivation by conventional techniques and in vitro cultures of new species of woody plant”,* and the project 20.80009.7007.14 *“Research on mobilizing plant diversity with ornamental potential for ex-situ conservation”.*

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

POPULATION MIGRATION PROCESSES AND DIGITAL COVERAGE IN RURAL AREAS OF BULGARIA

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Abstract

Geodemographic as a scientific discipline includes the mechanical movement in its nomenclature, which, in turn, contains demographic processes of settlement and emigration, which form the mechanical growth of the population. It is interesting to trace the intertwining of migration processes with Internet access and the extent of its use in rural areas. The development includes research and analysis of the mechanical movement of the population in rural municipalities (region) and districts of the country, united in their regions according to the NUTS classification for the period 2015-2019. The mechanical movement of the population in tables and figures is visualized, indicating the dynamics of numerical values in per thousand (‰) and their change during the study period. On the other hand, data on the share of Internet access and its regular use are presented. Conclusions are presented in the conclusion of the review of the mechanical movement of the population in rural areas of the country and how this may affect the trends for accessibility and coverage of digital services.

Key words: *Rural areas, mechanical traffic, migration, internet access and digital services.*

INTRODUCTION

Regional development is proving to be an increasingly recognized national priority, despite Globalization as a process affecting the Old Continent and in particular the countries of the European Union (EU). In turn, the functional nature of regional development implies a territorial approach to the management of the respective communities, leaving the centralized system. In this respect, the focus on Rural areas (RA) challenges us to solve a series of complex tasks related to the socio-economic and environmental development of these areas. The European Union's rural development policy is driven by concomitant factors (social, economic and environmental) that approximately 60% of the population of the 27 Member States live in rural areas, covering 90 % of the Union's territory. Rural areas in the Community are diverse in a number of factors - physiographic, geopolitical, administrative, socio-economic, environmental, institutional, technological and others. This difference is one of their greatest resources within the EU, but it still poses challenges for many Member States in defining and defining a territory as a 'rural area'. The main reasons are the differences in the socio-economic development, the administrative division, the number of the population and last but not least the size (area) of the respective country in the EU.

After Bulgaria's accession to the EU in 2007, the problems in rural areas came to the fore, and the “Rural Development Program” was re-adopted nationally (RDP), in a programming period of seven years. On this basis, there is an accepted definition, which defines the respective territory for “rural municipality” or “region” [2].

Geodemographic considers two types of migration processes: internal and external [11]. Internal processes or mechanical movement take place within the borders of the state between its administrative-territorial units and settlements, from the highest to the lowest level of the NUTS classification, between the types of settlements: “village-city”, “city-city” Town-village” and “village-village”. This type of migration does not include daily travel for work and study, as well as suburbanization as a process [8]. The internal mechanical movements in the RA of Bulgaria include: settlements and emigration, as well as various types of social, economic, environmental and other types of processes caused by the need for better education, work and raising living status [4, 7]. External migrations are characterized by crossing state and continental borders, moving from one region/state to another.

The national definition defines as a rural area - the municipalities of (LAU 1), in which there is no settlement (municipality) with a population of over 30,000 people. According to this definition, 232 of them are classified as rural, out of a total of 265 municipalities in Bulgaria for 2020. This means that the issues related to rural development cover over 82 % of the territory of the Republic of Bulgaria with a population of approximately 35-40 % of the total number (due to high migration, negative growth, deteriorating socio-economic picture and not lastly, the low life expectancy - most municipalities in the country move to the category of rural, adhering to the above definition).

In 2021, the municipality of Nessebar was separated from the administrative-territorial structure - the municipality of Obzor, the decision has not yet been promulgated in the State Gazette. Based on the above definition, the “new territory” will belong to rural municipalities.

On the other hand, the territory of the Republic of Bulgaria is divided into districts according to the NUTS 3 Territorial Unit Nomenclature, which means 28 districts, seven of which are rural. One of the main factors for analyzing the access to digital services is to monitor the migration of the population according to the services provided in rural areas and the access of the population to the Internet. The demographic factor and how much of the population in these rural areas can use the internet to access digital services are essential.

MATERIALS AND METHODS

The above definition for rural areas, united by the districts in which they are located, is adopted in the development, and they in turn are grouped according to their administrative-territorial division in the respective planning regions. Based on the Law on Regional Development in force since 31.08.2008, Prom. NP. 50 of 30 May 2008, amended NP. 21 of 13 March 2020, Chapter Two - Territorial basis of regional development, Art. 4. (3) (suppl. - NP 21/20, in force from 13.03.2020) [3].The regions, which form level 2, shall be regions for planning, shall not represent administrative-territorial units and shall have territorial scope.

The aim of the study is to study and analyze the mechanical growth in per thousand (‰) for rural areas and Rural areas for the period 2015-2019. In the context of migration processes to make a comparison for migration and whether the direction of movement is in areas with higher access to digital services (internet). The information includes the total number of the population for Bulgaria, settled, displaced, as well as that in rural (municipalities) areas. The research is based on a mathematical approach and analysis in the processing of statistical information by (NSI), reducing the numerical indicator to per thousand (‰). Applying the formula for calculating the mechanical movement of the population for a certain period of time:

$$(A - B) / G * 1,000 = D$$

where:

A – Populated (in the year of the survey)

B – Emigrants (in the year of the survey)

G – Total population of the previous year (in thousands) *1,000 – Coefficient

D – per thousand (‰)

The survey used statistical information from the National Statistical Institute [6], Eurostat [1], and the Ministry of Agriculture and Food [5], as well as definitions and definitions from the Rural Development Program 2007-2013 [10]. The development is based on the Regional Development Act of 2008. For the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

processing of numerical values, the program - Excel is applied.

RESULTS AND DISCUSSIONS

Migrations as a social process accompany the development of human civilization, at all stages of its development, and they have a geodemographic, economic, social, environmental or political nature. The basis for the movement of the population from one territory to another is its number [14]. During different historical periods, it has changed its number, influenced by a number of socio-economic factors.

The study includes the total population of the country, as well as the systematized number of the same, located in the RA, as a base (the total population of the RA of Bulgaria is derived), grouped in the six regions according to the NUTS 2 classification, specified in Table 1 in thousand, for a period of five years 2015-2019.

Table 1. Population in the country and RA by regions

District	2015	2016	2017	2018	2019
Bulgaria	7,153,784	7,101,859	7,050,034	7,000,039	6,951,482
RA of Bulgaria	**2,376,901**	**2,378,512**	**2,364,896**	**2,338,166**	**2,342,102**
Northwest	410,471	421,332	422,288	413,068	404,814
North Central	292,683	288,056	283,404	278,604	274,479
Northeast	369,919	366,349	362,549	358,822	356,426
Southwest	348,332	343,591	339,305	359,386	360,477
South central	569,996	577,048	578,633	564,410	572,976
Southeast	385,500	382,136	378,717	363,876	372,930

Source: NSI [6] and authors' calculations.

The analysis of the population of Bulgaria, visualized in Table 1 includes the period from 2015 to 2019, showing a decrease of the same. Within 5 years, the decline is 202,302 peoples, according to official statistics. For 2015 the population in the RA of the country is 33.23% of the total number, overlapping the European values in the same regions. During the study period, no sharp changes in the number of population in the RA of the country were reported. The lowest indicators for SR in the country were reported in 2018, compared to the original year there was a decrease of 38,735 people. The north-western region for the whole period of the study reported a gradual decline in population, and in the end, it decreased by 32,377 peoples, or 9.47%. For the North Central region, the geodemographic picture is similar with negative values for the whole period. In the Northeast region for the five-year period, the decline is insignificant. The only region that reports population growth in the RA is the Southwest - the mechanical growth is 12,145 peoples, or 3.48%, the population is growing in the last two years of research. The South Central region during the study period reported minimal values of change between positive and negative aspects. The south-eastern region follows the gradual decline of the population in the SR, and from the initial to the final period; the negative value is 12 570 people.

The mechanical movement (MM) of the population is part of the geodemographic processes taking place at the micro and macro level. The process involves the settlement and emigration of the population of a given territory and determines the values of the Mechanical Growth for a certain period of time.

Table 2 shows the MM of the population in the RA by regions, related to the total number of RA in Bulgaria and that of the country, as numerical values in per thousand (‰).

The mechanical movement of the population has been studied and analyzed (in chronological order) for five years, including the total number of RA and the population in them, as well as the grouping of the same by regions.

Table 2. Ratio of Mechanical movement in per thousand (‰) to RA and Bulgaria

District	RA	BG	RA	BG	RA	BG	RA	BG	RA	BG
	2015		2016		2017		2018		2019	
RA of Bulgaria	4.22	1.40	-4.19	-1.34	-2.85	-0.95	-2.93	-0.98	0.68	0.23
Northwest	0.93	0.31	-1.27	-0.41	-1.15	-0.38	-1.22	-0.41	-0.95	-0.32
North Central	0.03	0.01	-0.62	-0.20	-0.53	-0.18	-0.96	-0.32	-0.59	-0.20
Northeast	1.20	0.40	-0.20	-0.07	-0.09	-0.03	-0.11	-0.04	0.43	0.14
Southwest	1.07	0.35	-0.65	-0.21	-0.35	-0.12	-0.47	-0.16	-0.13	-0.04
South central	0.48	0.16	-1.19	-0.38	-0.55	-0.19	0.02	0.01	1.64	0.55
Southeast	0.88	0.29	-0.30	-0.10	-0.18	-0.06	-0.19	-0.06	0.27	0.09

Source: NSI [6] and authors' calculations.

For the RA of the country during the study period 2015-2019, per thousand are in negative value except for 2015, positive - both for themselves and compared to the country. Over the next three years, per thousand was negative, at the lowest level for 2016. In the last year of the survey, the figures were zero.

During the five years of research, in the North-West region the values of MM in rural areas, calculated according to the population of the country, report negative numerical values. An exception is 2015, where the values are above zero.

In the North Central region, the geodemographic picture of the MM does not differ from the other territories visualized in Table 2. During the 2015-2019 survey period, the numerical values of ‰ were negative.

The northeastern region, compared to the previous one, has better numerical indicators, in the first year, the values are slightly above zero and in 2015, the MM in the RA has a positive sign. At the end of the study, the values are slightly above zero. In other years, per thousand is negative.

In the South-West region, only before 2015, the RA reported positive values above zero. During the remaining years of research, the analysis showed negative numerical values.

The South-Central region has the best indicators compared to other territories. The only negative values were reported in 2016-2017, as significantly lower than the same in other regions. In other years, the numerical expression in ppm has a positive sign.

The southwestern region in the first year reported values slightly above zero. The negative numbers of MM are in the period 2016-2018. At the end of the study, the values are slightly above the numerical zero expression.

The number of the population as a numerical expression has always been important for the course of geodemographic processes at the micro and macro level [12].

The total number of the population was used in the study as a basic indicator for comparison of the same from the RA, grouped in regions for the five-year study period, presented in Fig. 1.

In the first year of 2015 (7,153,784 in the country), the analysis showed that all regions had a positive increase in MM. With minimal values in ‰ is the North-Central region, followed by the South Central. High indicators are reported in the total number of RA in the country, as well as in the regions - Northeast and Southwest. Over the next three years of the survey, all regions, including the total number of RA for the country, reported negative MM indicators.

The last year, 2019, (number in the country 6,951,482 people) the values in per thousand (‰), show with the highest growth of MM in the South-Central region, followed by the total number of RA in the country, Northeast and Southeast. The others have a negative numerical indicator.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

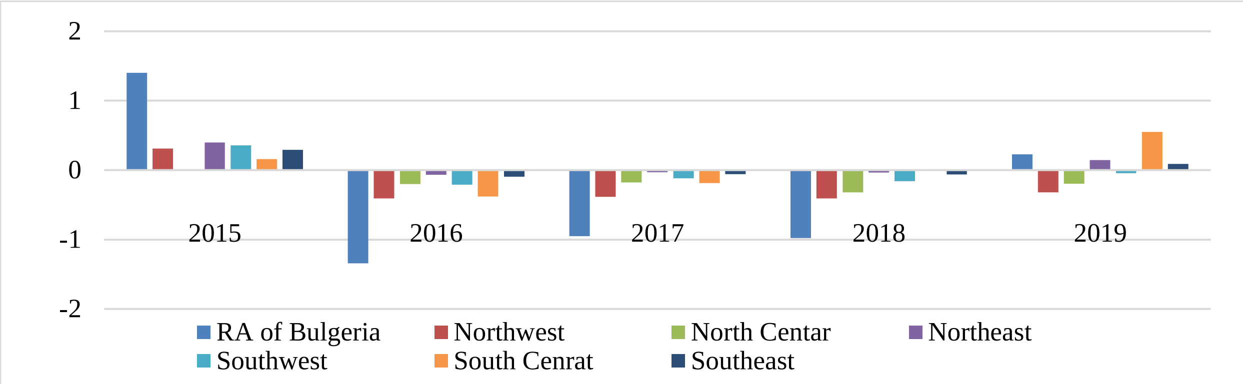

Fig. 1. Mechanical movement in per thousand (‰) in RA, grouped by regions, relative to the total population of BG
Source: NSI [6] and authors' calculations.

In connection with the correct idea of migration processes, it is appropriate to present information on rural areas according to the NUTS 3 division, namely: Vidin, Razgrad, Silistra, Targovishte, Smolyan, Kardzhali, Sofia region. As a basis for comparison, calculations have been added for the average coefficient of mechanical growth and that for the average level in Bulgaria. The period under consideration is five years 2015-2019.

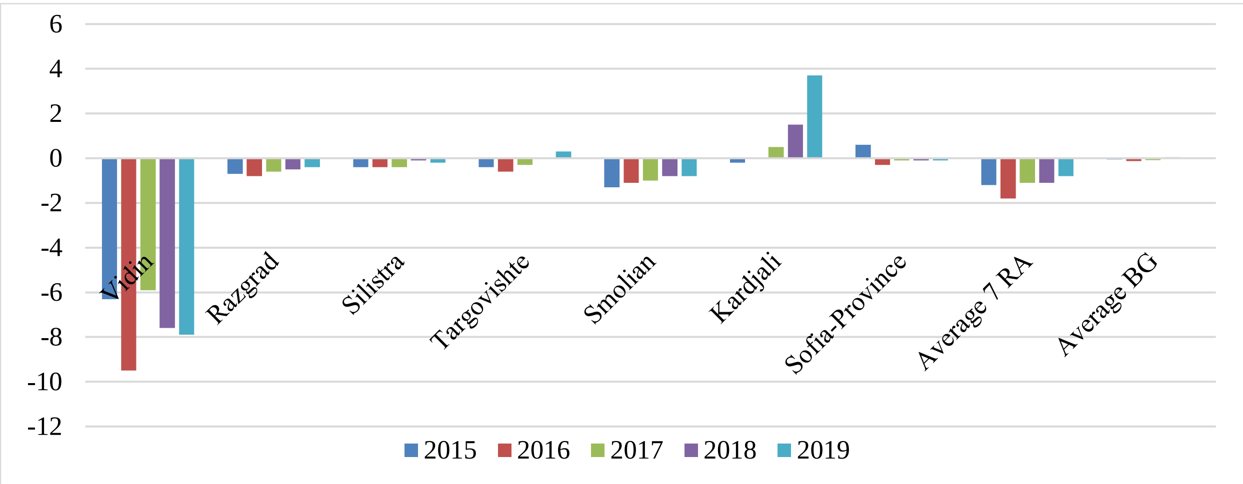

Fig. 2. Mechanical growth rate of rural areas in Bulgaria and average values at national level, in per thousand (‰)
Source: https://www.regionalprofiles.bg/bg/[9] and authors' calculations.

Of all the considered areas, the most drastic decrease of the mechanical growth coefficient is observed in Vidin, as it reaches its lowest value in 2016, and at the end of the considered period it reaches values of -7.9 ‰. This remains the only area with a negative trend in the period under review.
There are two districts that are experiencing an increase in the rate of mechanical growth and these are Kardzhali and Targovishte. The increase is larger in Kardzhali and there is a change from negative values at the beginning of the period, reaching + 3.7 ‰ at the end. In Targovishte district for 2019, this value reaches only + 0.30 ‰, but still has a positive value.
Only Sofia district at the beginning of the period under review has a positive value and in 2019 is already below zero. The explanation can only be the greater migration to the capital and Sofia region, as the closest is, respectively, the most affected by this process.
For the other districts of Razgrad and Silistra there is a similar trend of a slight increase in the coefficient of mechanical growth, but it still remains with negative values. This trend is maintained as an average coefficient for the seven areas considered. At the national level,

no significant changes in the mechanical growth rate are observed. In connection with digitalization and access to Internet services, below in Fig. 3, is presented data on the relative share of households with Internet access and the relative share of persons aged between 16 and 74 using the Internet regularly (every day or at least once a week).

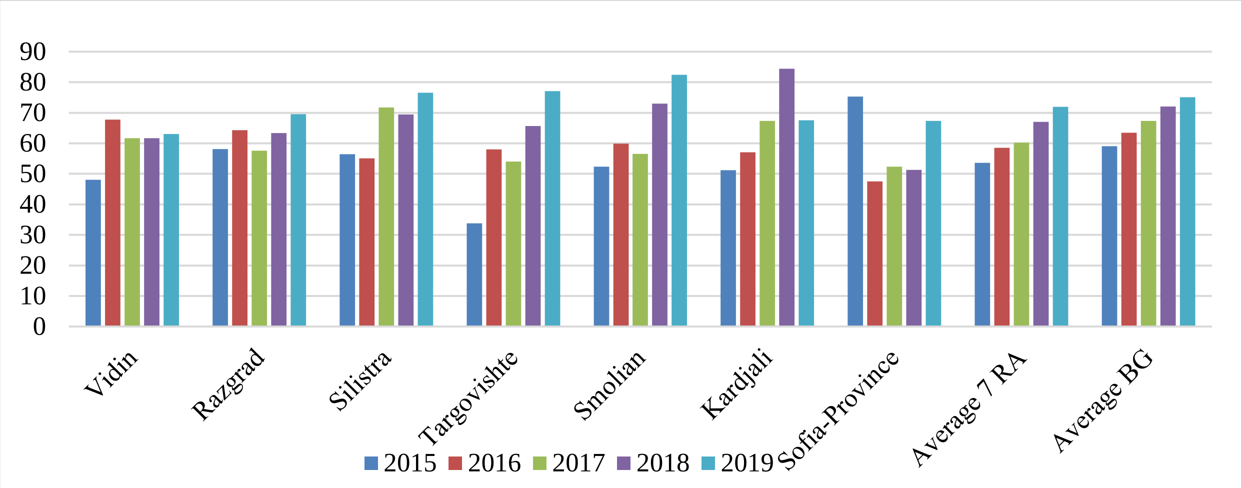

Fig. 3. Relative share of households with internet access in percentage (%)
Source: NSI [6] and authors' calculations.

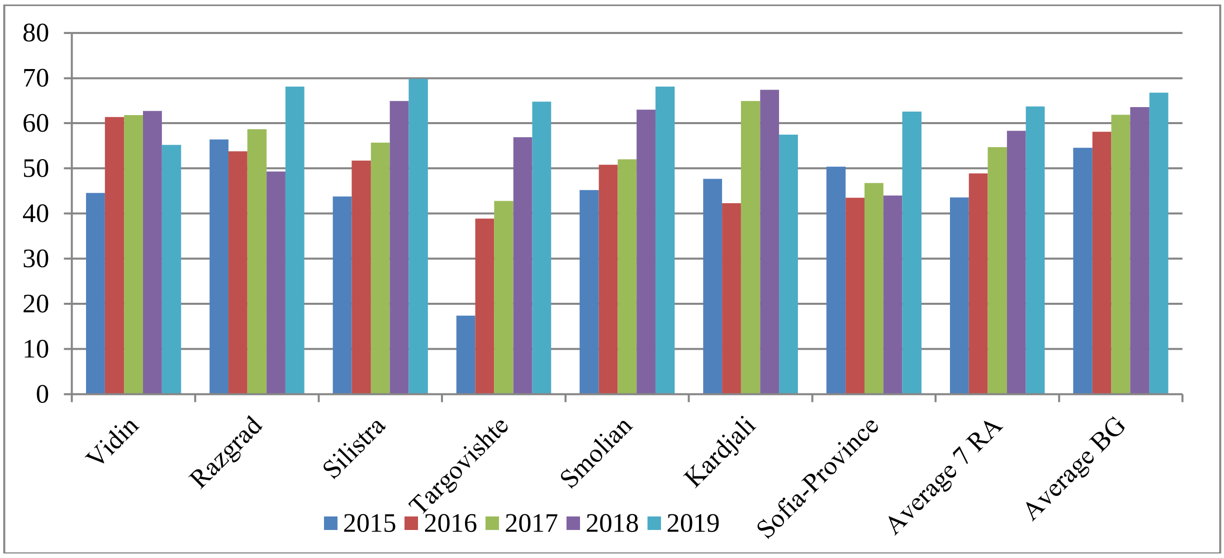

Fig. 4. People aged 16-74, using the Internet regularly in percentage (%)
Source: NSI [6] and authors' calculations.

According to the data presented in Figures 3 and 4, the following findings can be made:
-The relative share of households with Internet access is highest in Smolyan district with a value of 82.4%, and the increase in the period 2015-2019 is about 30 %. This leads to a 22.9% higher share of regular internet use.
-The biggest jump in Internet access is in Targovishte district, with an increase of 43.3%, and at the end of the period compared to the beginning it reached 77.1%. This also affects the share of regular internet use and it increased from a modest 17.4% in 2015 to 64.8% at the end of the 5-year period.
-In the districts of Vidin, Razgrad and Kardzhali similar trends are observed and there the share of households with Internet access is about 65-70 % at the end of the period and the average regular use increases by 10-12 % for the period.
-Sofia District is the only district with a decrease in household access to the Internet but at the same time an increase in its regular use.

-On average, for the 7 considered districts there is an increase for the considered period of the share of households with Internet access by 18.3 %, and the share of those who regularly use the service increases by 20.1 %.
The average for the country also has an increase but it is less than the average for rural areas.

CONCLUSIONS

The analysis of the mechanical movement of the population gives a clear geodemographic picture of the migratory mobility, during the study (2015-2019), settlement, emigration, as well as the coefficient of mechanical growth of a given territory. The population of the country has been declining for decades and the reasons are socio-economic, and this is most pronounced in rural areas. Migration to major cities and abroad are the main processes for the mechanical movement of the population. Negative values in rural areas during the study period are typical for all areas. The territories located in the northwestern and North-central part of the country have deteriorated geodemographic indicators [13]. The demographic picture of negative numerical indicators is also reported in the regional cities of the above-mentioned regions. According to the results of the presented data on migration processes, the increasing availability of the Internet and the increasing dynamics of its use are enough to conclude that rural areas and districts are shrinking and moving towards a higher technological standard. It is normal for the development of technology to affect smaller areas, although this is happening at a slow pace. For the considered period of 5 years, we observe a good result of a higher share of Internet access and more frequent use on a daily basis.
This implies facilitation in the use of some of the services that have been more difficult to access in the past and the tendency is for this process to be optimized and for the population to acquire higher qualifications.

ACKNOWLEDGEMENTS

We express our gratitude for the financial support of the National Scientific Porgram “INTELLIGENT PLANT PRODUCTION“, to Component 4: Artificial Intelligence and Digital Technologies - Engine of Innovative Management Systems, Sectoral Dynamics and Change in Quality of Life. WP 4.3. Rural development and human capital driven by artificial intelligence and digital technologies.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SEASONAL DEPENDENCE OF THE PRODUCTIVITY OF IRISH ORIGINS SOWS FROM THE TYPE OF MICROCLIMATE SYSTEMS IN THE FARROWING ROOM

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Abstract

The aim of the article was to compare the annual dynamics of reproductive qualities of Irish origin sows during keeping them in farrowing rooms with different valve and geothermal microclimate systems. It was found that the number of piglets at weaning, which were kept in geothermal microclimate systems, outnumbered peers kept under classical ventilation by 0.37 goals or 2.98% (p <0.05) in winter, by 0.63 goals or 5.08% (p <0.05) in spring, by 0.58 goals or 4.73% (p <0.05) in autumn and by weight of the nest of piglets when weaned by 3.92 kg or 5.85% (p <0.01) in winter months, by 5.90 kg or 8.44% (p <0.001) in spring months, by 4.13 kg or 6.35% (p <0.01) in summer months and by 4.37 kg or 652% (p <0.01) in autumn months. During the autumn, the predominance of pigs kept in the geothermal microclimate system was found over the analogues kept in the valve system in terms of preservation by 4.27% (p <0.05). In terms of absolute, average daily and relative growth of piglets growing in farrowing room with different ventilation had no significant difference during the year.

Key words**:** *sow, stillbirths piglet, type of ventilation, growth intensity, weight of one head, safety of piglets*

INTRODUCTION

More efficient pork production requires close control of all factors that may affect its productivity. The microclimate on pig farms is one of these factors, as a proper ventilation system will have a positive impact on animal welfare and farm profitability [4, 24].

Pigs are extremely sensitive to ambient temperature. When it is too cold and the pigs have to use the energy they get from the food to keep warm. This means that they will not grow as well as they could. Meanwhile, excess heat suppresses appetite and air quality deteriorates, making animals more susceptible to disease. To reach the peak state, pigs need the appropriate comfort temperature [8, 18].

The ideal humidity for a pigsty is 60% to 75% (RH). Too dry air can damage the mucous membranes of pigs' noses and increase the risk of infection. At the same time, excess moisture creates ideal conditions for the spread of pathogens in water droplets [9].

The main elements that create the microclimate in the room for farrowing sows are air temperature, relative humidity and air velocity, as well as the concentration of harmful gases and other pollutants. The building's lighting and sun exposure are also important [1, 13].

In an intensive pig farming system, a mechanical ventilation system seems to be key to providing a heat-neutral zone for sows and piglets, especially in the warm season [11, 27]. In countries with hotter climates, farrowing facilities with side canopies are more comfortable for keeping pigs [19, 23]. This type of building provides natural through ventilation. However, rising global temperatures are a matter of global concern and require new methods and additional technologies to improve the cooling of animals in summer. Heat stress conditions are a major factor influencing animal health and productivity, especially in modern genetic lines [5, 21].

There are various modifications of the microclimate system that can improve heat transfer in pigs. Some systems can cause a decrease in room temperature for farrowing or direct cooling of the skin of sows and piglets. Most microclimate systems use the effect of water evaporation: fogging, spraying, evaporating gaskets, drip cooling. Heat loss by pigs in the heat can also be improved by using methods that improve convection or conductive heat transfer. Breeding pig farms often used technologies based on increasing air velocity, such as zonal cooling and tunnel ventilation [2, 26]. In particular, for sows kept separately during pregnancy or lactation, increased conductive heat transfer using floor cooling technologies can also help mitigate the effects of heat stress [10, 22].

Changes in animal physiology, behavior, and productivity have been widely considered as indicators of animal welfare. They were often taken into account together with the monitoring of microclimate parameters, primarily temperature, humidity and gas composition [3, 6, 17].

It is known that during farrowing the number of live piglets decreased ($P < 0.05$) and stillbirths increased with increasing humidity of the pigsty ($P < 0.001$). There was also a decrease in the number of weaned piglets when humidity was increased during the weaning period ($P < 0.05$), but mortality before weaning was not affected ($P > 0.05$) [28].

An increase in farrowing room temperature can significantly increase the concentration of NH_3. Recent studies have shown that even minimal exposure to ammonia can be harmful. For example, pigs exposed to 50 parts per million of ammonia for four minutes only four times a day had reduced productivity and reduced live weight gain (37 to 90 kg) [20, 29]. In addition, ammonia can seriously affect respiratory health and slow down puberty, even at a low level of 20 parts per million [7].

Chronic hypoxia, depression, loss of appetite, weight gain, weakness, and increased susceptibility to infection may occur in piggeries with too high a CO_2 content and oxygen deficiency over a long period of time [12, 31, 32].

Hydrogen sulfide emissions from livestock systems affect not only pig productivity but also local and regional air quality [30]. The results showed that the effect of hydrogen sulfide reduced the average daily gain, average daily feed intake and increased the incidence of diarrhea in piglets. Hydrogen sulfide can increase the number and diversity of intestinal microorganisms. Hydrogen sulfide disrupts growth productivity and destroys the balance of microbial bacteria in weaned pigs [6].

Recent studies have shown that the content of H_2S in the pigsty increases the severity of respiratory distress and lung pathology associated with influenza A-type pathogens in pigs [25].

In our previous studies, no patterns were found for the total number of piglets born, the number of piglets born alive, the weight of piglets born, the nest weight of piglets at birth and the number of piglets weaned from sows kept during suckling in farrowing rooms with valve ventilation and geothermal ventilation type. However, the effect of geothermal ventilation resulted in a significant excess of 6.83-8.37% of the weight of one piglet at weaning and 6.26-8.37% of the nest weight at weaning compared to the effect of valve-type ventilation [15]. We also found earlier that no significant difference between the indicators of absolute, average daily and relative growth of piglets kept under different microclimate maintenance systems during the year was found. This is due to the weak influence of the type of ventilation factor on the growth intensity in the range of 7.71-10.20% [16].

Thus, due to the differing views of scientists on the problem of the impact of the microclimate system on the reproductive qualities of sows and the intensity of growth of piglets before weaning, the study of this issue remains relevant today.

The aim of the article is to study the influence of geothermal and valve systems of the microclimate on the reproductive performance of Irish origin pigs in the farrowing rooms of industrial pig complex.

MATERIALS AND METHODS

In order to achieve the objectives of the study, a scientific experiment was set up on the basis of the pig industrial complex LLC "Globinsky Pig Complex", Globinsky district, Poltava region.

In the process of setting the tasks of the experiment, the object of research was determined by the influence of the ventilation system in the farrowing room on the reproductive characteristics of F_1 sows of the maternal line Hermitage Genetics. At the same time, the material for the experiment was generalized data on sows reproductive qualities collected during the calendar year separately for each season. The experimental sows were formed into two separate technological groups, after which they were inseminated with sperm of boars of the synthetic Maxgro line, according to the hybridization scheme of the mentioned pig complex.

The process of studying the reproductive qualities of pigs was based on statistical and analytical analysis of the results of farrowing of two groups of sows during 2019-2021. Sows and piglets were kept in identical farrowing rooms, which differed only in the technical characteristics of the microclimate systems. Sows with piglets of both groups were kept in the premises for farrowing of the breeder №1 LLC "Globinsky Pig Complex", equipped with ventilation equipment from Big Dutchman. The pigs of the I-control group were kept in farrowing rooms equipped with ventilation, where the inflow of air was carried out through supply valves located on both sides of the section. At the same time, pigs of the II-experimental group were kept in a farrowing room of similar planning, but with a different system of preparation and supply of air to the area of animal activity.

The farrowing room, which was equipped with a fairly common negative pressure microclimate system, equipped with air intake valves for air intake and exhaust roof fans for its release, was installed as a control in the experiment and pigs kept there are formed in the first control group (Fig. 1).

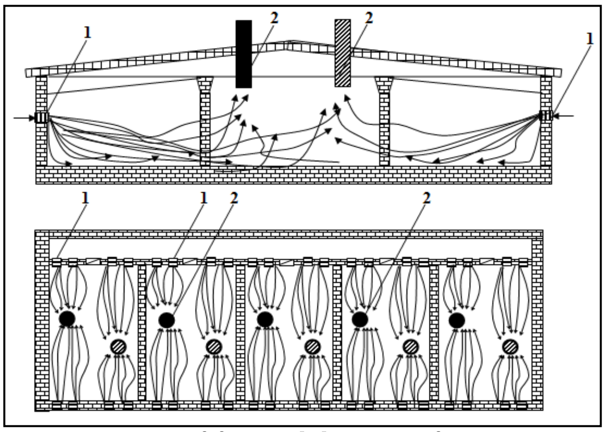

Fig. 1. Location of fans and direction of air movement in the section according to the valve system of microclimate in the farrowing room (I control group)
1 - supply valve; 2 - exhaust shaft.
Source: Own determination.

The operation of intake and exhaust elements of the control farrowing room was regulated by the software control module of the microclimate system, which performs general control of air movement and analyzes its temperature and gas parameters. It was equipped with automatic emergency stop sensors, light and sound warning devices to prevent abnormal ventilation. During the warm seasons of the year, the flow of outside air was directed directly to the area of activity of sows and piglets. And in the cold season, the outside air was directed first to the radiators of the heating system to first raise its temperature and then moved around the farrowing room. At the same time, heated and exhaust air was removed from the farrowing room by exhaust fans of roof shafts.

The farrowing room where the geothermal negative pressure microclimate system was installed has been established as experimental in the study and the pigs kept there were formed into the second experimental group (Fig. 2).

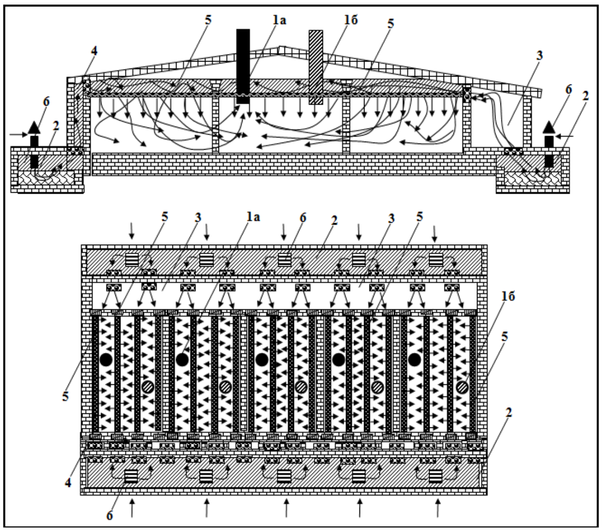

Fig. 2 Location of fans and direction of air movement under geothermal ventilation in the section of the farrowing room (II experimental group)
1a, 1b - exhaust shafts; 2 - underground tunnels; 3 - technological corridor; 4 - transverse air duct; 5 - under-ceiling supply air ducts; 6 - intake shafts.
Source: Own determination.

In contrast to the classical ventilation, equipped with supply valves, a negative pressure microclimate system with pre-treatment of air in underground external and subfloor tunnels and technological corridors of the section was used in the experimental room for farrowing.
The air was distributed through perforated air ducts located under the ceiling above the sow farrowing machines. Due to the vacuum created by the exhaust roof shafts, the outside air was drawn into the farrowing room through underground deep tunnels filled with stones.
Then the air moved through air ducts located on both sides of the room, going to the perforated channels-distributors, which are located above the individual pens for farrowing sows. Such a system was controlled by the Big Dutchman control module.
During the experiment, participants followed the rules of humane treatment of animals.

RESULTS AND DISCUSSIONS

Evaluation of the results of the study revealed that during the winter season there was no significant difference in such indicators of sow productivity as the number of piglets at birth, the number and proportion of stillborn piglets, the number of live piglets, the nest weight of piglets at birth, the weight of piglets at birth. However, it was found that the number of piglets at weaning, which were kept in geothermal microclimate systems, outnumbered peers kept under classical ventilation by 0.37 goals or 2.98% ($p < 0.05$) and by nest weight of piglets at weaning at 3.92 kg or 5.85% ($p < 0.01$). There was no statistically significant difference between the pigs of both groups in terms of safety, the weight of one head at weaning, the weight of the nest of piglets at weaning between the livestock of both groups (Table 1).

Table 1. Reproductive qualities of sows depending on the design features of the ventilation system during the winter season, n = 475

Indicators	Control group	Experimental group
The total number of piglets at birth, heads	15.37±1.03	15.51±0.33
Number of stillborn piglets, heads	0.90±0.22	1.12±0.19
Proportion of stillborn piglets,%	5.81±1.04	7.19±1.08
Number of piglets born alive, heads	14.46±0.83	14.39±0.18
The weight of the nest of piglets at birth, kg	18.70±1.03	18.47±0.25
Weight of piglets at birth, kg	1.29±0.01	1.28±0.01
Number of piglets at weaning, heads	12.41±0.09	12.78±0.14[1]
Preservation of piglets,%	85.82±2.40	88.85±1.68
Weight of 1 head at weaning, kg	5.40±0.21	5.55±0.21
The weight of the nest of piglets at weaning, kg	67.01±1.01	70.93±1.02[2]
Absolute gain, kg	4.11±0.21	4.27±0.21
Average daily gain, g	147±0.01	153±0.01
Relative increase,%	122.87±2.33	125.04±2.39

[1] – $P < 0.05$; [2] – $P < 0.01$; [3] – $P < 0.001$.
Source: Own calculation.

There was also no statistically significant difference in absolute, average daily and relative growth rates between piglets kept under different types of ventilation during the winter.

The study of reproductive qualities of Irish origin pigs in the spring season revealed no significant difference between animals kept in valve and geothermal microclimate systems in terms of number of piglets at birth, number of stillborn piglets, proportion of stillborn piglets, number of piglets born alive weight of piglets at birth, safety of piglets, weight of 1 head at weaning.

Table 2. Reproductive qualities of sows depending on the design features of the ventilation system during the spring season, n = 475

Indicators	Control group	Experimental group
The total number of piglets at birth, heads	15.30±0.36	15.27±0.31
Number of stillborn piglets, heads	1.27±0.35	1.00±0.67
Proportion of stillborn piglets,%	8.36±2.36	6.60±0.67
Number of piglets born alive, heads	14.04±0.55	14.26±0.33
The weight of the nest of piglets at birth, kg	18.71±0.43	19.00±0.09
Weight of piglets at birth, kg	1.33±0.03	1.33±0.03
Number of piglets at weaning, heads	12.40±0.19	13.03±0.21[1]
Preservation of piglets,%	88.31±3.33	91.37±0.98
Weight of 1 head at weaning, kg	5.64±0.37	5.82±0.20
The weight of the nest of piglets at weaning, kg	69.93±1.28	75.83±1.25[3]
Absolute gain, kg	4.31±0.11	4.49±0.09
Average daily gain, g	154±0.01	160±0.01
Relative increase,%	123.67±0.40	125.59±1.35

[1] – $P < 0.05$; [2] – $P < 0.01$; [3] – $P < 0.001$.
Source: Own calculation.

There was a significant advantage of pigs kept with the microclimate system of the experimental type over peers kept in farrowing rooms with the microclimate system of the valve type by the number of piglets at weaning at 0.63 goals or 5.08% ($p < 0.05$) and the weight of the nest of piglets at weaning at 5.90 kg or 8.44% ($p < 0.001$) (Table 2).

The difference in absolute, average daily and relative growth rates during the spring season was not statistically significant between piglets kept using different types of microclimate systems in the farrowing room.

Analysis of reproductive performance of pigs kept under different microclimate systems during the summer season showed that they had no significant differences between animals of both groups in number of piglets at birth, in number and proportion of stillborn piglets, in number of live piglets, in nest weight at birth, in the weight of piglets at birth, by number of piglets at weaning.

Table 3. Reproductive qualities of sows depending on the design features of the ventilation system during the summer season, n = 475

Indicators	Control group	Experimental group
The total number of piglets at birth, heads	15.56±1.06	15.32±0.74
Number of stillborn piglets, heads	1.07±0.35	0.86±0.08
Proportion of stillborn piglets,%	6.72±1.82	5.59±0.25
Number of piglets born alive, heads	14.49±0.71	14.46±0.66
The weight of the nest of piglets at birth, kg	18.8±1.57	18.66±1.00
Weight of piglets at birth, kg	1.3±0.05	1.29±0.01
Number of piglets at weaning, heads	12.32±0.77	12.83±0.75
Preservation of piglets,%	86.39±1.36	88.75±0.45
Weight of 1 head at weaning, kg	5.28±0.15	5.39±0.08
The weight of the nest of piglets at weaning, kg	65.04±1.17	69.17±1.28[2]
Absolute gain, kg	3.98±0.11	4.10±0.09
Average daily gain, g	0.142±0.01	0.146±0.01
Relative increase,%	120.97±0.40	122.75±1.35

[1] – $P < 0.05$; [2] – $P < 0.01$; [3] – $P < 0.001$.
Source: Own calculation.

It was found that sows that farrowed in a farrowing room with a geothermal type of microclimate system had a significantly higher nest weight of piglets at weaning by 4.13 kg or 6.35% (p <0.01) than their counterparts, which were placed in farrowing rooms with a valve type of ventilation (Table 3).

During the summer season, no statistically significant difference between the piglets of the control and experimental groups in terms of absolute, average daily and relative growth was found.

A study of sow productivity during the autumn months found that the type of microclimate system did not significantly affect such indicators as the number of piglets at birth, the number and proportion of stillborn piglets, the number of live piglets, the nest weight of piglets at birth, the weight of piglets at birth in pigs of both groups.

Table 4. Reproductive qualities of sows depending on the design features of the ventilation system during the autumn season, n = 475

Indicators	Control group	Experimental group
The total number of piglets at birth, heads	15.51±1.03	15.49±0.36
Number of stillborn piglets, heads	0.89±0.23	0.92±0.03
Proportion of stillborn piglets,%	5.66±1.16	5.97±0.19
Number of piglets born alive, heads	14.62±0.86	14.57±0.35
The weight of the nest of piglets at birth, kg	18.71±1.03	18.74±0.50
Weight of piglets at birth, kg	1.28±0.02	1.29±0.01
Number of piglets at weaning, heads	12.26±0.20	12.84±0.09[1]
Preservation of piglets,%	83.86±1.31	88.13±1.18[1]
Weight of 1 head at weaning, kg	5.47±0.24	5.56±0.13
The weight of the nest of piglets at weaning, kg	67.02±1.20	71.39±1.18[2]
Absolute gain, kg	4.19±0.25	4.27±0.13
Average daily gain, g	0.150±0.01	0.153±0.01
Relative increase,%	124.15±3.26	124.67±1.57

[1] – P < 0.05; [2] – P < 0.01; [3] – P <0.001.
Source: Own calculation.

However, it was found that sows of the experimental group outperformed analogues from the control group in terms of the number of piglets at weaning by 0.58 goals or 4.73% (p <0.05), according to the preservation indicator by 4.27% (p <0.05), according to the weight of the nest of piglets at weaning by 4.37 kg or 652% (p <0.01) (Table 4).

During the autumn season, no significant difference was found between the growth intensity of piglets kept under geothermal ventilation and valve ventilation in terms of absolute, average daily and relative growth.

The study of the annual dynamics of the total number of piglets revealed its tendency to increase from winter to autumn in the control group and to decrease during spring and summer in the experimental group (Fig. 3).

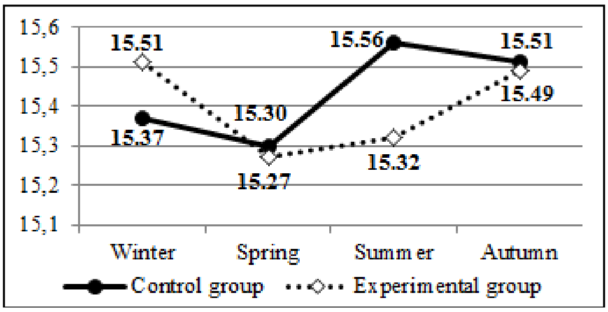

Fig. 3. Annual dynamics of the total number of piglets at birth
Source: Own determination.

Control of the annual dynamics of the number of piglets born alive showed that there was no significant difference between its seasonal indicators in pigs kept under valve ventilation and kept under geothermal ventilation (Fig. 4).

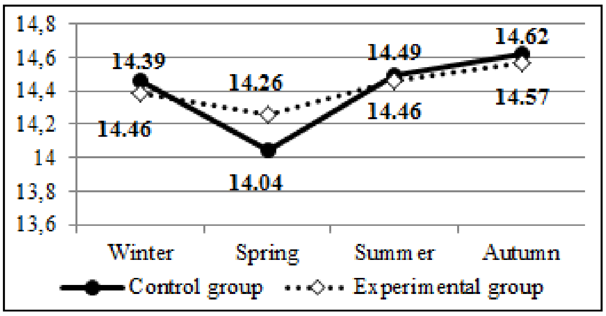

Fig. 4. Annual dynamics of the number of piglets born alive
Source: Own determination.

Evaluation of the annual dynamics of piglet preservation revealed no statistically significant difference between its values during each season in the population of both experimental groups of pigs. We can note only the tendency to a slight increase in the spring in animals in both groups (Fig. 5).

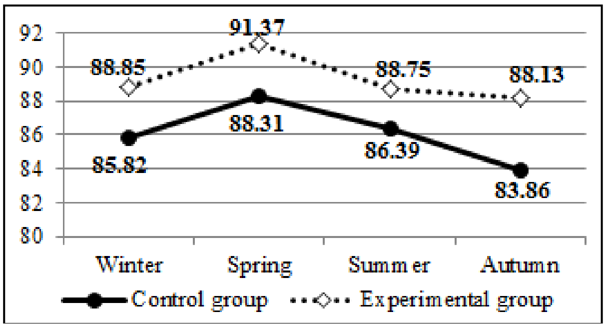

Fig. 5. Annual dynamics of piglets preservation
Source: Own determination.

After analyzing the annual dynamics of the number of weaned piglets, we found only a tendency to decrease during the season for sows kept under valve system of the microclimate, and for analogues kept under geothermal ventilation (Fig. 6).

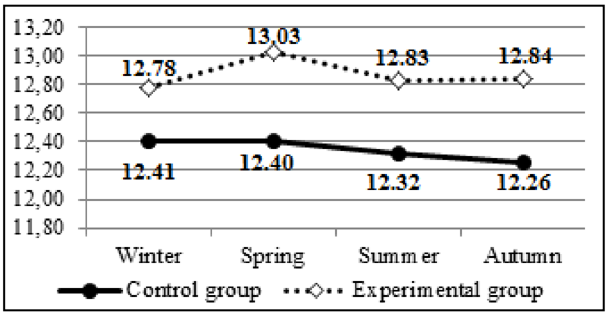

Fig. 6. Annual dynamics of the number of weaned piglets
Source: Own determination.

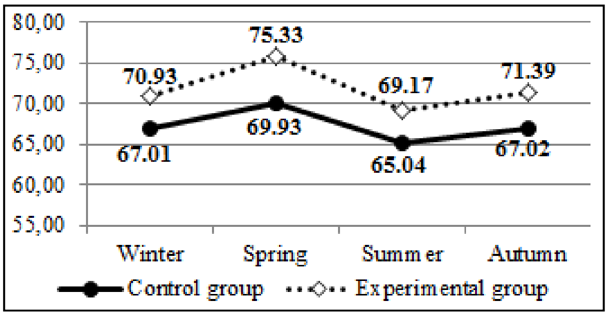

Fig. 7. Annual dynamics of the nest weight of piglets at weaning
Source: Own determination.

Analysis of the annual dynamics of the nest weight of piglets at weaning revealed the absence of a significant difference between its indicators during the year in piglets of the I-control group. At the same time, it was found that the nest weight of piglets was 4.90 kg or 6.91% (p <0.01) higher than in winter, and there was no significant difference between the indicators of piglets of the II experimental group during other seasons (Fig. 7).

The study of the annual dynamics of the average weight of 1 head at weaning made it possible to establish the absence of a statistically significant difference between seasonal fluctuations of the indicator during the study period in piglets of both groups (Fig. 8).

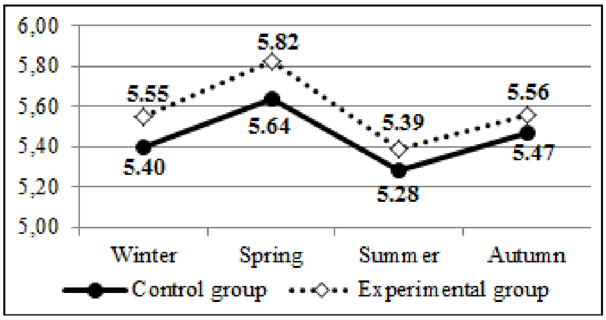

Fig. 8. Annual dynamics of the average weight of 1 head at weaning
Source: Own determination.

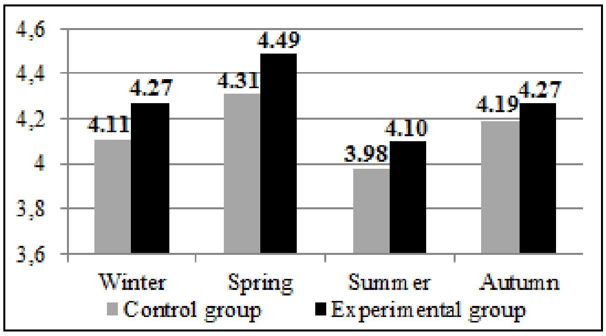

Fig. 9. Annual dynamics of absolute growth of piglets
Source: Own determination.

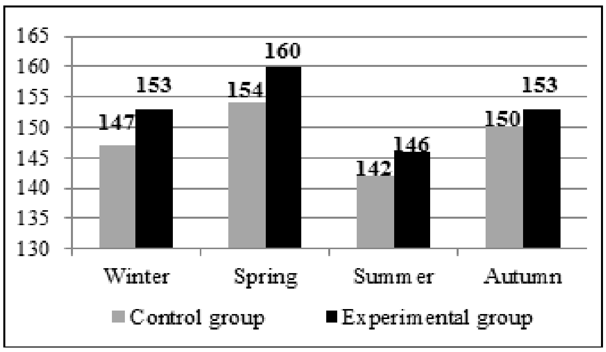

Fig. 10. Annual dynamics of average daily growth of piglets
Source: Own determination.

The study of the annual dynamics of absolute, average daily and relative growth showed that there was no significant difference between the seasonal values of both groups of pigs kept in the valve and pigs kept in experimental ventilation during the year (Fig. 9, 10, 11).

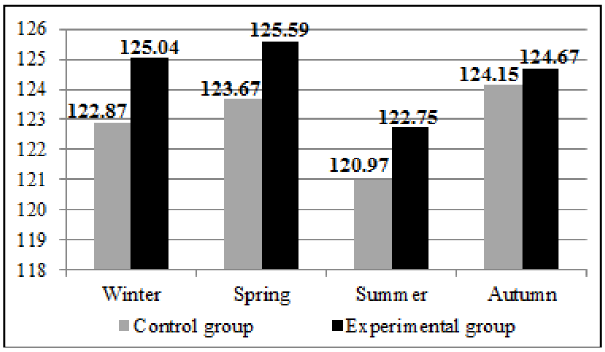

Fig. 11. Annual dynamics of relative growth of piglets
Source: Own determination.

Our studies did not coincide with other reports [29], which indicated an increase in the number of stillborn piglets with increasing humidity in the spring and autumn seasons in the survey premises (P <0.001). We did not find such a dependence and during the spring and autumn we did not notice a significant change in the number or proportion of stillborn piglets. We also did not observe a decrease in the number of weaned piglets during the usually wetter spring season during the weaning period, as noted in these scientific studies [29].

The results of our previous studies on the lack of influence of the type of ventilation on the growth rate of piglets was confirmed by the current experiment. We did not receive statistically significant confirmation that the type of ventilation affected the absolute, average daily and relative growth both in terms of groups and during individual seasons [16].

The results of the study did not coincide with our previous conclusions about the effect of geothermal ventilation on the growth of 6.83-8.37% of the weight of one piglet and 6.26-8.37% of the nest weight at weaning [17]. We found the effect of geothermal ventilation on other indicators of reproductive qualities of pigs, namely: to increase the number of piglets at weaning and to increase the nest weight of piglets at weaning in winter, spring and summer, and in autumn – in addition to increasing preservation.

We found the dependence of the nest weight of piglets when weaned from the ventilation system of the premises makes this figure higher when keeping pigs in the farrowing room with a geothermal ventilation system by 5.85-8.44%, which coincides with the another conclusions [14], which indicates an 11.00% excess of the nest weight of piglets for keeping using geothermal type of ventilation compared to the valve.

CONCLUSIONS

It was found that when keeping pigs in farrowing rooms equipped with geothermal type of microclimate system such indicators as the number of piglets at weaning and the nest weight of piglets at weaning were significantly higher than their counterparts kept in the valve system of microclimate in all seasons.

The annual dynamics of reproductive quality of pigs in both sows kept under valve ventilation and sows kept under the geothermal ventilation had no statistically significant seasonal differences.

The type of microclimate system did not affect the intensity of growth of piglets in terms of technological features of ventilation equipment or method of preparation and supply of air to the area of animals activity, nor in terms of seasons.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

HOW THE NATIONALITY AND TYPOLOGY OF TOURISTS INFLUENCE THE LENGTH OF STAY PRIOR AND DURING PANDEMIC CONTEXT - CASE OF FULL-SERVICE HOTELS FROM MAMAIA RESORT, ROMANIA

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Abstract

The length of stay of a tourist is an index having a high significance for tourist destination management given that a longer length of stay leads to a higher occupancy hotel rate and higher revenues. The aim of the present paper is threefold. Firstly, it determines the average length of stay in the most popular Romanian Black Sea resort – Mamaia, for the four, respectively five-star hotels. Secondly, it concisely examines the extent to which the typology and nationality of tourists influence their average length of stay in this seaside resort. Finally, it examines the extent to which season's year and the months of summer season influences the average length of stay. The data was collected from the platform Booking.com. The results indicate that, in Mamaia resort, the length of stay is mainly explained by the residential status of the tourists, their nationality and typology, respectively by the season's month.

Key words**:** *tourist behaviour, length of stay, nationality, typology of tourists, Mamaia resort, Romania*

INTRODUCTION

In many countries at the global level, tourism was seen as being an important economic engine, even though the Travel and Tourism industry is facing nowadays an unprecedented period, as this ongoing COVID-19 pandemic impacted it the most. As a result of this pandemic, there have been important changes in the behavior of tourists all over the world. Each tourist destination has a particular character, highlighting different models of tourist behavior that plays an important role to adjust the supply of touristic services in the area.

Among the most favourite tourist destinations worldwide can be highlighted the seaside resorts. The reasons for choosing a hotel in a seaside resort are given by the purpose of tourist's visit: recreational tourism or business tourism. Despite the purpose of visit, the length of stay (LOS) of a tourist has high relevance for any seaside touristic destination because reveals consumption and revenue levels collected. This index has high relevance for tourist destination management since a longer length of stay determines the consumption of more goods and services. Therefore, a higher length of stay is beneficial to local economies.

The incentive for the present research is given by the fact that seaside tourism at the Black Sea in Romania is a subject that has not attracted many researchers so far, despite its significance at the national level. This research emphasizes the tourist's behavior in the seaside area at the Black Sea.

According to the best of the authors' knowledge, the present study is the first to highlight the influence of the typology and nationality of tourists on the average length of stay of tourists in seaside resorts and the influence of seasonality over the number of tourists, respectively over the average length of stay. Therefore, this paper contributes to tourism literature for the Black Sea. This contribution of the present paper is given by the focused view of the factors influencing the LOS in the main seaside resort from the Romanian Black Sea, which can be seen as a premise for the analysis in all main international Black Sea resorts.

The current study aims to explore the influence of two factors, nationality and tourists' typology, on LOS in the case of 4- and 5 -stars hotel guests at the seaside. Thus, the study makes several contributions to the literature. Firstly, by considering the impacts of pandemic context on tourist behaviour. Such an approach has not yet been employed and the study investigates the influence of the COVID-19 situation upon the length of stay using a comparison with the previous times. Secondly, the study is focused on the Online Travel Agency (OTA) clients for the hotels of 4- and 5-stars classification, which presents more pieces of evidence regarding the tourist behavior of this market segment.

The main purpose of the present paper is to investigate and identify how the typology and nationality of tourists influence the average length of stay of tourists in Mamaia seaside resort for full-service hotels. Also, it concisely examines the extent to which seasonality influences the number of tourists, respectively the average length of stay.

In Romania, seaside tourism plays a significant role in tourist activity even though this form of tourism is characterized by an acute seasonality, which creates significant problems for the providers of tourist services in this area. Annually, the season in Romania begins officially on the 1st of May and ends at the end of September.

In terms of accommodation infrastructure, the seaside area encounters 8.44% of the entire national accommodation units and 18.4% of the country's hotels. The units present in this region have been settled to serve the mass tourism development, thus consequently the number of rooms the seaside accommodation units count 23.2% of the total at the national level, registering a higher value in the case of hotels, around 34% [13].

The most popular Romanian Black Sea resort is Mamaia. It is populated mostly during the summer and has more than 85% of accommodation units seasonal operating. Hotels range from 1-star to exclusive 4- and 5-star hotels. The classification of the hotels from the analyzed resort, based on OTA's database (Booking.com September 9, 2021), is presented in Table 1.

Table 1. Number of hotels in 2021 in Mamaia resort depending on the level of compliance

Classification based on star	Number of hotels	Percentag e
2 stars	5	5.10
3 stars	44	44.90
4 stars	36	36.73
5 stars	1	1.02
Unclassified	12	12.25
Total	**98**	**100**

Source: Authors' calculations based on Booking data, September 9, 2021 [5].

Literature perspective

The research activity regarding tourists' length of stay at destinations and accommodation units represent a topic that has captured attention in the last years. Length of stay matters because it has a direct effect on the occupancy rate and income of tourism, therefore should be taken seriously by managers and entrepreneurs in planning and promoting their offer. A strong investigation path of the cultural values influences upon the tourists' behavior [17], [19] and style of tourism [20] revealed the link between nationalities and length of stay.

Existing studies investigated different typologies of tourists and using their profile examined the influence upon the LOS. Consequently, an additional factor observed to play an essential role in determining the duration of the tourists' trip is the motive or travel reason. Thus, Oliveira-Santos, Ramos and Rey-Maquieira [15] found out that tourists visiting friends or relatives stay for a longer time. Instead, Rodriguez et al. [21] concluded that those who travel for business reasons registered a longer length of stay. In terms of tourist typology, some studies revealed that individual travellers stayed for a longer period than other categories [9].

A previous experience in the destination seems to affect the length of stay. Thus, [9] and [12] observed that tourists who travelled before to the destinations stayed for more days compared with those on their first visit. Again, this assumption is not sustained by other studies [11] which found by contrary the repeated visit being correlated with a shorter duration. Also, it was researched the effect of a destination's attractiveness or image upon the length of stay, because some destinations are recognized in the market due to some special attributes or characteristics [11]. Thus, findings strengthen the idea that some destination attributes, related to a well-established reputation, such as gastronomy, nature, sea, culture, have a positive impact on the hazard of the length of stay, suggesting growth of LOS. This result implies that each destination should be analysed independently and the length of stay is specific to each tourism destination [16].

Since tourists' behaviour is influenced by social factors such as social stimuli, family or social roles, some studies included in the LOS' research model the companionship status [4], [10], [18]. The social group represents in many cases an essential influence factor in the choice of a holiday destination, the sources of information used to make decisions, the facilities and services preferred during their stay, the type of tour packages and even the length of stay, because deciding how long to stay is decided in consensus with the other members of the social group.

Some studies [8] concluded that single tourists tend to stay longer because they only spend for themselves. This segment travels most of the time with friends, being engaged in more activities at the destination. In comparison with the married couple, single tourists may have the freedom of spending more time on vacations. Instead, other studies [1] concluded that party size appears to exert a negative influence upon LOS. Thus, Gomes de Menezes, Moniz, & Cabral [10] identified that in comparison with couples, those tourists who travel with friends prefer a shorter length of stay. Still is not a consensus in the literature about the relation of companionship with the tourists' length of stay.

In summary, we find that different explanatory variables seem to influence the number of days spent by tourists in a destination. Most of the studies indicated that, even if there are mentioned sometimes contradictory effects for the same variable, sociodemographic characteristics influence in a relevant manner the tourists' LOS.

Starting from these findings and conclusions, six hypotheses to be tested in the case of tourists spending their summer holiday at the Romanian seaside area were advanced. In the process of defining the hypothesis, the following criteria have been considered: the new pandemic context which could affect the tourist behaviour; the main season for spending the holiday at the Romanian seaside – from May to September and two criteria for the tourist characteristics (nationality and social group).

H1: The length of stay is higher in the case of international tourists in comparison with residents ones.

H2: The season's year influences the tourist's length of stay.

H3: The interaction between the variables tourists' residential status (resident or non-resident) and season's year is correlated with length of stay.

H4: Nationality, as a social-cultural characteristic of tourists, influences the length of stay at the 4- and 5-stars Romanian hotels.

H5: The month of the summer season determines significant differences in the length of stay.

H6: The length of stay is higher in the case of families as a category of the tourist typology based on social group.

The remainder of this paper is organized as follows: the next section emphasizes the research methodology that has been employed. The paper continues with an in-depth discussion of the research findings and finally points towards the most important conclusions of this topic.

MATERIALS AND METHODS

Considering the main objectives of the present paper, the studied population is represented by Romanian and foreign tourists who have chosen Mamaia as their tourist destination and who have benefited from four, respectively five-star hotel services. In the present research, the sampling unit is represented by the hotel, and the observation unit is represented by the resident or foreign tourists.

The results of the research will extend to the entire studied population, i.e. to the level of all tourists who, during the analyzed period [2018; 2021], visited Mamaia and were accommodated in the four, respectively five-star hotels. To ensure the level of statistical and structural representativeness, an equivalent of the sampling base intended to provide a probabilistic sample has been designed and used. The starting point for the establishment of the sampling base was the realization of a probabilistic group sampling, because each hotel represents the expression of a group of tourists, even if the structure of each hotel maybe, to a certain extent different.
In order to compass the main objectives of our research, the procedure for establishing the sample base and the sample was as follows:
-the data was collected from the platform Booking.com;
-the data collection was between 15.09.2021 – 08.10.2021;
-the data was collected according to the following variables:
(1) the **year** in which the tourists accommodated in Mamaia holiday resort: 2018, 2019, 2020 or 2021;
(2) the **typology of tourists**. The following categories were identified: families, couples, groups of friends, respectively individual travellers;
(3) **number of stars**: four, respectively five-star hotels;
(4) **nationality**. The following categories were identified: tourists from Romania, Germany, England, Italy, France, Austria, Sweden, Moldova, Spain. In the category "other nationalities" were included tourists arriving from the USA, Bulgaria, Poland, Belgium, Denmark, Hungary, Ireland, Norway, Colombia, Slovakia, Switzerland, Northern Macedonia, Philippines, Luxembourg, British Ocean Territory of India, Turkey, Russia, Greece, Netherlands, China, Israel, Czech Republic, Portugal, Ukraine, Finland, Sweden;
(5) **length of stay** (days);
(6) the **month** in which the tourists accommodated in Mamaia;
- in the case of four-star hotels, it was chosen to include in the sample those hotels, at the level of which, the number of ratings was the highest, respectively, whose rating averages were dispersed;
- in total, data related to 5,676 tourists were used, as follows: at the level of four-star hotels, the number of tourists included in the research was 4,457, and in the case of five-star hotels 1,219;
- the data was processed using the SPSS program.
The validation of the sample was carried out by employing a test to compare the differences between the percentages. Only one practically possible variable was considered, namely, the number of hotels according to the level of compliance.

RESULTS AND DISCUSSIONS

The results analysis based on the main objectives of the research and hypotheses advanced, drive to the following findings.
The average length of stay of the tourists scrutinized in the present study registered an increasing trend: from 2.587 in 2018 to 2.811 days in 2021. In 2020 was registered the highest length of stay (2.835), while in 2019 there was the same case as in 2021. A possible explanation is due to the increase in the number of Romanian tourists (pandemic determined most of them not to give up on their vacation plans, being willing to stick to domestic seaside destinations). Other than this, holiday vouchers supplied to Romanian citizens by the state have been a stimulus leading to a higher length of stay during vacations.
Concerning the average LOS of Romanian and foreign tourists in Mamaia, in the analyzed period, data shows that the highest value was registered for the international tourists (3.185 days), for the Romanian tourists being just 2.752 days. The most significant non-resident tourists markets are from Spain, Moldova, Germany, the UK, French and Italy. Other than this, Spanish tourists accommodated the longest, followed by Moldavians, Germans and English people. Italians accommodated the smallest period, followed by the French. If we examine deeply the data, it is interesting to highlight that

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

tourists from Spain recorded the longest period of stay in 2019 and 2020, while in 2021 Moldavians did that. By contrast, tourists from Italy recorded the shortest period of stay in 2019 and 2021, while in 2020 Austrians did that. In the case of Romanian tourists, the longest stay was recorded in 2020 (2.856), followed by 2021 (2.729). Even though the Pandemic had, and has, a negative influence on humanity, it had a positive contribution in terms of capitalizing on the touristic potential in Mamaia.

In terms of the Typology of tourists, in the analyzed period, families accommodated the longest. A possible explanation is that many families will tend to go on vacation in the same place and for a longer time, if possible, due to familiarity and because it reduces the risk of an unsatisfactory experience if they choose another place. By contrast, individual travelers accommodated the least in 2019 and 2020 and groups of friends in 2021. This can be influenced by travel reasons.

Further, a difference concerning the season's month preferred for vacation in Mamaia resort is registered based on the tourist's residential status: resident tourists tend to prefer August and September, while non-resident tourists July and August. Other than this, both category of tourists tends to prefer a shorter LOS in May, while September tends to become more popular.

The literature suggests that domestic and international tourists may respond to factors affecting their demand to varying degrees. From this perspective first, it was investigated if there are some differences regarding the length of stay between the Romanian and international tourists.

Since the database includes variable's values registered in the last 4 years, have been employed the average lengths of stay, separately for each annual summer season and category of tourists (domestic and international). Thus, as Table 2 reflects, with one exception of 2020, the value of LOS in the case of non-resident tourists is higher than the average computed for the resident tourist category.

Table 2. Analysis of LOS for domestic versus international guests for Mamaia hotels

Year	Domestic/ International	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
2018	Domestic	2.378	.279	1.831	2.926
	International	**3.444**	.566	2.335	4.554
2019	Domestic	2.651	.052	2.550	2.753
	International	**3.409**	.100	3.212	3.606
2020	Domestic	***2.856***	.045	2.767	2.945
	International	2.600	.152	2.302	2.898
2021	Domestic	2.729	.053	2.626	2.833
	International	**3.216**	.118	2.986	3.447

Source: Authors' calculations.

According to the Eurostat Statistics report [6] the number of nights spent by foreign tourists in 2020 compared with the previous year decreased in all EU Member States, but the largest decreases of more than 80% were observed in Cyprus and Romania. If in the case of Cyprus this negative impact has been compensated with an increase (15%) for the number of nights spent by residents, in the case of Romania the tourism drop was amplified in 2020 by a decrease with 18% of the domestic tourists' number of nights spent in accommodation establishments. So, due to the travel restrictions and the other Covid precautionary measures taken in 2020, the number of nights spent by non-residents of the country fell dramatically and influences consequently also their length of stay. This pattern is not observed in the case of residents of the country. Even if it was registered a reduction of the number of nights spent by resident guests, their average length of stay in 2020 slightly grew and continues to grow in 2021.

Thus, another essential empirical result is the reverse tendency of LOS for both categories of tourists during the period studied 2018-2021: a decrease for non-residents guests and a significant growth for Romanian tourists. This emphasizes how the pandemic context changes the tourist's behaviour in general. Therefore, the behaviour at the seaside followed the same tendency identified at the European level: a steady recovery of domestic tourism for 2020-2021 accompanied by an important growth of the number of nights spent by EU tourists' residents in their country accommodation units.

To evaluate the research hypothesis H1, H2 and H3, the ANOVA test was applied with two independent variables (residential status and Summer season's year) with an interaction between each other. The findings of this analysis highlight that both variables influence the length of stay. Moreover, the dependent variable is also influenced by the interaction between the two independent variables. According to H1, H2 and H3 which are confirmed by the research results, the actual pandemic context determined a new predisposition of travel behaviour for both groups of guests which influence eventually also their length of stay.

Table 3. The results of ANOVA test for research hypotheses H1, H2 and H3

H_1	**H_2**	**H_3**
F= 9.326	F= 3.319	F= 9.438
df: 1	df: 3	df: 3
Sig: .002	Sig: .019	Sig: .000
$F_{.05;1;4160}=3.84$	$F_{.05;3;4160}=2.60$	$F_{.05;3;4160}=2.60$

Source: Authors' calculations.

The analysis of the non-resident tourist's nationality for the 4- and 5-stars hotels from Mamaia revealed that the most important international markets are in the following order, based on the number of clients and number of nights spent: Spain, Moldova, Germany, UK, Sweden, France, Austria, Italy. According to the average length of stay computed in the case of the Nationality of tourists variable the lowest value of 2.629 is characteristic for Italian tourists, while the highest mean of 4.048 days is reached for the tourists from Spanish, as Table 4 presents.

Regarding the influence of nationality, it is important to underline that tourists from Germany represent the most important international market for 4- and 5-stars hotels from Mamaia, from both perspectives: in terms of the number of guests and the LOS.

Besides, Moldavian tourists correspond to the tourists with the most effective length of stay, but with a less significant volume, while tourists from Spain represent an opportunity to be fruitful since they have a higher LOS.

Table 4. Results of descriptive analysis of Average Length of Stay in relation to Tourist Nationality

Nationality	**Mean**	**Std. Error**	**95% Confidence Interval** Lower Bound	Upper Bound
Romanians	2.752	.029	2.696	2.808
Germans	**3.699**	.167	3.371	4.027
English	**3.223**	.154	2.920	3.526
Italians	2.629	.287	2.065	3.192
French	2.955	.256	2.452	3.457
Austrians	2.818	.362	2.108	3.529
Moldavians	**4.000**	.694	2.640	5.360
Swedish	3.000	.425	2.167	3.833
Spanish	**4.048**	.371	3.321	4.775

Source: Authors' calculations.

Further, the present study investigates how the social group predilections, which determine four tourists types (i.e. Families, Couples, Groups of friends, Individual travelers), influences the length of stay. In the analyzed sample, it is acknowledged the existence of differences between the averages of LOS at four groups formed according to the Typology of tourists. The average number of days booked in Mamaia resort during the analyzed period by the families is 3.100 days, while for the group of friends is 2.432 days, the daily difference being .668. From the analysis of the confidence interval, it is observed that some of them intersect, which suggests that between the averages of those categories there may be no differences.

Table 5. Results of descriptive analysis of Average Length of Stay associated to Tourist Typology

Typology of tourists	**Mean**	**Std. Error**	**95% Confidence Interval** Lower Bound	Upper Bound
Families	3.100	.043	3.016	3.183
Couples	2.724	.039	2.648	2.800
Group of friends	2.432	.085	2.265	2.599
Individual travellers	2.446	.098	2.253	2.639

Source: Authors' calculations.

To gain a more detailed knowledge regarding hotel service consumer behavior, the mean of the variable length of stay, based on subgroups formed by crossing the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

independent variables (Typology of tourists and Nationality), was analyzed.
Related to these subgroups, the following findings can be underlined:
•the longest LOS is recorded in the case of families from Moldova (an average of 7 days);
•the shortest average length of stay, namely 2.778 days, was found in the case of families from Italy, followed by families from France. In their case the average length of stay was 2.818 days;
•the longest LOS in the case of couples was for Sweden tourists (an average of 4.2 days);
•couples from Moldova stayed for the shortest period in Mamaia, with an average length of stay of only 2 days;
•for the category groups of friends from France and Spain, the average length of stay is 4.0 days;
•in the case of groups of friends, the longest length of stay characterized tourists arriving from France and Spain (average: 4 days) and the shortest referred to groups arriving from Austria (average: one day);
•the longest average length of stay – in case of tourists travelling individual – referred to tourists arriving from Spain: 5.5 days. Regarding the analyzed variable, the lowest value was found in the case of tourists arriving from Austria (one day).
To create marketing strategies and policies, hotels should aim to describe the relationships between variables that define the hotel sector. In our opinion, these variables include the Type of tourists and the Nationality of tourists. With the help of factor correlation analysis, it is possible to capture the association between the categories of the respondents based on the variables mentioned above. Small differences between the respondent categories indicate a strong association and large differences indicate a weak or no association.
According to the data presented in the figure below, it can also be noticed a strong association between couples and families and domestic tourists. Also, the same association was registered between these categories of tourists and those coming from the UK. Tourists who travel alone are associated with the following nationalities: Austria and Italy. Tourists arriving with groups of friends are associated with Spain and Austria international market segments. It is also possible to observe relatively large distances of association in the case of tourists arriving from France, Moldova and Sweden related to the variable Typology of tourists.

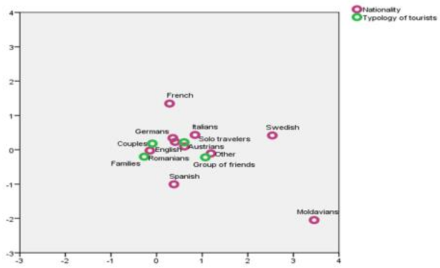

Fig. 1. Association between: Typology and Nationality of tourists
Source: Authors' calculations.

To test the research hypothesis (H4) and (H6), the ANOVA test was applied considering two independent variables (Tourist Typology and Tourist Nationality) with no interaction between each other. The findings of this analysis highlight that both variables have an impact on the independent variable Length of Stay in the seaside resort 'Mamaia'.

Table 6. The results of ANOVA test for research hypotheses H4 and H6

H4	H6
F= 32.980	F= 8.173
df: 3	df: 9
Sig: .000	Sig: .000
$F_{.05;3;4155}$=2.60	$F_{.05;9;4155}$=1.88

Source: Authors' calculations.

To plan and design the appropriate strategies, hotels need to understand the tourists' behavior during the summer season, so another aspect to be investigated is to identify the demand pattern. Thus, the analysis of the season's month influences upon the number of nights and length of stay have been developed. A better approach to investigate the variable impact was to perform separately for resident and non-resident tourists. Thus, as Table 7 presents, resident tourists prefer for summer holidays September and August, while non-resident tourists are present in higher ponder during August and July.

Table 7. Results of the demand pattern analysis

		Season's Month					Total
		May	June	July	August	September	
Domestic	Count	442	607	766	812	913	3,540
	Expected Count	434.9	591.1	764.4	855.3	894.3	3,540.0
International	Count	70	89	134	195	140	628
	Expected Count	77.1	104.9	135.6	151.7	158.7	628.0
Total	Count	512	696	900	1,007	1,053	4,168
	Expected Count	512.0	696.0	900.0	1,007.0	1,053.0	4,168.0

Source: Authors' calculations.

To test the relationship between the residential status of tourists and the season's month to spend their summer holiday it was applied a Chi-square test. Since the value of Asymp. Sig. (2-sided) .000 is less than .05, (i.e. $\chi 2$ calc20.743 >χ2.05;4= 9.488), the differences between the observed and expected frequencies existing in the sample are statistically significant to guarantee with 95% probability that there is a relationship between the two variables. Thus, there is a correlation between the season's month and tourist residential status.

Table 8. The results of Chi-Square for testing the correlation between Season's Month and Tourist Residence situation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.743[a]	4	.000
Likelihood Ratio	19.988	4	.001
Linear-by-Linear Association	1.359	1	.244
N of Valid Cases	4,168		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 77.14.
Source: Authors' calculations.

This came following the statistical results at the European level revealed by the Eurostat report [6, 7], where August and July resulted in the months characterized by the highest demand for international tourists.

Regarding the years included in the analysis, the difference between the average Length of Stay in August and September shows a continuous decrease. In 2019 the difference was 1.007 days, in 2020 it was .661 and in 2021 it meant .360 days. As such, the month September continues to become more and more popular among tourists visiting Mamaia resort. May is still the month with the shortest Length of Stay.

According to the data presented in the table below (H=456.316>χ2.05;4= 9.488, respectively Asymp. Sig. = .000 < .05), H5 is confirmed, meaning that among the five population groups (based on the seasonal months) there are differences regarding the Length of Stay.

Table 9. Results of the Kruskal - Wallis test for research hypothesis H5

Test Statistics[a,b]

	Length of stay
Chi-Square	456.316
df	4
Asymp. Sig.	.000

a. Kruskal Wallis Test
b. Grouping Variable: Month

Source: Authors' calculations.

The findings support the hypothesis considered. It is found that non-resident tourists influence the LOS, validating H1 (hence, the international tourists increase LOS in Mamaia); season's year influence the LOS, validating H2 (it is a broadly intuitive result). Then, nationality and typology of tourists explain LOS, validating H4 and H6 (Moldavians, Germans and Spanish represent some of the most important international tourists; families accommodated the longest period). Further, the season's year and month explain the LOS, validating H3 and H5 (the conclusions relative to the residential status of the tourists are different).

CONCLUSIONS

The study's findings revealed that there are several considerations about the impact on the seaside tourist behavior during the pandemic context. The first conclusion regards the appropriate research methodology to clarify the influence of the six variables upon the average length of stay, in the case of full-service hotels. Thus, the study highlights the convenience and reliability of using as the main data source Booking.com listings. In comparison with tourists who address to travel agencies or tour operators for a complete summer holidays package at the seaside, those who opt for an OTA (online travel agency) channel represent a different market segment that required distinctive attention in studying its behavior at the destination. If in the case of the first category of tourists there is a kind of standardization of the LOS based on the package's elements established by a tour operator, in the case of OTA guests we can talk about higher flexibility and a higher influence of the customer's features upon the LOS.

Consequently, resulted interesting differences in the length of stay across nationalities. First, it was confirmed the positive association between the international market and length of stay in full stars hotels. Similarly, with other studies [2], [3], [22] and [14] in terms of nationality, our results confirm that Spanish and German tourists are positively related to a longer LOS. This pattern has an important effect on the international tourists' LOS specific for the Romanian seaside. On the other hand, the typical UK tourists' behavior who spent their summer holiday in full-service hotels from Mamaia doesn't confirm the previous studies [2] and [14], which concluded that they prefer a shorter length of stay at the destination, corresponding for a weekend time. In contrast, when they spend the summer holiday at the Romanian seaside, using an OTA platform, their average length of stay is higher. In conclusion, according to nationality, international tourists who use OTA for booking seaside holiday accommodation at full-service hotels tend to have longer LOS.

Furthermore, this study provided strong pieces of evidence related to the fact that the pandemic context did not interfere in the positive evolution of LOS for domestic tourists. More than that the 2020 year provided the circumstances when this average surpasses the average for international tourists. Contrary, to international tourists the Covid 19 context determined not only a decrease in number but also in the LOS at the seaside. At the same time, it was statistically proved that the season's month is a significant determinant of the LOS at the full-service hotels from Mamaia resort. If for Romanian tourists September seems to be preferred, in the case of international guests' results lead to August. This result is very important as a distinguishing element that can be used in the local tourism strategy targeting how to promote a destination for summer holidays and by full-service hotels in their competitive operations strategies.

Compared to other studies in the literature it was analyzed not only the LOS according to the social group typology, but even more, associated with nationality. In this respect, resulted that for residents' guests the highest LOS at the full-service hotels is in the case of families and for international tourists is in the case of individual travellers. Thus, from a managerial perspective knowing who are the determinants for the length of stay provide a practical approach to more targeted extended stay policies.

In terms of an average length of stay at 4- and 5 stars hotels from Mamaia resort, even if lately there is a clear increasing tendency, however almost 3 nights spent represents a short period in comparison with other summer holiday destinations from this region. This implies that financially capable tourists, as are those who are attracted by the full-service hotels' offers, are not inclined to stay in Mamaia resort for a long time. This finding suggests that the destination even may be unable to provide superior and comfortable accommodations favorable to relaxation, as well as to offer a wide selection of tourist activities and attractions for tourists or the pricing strategies might be unbalanced with the value offered.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STANDARDS AND INDICATORS USED TO INCREASE EFFECTIVENESS AND EFFICIENCY IN MANAGEMENT OF CRISIS (COVID-19) AND ITS IMPACT ON AGRICULTURAL FARM/INDUSTRY MANAGEMENT AND MARKETING

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Abstract

Animal health and diseases have a major impact on human health and behaviour (i.e. zoonosis, schools, communication etc), food production (African Swine Fever), economy (direct and indirect costs) and trade (export, import, intercommunity trade). Even almost all countries have implemented all kind of management measures, humanity still face up today huge problems, for example the most recent experience, being COVID-19, which ceased almost all human activities in the world and changed people behaviour for several years (2019 up today). For this reason, the paper represents a systemic review of recent information on different management indicators developed - epidemiological/economic etc in order to assist managers (politically, authorities, farmers, all the people involved) to prevent, survey and control such diseases, to develop best practices for benchmarking their country health systems/farm management system etc, and finally to led to an effective and efficient management of infectious disease in livestock during crisis. In this regard, the retrospective method was used and the information reviewed was collected from the latest information published between 2019-2022, available on WHO, Economic Impact, CDC websites, where through a tremendous and collaborative effort across different public health organisations, scientists in the world, dashboards and standard indicators publicly available have been developed. The results of this study demonstrate that the managers of livestock during crisis, the competent authorities, the governments have to consider, undertake and include these kind of tools/indicators in their management in order to assist them to develop their emergency preparedness capacity and to manage in an effective way the infectious diseases during crisis respectively prevention, early detection, rapid response, identifying their vulnerabilities etc.

Key words: *animal health, crisis management, economy, trade, zoonosis*

INTRODUCTION

The paper represents a systemic review of recent information on different management indicators developed - epidemiological/ economic etc in order to assist managers (politically, authorities, farmers, all the people involved) to develop best practices for benchmarking the capabilities system in context of crisis and finally to led to an effective and efficient management of infectious disease during crisis, such as early detection of a crisis (pandemic episode), keeping track of impact of the diseases and effective management of the crisis situation [8, 9, 10]. The dashboards /indicators provide them in real time information in order to analyse, prioritise and plan their activities, invest efficiently and durable and to identify and address their system vulnerabilities.

MATERIALS AND METHODS

Information analysed in this paper is data publically available developed especially as a result of COVID 19 pandemic episode through a tremendous and collaborative effort across different public health organisations, experienced reaschers in the world. The paper is looking to factors that influence the health system capability involved in the management of pandemic crisis, encompassing fundamental elements and mechanisms, associated relations and rules between them and the indicators/standards used to

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

characterize it (if exist/not/are defined/not, are functional/not ?/ their dynamic in time).
Finally the paper covers:
- **Entities** affected by the crisis,
- Organisations **hierarchy,**
- **Links** between entities.
- **Activities** carried out by entities.

RESULTS AND DISCUSSIONS

Based on the analyse of the data reviewed it is understandable that because of the evolution of Covid 19 a new era of SMART Inter/Intra - Entities communication tools have been developed and put in place, such as new and/or improved platforms, dashboards which are publically available. They can be used in different ways: to evaluate the health system of countries/ to compare data across the countries of the world, identify vulnerabilities, keeping track of impact of disease and finally can be used to decide and manage the crisis [13].
The Global Health Security (GHS) Index [4] is an example of the most recent benchmarking tool of health system capabilities of countries in the world. The GHS Index has been initiated in 2019 by the Johns Hopkins Center for Health Security at the Bloomberg School of Public Health, Nuclear Threat Initiative and 80 researchers from Economist Impact based on the information already available on the countries preparedness systems (Table 1, Fig. 1).
Using the GHS Index the system capabilities and capacity of a country can be evaluated using: 6 categories, 37 indicators, and 171 questions.
The score for each country is a sum of the six categories. Each category is scored on a scale of 0 to 100, in which 100 stands for the best scenario and 0 correspond to the worst scenario.
However weights are dynamic and can be changed when the system is used. In addition the system is revised and improved each time that a new knowledge emerges, such as the experience gained during the COVID 19 pandemic, reshaping the individual country profile concerning its capability and capacity to respond to pandemic crisis.

Table 1. Some epidemiological indicators used in case of COVID

GHS indicators	
PREVENTION	
Cases in the preceding days	Biosecurity
Weekly Case % Change	Biosafety
Cases in the last X days/1M pop	Dual use research and culture of responsible science
Deaths in the last X days	Immunization
EARLY DETECTION & REPORTING	
	Laboratory systems (SWOT)
	Forecasts supply chain for clinical laboratories
	Immediate surveillance and reporting
	Accessibility and transparency of the data collected through Surveillance programmes
	Investigation case by case
	Sustainable and well trained epidemiologists
PROMPT RESPONSE TO CRISIS	
	Planning - preparedness and response in case of crisis
	Continues practing of operations involved in an emergency response
	Cooperation and coordination between authorities involved (public health,security etc)
	Communication of risks
	Infrastructure available for communication
	Imposing restrictions on trade and tarvel
ADEQUATE & LONG-LASTING SYSTEM TO DEAL WITH CRISIS	
	Enough capability
	Enough supply chain
	Enough trained personnel
	Measures and practices developed to respond to a threat or danger in their operations
	Communication system dedicated for emergencies
	Emergency equipment
	Testing and research capacity
	Quiq systems of approval of new changes in legislation
POLITICAL ENGAGEMENT TO IMPROVE CAPACITY, TO FINANCE AND TO ADHERE TO NORMS	
	Reporting system for measure crisis impact etc
	Available funds foreseen for crisis
	International and cross-border agreements for cooperation
	Internationally agreements on sharing data
COUNTRY VULNERABILITY TO THREATS/RISKS	
	Political ,security, environmental, Socio-economic
	Infrastructure capacity
	Public health system

Source: Economist Impact, 2021, GHS Index Methodology, [4]
https://www.ghsindex.org, Accessed on 31.01.2022.

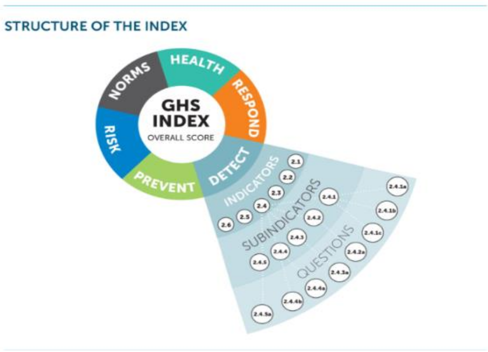


Fig. 1. The GHS Index assesses the system in crisis situation across 6 categories, 37 indicators, and 171 questions using publicly available information
Source: Economist Impact, 2021, GHS Index Methodology, [4]
https://www.ghsindex.org, Accessed on 31.01.2022.

Using this system many countries have been assessed during the COVID 19 pandemic episode.

Using the GHS Index has been identified that a lot of countries were seriously not ready for addressing the pandemic threats, such as:

- plenty political and security risks,
- no/poor resources allocated for management of a crisis,
- no taking into account the real needs of exposed population,
- no investments in pandemic preparedness,
-not having a capable system to address catastrophic biological events

So, using of this system revealed:

-concerns related to the detection and reporting system

-seriously problems related to the laboratory systems were found (no strength and quality of the laboratories, lack of laboratory supply chain developed and/or defined, not a real-time surveillance system, reduced reporting capacities for pandemic situations).

-triggered an alarm regarding the rapid response (plans,risks communication, links between public and authorities)

-it was found that only 69 countries have an comprehend national emergency response plan in place and 58% of countries scored below average.

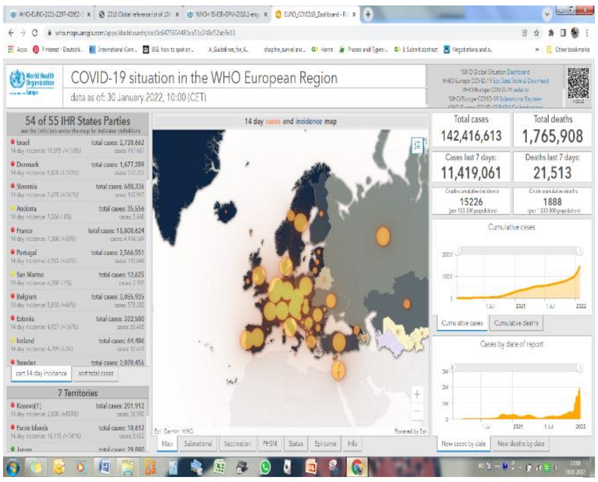
-showed serious concerns related to the health system capacity, respectively reduced workforce, facilities, and healthcare access.

-however, despite the assessment results out of 23 countries, **only 4 countries addressed the gaps** , which demonstrate that even the GHS Index helped to identify the systemic vulnerabilities, without commitment and accountability of the governments, no progress can be made to improve the health security system of the country.

-concerning country vulnerability to threats main indicators described are the risks associated to political, security, environmental systems, the infrastructure capacity and the adaptability of the socio-economic system.

the assessment exposed major problems such political instability due to repeatedly transfer of power, social tensions and unrest, lack of trust in government advice, which clearly have/had a huge negative impact on a country's response during the crisis.

Actually Covid 19 episode proved what the results of GHS Index showed.



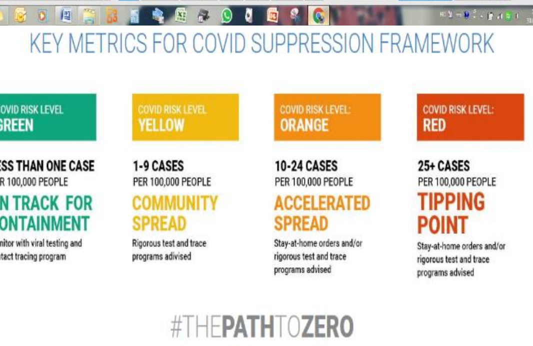


Fig. 2. Covid 19 situation in the WHO European Region
Source: WHO Europe, [16]
https://www.arcgis.com/apps/dashboards/ead3c6475654481ca51c248d52ab9c61, 05.02.2022.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Following COVID-19, based on the experienced gained many recommendations have been made in order to strengthen the preparedness for the future crisis situations of the whole world.

In conclusion using the tools described each country can have a prediction on the impact of the disease (population health, economic impact etc).

Moreover, the COVID-19 crisis has revealed that many factors are involved and influence the system response in a crisis:

- public health and scientific capacities,
- understanding the disease,
- measures put in place to respond to the threat,
- social and economic adaptability in short and long term.

The experienced gained during COVID proved that the factors listed above are crucial and have a huge impact on how countries respond during a pandemic crisis (Fig. 2).

Early M Sorrely & others are talking in their paper, *in 2015, Mapping of networks to detect priority zoonoses in Jordan [11]* about the challenges faced by middle income countries meet by public health and veterinary surveillance and laboratory sectors, drawing attention that early, timely detection of disease and warning systems are main concerns and are crucial to control the crisis and to create a link between main stakeholders involved.

However, most of the time limitation of resources (staff and money) affect the cross sector communication.

They highlight in their paper that Mapping zoonoses/diseases and the burden of diseases **help to identify vulnerabilities of the systems capabilities (**limited vaccine supply and inability of the system to cover the entire susceptible population locally tests not available, systems activated only in the case of emergencies**)** and where efforts should be focused to improve prevention, communication, and coordination across both veterinary and human health systems. In the end of their paper they identified three areas to be improved such as:

(1) the reporting and communication system structure,

(2) the emergency preparedness and response plan,

(3) the laboratory capacity.

According to the International Health Regulations (2005) – (IHR) [14] all members must build up and keep capacities for crisis situations.

At the beginning of 2021 the self assessment annual reporting tool (SPAR) was reviewed and improved, based on the experience got during the COVID-19 pandemic and has 15 capacities and 35 indicators compared to 13 capacities and 24 indicators in the first edition, such as policy, legal and normative instruments to implement IHR, IHR coordination and National IHR Focal Point, National IHR Focal Point function. Multisectoral coordination mechanisms, support for IHR implementation, Financing for IHR implementation and emergency response, Laboratory system (Specimen referral and transport system, Implementation of a laboratory bio safety and bio security regime, quality system, testing capacity modalities Effective national diagnostic network), Surveillance), Early warning surveillance function and Event management, Human resources etc.

The global scores for WHO shown in the figure below demonstrate that the world has made considerable steps in terms of health emergency preparedness in time (Figures 3 and 4).

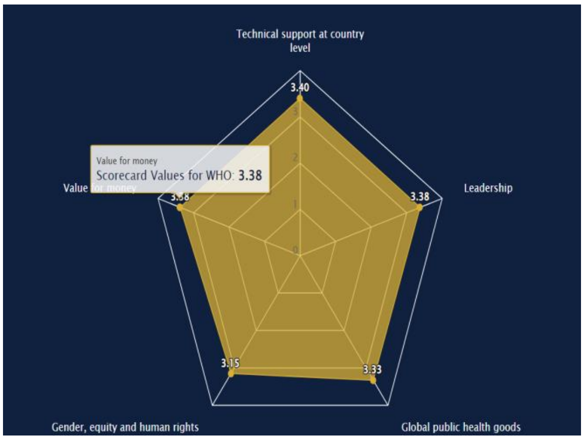


Fig. 3. Health emergency preparedness capacities
Source: WHO Europe, [16], https://www.who.int/about/accountability/results/who-results-report-2020-mtr/output/2020/2.1.2.-capacities-for-emergency-preparedness-strengthened-in-all-countries, Accessed on 30.01.2022.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Manuals of epidemiological burdens of diseases [11] have developed and bring an important contribution to estimate the disease severity and determining the populations at-risk for high risks diseases. Not controlling this kind of data it is enormously difficult for policy-makers to decide on how to distribute the already limited resources.

The tool developed by WTO in case of Seasonal Influence estimate the morbidity burden (incidence rates) estimate the proportion of cases who died (case fatality ratio), assess the plausibility of the results, identify gaps in the surveillance system (particularly related to data collection), asses the costs associated with the disease respectively the direct costs (care for the diseased) and the indirect costs (lost productivity, disabilities, or death).

The CDC in USA developed the CDC Covid Data Tracker [1] that provides an overview of several important indicators used to assess the impact of COVID-19.

They underline that no data should be seen as more important than the other, and the data provided should be analysed as a system, in order to understand entirely the COVID evolution and impact.

On the site can be found the integrated key data for COVID -19 in the United States and permit to explore data /compare data between different USA states. Data sources and methods used are described.

Other tools for surveillance have been developed by ECDCs [3] such as EPIPULSE (launched on 2021).

Country	Value	Trends	Value	Trends	Value	Trends	Value	Trends	Val
Lithuania	7250.1		70.9		47.9		3974.2		30
Luxembourg	1529.9		20.8		23.7		2439		751
Malta	270.7		19.4		4.1		3019.1		309
Netherlands	6921.6		8.7		38.6		5184.9		1630
Norway	4434.5		15.3		62.9		2951.9		430
Poland	990.4		85		22		1781.2		
Portugal	2527.3		57.6		17.5		5505.9		1372
Romania	1224		67.3		22		2155.7		1097
Slovakia	4745.7		51.1		30.3		7375.6		1826
Slovenia	3803.2		108.8		5.1		26255		2132
Spain	784.5		32.7		17.6		1632		588
Sweden	818.9		35.5		15.5		1386		564

Fig. 4. Global scores for WHO showing health emergency preparedness in time
Source: WHO Europe, [16], https://www.who.int/about/accountability/results/who-results-report-2020-mtr/output/2020/2.1.2.-capacities-for-emergency-preparedness-strengthened-in-all-countries, Accessed on 30.01.2022.

Dr. Jonas Gomes de Silva (2021) mentioned in his paper [2] that at the beginning of 2020 many countries were eager to learn from nations benchmarked as the best able to save lives during COVID pandemic. Based on the methodology developed by Silva (in 2020) among 108 well-evaluated countries, the top six benchmarked countries against Covid-19 were from Asia with emphasis on Vietnam, Taiwan, and Thailand.

The research is descriptive, uses an online questionnaire with bibliographic and documentary approaches, and the main policy measures adopted by the Tawain government was international travel control, effective public-private collaboration, public information campaigns, integration with mass media, increase the medical and personal equipment capacity, combat fake news, public event cancellations, improve intensive care unit structure, support the expansion of the testing system, and schools closures.

On the other hand COVID 19 further being a health crisis, **also have generated economic and food crisis** and consecutive its impact, governments have/had to ensure also the functioning of the food system, delivering safe food, finding alternative ways to deliver adequate amount of food to population in restrictive conditions, putting different measures in place in order to address staff shortage where was absolute necessary. .

As well, livestock farmers, slaughterhouses, producing plants have faced major problems, such as:

- Workers/Farmers' health and closing of their activities,
- Shortage of labour force,
- Animal Welfare issues,
- Trade and markets temporarily suspended and policy changes,
- Supply chain slowdowns and shortages,
- Disruption in to the supply chain,
- Support of farm prices
- Additionally costs for assure worker safety and staff protective equipment and other COVID measures,
- Shifting in market demands,
- Panic

Ben Lilliston of the Institute for Agriculture and Trade Policy back then was saying that

”*Workers are having to go back to work, and farmers are having to euthanize their animals*,” and “*It’s a very chaotic, crazy situation*.**[**Meat Plants Around the World Struggle With Virus Outbreaks. 2020, https://www.theguardian.com/environment/2020/may/11/chaotic-and-crazy-meat-plants-around-the-world-struggle-with-virus-outbreaks, Accessed on April 03, 2022)**]**

During COVID-19 many livestock were euthanatized, milk was dumped and fresh vegetables left to rot in contrast with people standing in lines for food banks (Photos 1 and 2).

Milk

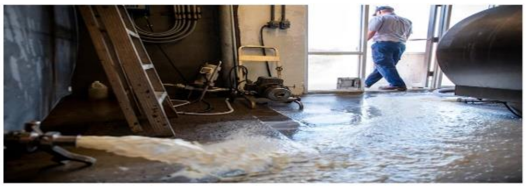


Photo 1. Ricky Jones, the operations manager at Magic Valley Quality Milk Transport, walks out the door as 4,100 gallons of milk pour down the drain. With restaurants and schools closed across the country, milk processors have lost a large chunk of their market, leaving dairy farmers with no one to take their milk.
Photograph by Pat Sutphin, Times-News Via AP,
Source: National Geographic, [7].

Potatoes

Photo 2. Ryan Cranney's farm in Oakley, Idaho, made 500,000 pounds of potatoes free to the public when restaurant sales collapsed due to pandemic closures.
Photograph by Pat Sutphin, Times-News via AP,
Source: National Geographic, [7],
https://www.nationalgeographic.com/science/article/covid-19-disrupts-complex-food-chains-beef-milk-eggs-produce, Accessed on 03.04.2022.

Meat

Pig production and poultry production in our days are designed as intensive productions and any disruption in their technological flow had a huge impact on both sides: upstream on animal welfare leading in killing many animals, downstream affecting the consumer’s behaviour and the environment (Figure 5).

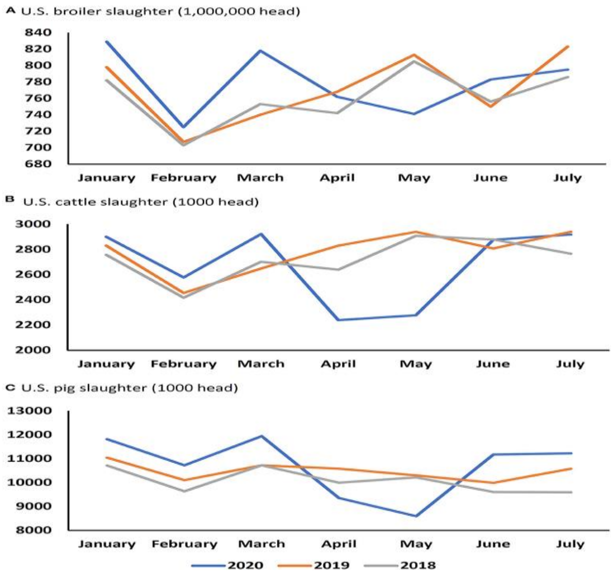


Fig. 5. Numbers of (A) broiler chickens, (B) cattle, and (C) pigs slaughtered per month in the United States between January and July over the last 3 years
Source: U.S. Department of Agriculture – National Agricultural Statistics Service, [12].

Actually closures of pig/poultry processing plant over several weeks, lead in cascade to closure of cattle, poultry, and pig farms, which means that in a while some animals will have slaughter weight, but had nowhere to go for slaughter, which because of animal welfare reasons will be euthanized.

This caused panics among the consumers and disruption in food supply (Photos 3 and 4).

Panic consumers and disruption in the food supply

Photo 3. Queues in big stores and shelves emptied by Romanians scared of corona virus
Source: Europe FM [5],

https://www.europafm.ro/emag-anunta-ca-va-subventiona-costul-mastilor-medicale/, Accessed on 03.04.2022.

Photo 4. The line for lunch at Sharing Caring Hands on Tuesday, March 24, in Minneapolis. David Joles/Star Tribune/AP
Source: Mother Jones [6], https://www.motherjones.com/food/2020/04/these-photos-show-the-staggering-food-bank-lines-across-america/, Accessed on 03.04.2022.

However despite the negative impact of the COVID 19, governments and farmers must to take into account the experience to review the current systems and policies/ legislation in order to address future crisis.

Therefore, consecutive COVID many policies have been analysed and have been changed accompanied by regulatory reforms, laying now the basis **for a more resilient, sustainable and productive agriculture food system**.

A **dashboard** has been developed by the Organisation for Economic Co-operation and Development (OECD) to monitor the recovery of their members' countries around 4 key priorities agreed by the OECD members:

- **Strong dimension** focuses on the recovery of household and businesses
- **Inclusive dimension** focuses on recovery of the income and jobs of the most vulnerable class,
- **Green dimension** focuses on progress towards a green transition, consistent with the goals of the Paris Agreement and the 2030 Agenda.
- **Resilient dimension** focuses on the factors that can assist countries to enhance endurance to crisis and to prepare better for potential challenges.

CONCLUSIONS

Many research papers and the last pandemic event (COVID 19) showed clearly the importance of standards and indicators developed by researchers and international organisations to help managers to decide on right policies and to design properly their actions during the pandemic crisis.

The tools developed also shows that the standards and indicators helped the world managers to warn the world about the pandemic crisis, to keep track of outcomes of the pandemic diseases and to manage the crisis.

However, the world will always learn new lessons from future pandemics and world experts will have to understand the new pandemics in order to respond to the new challengers.

Clearly opportunities will always exist to build up new capacities that will be more resilient to further long-term gains for preparedness of the countries.

This kind of standards and indicators developed proved during COVID 19 that they provided results that engaged globally all the entities involved, and contributed to open debates that guided to new viewpoints and catalyzed the progress in addressing COVID 19.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESULTS REGARDING *PRIMULA OFFICINALIS* HILL. TECHNOLOGY AND POSIBILITY FOR INTRODUCTION INTO CULTURE

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Abstract

The oldest form of treatment, over time, was phytotherapy, which was probably born with human being. Popular medicine has developed on an empirical basis in the context of a magical world where analogy and coincidence have played an important role in choosing remedy plants. Regarding the multiple biological effects of Primula officinalis Hill., the scientific literature highlighted anti-asthmatic, anti-inflammatory and strong antiviral properties. Glycosides contained in this plant have a role in the treatment of kidney and biliary disorders, bronchitis and some gastrointestinal diseases. Primrose is an endangered plant in many Western European countries. In Romania, the plant is found in hills, pastures and alpine meadows up to about 2300-2400 m altitude. Research regarding introduction to culture are ongoing at National Institute of Research and Development for Potato and Sugar Beet Braşov. This paper presents the results obtained regarding the cultivation technology and the establishment of the possibility for introduction into culture. To establish these experiences, the plants were harvested from the spontaneous flora in 2016 and then acclimated to the greenhouses in the Technology Department, Laboratory of medicinal and aromatic plants. In the second experimental year, during the vegetation, observations and measurements were made in dynamics on each experimental variant to highlight the phenological stages regarding the formation of vegetative and generative organs in Primula officinalis (the emergence, the development of the foliar apparatus, the initiation of the floral buttons, the appearance of flowering stems, flowering, capsule and seed formation).

Key words: *Primula officinalis, biology, technology, phytotherapy, culture*

INTRODUCTION

Primula officinalis Hill. (synonym with *Primula veris* L.) has been frequently misidentified or mistaken with similar species of *Primula* genus. This species was mentioned by Pliniu the Elder in his writings, for early blossoming [18]. *Primula officinalis* (in popular language, St. Peter's plant, Petrella or the cuckoo) it is a known medicinal plant, which grows spontaneously in our country, being a species endangered by the irrational harvesting. The plant grows in warm, sunny, dry habitats, most commonly on meadows and pastures, but also in hardwoods [3, 15]. Some of its natural sites are endangered as a result of massive deforestation, by taking land cultivation or grazing intensively.

This specie is under partial legal protection in Poland. The plant can be harvested from areas where the species is widespread in low hill areas and in lower mountain parts [18, 16, 8].

In countries such as Austria and Switzerland, *Primula officinalis* is protected by law [6]. Loki Schmidt Foundation based in Hamburg, Germany has appointed primrose (*Primula veris* L.) the flower of 2016 year. The flower is on the red list of species endangered in most German states [7, 17]. Ecology and biodiversity conservation in the *Primula* species were studied over time by many researchers [16, 4].

Pharmacological studies have shown that extracts of *Primula officinalis* have powerful asthmatic, inflammatory and antiviral proprieties [6]. In the literature results have been reported on the isolation and identification of 10 lipophilic flavonoids from *Primula* leaves *in vivo* and *in vitro* culture [9].

Primula officinalis is a herbaceous species which belongs to the *Primulaceae* family, one of the 400 species of the genus *Primula*. Is widespread in most of Europe, with the exception of the northern Caucasus, some northern areas of Europe, including northwest Scotland. Recently, her appearance was reported again in the northern Scottish provinces Sutherland, Orkney and in Scandinavia [14].

Primula officinalis is a small plant, which is usually found in limestone pastures, poor in nutrients, grassland or coastal dunes. It can be also found along forest edges and open forests of mixed oak and beech [1].

Primula officinalis is a perennial plant, with bush appearance and a height of 15-30 cm. The underground part consists of a cylindrical rhizome of up to 10 cm long and 0.5 cm thick, with many roots, up to 15 cm long, thin, white-yellowish. The aerial stem is cylindrical, 15-30 cm high, erect, hairy, leafless, ending with inflorescence. The leaves are arranged in a basal rosette, ovate, crenate or crimped edge, up to 15 cm long and 5 cm width, with prominent veins on the undersid, green on the upper face and gray on the underside due to the bristles, the petiole is long and winged. The flowers are type 5, in a number of 6-18, with persistent calyx and golden yellow corolla [5]. The fruit is a ellipsoidal capsule, 6 -10 mm long, with persistent calyx. Blooms in April-May, sometimes even in March [10] .

Floral morphology and reproduction of the species have been extensively studied [12].

In the book "Nature pharmacy" [2] are presented for the first time recommendations regarding the technology of *Primula officinalis* in our country.

Current paper presents the results obtained in the second study year regarding the technology cultivation of this species and the possibility for its introduction in culture.

MATERIALS AND METHODS

Research has started with *Primula officinalis* plant harvested from spontaneous flora of Brasov County, which were acclimatized in the greenhouse of Technology Department, Laboratory of Medicinal and Aromatic Plants from National Institute of Research and Development for Potato and Sugar Beet Braşov [11].

The research aim is to highlight certain aspects of biology and technology regarding introduction in field of species *Primula officinalis* Hill.

These studies of biology and technology are required to obtain scientific information useful for the development of cultivation technologies that meet current requirements, both phytotherapeutic and economically.

Research has started by setting up an experience with variants having three rows in three repetitions. The length of a variant was 200 cm. Factor A - the distance between rows having graduations: 25 cm, 50 cm, 75 cm.

Factor B – the plant spacing per row: 10 cm, 25 cm, 50 cm.

The variant with density 10 cm between plants per row was considered the control variant of the experience.

Was followed the emergence and growth dynamics of the foliage until flowering, when three plants were harvested from each variant/repetition.

The following determinations were made for each harvested plant: the height of the plant, the weight of roots, the number of leaves and their weight, the number of floral stems and their weight, the number of inflorescences. The average of the results obtained was also the average of the experimental variants [13].

In order to establish the average yield of fresh herba/ha for each experimental variant, the yield obtained (g/plant) with the number of plants/ha /variant was multiplied.

Determinations for dry herba were carried out after the drying of the plants, when a new weighing was carried out, thus establishing the correlation between the freshly and the dried harvested herba.

RESULTS AND DISCUSSIONS

In Brasov, 2017 – 2018 year, until the end of August, was unusually warm and rich in rainfall. In the winter-spring period before the experimence emergence, the average air temperature was higher by 1.5°C compared to

the MMA value of 0.7°C [11], leading to a plants emergence earlier with 2 - 3 weeks.
The main phenological data in the experience to establish the optimal nutritional space for *Primula officinalis* in year 2018 are shown in Table 1.

Table 1. Main phenological data to establish the optimal nutritional space (Brașov 2016 – 2018)

Phenological observations	Data
planting data	20. 10. 2016
beginning of the emergence data	12. 03. 2018
issue data of floral steams	30. 03. 2018
beginning of the bloom	10. 04. 2018
harvest data for herba	27. 04. 2018
data of fructification	14. 05. 2018
harvest data for seeds	27. 06. 2018

Source: Own calculation.

From the emergence of first plants till the end of emergence of all plants/variant the emergence data was noted in dynamics. The beginning of the flowering was noted in dynamics and the results were processed graphically. The fructification data was recorded when 10% of the plants formed capsules. Harvesting was done when 90% of plants were blooming and harvesting for seeds when 90% of the capsules reached phenological maturity.

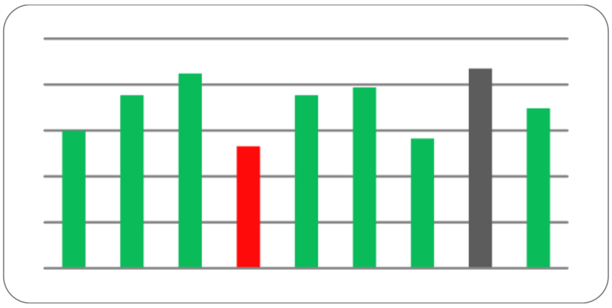

Fig. 1. Weight of emergence of plants/variants (12.03.2018)
Source: Own calculation.

Weight of plants/variants emergence in 2018

If, on March 12, 2018, V4 variant, with 10 cm between the plants per row and 50 cm between the rows, was inferior to the other variants with a 53%, increase (Figure 1) quickly recovered and on March 20, when the following observation (full blossoming) was done, overcome all other variants, reaching 90% (Figure 2).
Variant V2 (10/25) had the worst rising, registering 77%. However, the variants was good (84%), demonstrating that the plants were wintering well and did not suffer significant losses.

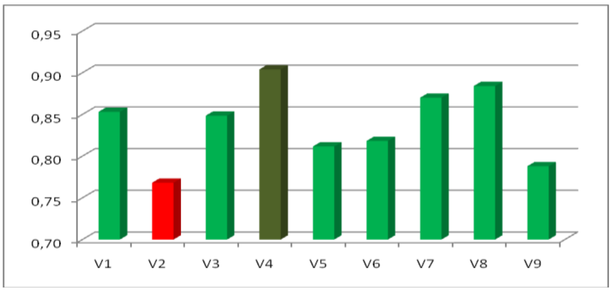

Fig. 2. Weight of emergence of plants/variants (20.03.2018)
Source: Own calculation.

The average number of flowering stems in the experience regarding the nutrition space in 2018

The number of floral stems was recorded when all the plants in experience reached full blossom. In Figure 3 are presented the number of floral stems in the second year. The V1 variant (10/25), with the smallest nutrient space and the highest plant density, presented only few floral stems. Variants V2 (25/25), V3 (50/25), V5 (25/50), V6 (50/50) and V8 (25/75) presented an average of 8 flowering stems per plant.

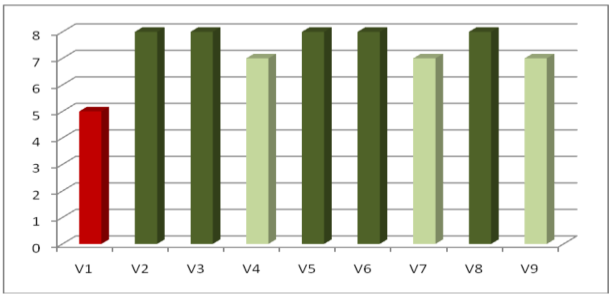

Fig. 3. The average number of floral stems/variant in 2018
Source: Own calculation.

Influence of distance between rows and between plants on rows on the height of the plants in 2018

Studying the influence of A factor (distance between rows) and B factor (plants on rows) on the height of *Primula* plants (Table 2), it was found that there were differences regarding the influence of the two factors on the height of the plants, with a decisive role on the production achieved on each studied surface unit. Factor A responded favorably to both variants compared to the control variant. A2 variant (50 cm) showed distinctly significant differences and A3 variant (75 cm) significant differences. The influence of B factor on plants height provides distinctly significant differences in variant B2 (25 cm), with an average of 45.33 cm, B3 variant (50 cm) having values close to those of control B1 variant.

Table 2.Influence of factors (A) and (B) on the average height of plants in 2018

A factor influence					
Sym.	Variant	Average	(%)	Dif.	Sig.
A1	(V1,V2,V3)	40.33	100.0	0.00	Mt.
A2	(V4,V5,V6)	45.11	111.8	4.78	**
A3	(V7,V8,V9)	43.56	108.0	3.22	*
DL (p 5%)				2.35	
DL (p 1%)				3.89	
DL (p 0.1%)				7.29	
B factor influence					
Sym	Variant	Average	(%)	Dif.	Sig.
B1	(V1,V4,V7)	41.11	100.0	0.00	Mt.
B2	(V2,V5,V8)	45.33	110.3	4.22	**
B3	(V3,V6,V9)	42.56	103.5	1.44	-
DL (p 5%)			2.38		
DL (p 1%)				3.34	
DL (p 0.1				4.71	

Source: Own calculation.

The influence of the interaction between the distance between plants on rows (factor B) and the distance between rows (factor A) on the average height of plants in 2018 is shown in Table 3.

It is noted the variant V2 (25/25) with distinctly significant differences towards control variant (V1), having an average height of 44.33 cm.

Non-significant differences from the control (V4) were recorded to the variants V5 and V6, with an average height of 45.00 cm and 44.67 cm respectively.

n the last analyzed interaction, where V7 variant (10/75) is the control one, the V8 variant reaches an average height of 46.67 cm, the differences being distinctly significant.

Table 3. The influence of the interaction between the number of plants per row (B) and the distance between rows (A) on the height of the plants

Sym	Variant	Average	(%)	Dif.	Sig.
B1 A1 (V1)	10/25	37.67	100.0	0.00	Mt.
B2 A1 (V2)	25/25	44.33	117.7	6.67	**
B3 A1 (V3)	50/25	39.00	103.5	1.33	-
B1 A2 (V4)	10/50	45.67	100.0	0.00	Mt.
B2 A2 (V5)	25/50	45.00	98.5	-0.67	-
B3 A2 (V6)	50/50	44.67	97.8	-1.00	-
B1 A3 (V7)	10/75	40.00	100.0	0.00	Mt.
B2 A3 (V8)	25/75	46.67	116.7	6.67	**
B3 A3 (V9)	50/75	44.00	110.0	4.00	-
DL (p 5%)				4.12	
DL (p 1%)				5.78	
DL (p 0.1%)				8.16	

Source: Own calculation.

From the interaction of A factor (distance between rows) and B factor (the distance between plants per row) on the average height of plants (Table 4), can be observed distinctly significant positive differences in V4 variant with a density of 50/10 and a height average of 45.67 cm.

Variants V6 and V9, (50/50 and 75/50, respectively), have positiv significance. The other analyzed variants have no statistical differences compared to the control variant.

Table 4. Influence of the interaction between rows distance (A) and plant on rows (B) to the average height of plants

Sym	Variant	Average	(%)	Dif.	Sig.
A1B1 (V1)	25/10	37.67	100.0	0.00	Mt.
A2B1 (V4)	50/10	45.67	121.2	8.00	**
A3B1 (V7)	75/10	40.00	106.2	2.33	-
A1B2 (V2)	25/25	44.33	100.0	0.00	Mt.
A2B2 (V5)	50/25	45.00	101.5	0.67	-
A3B2 (V8)	75/25	46.67	105.3	2.33	-
A1B3 (V3)	25/50	39.00	100.0	0.00	Mt.
A2B3 (V6)	50/50	44.67	114.5	5.67	*
A3B3 (V9)	75/50	44.00	112.8	5.00	*
DL (p 5%)				4.08	
DL (p 1%)				6.01	
DL (p 0.1%)				9.35	

Source: Own calculation.

The influence of the distance between rows and between plants on rows on the average mass of plants

An analysis of each factor show the positive influences of factor A on variants V4, V5, V6, with distinctly significant differences. V7, V8, V9 variants reaching values very significant in relation to control variants (Table 5).

The influence of B factor on the plant mass is distinctly significant to planting variant B3 variant, with a weight gain of 4.44 g compared to the control.

Table 5. Influence of factors (A) and (B) on the weight of plants in *Primula officinalis*

A factor influence					
Sym.	Variant	Average	(%)	Dif.	Sig.
A1	(V1,V2,V3)	51.00	100.0	0.00	Mt.
A2	(V4,V5,V6)	70.00	137.3	19.00	**
A3	(V7,V8,V9)	78.22	153.4	27.22	***
DL (p 5%)			6.23		
DL (p 1%)			10.31		
DL (p 0.1%)			19.29		
B factor influence					
Sym	Variant	Average	(%)	Dif.	Sig.
B1	(V1,V4,V7)	64.78	100.0	0.00	Mt.
B2	(V2,V5,V8)	65.22	100.7	0.44	-
B3	(V3,V6,V9)	69.22	106.9	4.44	**
DL (p 5%)			2.51		
DL (p 1%)			3.53		
DL (p 0.1%)			4.98		

Source: Own calculation.

From Table 6, where is shown the influence of the interaction between B and A factors on the weight of *Primula* plants in the first year of vegetation, planting at the distance 50 cm/25 cm increase the yield significantly with a difference of 5.33 g compared to the control variant.

Table 6. Influence of the interaction between the number of plants per row (B) and the distance between rows (A) on the plant mass in 2018

Sym.	Variant	Average	(%)	Dif.	Sig.
B1 A1 (V1)	10/25	49.00	100.0	0.00	Mt.
B2 A1 (V2)	25/25	49.67	101.4	0.67	-
B3 A1 (V3)	50/25	54.33	110.9	5.33	*
B1 A2 (V4)	10/50	69.67	100.0	0.00	Mt.
B2 A2 (V5)	25/50	67.67	97.1	-2.00	-
B3 A2 (V6)	50/50	72.67	104.3	3.00	-
B1 A3 (V7)	10/75	75.67	100.0	0.00	Mt.
B2 A3 (V8)	25/75	78.33	103.5	2.67	-
B3 A3 (V9)	50/75	80.67	106.6	5.00	*
DL (p 5%)				4.35	
DL (p 1%)				6.11	
DL (p 0.1%)				8.63	

Source: Own calculation.

Regarding the influence of interaction between A factor (distance between rows) with B factor (plant spacing per row) on the plant mass in 2018 (Table 7), it can be observed that the results were very significant for the variants V4, V7, V8, V9 and distinct significant for the V5 and V6 variants compared to the control variant.

Table 7. Influence of the interaction between the rows distance (A) and the distance between plants (B) on the plant mass in *Primula officinalis* Hill. in 2018

Sym.	Variant	Average	(%)	Dif.	Sig.
A1B1 (V1)	25/10	49.00	100.0	0.00	Mt.
A2B1 (V4)	50/10	69.67	142.2	20.67	***
A3B1 (V7)	75/10	75.67	154.4	26.67	***
A1B2 (V2)	25/25	49.67	100.0	0.00	Mt.
A2B2 (V5)	50/25	67.67	136.2	18.00	**
A3B2 (V8)	75/25	78.33	157.7	28.66	***
A1B3 (V3)	25/50	54.33	100.0	0.00	Mt.
A2B3 (V6)	50/50	72.67	133.7	18.34	**
A3B3 (V9)	75/50	80.67	148.5	26.34	***
DL (p 5%)				7.13	
DL (p 1%)				11.27	
DL (p 0.1%)				19.74	

Source: Own calculation.

The analysis of the correlation between the height and weight of plants and that of fresh and dry herba yield

Following the correlation coefficient between the average height of the plant and its mass, was obtained value r = 0.53659 (Figure 4).

Comparing this value with the probability of 5%, r = 0.54> 0.50, it can be observed that there is a slightly significant correlation between the average height of the plant and its mass.

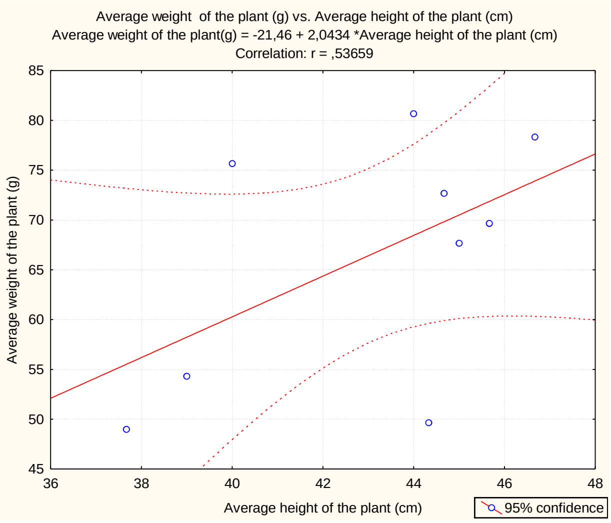

Fig. 4. The correlation between the average height of the plant and its mass
Source: Own calculation.

Analyzing the correlation between fresh herb and dry herba yield (g/plant), the coefficient increases (r = 0.95347), being very significant (Figure 5). The higher value of the correlation coefficient shows a very close relation between the two studied parameters.

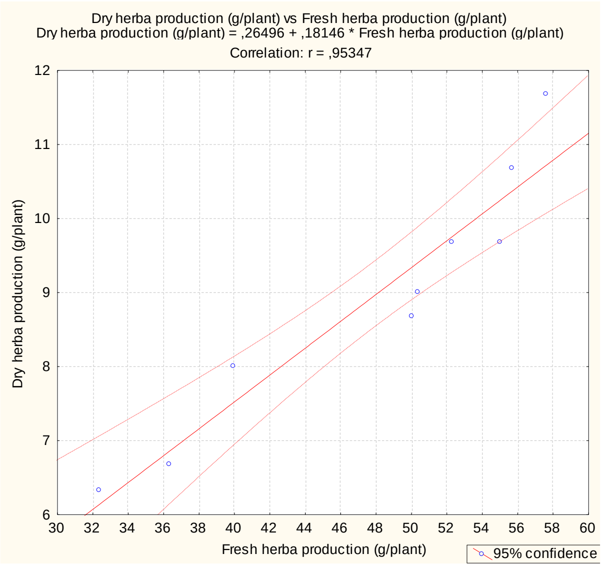

Fig. 5. The correlation between fresh and dry herba yield
Source: Own calculation.

CONCLUSIONS

Analyzing the results obtained regarding the technology of *Primula officinalis* Hill. species to establish the possibility for introduction into culture, the following conclusions can be list:

In climatic and soil conditions from NIRDPSB Braşov, *Primula officinalis* Hill species finds good growth and breeding conditions.

Experiences set up in the autumn of 2016 were well wintering, without losses in the spring.

The percentage of emergence plants/varieties in 2018 was very good to the V4 variant (with graduations of 10 cm between the plants per row and 50 cm between the rows), which exceeded all the other variants to 90%.

Variants V2 (25/25), V3 (50/25), V5 (25/50), V6 (50/50) and V8 (25/75) presented an average of 8 flowering stems per plant, being superior to the other variants.

It was observed that there were differences in the action of the two factors on the height of the plants, with a decisive role for the yield achieved on each studied surface unit.

Comparing the value of the correlation coefficient with the probability of 5%, r = 0.54> 0.50, it can be said that between the average height of the plant and its mass there is a little significant correlation.

Between the yield of fresh and dry herba (g/plant), the correlation coefficient is high (r = 0.95347), being very significant and reflecting a close relation between the two studied parameters.

In the case of large areas where the work is done mechanically, planting at a distance of 50 cm between rows and 10 cm between plants per row ensures high yields of herba/ha.

ACKNOWLEDGEMENTS

Some data are part of research PhD programme of the first author. The first author is thankful to National Institute of Research and Development for Potato and Sugar Beet Braşov for support during PhD programme.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANALYSIS OF THE LEGAL BACKGROUND REGARDING THE ACCESS TO SPACE IN ROMANIAN AQUACULTURE

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Abstract

In Romania the largest spaces used for aquaculture are under the management of the National Administration ``Romanian Waters", of the National Agency for Fisheries and Aquaculture and of some territorial administrative units. Each have separate regulations regarding the transmission of space use. Each has separate regulations on the use of space use. This paper has looked for an answer to the question: would it be beneficial if there was a single regulation for the cost and other conditions of use of aquaculture space? For this purpose, were studied data from national institutions and community institutions, there were talk with specialists in the fisheries sector, and has been studied the position of one Romanian fish farmers association. The study concludes that the road to a common interest, both economic and social, is bearing fruit and is above a self-interest, and does not violate the right to property or the good manifestation of property.

Key words*: *aquaculture, spatial planning, access to space, governance

INTRODUCTION

The traditional fisheries managers, the natural scientists, and the environmental groups were the primary influencers of aquaculture regulations and policies [1].

The aquaculture scholarship just only recently has concentrate on governance issues. A current evaluation of global aquaculture offer more attention for underlining the importance of governance themes like value chain dynamics, best practice standards and public-private partnerships. Although the largest aquaculture production is in Asia, it is also growing rapidly in Africa, America and Europa. The aquaculture governance even in the representative countries like Egypt, Nigeria, USA, Chile, Ecuador, Brazil and Norway in country -level evaluation is not optimal. Worldwide, economically, one of ten people in one way or another, count on the aquaculture and fisheries economy. Fish contribute to the nutrition security, but this can be done only with a good governance that ensures an appropriate environment for food quality, fair access and distribution. It is very important where aquaculture takes place. The waterways and the coastlines, in terms of property rights and the last established institutions, are not enough governed place, being used for several uses by several groups. In the middle-income countries and in the low-income countries, the tourism, port and residential development under the Blue Economic Strategy and the Blue Growth Strategy can be harmful to food production and this aspect creates concern. The governance challenge regarding the physical space access and for the freshwater availability and quantity are : who has access, management, alienation rights, withdrawal and exclusion. Aquaculture need space and the costs and competition can be high. For inland aquaculture if the water resources are far away or limited the competition can be high. About of climate and earth system stability the governance challenge are: who an how contributes for maintaining the earth system stability. Sea-level rise, coastal storms, varied temperatures can influence the sufficient water availability. The knowledge of aquaculture commons and the proper institutions to govern them is lagging behind other sectors [19]. The multiple regulations that could be constrain the aquaculture sector can be found in high income countries, and in a middle-income countries and in a low-income countries the regulations are less demanding and fewer. The collective action is lagging behind, even though water management technologies have been at the forefront [9]. Fishing and aquaculture are also part of the bio-economy, the type of economy that produces and processes biological resources from terrestrial and aquatic agro-ecosystems [8].

The European Union has invested in aquaculture sector in the period 2000-2014, 1.17 billion Euro, and in the plan was to spend 1.72 billion Euro over the period 2014-2020 [7].

To build a sustainable future for aquaculture in all EU Member States, in 2009 the European Commission published the Communication Com (2009)0162[5]. The purpose of this communication was to implement several actions in order to ensure the increase of production and jobs. In order to solve the competition regarding space in the aquaculture sector, to stimulate the competitiveness of aquaculture production, one of the actions identified for implementation was to promote the spatial planning. The European Commission's strategic guidelines, COM (2013)0229 [6] provides assistance to Member States in defining national objections, a priority area representing the spatial planning with the aim of overcoming obstacles caused by the lack of space. Multiannual strategic plans were made for 2014-2020, where one of the goals proposed was to pursue security for operators regarding access to space and water.

This research is a continuation of previous studies on the evidence for the state-owned lands in Romania [18] and economic efficiency of Romanian aquaculture in terms of resource use [17] which lasts three years.

The question that arose during the research and to which the answer was found in this paper: would a single legal regulation on the cost and duration of access to aquaculture space be beneficial? The usefulness of the research lies in identifying the best practices regarding the economy of the fishing sector in Romania. Romania's natural potential for the fishing sector is valuable. Natural lakes and pools surfaces approximately 300,000 ha, the artificially created pools and lakes surfaces approximately 98,000 ha, hill and plain streams 47,000 km, mountain streams approximately 19,000 km, Danube river 1,075 km. Between Sulina and Vama Veche is located the Romanian fishing maritime area. The length of cost line is approximately 243 km [24]. We cannot afford to waste resources. This idea was the starting point of the present research, regarding the land exploitation related to the aquaculture farms on the Romanian territory.

There are overlaps in land records between lands destined to aquaculture with other lands. The owner of the land can be the state, the territorial administrative unit, or other natural and legal persons. This paper analyzes only the situations when the owner is the state or the territorial administrative unit.

These areas being highlighted both in the Inventory of the goods that make up the public domain of the state and in the Inventory of the goods that make up the public and private domain of communes, cities, municipalities and counties. These overlaps are reflected in the fact that some lands have been included both in the Inventory of the goods that make up the public domain of the state and in the Inventory of the goods that make up the public and private domain of communes, cities, municipalities and counties. This prevents the undisturbed economic manifestation of land [18]. These overlaps are clarified within a fairly long time, getting in court, requiring human and financial resources.

Another study presented the history of the legal status from 1989 to 2019, but also the amount of land areas related to aquaculture [17]. According to the author, in 1989 the land area on which aquaculture farms were located was approximately 105,300 ha, owned by the Romanian state. Of this area, approximately 61,400 ha were under the coordination of the Central Fish Production and Industrialization (CPIP), and approximately 43,900 ha were located on the territory of the Danube Delta under the coordination of the Danube Delta Station. The Multiannual National Strategic Plan on Aquaculture 2014-2020 published on the website of the National Agency for Fisheries and Aquaculture [2] showed that in the Danube Delta from the total area of 43,937 ha in 2013 the area of 20,662 ha is still used for aquaculture farming, the rest being transformed into area with the category of arable, pasture or unproductive use. The area of 61,400 ha that was in the CPIP management, after 1990 passed into the patrimony of the 34 newly established joint stock companies. In 2001, through Law 268/2001 [21], the State Domains Agency (ADS) was established, and took over in its administration the shares of these companies, to which was added the administration of several State Agricultural Enterprises (IAS) that owned aquaculture farms. The IAS managed an area of 2,512.58 ha and the companies 63,671.68 ha. The aquaculture sector has gone through the privatization process, process coordinated by ADS. The shares were sold and the land was leased.

Table 1. The land surfaces taken from the ADS

County	The land surface-ha
Alba	202.30
Arad	955.47
Bacău	198.29
Bihor	1,354.14
Bistrița - Năsăud	134.02
Botoșani	2,780.60
Brăila	8,308.88
Brașov	418,32
București	14,65
Buzău	2,707.15
Călărași	2,821.21
Caraș-Severin	127.73
Cluj	921.56
Constanța	11,818.96
Dolj	3,998.00
Dâmbovița	657.28
Galați	3,940.68
Giurgiu	1,299.85
Ialomița	1,934.04
Iași	3,213.79
Ilfov	1,075.20
Mehedinti	1,109.46
Mureș	1,032.68
Neamt	504.76
Olt	19.00
Prahova	803.98
Sălaj	158.68
Satu- Mare	779.22
Sibiu	672.12
Suceava	654.38
Teleorman	1,520.36
Timis	683.20
Tulcea	2,054.63
Vâlcea	57.04
Vaslui	1,190.23
Vrancea	1,325.16
Total	**61,447.01**

Source: own calculation on the basis of data from Multiannual strategic plan for aquaculture 2021-2030 [4].

In 2001, Law 192/2001 established the National Fisheries Fund Management Company (CNAFP) [23], which took over the remaining packages of shares, privatization contracts, concession contracts, as well as land. In 2008 CNAFP is abolished, handing over the entire portfolio to ADS, the National Agency for Fisheries and Aquaculture (ANPA) is established, which in 2010 according to Law 317/2009 [22] takes over from ADS the remaining shares, contracts and lands. The lands taken over by ANPA from ADS had a total area of 61,447.01 ha, Table 1.
Following the privatization, some companies existing at that time did not resist the market economy, stopped the activity or went bankrupt, or changed the category of use of the land from muddy waters to arable land, in the desire to obtain a subsidy from the state. As a consequence, the area exploited in the Romanian aquaculture sector decreased during the mentioned period, and in 2019 the production in this sector was at a volume of only 40% compared to 1989 (ANPA).
As a result of the fact that there is a double management of the lands, of the fact that the process of cadastre and tabulation is slow, for 2019 there is no clear and complete evidence of the patrimony arranged for aquaculture. This lack of clarity in the records complicates the process of sizing the financial support for the sector development. Regarding the areas managed by ANPA, a part of 31,189 ha are areas in operation, and 27,998 ha are not leased due to the multiple issues of the legal status of the areas (ANPA). The fish potential represented by the accumulation lakes - which are managed by the National Administration "Romanian Waters" (ANAR) and the administrative-territorial units - covers an area of approximately 20,000 ha, which are or can be used for extensive and semi-intensive aquaculture. Regarding the accumulation lakes, an area of 17,426 ha has been identified for floating aquaculture, of which, according to the recommendations, only a percentage of 10% can be used, respectively 1,743 ha (ANPA). The management of aquaculture land by various state institutions, the transfer of use to various business agents - regulated by different regulations, creates uncertainty

about the rights of users for medium and long term, necessary to justify the investments to be made. Eight normative acts have been identified that regulate the operation legality in aquaculture. In order to achieve the goals of these regulations, different conditions and validity terms are provided.

In this context, the purpose of the paper is is to find out if only one regulation is beneficial for the concession of the land under the management of ANAR, ANPA and territorial administrative units.

MATERIALS AND METHODS

The method used in this research is qualitative, using the documents provided by National Agency for Fisheries and Aquaculture (ANPA), but also by applying interviews to specialists with long experience in the aquaculture sector, with two heads of regional services from ANPA, 2 inspectors working on ANPA with more than 30 years of experience in the field, a specialist who was president of ANPA, as well as direct observation of the procedures for the enforcement of the legislation in force on aquaculture, and their effect on the fisheries sector. One analyzed the data received from Romfish Association, which represents the interests of the business agents in the fishing sector, and is a consultant for the fishing sector. The reference area of the data used refers strictly to the national level.

RESULTS AND DISCUSSIONS

Until 1989, most aquaculture farms included the primary processing of fish. After 1990, the factories gradually decreased their production and even ceased their operations.

At the level of 2019, on the Romanian territory, the situation of the aquaculture facilities registered in the Register of Aquaculture Units (RUA) was as follows: 728 aquaculture licenses were granted for breeders covering a total area of 72,835 ha and 241 licenses for nurseries with a total area of 7,256 ha (ANPA). These areas, in addition to state ownership and the ownership of territorial administrative units, also include private property.

Data taken from the quantitative research report Consumption of fish and fishery products in Romania, show that in 2018, in Romania, the annual consumption of fish was 8 kg per capita, and in 2019 was 7.5 kg per capita [3].

The volume of national aquaculture production in the period 2015-2019 is presented in Table 2.

Table 2. The volume of aquaculture production during the period 2015-2019

Year	Production (tons)
2015	11,018
2016	12,472
2017	12,796
2018	12,300
2019	12,848

Source: own calculation on the basis of data from ANPA [3].

In terms of distribution by development region, the largest share of national aquaculture production is in the North-East development region, with 29% of total production, followed by the South, South-East, North-East development regions. West and Center, with shares between 9% and 21% (ANPA). The low share of aquaculture production in the South-West and Bucharest-Ilfov regions is due to the fact that, in most fisheries facilities, there are farms where recreational fishing is mainly practiced.

From the point of view of the volume of national aquaculture production in the period 2015-2019, there are moderate fluctuations, from an increase of 16% during 2015-2017, to a decrease of approximately 4% in the production marketed in 2018, compared to 2017.

One of the reasons for the decrease in the national aquaculture production in 2018 was the land concession procedure by the Romanian Waters National Administration, which, during the procedure, practically blocked the production within the natural or accumulation lakes. Another cause of fluctuating and low aquaculture production is due to excessive bureaucracy and cumbersome procedures for access to fisheries facilities and aquaculture, in relation to the importance of the aquaculture sector in society.

The institutions involved in the legislative regulations (through the eight normative acts regarding these procedures), are:

1. Environmental Protection Agency, for the issuance of the environmental permit Order 1798/2007 [16] and Order 1171/2018 [15];

2. National Agency for Fisheries and Aquaculture;

- leases the lands managed, regulated by Order 533/2019 [11];
- issues the aquaculture license according to Order 332/2008 [10];

3. National Authority Romanian Waters:

- leases the use of managed lands regulated by Order 1093/2017 [14];
- issues the water management permit in accordance with Order 891/2019 [13];
- issues the permit for safe operation of dams, regulated by Order 118/2002 [12];

5. Territorial Administrative Units (TAU):

- concedes the use of the land owned according to GEO 57/2019 [20].

The concession of the land in the state property and in the ANPA administration or in ANAR administration or the property of ATU observes GEO 57/2019 regarding the Administrative Code, and is made by auction by the land manager. The start-up fee is calculated, the final fee being set by auction, but without the possibility of being lower than the start-up fee. The price of the starting fee differs, depending on the land manager.

In the interviews with the specialists, they all expressed their opinion that the economy in the fishing sector would benefit if there were a single legislation regarding the access to space in the fishing sector. Romfish Association also expressed this view.

The concession duration is a factor of interest, in terms of the investments required for the operation of the fishery arrangement.

CONCLUSIONS

Spatial planning for aquaculture includes landscaping, both inland and marine area. In the inland area, it is considered a priority for the aquaculture development. In the marine area, reference is made to the area where aquaculture can be developed, and which provides an integrated approach. Common regulations on access to aquaculture land would facilitate an easier accessibility, helping to harmonize environmental and economic policies.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIA'S AGRO-FOOD FOREIGN TRADE CONCENTRATION WITH THE EUROPEAN UNION COUNTRIES, 2013-2021

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Abstract

The paper analyzed Romania's agro-food export, import and trade balance with the EU-27 countries in the period 2013-2021 using the empirical evidence from National Institute of Statistics. Fixed basis and structural indices, as well as Herfindahl-Hirschman Index (HHI), Gini-Struck Index (GSI) and the Coefficient of Concentration (CC) were used to characterize the concentration degree of the agri-food trade. In 2021, export value accounted for Euro 5,471.8 Million, import value for Euro 8,459.7 Million and the trade balance registered a deficit of Euro -2,987.9 Million. The figures reflect an increase both in export and import, but import exceeded the export reflecting that Romania is a net importer of agro-food products. The highest market share in Romania's export is kept by Italy, Bulgaria, Netherlands, Spain, Germany, Hungary, France, Greece, Belgium and Poland, while the main import partners are Germany, Hungary, Poland, Netherlands, Bulgaria, Italy, Spain, France, Greece and Belgium. The concentration degree both in case of export and import is small as proved by the values of HHI, ranging between 0.0845 and 0.0996 for export and between 0.1065 and 0.1106 for import. GSI values ranged between 0.2220 and 0.2406 for export and between 0.2687 and 0.2764 for import. CC values were below 0.5 also reflecting a competitive market. To diminish the dependence of imports, agro-food export has to be stimulated by the increase of agricultural production which has to provide more products with high value added and of a higher quality to enhance competitiveness, and also imports have to be revised and a better resource allocation is needed to strengthen internal production and cover better domestic consumption.

Key words: *agro-food foreign trade, **export,** import, trade balance, Herfindahl-Hirschman Index, Gini-Struck Index, Concentration coefficient, Romania*

INTRODUCTION

Agro-food trade plays a crucial role in ensuring food security through by the offer volume and diversity. At the same time, it is the driver of the agriculture capacity to produce more and of high quality products to cope with growing competition in the agro-food market [1, 20].

The development of the EU unique market allowed the free movement of agro-food products and, of all the commodities among the member states, under the condition of the lack of customs tariffs, checking the origin of products according to traceability principles, quality standards and favored the intensification of commerce transactions and transport with agro-food products [17].

The intensification of the commercial exchanges between the member states is a key factor for a faster economic growth, for improving production structure, productivity and product quality using the competitive advantage of each country regarding geo-climate conditions, resource availability in terms of land, capital, human experience and knowledge. More than this, trade relationships sustain producers to carry a higher output and to improve their incomes and living standard [5, 6, 11].

It is unanimously recognized that a rise in exports stimulates economic growth, as exports helps investment to the most efficient sectors of the economy, resulting a higher productivity and more competitive products for export [6, 35].

The EU enlargement has favored the extend of agro-food market developing close relations between countries.

The agro-food commerce development is closely linked to agriculture performance based on the degree of use of the agricultural area, production technologies, farm structure and size, incentives and subsidies for agriculture and the development of the rural communities [34].

A more intensive foreign trade diminishes the dependence of a country on imports, improves trade balance and supply foreign currency in the payment balance [8, 36].

The intensification of the agro-food trade flows has a multiplying effect which involves and strengthen the development of agri-business, modeling market structures to suit the market requirements.

Enhancing export is the desire of any country looking for an increased competitiveness and agriculture performance [4].

The development of agro-food intra trade in the EU is an image of economic integration and economic growth of each member state as a result of the enlargement process and Common Agricultural Policy [2, 3, 27].

Significant changes and new opportunities for intensifying production and commercial exchanges with agro-food products have been created grace to the accession of new member states from the Central and South Eastern Europe to the EU structures [12, 13].

Romania is an important "player" in the EU agro-food market, operating especially in cereal and oil seeds market as a top supplier and also with imports oriented much more to manufactured agro-food products of animal origin. Its foreign trade has grown continuously after accession and at present it is highly dependent on the EU market.

In this context, the goal of the paper was to analyze the dynamics of Romania's the agro-food trade in the period 2013-2021 with the EU countries, pointing out the value of export, import and trade balance, as well as the changes in commercial transactions with the main partners. More than this, the paper aimed to quantify the concentration degree of export and import in terms of Herfindahl-Hirschman Index, Gini-Struck Index and Concentration coefficient.

MATERIALS AND METHODS

A short overview on Romania's agriculture

Romania is an important "actor" in the EU agro-food market because agriculture is a basic branch in the economy contributing by 4,2% to GDP and has a high gross value added [23, 33].

Agriculture is a predominant occupation of the rural population, accounting for 45% of Romania's inhabitants and about 19% of the population is employed in agriculture compared to 4.1% the EU average and 2% the EU-15 average.

Romania has 3.2 million farms representing one third of the EU agricultural holdings, but the average farm size is very small of only 3.7 ha compared to 16.2 ha the EU-average. agriculture is dominated by family subsistence and semi-subsistence farms, only 1% of agricultural holdings are commercial companies which intensively work 46% of arable land [16, 19].

The geographical position and soil-climate conditions favor agriculture. About 11% of agricultural land is cultivated with cereal and oil seeds, Romania being the top supplier of maize in the EU [28] and sunflowers seeds [21, 29] and also is among the top five producers of wheat [28] and soybean [32].

Also, the country has orchards, vineyards and grasslands, and animal sector includes all the farm species: cattle [25, 31] , swine [24, 30], poultry, sheep and goats, beekeeping [18, 22, 26].

Agro-food trade is more oriented to exports of raw materials such as cereals grains and oil seeds, and imports are predominantly agro-food products including meat and dairy products, vegetables and fruits, feed ingredients and beverages.

This reflects the dual connection between Romania and the EU member states and strengthen their commercial relationships. Romania's intra-industry agro-food trade with the EU is of a vertical type, regarding commercialized products of different quality [9, 10, 27].

In fact, Romania is a net importing country of agro-food products which requires an improved future strategy to enhance production, create more value added and sustain competitiveness and diminish the deficit of agro-food trade balance [7, 14].

Data collection

The study is based on the empirical evidence provided by National Institute of Statistics, Tempo Online data base for the period 2013-2021.

Methodological approach

In this study, the following indicators characterizing agro-food foreign trade were used:

- agro-food export by EU member state and at the EU-27 level;
- agro-food import by EU member state and at the EU-27 level;
- share of agro-food export by country in Romania's agro-food export with the EU-27;
- share of agro-food import by country in Romania's agro-food import from the EU-27;
-agro-food trade balance by each EU member state and also at the EU-27 level.

The processing of the data involved various procedures and methods such as: dynamics analysis based on fixed basis indices, structural indices, and finally the concentration degree on exports and imports were assessed using Herfindahl-Hirschman Index (HHI), Gini-Struck Index (GSI) and the Coefficient of Concentration (CC), whose formulas are:

HHI= $\sum_{i=1}^{n} g_i^2$ ....(1)

GSI= $\sqrt{\frac{n\sum_{i=1}^{n} g_i^2-1}{n-1}}$ **...........................** (2)

CC = $\frac{n}{n-1}$ GSI ....(3)

The calculations were made for the whole studied period 2013-2021, and also for the year 2013 and for the year 2021 separately.

The results were tabled and graphically illustrated and the related comments were correspondingly made.

The main conclusions were presented at the end of this paper.

RESULTS AND DISCUSSIONS

Romania's agro-food export value with the EU-27

After its accession to the EU, new challenges and opportunities have appeared for Romania's agriculture due to CAP provisions and financial support with a deep impact on production performance and intensification of agro-food trade with the EU partners.

The agro-food export value has considerably increased and in the studied period it raised from Euro 3,167,642 thousand in the year 2013 to Euro 5,471,804 thousand in the year 2021, which means by +72.7%. Taking into account the whole period 2013-2021, the value of agro-food export accounted for Euro 37,299,193 thousand (Table 1).

Table 1. Romania's agro-food export value with the EU-27 in 2021 versus 2013
2013

	2013	2021	2021/ 2013 (%)	2013-2021
Export value (Euro Million)	3,167.64	5,471.8	172.74	37,299.19

Source: Own calculation based on NIS data, 2022 [15].

Romania exported agro-food products in all the EU countries in various amounts and at different prices, assuring a general increasing trend to export value. Analyzing the situation by country, the export value increased in relation with almost all the EU commercial partners, except Malta, where the export value declined by 70% in 2021 versus 2013 (Figure 1).

Figure 1 shows the agro-food export by EU country in the Year 2013 reflecting that, the highest export value was achieved with the following countries, in the decreasing order: Italy, Hungary, Netherlands, Germany, Spain, France, Greece, Belgium, and the lowest export value was with Finland, Luxembourg, Latvia and Estonia.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

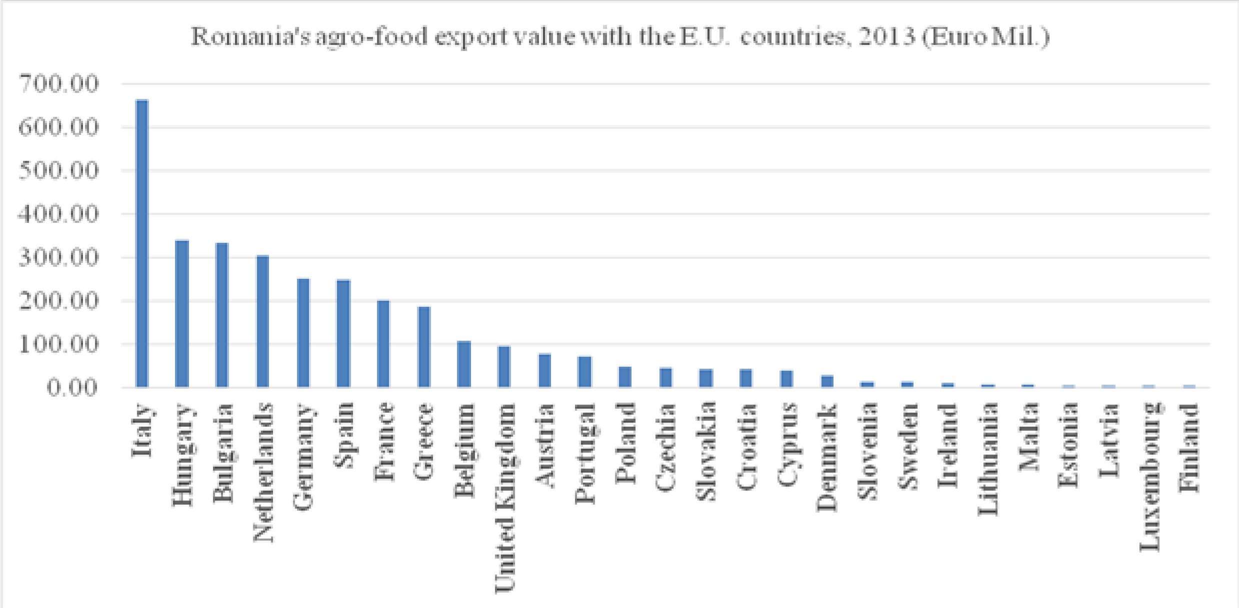

Fig. 1. Romania's agro-food export value with the E.U. countries, 2013 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

Figure 2 also reflects the absolute value of agro-food export with the EU countries, but in the year 2021, allowing us to make a comparison with the situation in the year 2013 and identify what changes have appeared in the interval of nine years. Italy keeps its top position, but, it is followed by Bulgaria and Netherlands, while Hungary passed from the 2nd position to the 4th one. Spain jumped on the 5th position, while Germany moved to the 6th. France maintained its 7th position, while Poland has become an important commercial partner passing from the 13th position in 2013 to the 8th in 2021. Greece remained on its 9th position, while Czechia climbed from the 14th position in 2013 to the 10th position in the year 2021. Therefore, in nine years, there were some movements in the hierarchy of the top EU beneficiaries of Romania's agro-food exports (Figure 2).

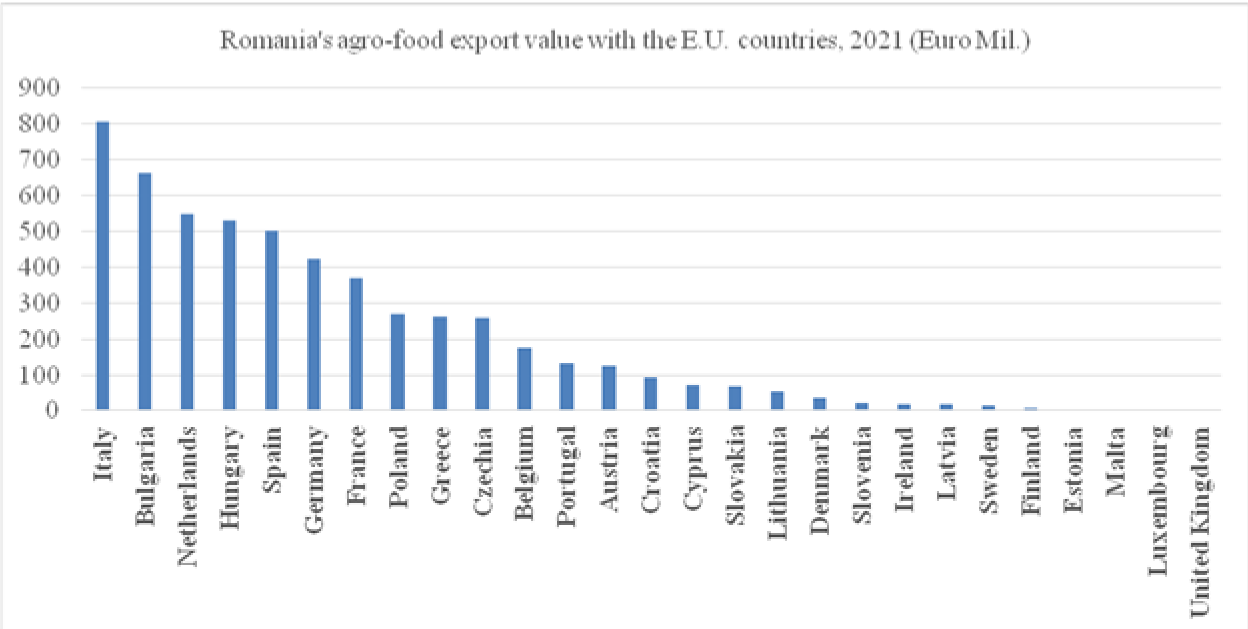

Fig. 2. Romania's agro-food export value with the E.U. countries, 2021 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

The growth rate of agro-food exports varied from a country to another. In relation to Finland, in 2021, Romania registered an export value 23 times higher than in 2013. Also, in the same year, high growth rates of export were recorded with: Lithuania (+748.3%), Czechia (+476.2%), Poland (+473.2%), Latvia (+454.7%), Croatia (+132.9%), Ireland (+132.6%), and Spain (+100.4%), Lower growth rates were recorded in case of Sweden (+26.9%) and Italy (+21.7%) as shown in Table 2.

Table 2. Growth rate of Romania's agro-food export value with the EU countries in 2021 versus 2013 (%)

Country	Export value growth rate (%)	Country	Export value growth rate (%)
1. Austria	164.4	15.Latvia	554.4
2.Belgium	164.5	16.Lithuania	848.3
3.Bulgaria	199.1	17.Luxembourg	198.9
4.Czechia	576.2	18.Malta	29.66
5.Cyprus	177.2	19.Netherlands	179.2
6.Croatia	232.9	20.Poland	573.2
7.Denmark	142.0	21.Portugal	186.6
8.Estonia	142.2	22.United Kingdom	-
9.Finland	2,300.9	23.Slovakia	169.5
10.France	183.2	24.Slovenia	167.6
11.Germany	168.7	25.Spain	200.4
12.Greece	139.0	26.Sweden	126.9
13.Ireland	232.6	27.Hungary	156.4
14.Italy	121.7		

Source: Own calculation based on NIS data, 2022 [15].

Taking into account the whole analyzed period 2013-2021, we may notice that the most important EU countries where Romania sold its agro-food products were, in the descending order: Italy, Bulgaria, Netherlands, Spain, Germany, Hungary, France, Greece, and Belgium (Figure 3).

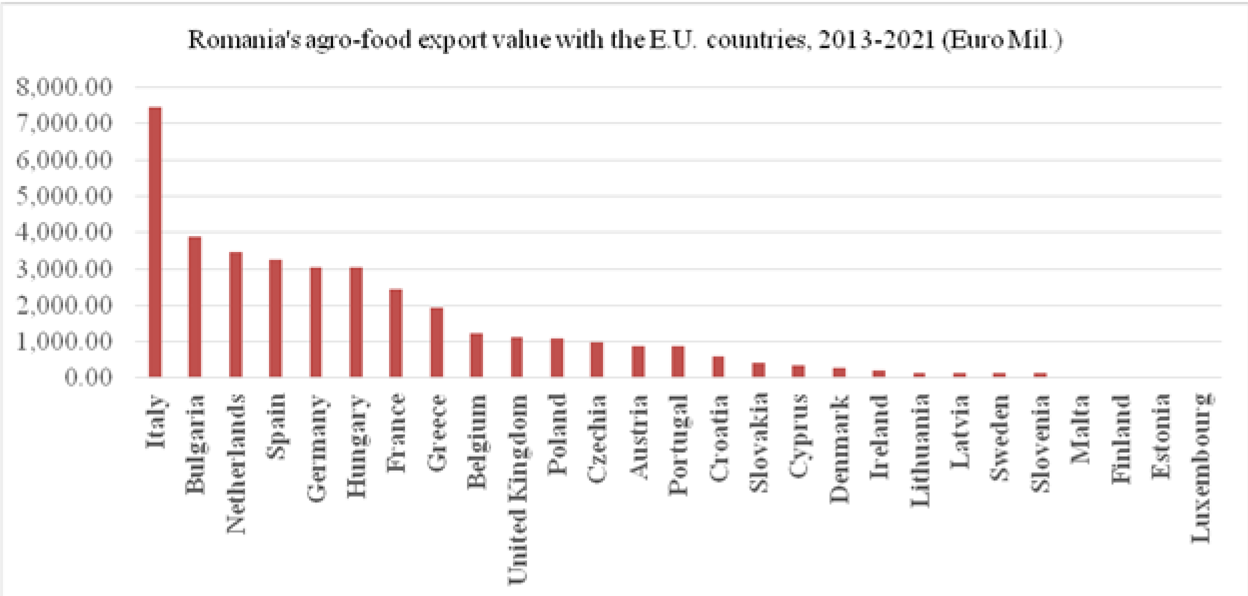

Fig. 3. Romania's agro-food export value with the E.U. countries, 2013-2021 (Euro Mil.)
Source: Own design based in NIS, 2022 [15].

The market share of the top 8 EU countries in Romania's agro-food export value in 2013, 2021 and in the period 2013-2021 is presented in Table 3.

Table 3. The market share of the top 8 EU countries in Romania's agro-food export value in 2013, 2021 and 2021-2013 (%)

2013		2021		2013-2021	
Country	Market share (%)	Country	Market share (%)	Country	Market share (%)
1.Italy	20.90	1.Italy	14.73	1.Italy	20.04
2.Hunagry	10.70	2.Bulgaria	12.12	2.Bulgaria	10.39
3.Bulgaria	10.50	3.Netherlands	9.99	3.Netherlands	9.25
4.Netherlands	9.63	4.Hungary	9.69	4.Spain	8.71
5.Germany	9.62	5.Spain	9.14	5.Germany	8.19
6.Spain	7.87	6.Germany	7.74	6.Hungary	8.14
7.France	6,36	7.France	6.74	7.France	6.51
8.Greece	5.92	8.Poland	4.92	8.Greece	5.25

Source: Own calculation based on NIS data, 2022 [15].

Romania's agro-food import value with the EU-27 countries

Imports are called to cover the non sufficient amount of agro-food products on Romania's domestic market as production is not able some times to cover the market needs. There are many reasons why this happens, and among them we could mention: the unbalanced ratio between vegetal and animal sector, the negative effects of the climate changes on harvests (droughts, floods, storms etc), milk and pork crisis, the decline of the livestock and African Swine Fever, not sufficient incentives for farmers, high farm input prices and low acquisition prices etc.

In 2013, the value of agro-food imports in Romania accounted for Euro 4,040,099 thousand, and in the year 2021, it was more than double, that is Euro 8,459,748 thousand. This means, an increase by +109.3%. In the whole period, 2013-2021, the import value accounted for Euro 54,694,569 thousand (Table 4).

Table 4. Romania's agro-food import value with the EU-27 in 2021 versus 2013
2013

	2013	2021	2021/2013 (%)	2013-2021
Import value (Euro Million)	4,040.0	8,459.7	209.3	54,694.5

Source: Own calculation based on NIS data, 2022 [15].

The import value increased in case of almost all EU suppliers, except Cyprus and Portugal, from which the imports declined by 46.7%, and, respectively, by 18.9%.

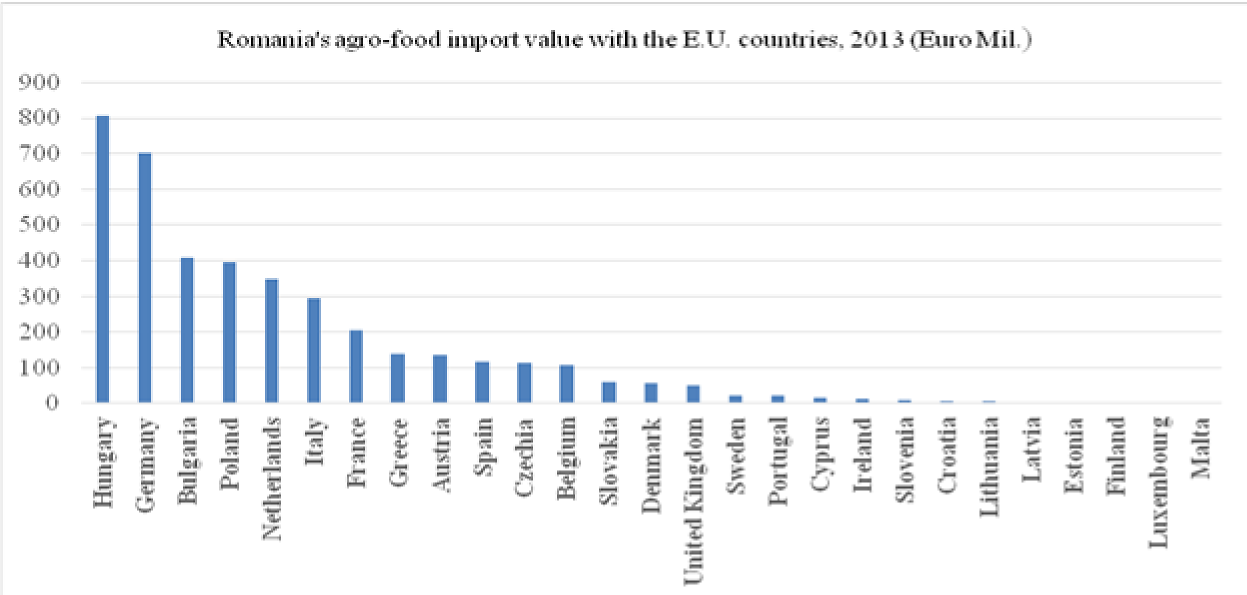

Fig. 4. Romania's agro-food import value with the E.U. countries, 2013 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

Figure 4 reflects that the main suppliers of agro-food products for Romania in 2013, in the decreasing order, were: Hungary, Germany, Bulgaria, Poland, Netherlands, Italy, France, Greece, Austria, Spain, Czechia and Belgium (Figure 4).

Figure 5 also shows the absolute value of agro-food imports, but in the year 2021. At that moment, on the top position came: Germany, followed by Hungary, Poland, Netherlands, Bulgaria, Italy, Spain, France, Belgium and Greece.

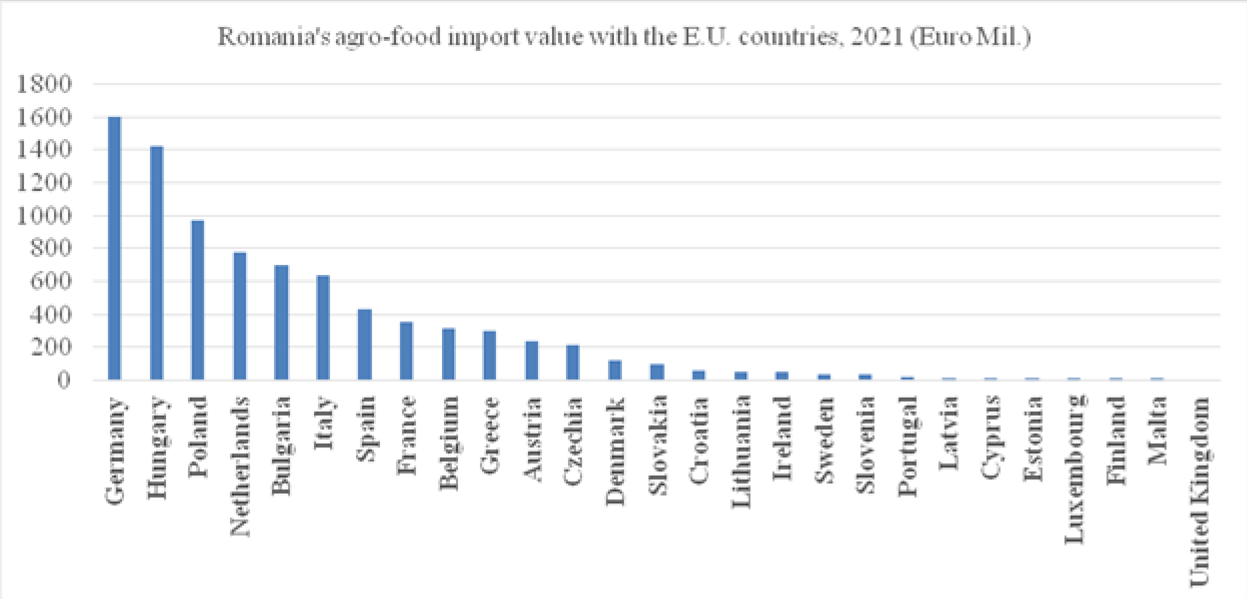

Fig. 5. Romania's agro-food import value with the E.U. countries, 2021 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

Figure 6 emphasizes the position of the leading EU countries which supply agro-food products to Romania, the hierarchy being identical with the one registered in the year 2021, for the first 8 positions. The only change was between Greece and Belgium, the first passing to the 9th position and the latter on the 10th position.

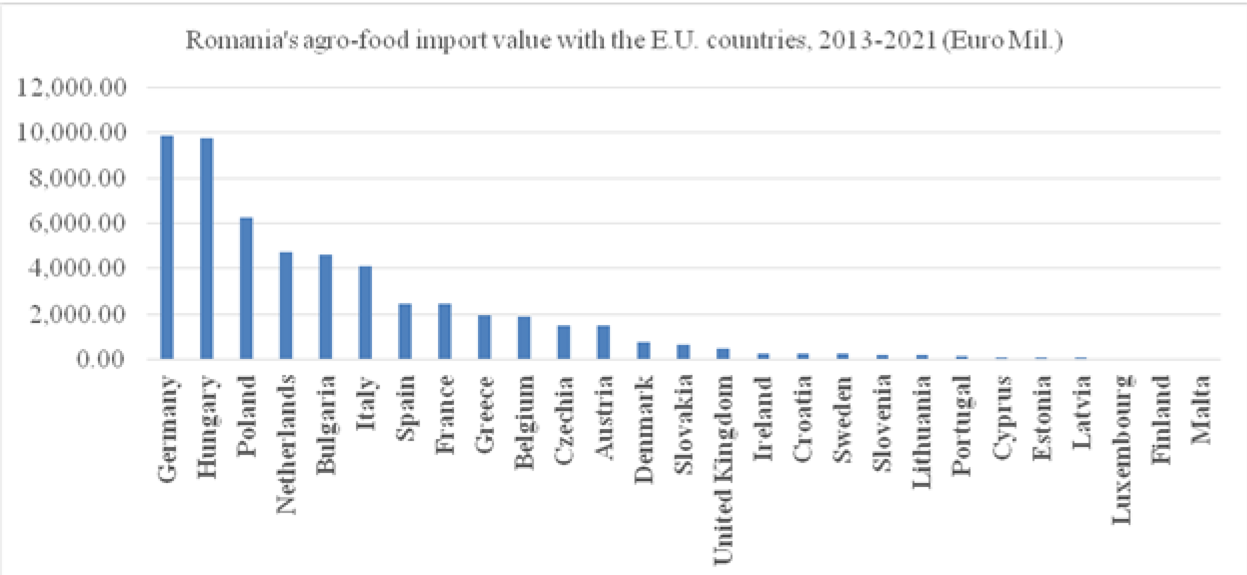

Fig. 6. Romania's agro-food import value with the E.U. countries, 2013-2021 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

The growth rate of agro-food import value ranged from a country to another. In the period 2013-2021, the highest growth rate was registered by Croatia (+824.7%), Lithuania (+970.6%), Latvia (+375.9%), Ireland (+411.1%), Luxembourg (+204.6%) and Belgium (+192.3%).

The lowest growth rates were recorded in relation to Sweden (+63.2%), Slovakia (+54.5%) and Finland (+18.7%) (Table 5).

Table 5. Growth rate of Romania's agro-food import value with the EU countries in 2021 versus 2013 (%)

Country	Import value growth rate (%)	Country	Import value growth rate (%)
1. Austria	177.9	15.Latvia	475.9
2.Belgium	292.3	16.Lithuania	970.6
3.Bulgaria	172.4	17.Luxembourg	304.6
4.Czechia	190.0	18.Malta	248.6
5.Cyprus	53.3	19.Netherlands	221.7
6.Croatia	924.7	20.Poland	245.9
7.Denmark	212.1	21.Portugal	81.1
8.Estonia	263.3	22.United Kingdom	-
9.Finland	118.7	23.Slovakia	154.5
10.France	173.8	24.Slovenia	380.0
11.Germany	228.2	25.Spain	367.8
12.Greece	216.4	26.Sweden	163.2
13.Ireland	411.1	27.Hungary	176.4
14.Italy	217.2		

Source: Own calculation based on NIS data, 2022 [15].

The share of the top 10 EU suppliers of agro-food products for Romania in 2013, 2021 and 2013-2021 is shown in Table 6.

Table 6. The market share of the top 10 EU countries in Romania's agro-food import value in 2013, 2021 and 2021-2013 (%)

2013		2021		2013-2021	
Country	Market share (%)	Country	Market share (%)	Country	Market share (%)
1. Hungary	20.00	1.Germany	18.98	1.Germany	18.10
2.Germany	17.41	2.Hungary	16.85	2.Hungary	17.87
3.Bulgaria	10.06	3.Poland	11.49	3.Poland	11.47
4.Poland	9.79	4.Netherlands	9.12	4.Netherlands	8.60
5.Netherlands	8.61	5.Bulgaria	8.29	5.Bulgaria	8.39
6.Italy	7.25	6.Italy	7.52	6.Italy	7.52
7.France	5.28	7.Spain	5.09	7.Spain	4.54
8.Greece	3.47	8.France	4.22	8.Franec	4.49
9.Austria	3.34	9.Belgium	3.74	9.Greece	3.61
10.Spain	2.90	10.Greece	3.58	10.Belgium	3.44

Source: Own calculation based on NIS data, 2022 [15].

Romania's agro-food trade balance with the EU-27 countries

The dynamics of export and import value of agro-food products reflected discrepancies regarding the high value of imports compared to the export value. This means that Romania is a net importing country of agro-food products, the value of the trade balance being a negative one both in 2013, 2021 and in the whole period 2013-2021 (Table 7).

The figures show that in the interval 2013-2021, the negative trade balance increased 3.4 times, as the growth rate of imports exceeded the growth rate of the export value.

Table 7. Romania's agro-food trade balance with the EU-27 countries in 2021 versus 2013
2013

	2013	2021	2021/2013 (%)	2013-2021
Trade balance (Euro Million)	-872.4	-2,987.9	342.47	-17, 395.3

Source: Own calculation based on NIS data, 2022 [15].

The dynamics of agro-food trade balance in 2013 is shown in Figure 7, from which we may see that the countries with whom Romania had a positive trade balance, in the descending order, are: Italy, Spain, Portugal, Greece, United Kingdom, Croatia, Cyprus, Malta and Slovenia, while the countries with whom Romania registered a negative balance are: Hungary, Germany, Poland, Bulgaria, Czechia, Austria, Netherlands, Denmark, Slovakia, Sweden, France, Ireland.

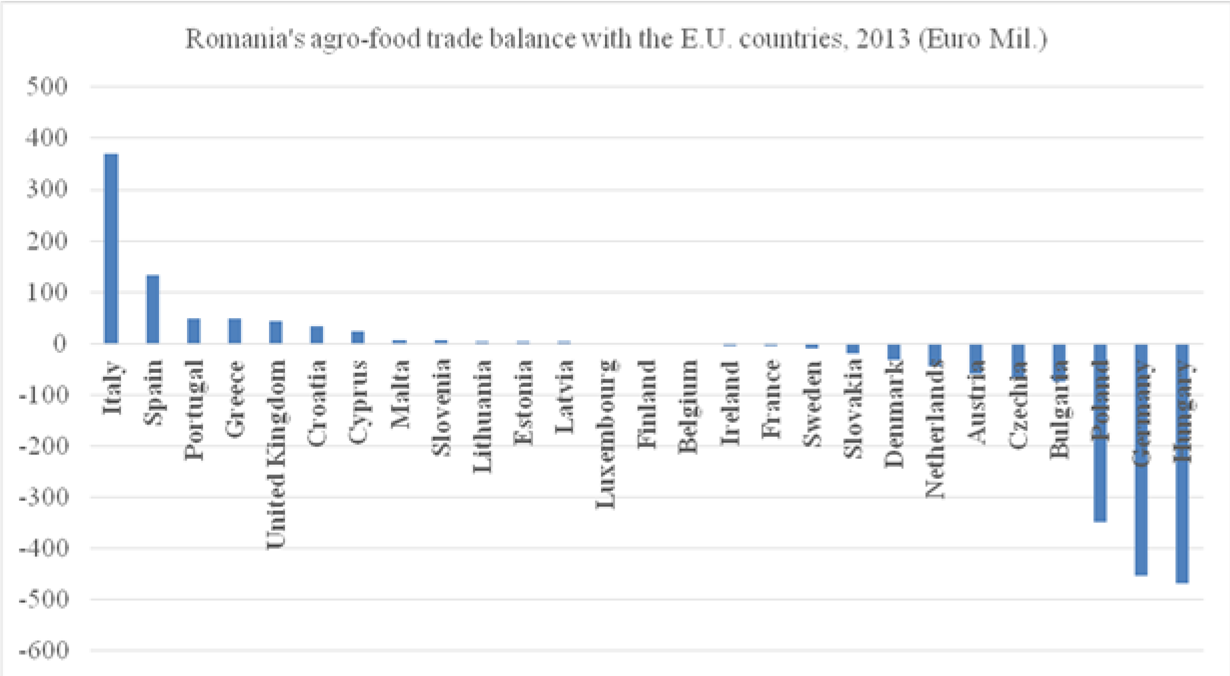

Fig. 7. Romania's agro-food trade balance with the E.U. countries, 2013 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

Figure 8 shows Romania's agro-food trade balance with the EU-27 by country in the year 2021, from which we may notice that the commercial exchange with Italy, Portugal, Spain, Cyprus, Czechia, Croatia, France, Lithuania, Latvia, Finland resulted in a positive trade balance, while the commerce with Germany, Hungary, Poland, Netherlands, Belgium, Austria, Denmark, Greece, Bulgaria, Ireland, Slovakia, Slovenia led to a negative trade balance.

Figure 9 presents the agro-food trade balance for the whole period 2013-2021. It reflects that the commercial relations had a positive impact on trade balance with Italy, Spain, Portugal, United Kingdom, Croatia, Cyprus, Latvia, Malta, while with Germany, Hungary, Poland, Netherlands, Bulgaria, Belgium, Austria, Czechia, Denmark, Slovakia, Sweden and Ireland it had a negative result.

The analysis reflected that Romania is still a net importing country as it started to be after 1990.

A study made in the period 2007-2015 confirmed Romania's status of net importing country of agro-food products in relation to the EU [27].

A continuous growth of Grubel-Lloyd intra-industry trade index was noticed for almost all the agro-food products, reflecting a high intensity of intra-industry trade. Also, Brülhart marginal intra-industry trade index A value values reflected a higher intensity of marginal intra-industry trade, while Brülhart marginal intra-industry trade index B confirmed a high performance of agro-food industry. In the period 2007-2015, import coverage by export accounted for 0.57 in 2007 and 0.86 in 2015 [27].

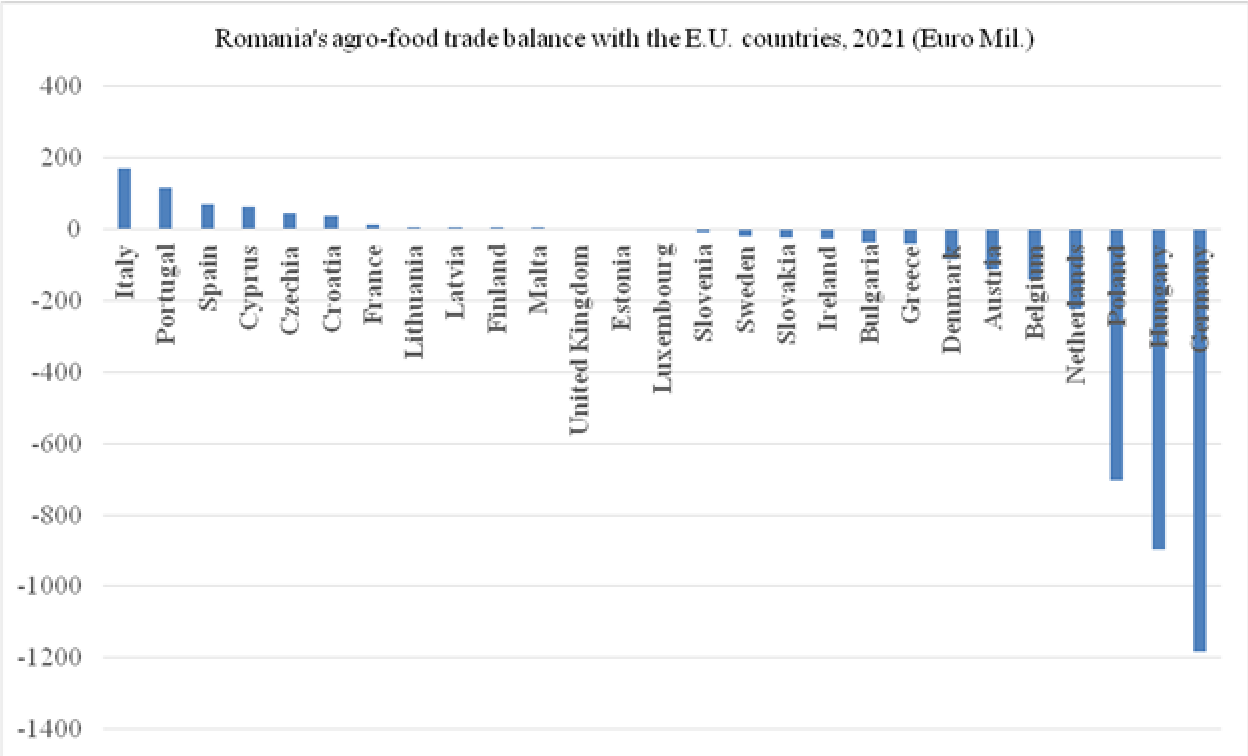

Fig. 8. Romania's agro-food trade balance with the E.U. countries, 2021 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

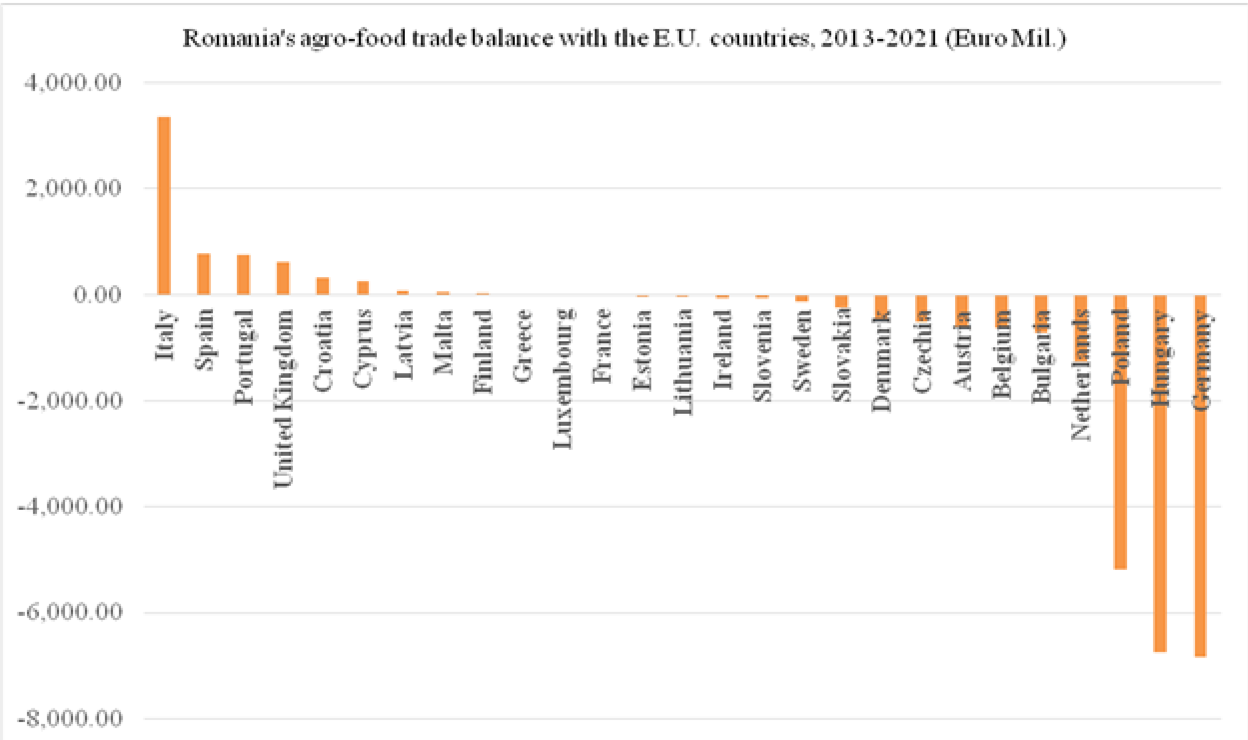

Fig. 9. Romania's agro-food trade balance with the E.U. countries, 2013-2021 (Euro Mil.)
Source: Own design based on NIS data, 2022 [15].

Comparatively analyzing the agro-food export and agro-food import value in the period 2007-2015 and 2013-2021, we may notice that export value increased, but in 2021 is below the level of 2015. Import value also increased, and in 2021 is by 25% over the level of 2015.

Trade balance is negative in all the years, but in 2015 had the smallest negative value. In 2021, the negative trade balance is 22 times higher than in 2015.

Analyzing import coverage by export index, we may notice the highest value of 0.86 in the year 2013, and the lowest values 0.57 in 2013 and 0.65 in 2021. This reflects a high dependence of Romania on the EU market to supply agro-food products to assure food security (Table 8).

Table 8. Import coverage by export index in the period 2013-2021 versus 2007-2015 in Romania's agro-food trade with the EU

	Popescu, A., 2017 [27]		Popescu, A., Dinu, T.A., Stoian, E., Serban, V., 2021, present study	
	2007	2015	2013	2021
Export value, Euro Mill.	1,122.3	5,918.2	3,167.6	5,471.8
Import value, Euro Mill.	3,338.7	6,055.2	4,040	8,459.7
Trade balance	-2,216.4	-137	-872.4	-2,987.9
Import coverage by export	0.57	0.86	0.78	0.65

Source: Own results.

Concentration of Romania's agri-food export and import with the EU countries

In case of agro-food export, the values of Herfindahl-Hirshman Index (HHI) both in the year 2013, 2021 and for the whole analyzed period 2013-2021 were smaller than 0.15 and ranged between 0.0845 and 0.0996, reflecting that there is a lack of concentration, and there are no signs of anti-competitive aspects.

A similar situation was noticed in case of agro-food import, where the values of Herfindahl-Hirshman Index were also below 0.15, ranging between 0.1065 and 0.1106. In this case, there is an unconcentrated situation and no signs of anti-competitive effects.

Gini Struck Index (GSI) also does not have high values, as they ranged between 0.2220 and 0.2406, reflecting that agro-food export value has a small inequality among the EU countries, therefore Romania has a competitive market. A similar situation was identified in case of agro-food import, where Gini Struck Index values ranged between 0.2687 and 0.2764.

The values of Concentration coefficient (CC) are below 0.5 both in case of agro-food export and agro-food import, reflecting a competitive market.

However, if we compare the values of these three indices for agro-food export with the values obtained for agro-food import, we may easily notice that in case of import the values are a little higher (Table 9).

Table 9. Concentration degree of Romania's agro-food export and import on the EU market, 2013-2021

Trade indicator	Concentration Indices	2013	2021	2013-2021
Agro-food export	HHI	0.0996	0.0845	0.0928
	GSI	0.2548	0.2220	0.2406
	CC	0.4756	0.4383	0.4598
Agro-food import	HHI	0.1106	0.1074	0.1065
	GSI	0.2764	0.2704	0.2687
	CC	0.4923	0.4904	0.4986

Source; Own results.

CONCLUSIONS

The analysis regarding Romania's agro-food trade with the EU-27 countries in the period 2013-2021 pointed out a positive dynamics both of export and import values reflecting the efforts made by the country to improve agricultural production for covering internal market needs and also to be more competitive on the EU market.

In 2021, agro-food export value reached Euro 5,471.8 Million being by +72.7% higher than in 2013, while import value accounted for Euro 8,459.7 Million being 2 times higher than in 2013. As a result, the trade balance was negative, Euro -2,987.9 Million, by +242.4% higher than in the first year of the analysis.

This reflects the good commercial relationships exiting between Romania and the European Union, which is its main partners both for export and import for agro-food products and not only.

However, the status of net importing country reflects that import value is much higher than export value.

The study emphasized that the position and market share of each commercial partner and also the movements among EU countries in their hierarchy and importance either in Romania's export and import of agro-food products have changed during the period 2013-2021.

The main export partners for Romanian agro-food products are Italy, Bulgaria, Netherlands, Spain, Germany, Hungary, France, Greece, Belgium and Poland, and the main partners for import are Germany, Hungary, Poland, Netherlands, Bulgaria, Italy, Spain, France, Greece and Belgium.

While in relation with Italy, Spain, Portugal, Croatia and Cyprus, the trade balance is positive, the highest deficit in the trade balance is achieved in the commercial exchanges of agro-food products with Germany, Hungary, Poland, and Netherlands, and also in a lower proportion with Bulgaria, Belgium, Austria, Czechia and Denmark.

The results showed that Romania has penetrate with its exports in all the EU countries and also imports agro-food products from all the EU members states in various proportions, structures, prices and value. Therefore, its market is a competitive one, as long as the values of Herfindahl-Hirschman Index, Gini-Struck Index and Concentration coefficients were very small reflecting a lack of concentration both in case of agro-food export and import.

Taking into account the results of this analysis, it is obviously that more incentives have to be allotted to export and a new orientation in export structure and product quality has to improve the links between agricultural performance and competitiveness of agro-food export. Export has to become the image of a viable and sustainable agriculture in Romania.

Agricultural production has to increase its volume and harmonize its structure and to deliver only high quality products. Romania has to carry out agro-food products with more value added to strengthen the competitiveness of Romanian products on the EU market.

For diminishing Romania's dependence on imports, import structure has to be revised and to look for solutions in agriculture and food-industry where to allocate more resources and incentives to produce in the country a part of the imported products.

Only in this way, the deficit of the agro-food trade balance could be reduced.

In this context, the strategy for the future development of agro-food system for a medium and long-run horizon 2020-2030 is destined to valorize the agro-food potential of Romania and assure the development of rural areas as well, so that to increase the coverage of food consumption from the domestic production and Romania to regain its status of net agro-food exporter.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIA'S TOURISM OFFER AND DEMAND IN THE COVID-19 PANDEMIC OF 2020 AND 2021 COMPARED TO 2019. A STATISTICAL OVERVIEW

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Abstract

The goal of the study is to analyze Romania's tourism in the years of the COVID-19 pandemic, 2020 and 2021, in order to quantify the gaps compared to the highest performance achieved in 2019 and in what measure tourism started to recover. Offer in terms of units with function for tourists' accommodation, their number, structure and evolution, number of places and their dynamics by accommodation type, and demand in terms of arrivals, overnight stays both at national level and in rural tourism, index of net use of accommodation capacity, incoming and outgoing tourism were the main studied indicators using fixed basis and structural indices and comparison method. Compared to 2019, in 2021 the number of accommodation units reached 9,146, being by +8.8% higher and the number of places accounted for 364.5 thousand (+2.2%). In 2020, tourist arrivals represented 47.8% and in 2021 accounted for 69.3% of the 2019 level, and the overnight stays followed a similar situation. The main destinations were the seashore, mountain and spa resorts, Romanian tourists having about 90% share in total arrivals. The pandemic was an incentive for Romanians to "Rediscover Romania" and the holiday vouchers were of much help. In a low measure, mainly in 2021, outgoing tourism to Bulgaria, Greece, Turkey, Maldive, Egypt exceeded the incoming tourism. The year 2021 was better than 2020, as the relaxed measures started earlier than in 2020 and tourism managers adopted flexible offers, personalized packages, last minute, early booking, free cancelation, lower tariffs, bonuses etc. The increasing trend is a hope that in 2022 tourism will have a much better dynamics and there are chances to recover!

***Key words**: tourism, agro-tourism, trends, Covid-19 pandemic, Romania*

INTRODUCTION

Tourism, the key contributor to the world service industry, one of the most dynamic branch of the global economy has been strongly affected by the COVID-19 pandemic [1, 7].
First of all due to the restrictive measures imposed to stop the extend of the disease. This stopped or diminished the tourist flow, which produced important economic losses in tourism business [2]. Human health and normal life have been disturbed. Many people lost their job or passed to "home work", income per family declined, strange feelings and emotions, depression and the perception of the travel risk determined the people to stay home or to travel close to the house [21, 22].
In the period of more relaxed restrictions, tourism managers adopted new flexible strategies adapted to the new conditions to attract tourists [8, 22].
Decision making under uncertainty, promoting tourist destinations, adopting new technologies, assuring a safe stay and well-being for tourists have been the main problems to which tourism had to respond [23].

The most difficult year was 2020, an atypical year for tourism, after a glorious period of a continuous increase in tourist arrivals, overnight stays and receipts both at the global level and the EU [11, 24].

International arrivals declined by 73% at the world level, and in 2021 even though a 4% surplus of arrivals was registered, they are still by 72% smaller than in 2019 [24].

The year 2021 brought a hope of recovery in Europe and Americas, by +19% and, respectively, +17% compared to 2020. However, a gap of 63% is still present. A good point registered the Central and Eastern European countries were arrivals were by +18% over the 2019 level [24].

As long as people like and need to travel, they are confident in the future recover of the tourism [4, 5].

Romania was no strange to problems in tourism mainly in the year 2020 [3], but domestic tourism saved the industry under the slogan "Rediscover Romania" which assured about 48% arrivals in tourist accommodation units of the 2019 level [12].

The main destinations preferred by Romanians proved to remain in the top: the seaside resorts during summer season, mountain resorts and spa tourism units [6, 14, 15, 16,17, 18].

Also, regarding the location, most of people was oriented to hotels on the seaside where safe conditions were assured, but also to small hotels, villas, chalets and agro-tourist guesthouses, situate in isolated areas suitable for a family or a group of friends [13, 19, 20].

The year 2021 brought the relaxation measures earlier which favoured better tourism and again internal tourism dominated the market with the same desired destinations, but tourism managers have been much better prepared with offers and facilities to stimulate tourist flows [9]. A similar tendency was noticed in other countries like Czechia and Slovakia [25].

In this context, the present study continues the researches started before and aimed to carry out a more comprehensive analysis of the performance in tourism offer and demand in the year 2021 compared to 2020, the two years of the COVID-19 pandemic, and also to 2019 as term of reference, when tourism reached the top performance in its evolution in Romania.

MATERIALS AND METHODS

To set up this paper, the following indicators characterizing tourism offer and demand were taken into consideration:

- number of units with function for tourist accommodation;
-accommodation capacity in terms of the number of places;
-tourist arrivals;
-tourist overnight stays;
-the net utilization capacity index;
-inbound tourism;
-outbound tourism.

The data were analyzed in 2021 compared to the results achieved in the year 2020 and also with the highest performance in Romania's tourism carried out in the year 2019.

For this purpose, the data were collected from Tempo online data base provided by National Institute of Statistics for the period 2019, 2020 and 2021.

The data were processed in their dynamics emphasizing the values of the fixed indices and structural indices, correspondingly interpreting the differences from a year to another and from a month to another.

The performance in tourism was analyzed both at the national level and also regarding rural tourism which was also a preferred alternative by tourists during the pandemic.

The results were graphically illustrated and tabled, depending on the case and specificity of the results and finally they were interpreted pointing out the main trends.

At the end of the paper, the conclusions synthesized the main ideas and identify what it is needed to do in 2022 and the coming years as tourism to recover at least at the level of 2019.

RESULTS AND DISCUSSIONS

Tourism offer

Number of tourist reception units with accommodation functions

In 2021, in Romania's tourism, the number of tourist reception units with accommodation functions increased by 744 units, meaning by +8.85% from 8,402 units in 2019 to 9,146 units (Table 1).

Table 1. Number of tourist units with accommodation function and number of places in Romania's tourism in the period 2019-2021

	2019	2020	2021	2021/2019%	2021/2020%	2020/2019%
No. of units	8,402	8,610	9,146	108.8	106.2	102.4
No. of places	356,562	358,119	364,507	102.2	101.7	100.4

Source: Own calculation based on the data from NIS, 2022 [10].

This increase at national level have to be analyzed in details by type of accommodation units, because there are differences determined by the challenges and restrictions caused by Covid-19 pandemic started since the year 2020.

Hotels, which keep an important part of the accommodation capacity, were facing the biggest problems due to the lower tourist flow during the period of Covid-19 pandemic, especially in 2020 and also in 2021 [20].

The worst year was 2020, as long as there were imposed movement restrictions for the population starting from March till June. Many hotels were obliged to close and the employees remained without job. In the interval 2019 - 2021, there were lost 25 units from the hotels map, remaining available just 1,583 units in 2021, representing 98% of 1,608 units existing in the year 2019.

The reopening of the accommodation units came in delay both for hotels, treatment and spa centers and other accommodation units, at the beginning at a limited capacity. Also, the restaurants had the obligation of creating open terraces and to assure a corresponding distance between tables inside. Severe hygiene regulations were imposed, the units had to assure disinfection materials, and the staff to wear mask etc.

The summer season brought a mouth of fresh air in hotel industry as the months June, July, August and September were favourable for the improvement of the degree of accommodation occupancy and for running the service activities in a relatively normal manner.

The number of hostels increased by 9 units in the analyzed interval, which means by +2.7%, from 323 units in the year 2019 to 332 units in the year 2021. They look to have the advantage as being a lower cost alternative compared to hotels, as long as booking is per bed in a dormitory and not per room, a cheaper solution for especially for young tourists and for one night.

The number of motels declined by 4 units, remaining just 215 units of this type in the year 2021 compared to 2019.

The change in tourists' preferences for the type of accommodation unit, to be smaller and offer the opportunity to live with the family or small group of friends has favoured the development of tourist villas, their number increasing by 6%. Villas have become an ideal location where a family to have a safe accommodation, so that in 2021 their number reached 752 units, that is by 43 units more than in 2019.

The chalets and inns preserved their number at 222 and, respectively 3 in the analyzed interval.

A part of the bungalows, the holiday villages and the tourist stops as well as the school camps were closed, so that their number declined by 9.7%, 11.2%, 6.4% and, respectively 5.5%.

But, the camping registered a higher number accounting for 67 units in the year 2021, as many tourists used their own car to travel and avoided other transportation means.

Also, the tourist small houses registered a higher number by 40 units, that is by +36.5%, summing 112 units in the year 2021 compared to 2019.

The guesthouses looked to be one of the most preferred location for accommodation due to the reduced number of rooms and a more convenient price per room than in a hotel. The number of tourist guesthouses in the urban area increased by 76 units (+4.5%), totalling 1,745 units in the year 2021 versus 2019.

A better situation was in case of agro-tourist guest houses, their number facing a "boom" of 660 additional units in the studied interval, so that in 2021 their number accounted for 3,460 units, that is by +23.5% more compared to 2019. Their advantage for tourists consisted not only in the ideal small accommodation capacity and low price per room, but also for the fact that they could be rented for the whole family or a group of friends and also for offering the opportunity for meals [13, 19]. (Table 2).

Table 2. Structure of units with function for tourists accommodation, structure of accommodation places by type of units and the growth rate of their number in 2021 versus 2019

	Units with function for tourists' accommodation		Places in units with function for tourist accommodation	
	Structure by unit type (%)	Growth rate 2021/2019 %	Structure by unit type (%)	Growth rate 2021/2019 %
Total	9,146 units	-	364,507 places	-
Hotels	17.3	98.4	54.2	99.5
Hostels	3.6	102.7	3.9	103.3
Hotel-apartments	0.2	135.2	0.7	157
Motels	2.3	98.1	2.4	102.0
Inns	0.03	constant	0.02	constant
Tourist villas	8.2	106.0	4.7	103.9
Chalets	2.4	constant	1.7	102.2
Bungalows	5.5	90.3	1.1	104.7
Holiday villages	0.08	88.8	0.1	78.6
Camping	0.7	115.5	2.9	101.1
Tourist stops	0.5	93.6	0.5	63.3
Tourist houses	1.2	135.6	0.8	124.7
Scholar camps	0.6	94.5	1.6	90.5
Tourist guesthouses	19.5	104.5	9.7	100.5
Agro-tourism guesthouses	37.7	123.5	15.3	113.7
Accommodation spaces on fluvial and maritime boats	-	-	-0.2	98.2

Source: Own calculation based on the data from NIS, 2022 [10].

Number of places in the accommodation units with function for tourist reception

The number of places (beds) increased by 2.2% from 356.5 thousand in the year 2019 to 364.5 thousand in the year 2021 (Table 1).

Significant increases were signalled in case of hotels-apartments (+57%), tourist houses (+24.7%), agro-tourism guesthouses (+13.7%), tourist villas (+3.9%), motels (+2%), hostels (+3.3%), and bungalows (+4.7%).

Important reductions in accommodation places were noticed in case of the tourist stops (-36.7%), holiday villages (-21.7%), and scholar camps (-9.5%).

In 2021, the highest share in the total number of places is kept by hotels (54.2%), agro-tourist guesthouses (15.3%), tourist guesthouses in the urban area (9.7%), tourist villas (4.7%), hostels (3.9%) and camping (2.9%) [13, 19, 20]. (Table 2).

Therefore, the smaller accommodation units like villas, apartments, guesthouses and chalets have become of high attraction for tourists being chosen because they could offer a safe stay and privacy in less crowded locations. Tourists have become more aware that they need a safe stay, and looked to get information about this aspect to know if the personnel wear mask, if there are assured materials for disinfection, if there are game places for children, terraces and tables outside etc.

The year 2020 has intensified digitalization in tourism as tourists used internet and mobile phones for online booking, they accessed tourist platforms or contacted tourist agencies, and also the suppliers of tourism offers have become flexible and adapted to the customers' requirements providing various types of offers, tourist packages, "last minute' offers, free cancelation, cheaper offers in the period of restrictions, bonuses etc.

Tourism demand

Tourist arrivals

The year 2019 was the peak in Romania's tourism as the country was visited by 13.37 million tourists, of which 20% foreign tourists [11, 15].

The year 2020 was an atypical year for tourism, the worst year as never before in the world tourism but also in Romania. The movement of the people was facing periods of more of less restrictions imposed to stop the spread of the virus and to protect the population [12].

Not only tourism was affected, but also other sectors of activity. Work has been shaped and passed to an adapted form in the pandemic: "home work", but also a part of jobs were lost with a negative impact on family income.

In consequence, the people's reluctance to travel, the decisions to remain at home or to travel in the proximity of the house resulted in holiday cancellation, in allotting a smaller budget for travel, the increasing preferences for domestic tourism in isolated locations like family guesthouses and small hotels, apartments, villas, all these reflect a new manner of thinking during the pandemic and the change in tourists' behaviour adapted to the new conditions.

However, if inbound tourism suffered a lot during the pandemic in Romania, the domestic tourism "flourished" under the slogan "To rediscover my own country".

Therefore, in the year 2020, the tourism sector was very much affected registering only 6.39 million tourists, representing just 47.8% of the number of visitors in 2019. Internal tourism was dominated by Romanians with a share of 92.9%.

In 2021, as long as the vaccination process started, the people had become more confident to travel. In this year, the number of tourist arrivals increased and reached 9.27 million, being by 44.9% higher than in 2020, but by -30.7% smaller than in 2019. Also, the Romanians represented 90.9% in the total visitors, as just a small part decided to travel abroad (Table 3).

Table 3. Tourist arrivals and overnight stays in Romania's tourism in the period 2019-2021 (Million)

	2019	2020	2021	2021/2019%	2021/2020%	2020/2019%
Tourist arrivals	13.37	6.39	8.69	64.9	135.9	47.8
Overnight stays	30.08	14.58	20.65	68.6	141.6	48.5

Source: Own calculation based on the data from NIS, 2022 [10].

Therefore, we may say that "domestic tourism" saved Romania's tourism during the pandemic both in the year 2020 and in 2021.

Foreign tourists decided not to travel because of the different regulations in their country of origin compared to the ones in Romania at different intervals, the requirements related to the PCR tests at the frontiers, the certificate of vaccination etc. As a result, just a few number of foreign tourists could come to visit Romania.

During the pandemic important changes have appeared in the tourists' preferences for various destinations. One third of the visitors preferred to visit Bucharest and the cities of residence of the counties. The mountain resorts came on the 2nd position with 1/5 of total arrivals as long as mountains are pleasant of high attraction in any season of the year in summer vacation, in autumn and in winter for skiing and sleighing [6, 14, 18].

The seashore of the Black Sea with its necklace of beautiful resorts came on the 3rdposition with over 1.14 million tourists in the year 2021 [14, 16].

Also, the spa resorts received up to 10% of the total tourist arrivals [17] and the Danube Delta and Tulcea City registered the smallest percentage.

Compared to the distribution of tourists by destination in 2019, it is easy to notice the growth of tourist arrivals in the year 2021 in spa, seashore and mountain resorts, in the Danube Delta and other destinations as well. As a reflection of the desire to spend vacations much more in less crowded and safe areas, Bucharest and the cities of residence of the counties registered a reduction in the number of visitors.

Across the years of the pandemic, the monthly distribution of tourist arrivals has followed more or less the usual dynamics in tourism, that is with the highest peak in the summer season in the month of August [12, 20].

The worst situation was in the year 2020, when the limited movement due to the imposed restriction by the authorities affected tourism very much in March and April and even in May, but starting from June when relaxed measures were taken, tourism has recovered in the summer season. But, from September, when the infection rate increased and schools were reopened, tourist arrivals declined again, but in November and December did not reach the lowest level like in March, April and May.

In 2021, the dynamics of tourist arrivals was much better but following in general the "bell" shape characteristic to tourism seasonality with the peak of tourists in August. Also, we have to notice that in 2021, the measures of relaxation were taken by the authorities earlier than in the year 2020. In this way, tourist flow started to grow even from May and continued its ascending trend in the next months till the peak of August. September had a fine weather and this was an incentive for a part of the tourists to spend vacations in this month when usually the tourism managers apply reduced tariffs. December has brought a new chance for stimulating arrivals during Christmas and New Year's Eve especially in the mountain resorts [18].

The tourist arrivals were more consistent from a numerical point of view compared to the year 2020, as long as the people become more confident due to the vaccination which was also imposed to the staff working in the accommodation units and restaurants.

In August 2019, it was registered the highest number of tourist arrivals accounting for 1,869.3 thousand, but in 2020, their number declined to 1,301.4 thousand, representing 70% of the 2019 level. In the year 2021, it was registered 1,729.9 thousand tourists in August, accounting for 92.5% of the level of the year 2019 and being by +32.9% higher than in 2020.

The month of July 2021, also destined to vacations, it was recorded 1,434.3 tourists by +56.3% more than in the same month of 2020 and representing 86.8% of the level in the year 2019.

On the 3rd position is the month of September 2021, when 1,072.5 thousand tourists spent their holidays, by +35% more than in 2020, but being 825 of the 2019 level.

In June 2021, at the beginning of the summer season, 648 thousand tourists opened the touristic season being attracted by the offers at small prices. Their number was by +31.4% higher than in 2020, but it represented just 60% of the arrivals in the same month of 2019 (Figure 1).

The month of May was shadly approached by tourists, due to the restrictions imposed. However, 609.2 thousand tourists were registered in the accommodation units, compared to only 34.5 thousands in May 2020. This means 18 times more arrivals in the year 2021, but only 46.5% of the 2019 level.

The month of October 2021 was generous in fine weather and 648 thousand tourists travelled in this period, by +31.4% more than in 2020, but by 60% less than in 2019.

The month of December 2021 filled the mountain resorts by the ski lovers. The arrivals accounted for 579.3 thousand, being by +69.3% higher than in 2020, but representing only 69.4% of the 2019 level (Figure 1).

Discussing about rural tourism, compared to 1,272.8 thousand arrivals in the agro-tourism guesthouses in the year 2019, in the year 2020, only 755.4 thousand tourists were able to spend vacations and have accommodation in the rural areas. But, in 2021, a recovery was notice, and 1,020.6 thousand arrivals were recorded, being by +35.1% higher than in 2020, but accounting for only 80.1% of the level of 2019.

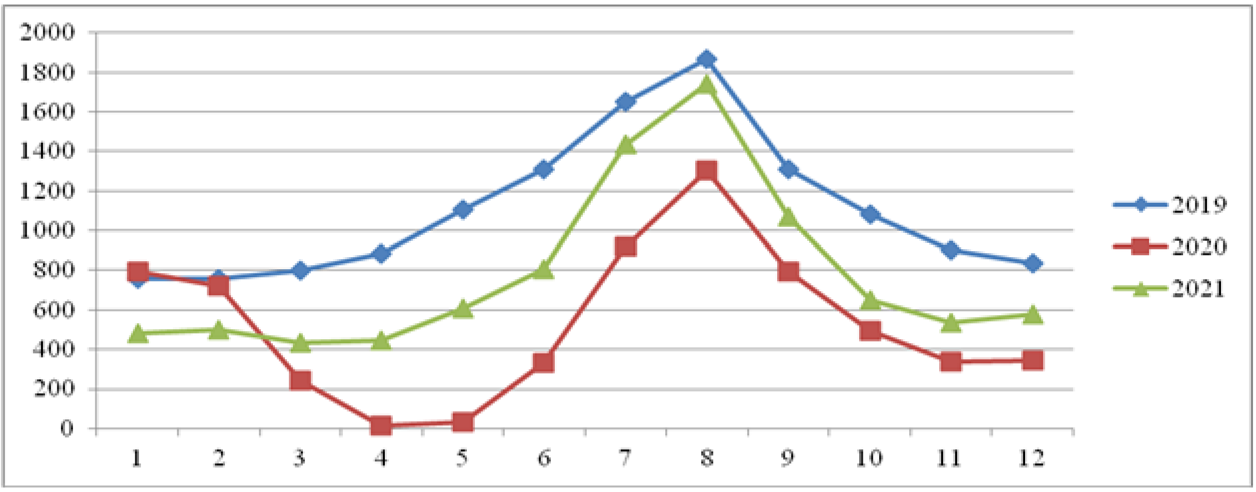

Fig. 1. Tourist arrivals distribution in Romania by month in 2019, 2020 and 2021 (Thousand)
Source: Own design based on the data from NIS, 2022 [10].

But, compared to 9.5% share of rural tourism in agro-tourist guesthouses in 2019, in the year 2020 the share was 11.8% and in the year 2021 was 11%, reflecting the higher importance given by tourist during the pandemic to this form of tourism and accommodation type to satisfy much better their needs of safe stay (Figure 2).

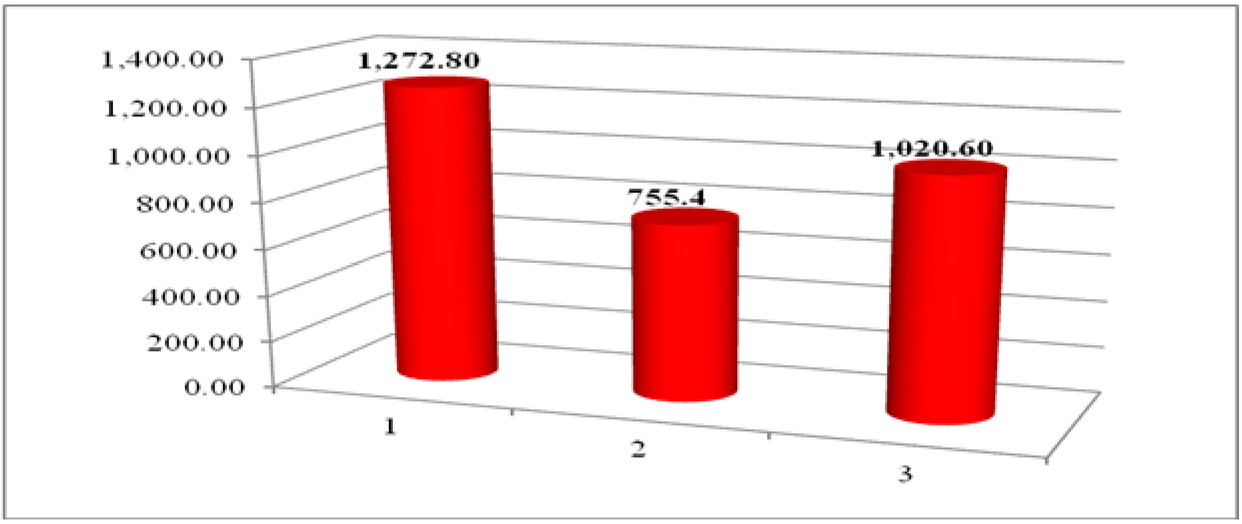

Fig. 2. Tourist arrivals in agro-tourism guesthouses in Romania by month in 2019, 2020 and 2021 (Thousand)
Source: Own design based on the data from NIS, 2022 [10].
Note: 1-2019, 2-2020, 3-2021.

Number of overnight stays

In the year 2021, it was recorded 20.65 million overnight stays, being by 41.7% more numerous than in the year 2020, but still by -31.4% less than the highest performance of 30.08 million stays registered in the year 2019 (Table 3).

In close relationship with tourist arrivals, the overnight stays were dominated by Romanian tourists: 82.4% in 2019, 93.2% in 2020 and 91.1% in 2021.

The number of overnight stays was closely connected to the number of tourist arrivals by category of accommodation units and tourist destination, the seasonality of vacations and the measures imposed by authorities. Therefore, the highest number of stays belonged to the months of summer season in all the three analyzed years (Figure 3).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

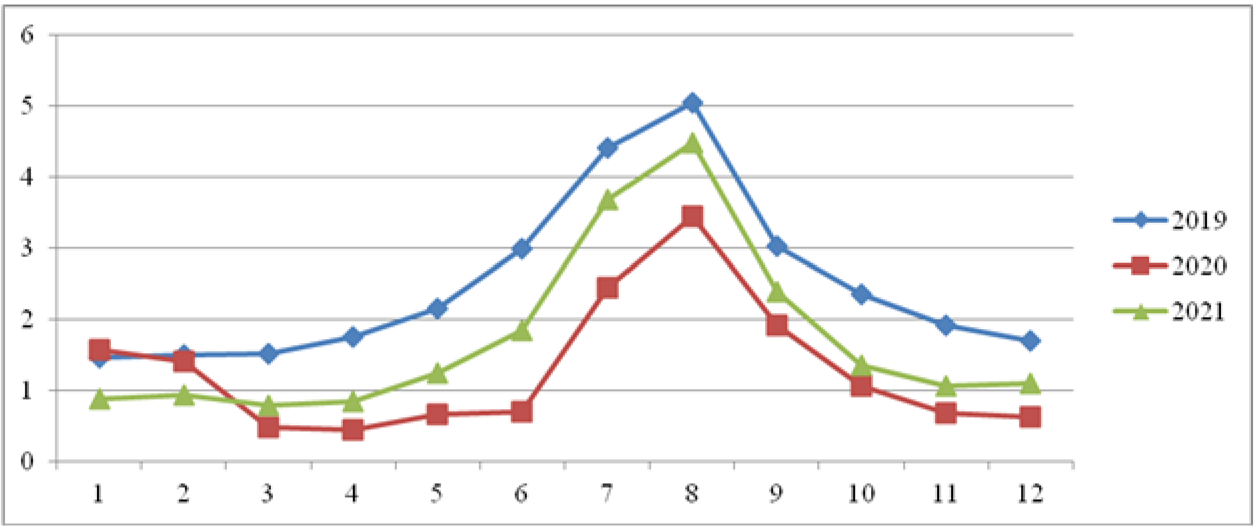

Fig. 3. Overnight stays in tourist accommodation units in Romania by month in 2019, 2020 and 2021 (Million)
Source: Own design based on the data from NIS, 2022 [10].

The index of net use of accommodation capacity

At the national level in 2019, this index was in average 33.9% but with variations from a type of accommodation unit to another. In 2020, it registered the lowest average accounting for 22.8%, but in the year 2021, it recovered a little reaching 26.5%.

In rural tourism, the index was much smaller: 20% in 2019, 16.5% in 2020 and 17.3% in 2021 (Figure 4).

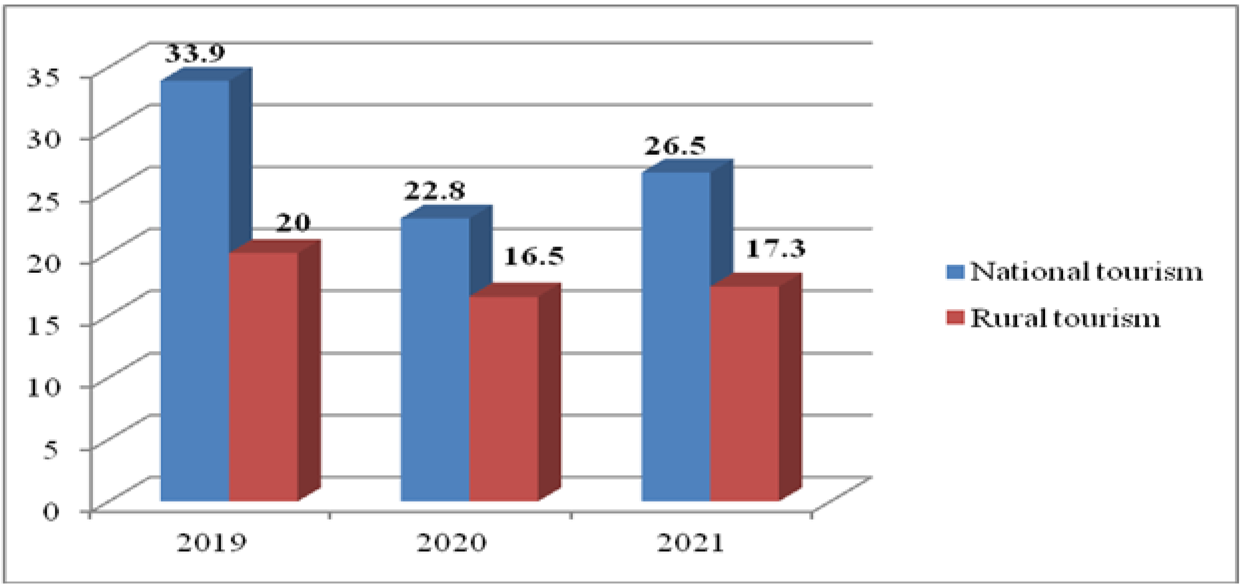

Fig. 4. Dynamics of the index of net use of accommodation capacity, Romanian tourism, 2019, 2020, 2021 (%)
Source: Own design based on the data from NIS, 2022 [10].

Inbound tourism

The arrivals of foreign tourists registered the peak in the year 2019 when it accounted for 12.81 million persons. In 2020, it was a pale presence of only 5 million, but in 2021 this indicator reached 6.78 million persons registered at the frontiers of Romania. In 2021, foreign arrivals accounted for 52.9% of the 2019 level, but by 35.1% more than in 2020.

The world football championship and "George Enescu" International Festival of Classic Music have deeply contributed to the increase of incoming tourism.

The most preferred means of transportation was by road with a share in total arrivals of

74.5% in 2019, 82.6% in 2020 and 79.1% in 2021. On the 2nd position came the transportation by plane with the following shares: 22.9% in 2019, 14.5% in 2020 and 17% in 2021 (Fig. 5).

Outbound tourism

In the period of analyzed years, we may say that in 2019, more than 23 million travels were recorded abroad by the Romanians. In the year 2020, the figure was modest, accounting for just 9.5 million travels, but in 2021, outbound tourism reached over 11.64 million travels. The main destinations were Bulgaria, Greece and Turkey for summer season and in autumn 2020 for exotic countries like Maldive. In 2021, new destinations like Egypt and Dominican Republic were added.

Romanian preferred first of all to travel abroad by road, especially by their own car. In 2019, it was registered 68.4% travels by road, while in 2020 it was recorded the highest performance of 71% and in 2021 of 66.5%.

Also, a part of the Romanians used the aircrafts to travel abroad, and the share of this mean of transportation in the total travels accounted for 30.9% in 2019, 28.3% in 2020 and 33% in 2021 (Fig. 5).

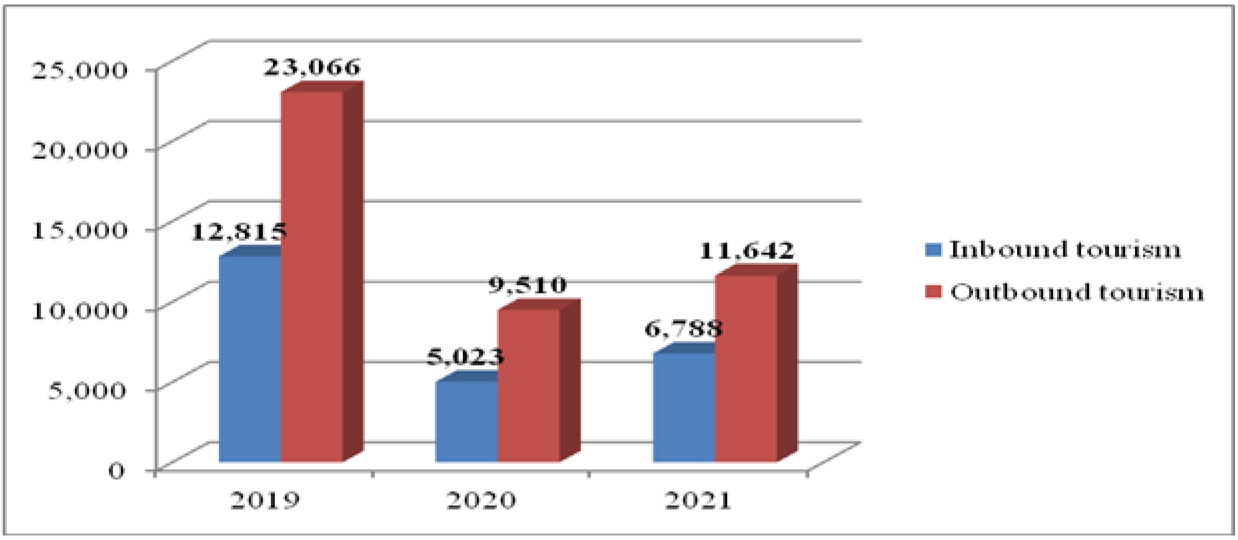

Fig. 5. Inbound and outbound tourism, Romania, 20219, 2020, 2021 (Thousand)
Source: Own design based on the data from NIS, 2022 [10].

CONCLUSIONS

Tourism crisis at the world level and in Romania was determined by the Covid-19 pandemic, the restrictive measures taken by the authorities and the fear of the people to travel.

The year 2020 was an atypical year for tourism which paralyzed the whole industry in terms of tourist flows, utilization of accommodation capacity, employment, salaries, losses in turnover and profitability.

In the period of more relaxed measures, Romanians proved to have the same desire to travel, the most frequent and wisest decision was to spend vacations in the country, to rediscover Romania.

The preference for accommodation were oriented to smaller units, able to assure a safe stay, privacy, and leisure with the family, to spend more time in the middle of nature, far away from the crowded places.

The preference for travels mainly by own car was the most frequent option for Romanians and rarely by plane for external destinations far away from Romania.

The "holiday voucher" have been a real opportunity to spend vacation in the country and helped a lot the managers of tourist units.

The offers of tourism agencies have been adapted to the tourists' needs including facilities like: zero advance, free cancellation of the bookings, "last minute" offers, "early booking" at lower prices, full refund of the paid amount if the Romanians will have no access to the respective country or the imposition of lockdown on their return in Romania etc.

The Romanian seashore was in top during summer season, week-end tourism was mostly practiced, and the fully opened mountains resorts both in winter 2020 and 2021 have been full of ski lovers and other tourists.

The state aid based on grants offered to tourism and hospitality industry have been of much help to cover a part of losses.

Taking into account that the alert status was cancelled from March 9, 2022, there is a hope that this year tourism industry will recover much better in Romania, even though tariffs have raised and transportation cost as well.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANALYSIS OF THE MAIN TECHNICAL INDICATORS OF CORN, WHEAT AND SUNFLOWER CROPS AT THE LEVEL OF THE EUROPEAN UNION

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Abstract

The content of this paper aims to analyze the main technical indicators of three of the most important crops in the European Union, namely corn, wheat and sunflower. By interpreting the statistical data provided by Eurostat on the cultivated area, the total production and the average production of the three crops mentioned above using the trend, the standard deviation and the coefficient of variation, an analysis of the Member States of the European Union will be carried out in order to determine which of them dominates the crop sector of corn, wheat and sunflower, in the end to figure out that not one of the analised Member States can be called the leader regarding the agricultural sector, because the results are so different beeing influenced by so many external factors.

Key words**:** *cultivated area, total production, average production, wheat, corn, sunflower*

INTRODUCTION

The European Union's concern for the agricultural sector has been present since its inception, to be more explicite since 1957, when the European Economic Community was set up. This clear concern for agriculture, and not only, was the result of the food concerns that preceded World War II [6, 1].

Under the 1957 Treaty of Rome, economic conditions such as the facilitation of trade between European states, European regulation of the market for agricultural products, the development of a common vision of protecting farmers' incomes, and the political will of that time were established one of the most important common policies, namely the Common Agricultural Policy [9, 4].

Playing a pioneering role in the process of integration into the European Union, being one of the foundations on which what we know today as the European Union was built, the Common Agricultural Policy is a partnership between agriculture and society, especially between Europe and farmers. The aim of this policy is to support farmers in improving agricultural productivity with a view to a stable supply of food at affordable prices, to protect farmers so that they can ensure a decent living, to contribute to the sustainable management of natural resources and in combating climate change, preserving landscapes and rural areas and last but not least maintaining the economic vitality of rural areas by promoting jobs in the agricultural, agri-food and other associated sectors [8, 7].

The agricultural sector has always been given increased attention not only because it is the activity of extracting or harvesting products from the soil, but also because it is part of the primary sector of the world economy, but especially because, although it is not the sector that brings the highest incomes, especially its contribution to the GDP of the European Union being very small, in 2020 agriculture contributing only 1.3% to the gross domestic product of the European Union [2], the forecast according to which worldwide, by 2050, world food production needs to be doubled to meet the needs of a growing population with resource-intensive eating habits [10, 11] is a wake-up call.

Given that the common agricultural policy is an extremely integrationist policy, agricultural policies in the Member States of the European

Union are largely replaced by common rules on the functioning of markets and the marketing of products, so all Member States are in line with the terms and conditions imposed by the common agricultural policy, it is necessary to carry out an analysis of the situation of the main technical indicators for three of the most important crops in the European Union, namely maize, wheat and sunflower.

MATERIALS AND METHODS

Starting from one of the definitions of statistics, namely: statistics is the science through which numerical data are collected, classified, presented and interpreted in order to draw conclusions and make decisions [8] and extracting numerical data relevant to the analysis that is wishes to be carried out in the framework of Eurostat (ec.europa.eu/eurostat), the body responsible for statistics at EU level, the area under cultivation, the average production and the total production for maize, wheat and sunflower crops will be interpreted to determine which of the EU Member States dominates the agricultural sector in the case of these three crops.

Statistical data will be interpreted by determining the trend they know, the trend representing the general trend that a series of values knows, highlighting the movement, the evolution of the values of the same data set in a well-established period of time [3].

In order to analyze in depth the statistical data series, they will be interpreted using the standard deviation and the coefficient of variation, as well as by determining the arithmetic mean, the minimum and the maximum. The standard deviation helps us to quantify the spread of numerical data in the interpreted data series. Representing the average square root of the set of deviations of each element of the mean of the set, this indicator determines the measure of the degree of data scattering and is measured in the same unit of measurement as the initial data.

The coefficient of variation is determined by relating the standard deviation of the data series to its arithmetic mean, therefore it allows the comparison of the analyzed statistical data series, from the point of view of the standard deviation. The coefficient of variation is expressed as a percentage, and the lower this indicator, the closer to the values in the series.

RESULTS AND DISCUSSIONS

As we mentioned earlier in the introduction of this paper, after World War II, politicians in many European countries at the time concluded that in order to avoid a new armed conflict, the best solution for the European continent was to do an economic and political union. Based on these discussions in 1950, the French Foreign Minister, Robert Schuman, proposed the inclusion of the coal and steel industries in Western Europe. Following this proposal, in 1951 Belgium, France, Italy, Luxembourg, the Federal Republic of Germany and the Netherlands laid the foundations of the European Coal and Steel Community, known as the ECSC. Six years later, the European Energy Community, or Euratom, and the European Economic Community (EEC) are set up following the signing of the Treaty of Rome, which states that the aim of the Member States was to remove trade and tariff barriers between them and strengthen a common market. The three communities merged in 1967, merging the ECSC, the EEC and Euratom, leading to the establishment of three new institutions, the European Commission, the Council of Ministers and the European Parliament. In 1973, after the failure of the first draft of economic and monetary union in 1970, the 6 states were joined by Denmark, Ireland and the United Kingdom. After 6 years, the European Monetary System (EMS) was consolidated in 1979, introducing fixed but still adjustable exchange rates, of course between EEC Member States. After 2 years, Greece joined the EEC, and then after another 5 years, in 1986, Spain and Portugal also joined. Also in the same year, 1986, the idea of economic and monetary union, originally outlined in the Werner Report in 1970, was relaunched at the same time as the adoption of the Single European Act (EEA), and in 1988, 18 years after the first draft, the European Council confirmed EMU (Economic and Monetary Union), thus setting up a committee of experts, chaired by the President of the European Commission, Jacques Delors, proposing a three-stage transition process, as set out in the Delors Report. One year later, in 1989, negotiations began on the Maastricht Treaty, beginning negotiations on the European Union, thus laying the foundations for the EU and the provisions for the establishment of EMU and the establishment of the European Central Bank. The Maastricht Treaty was signed only in 3 years, in 1992, introducing new forms of cooperation in new areas such as defense, justice and home affairs, laying the foundations for the European Union with the signing of the Treaty. Although signed in 1992, the Treaty did not enter into force until 1 November 1993, after it had been ratified by the 12 Member States. Austria, Finland and Sweden joined the European Union in 1995. In the period 1990-1999, the Monetary Economic Union was achieved in three stages, as established. In 2002, the use of euro coins and banknotes was introduced in 12 EU Member States. In 2004, on 1st of May, the largest wave of accession to the EU is taking place, with Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, the Czech Republic, Slovakia, Slovenia, and Hungary joining the European Union. Later, after 3 years, in 2007, joined also Romania and Bulgaria. The Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community enters into force in 2009. In order to ensure financial stability and improve the European Union's supervisory framework, the European Banking Authority, the European Insurance and Occupational Pensions Authority and the European Real Estate and Markets Authority and the European Seismic Committee are hereby established. In 2013, Croatia joins the European Union. In 2020, a premiere has ocured regarding the membership of a state in the European Union, year in witch a member of the EU has withdrawn from it, United Kingdom marking in this way a very important moment in the history of the European Union making [10][3].

Taking into consideration all of the above, especially the fluctuation of the number of members from the European Union in the laste past years, the analysis that wants to be determinated regarding the main technical indicators for corn, wheat and sunflower crops will be determinated at the level of the member states that have available statistical dates on the Eurostat platform at this point.

Considering the fact that three staple foods that are found in any hosehold from the European Union, respectively flour, cornmeal and sunflower oil come from some of the most widespreaded crops that are wheat, corn and sunflower, this three crops was selected for the analysis in this article.

Corn

According to statistical data provided by Eurostat on the area under corn, for both total and average corn production in 21 Member States within the European Union, there were calculated the minimum and maximum averages, the standard deviation and the coefficient variation of the three technical indicators of maize cultivation.

The area under corn has the lowest value over the reference period in 2020 in Luxembourg and the highest value in Romania in 2004. Judging by the average area under maize calculated for each of the 21 countries analyzed, the highest value of this calculated indicator was determined in Romania, and the minimum values in Sweden and Luxembourg. France is the second classed, with an average of 36% lower than Romania. The third ranked is Hungary, having a average area with 56% less than Romania.

Following the determination of the standard deviation regarding the maize cultivated area, in the first four places are Romania, Italy, Poland and France, in that order, so in the case of these four countries were recorded the most varied values of the area cultivated with corn in the mentioned period.

Yet, the coefficient of variation determined in the case of the area cultivated with corn, shows that in the case of Romania, the values of the area cultivated with corn determine a high degree of homogeneity, therefore the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

values determined during the analyzed period are not very different from the average. The same can be said for Italy and France, and for Poland, where the value of the coefficient of variation reaches almost 40%, we can deduce that the values on which the area under maize in this state during the analyzed period are quite different. The same is true for Luxembourg, Lithuania, Denmark and Sweden, where the value of the coefficient of variation increases from state to state (Table 1).

Table 1. Analysis on the area cultivated with maize, the total production and the average production of maize at the level of 21 member states of the European Union in the period 2002-2020

Country	Cultivated area (thousand hectares)				Total production (thousand tonnes)				Average production (tonnes / ha)			
	Min/ Max	Avg	Std. Dev	C.V.	Min/ Max	Avg	Std. dev.	C.V.	Min/ Max	Avg	Std. dev.	C.V.
Romania	2,094.2/ 3,196.1	2,580.9	261.2	10.1	3,853.9/ 18,663.9	10,668.8	3,650.6	34.2	1,703/ 7,6368	4.1	14.2	34.3
France	1,426.3/ 1,843.5	1,643.5	141.2	8.6	11,839.7/ 18,343.3	14,478.6	1,719.8	11.9	7,1502/ 10,1239	8.8	7.5	8.5
Hungary	939.1/ 1,242.6	1,127.9	96.1	8.5	4,026.7/ 9,315.1	7,326.7	1,563.8	21.3	3,7327/ 8,6301	6.5	15.4	23.6
Poland	262/ 946.1	482.5	190.4	39.5	1,260.7/ 6,694.7	3,012.2	1,389	46.1	4,1609/ 7,3481	6.2	8.8	14.4
Italy	591.2/ 1197	904.7	203.9	22.5	6,048.5/ 11,368	8,441.2	1,623.1	19.2	7,4811/ 11,2682	9.5	9.1	9.6
Bulgaria	214.4/ 581.5	394.2	93.8	23.8	980.1/ 4,059.8	2,174.6	860.8	39.6	2.8/ 7,9225	5.4	13.4	24.7
Germany	398.7/ 526.2	450.8	39.8	8.8	3,220.3/ 5,514.7	4,216.4	655.9	15.6	7,3845/ 10,6838	9.3	9.1	9.7
Spain	315/ 479.9	384.7	52	13.5	3,324.8/ 4,885	4,094	482.3	11.8	9,0408/ 12,2581	10.7	9.3	8.7
Croatia	235.4/ 319	285.1	25.5	8.9	1,279.6/ 2,504.9	1,933.7	357	18.5	4,1993/ 9,1238	6.8	14.5	21.2
Austria	181.2/ 220.7	203.6	11.6	5.7	1,637.9/ 2,453.1	2,076.6	267.9	12.9	8,1173/ 11,3449	10.2	9.4	9.2
Slovakia	140.4/ 221.5	176.1	26.7	15.2	601.4/ 1,814.1	1,145.8	361.9	31.6	3,9675/ 9,2537	6.5	15.8	24.6
Greece	113.5/ 269.1	194.2	52.6	27.1	1,178.1/ 2,820.2	2,042.2	508.5	24.9	9,9543/ 11,6702	10.6	5.1	4.8
Czech Republic	70.6/ 121	94.7	14.6	15.5	442.7/ 1,063.7	708.6	170	24	5,5358/ 9,7882	7.5	12.7	17.0
Portugal	73/ 141.4	103.2	19.7	19	514.4/ 929.5	734.6	113.3	15.4	4,6805/ 9,8043	7.3	15.1	20.7
Belgium	47.4/ 74.2	58.4	8.7	14.9	376.6/ 859.7	632	147.3	23.3	6,9744/ 13,1278	10.8	16.0	14.9
Slovenia	36.4/ 46	40.3	2.9	7.3	224.2/ 429.9	322.3	51	15.8	5,0802/ 10,7914	8.0	14.1	17.5
Lithuania	1.4/20. 2	9.2	5.9	64.1	2.7/ 141.7	56.5	44.8	79.3	1/7,6719	5.1	20.5	40.0
Netherlan ds	8.4/24. 5	17.3	4.8	27.5	84.6/ 252.3	178.7	48.5	27.1	6,4884/ 13,7419	10.5	21.1	20.0
Denmark	0/12.9	4.9	4.8	98.2	0/75.7	30.3	28.9	95.5	0/7,6842	3.7	33.1	90.0
Sweden	0/1.9	0.2	0.6	243	0/12.5	1.5	3.8	255. 6	0/6,9753	0.9	22.9	243.7
Louxembu rg	0.1/0.5	0.2	0.1	46.3	0.5/3.6	1.8	0.9	49.4	4,7143/ 10,8	7.2	15.6	21.7

Source: Eurostat [5], Accessing and processing data in March 2022.

In the case of total corn production, the ranking of the first three ranked states is similar to that of the area cultivated with maize, except that, in this case, Romania reaches the second position, being overtaken by France, while the third position is occupied by Italy, in terms of the calculated average, Hungary ranks fourth in this ranking. With the highest value of total maize production during the analyzed period, determined in 2014, France has an average higher by 26.31% than that of Romania, by 49.39% higher than that of Hungary and with almost 100% higher than the last-ranked state, Sweden. In the case of Romania, the most diversified values of the total maize production were registered. However, given that it has one of the highest total maize production during the period

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

considered, this maximum value of the standard deviation is not extremely surprising, but on the other hand it should not be neglected. Regarding the average maize production, the classification is extremely different from that found for maize and total maize production. Regarding the average maize production carried out during the analyzed period, Belgium, Spain and Greece are in the first places, while Romania is only on the 19th position, the average determined in Romania representing 38% of the average determined in Belgium, France in 8th place, with an average of almost 82% of the Belgian average, and Hungary in 14th place, with an average of almost 61% of the Belgian average.

The coefficient of variation is situated below 30% in 18 states, in of 10 of those the indicator is under 10%, more than that, in case of 6 countries the value determinated is below 10%. Even thow Romania has a great spot in the ranking regarding the production of maize, in this situation records the most varied values, the average maize production of this country fluctuating the most during the 19 years analyzed.

Wheat

As far as wheat cultivation is concerned, its analysis will be carried out in 27 Member States of the European Union over 19 years, respectively in the period 2002-2020. In the case of wheat, the first four countries are France, Germany, Poland and Romania, and the last three are Cyprus, Luxembourg and Malta. Registering the highest value in 2016 in France and the lowest values during the period analyzed in Malta, about the average area cultivated with wheat we can say that the highest average value of this indicator was recorded in France, Germany having an average of the cultivated area with wheat is almost 41% lower than that of France, Poland by 56%, and Romania by 60%.

Even thow the first four countries ranked are registering also the heightest values of the standard deviation, the coefficient of variation determinated in the case of the four help us conclude that the values of the average area cultivated with wheat it dosen’t register major changes during the 19 years analyzed.

The same conclusion is valid also for a major part from the others contries analized, in which cases, the coefficient of variation is registering values below 30% , it can be said that the values that the area cultivated with wheat has had over time are quite close. The non-compliant countries are Lithuania and Latvia, where the coefficient of variation slightly exceeds the 30% threshold, Malta, the country where the exposed indicator reaches 46%, and last but not least Portugal, the country where the coefficient The rate of change is almost 77%, so Portugal is the country in whose territory the most varied values of the area under wheat have been recorded over the 19 years referred to.

In the case of total wheat production, the highest value recorded during the analyzed period was in France in 2015, and the lowest values are also, as in the case of the area on the territory of Malta, during the whole period analyzed. The highest averages of wheat production were recorded in France, Germany, Poland and Italy, and the lowest averages in the same three countries as in the case of the area cultivated with wheat, meaning Luxembourg, Cyprus and Maltta.

In the majority of states, the determinated values of the coefficient of variation are below 30%, Belgium beeing the state where this indicator has the lowes value, but in 7 of the states the coefficent of variation exceeds the threshold of 30%, even more than that, in 3 of the 7 contries, namely Estonia, Latvia and Cyprus, the indicator is recording a value over 50% and in the case of 2 of the 7, Malta and Portugal, the coefficient of variation is over 70%.

Even if, in the case of the surface cultivated with wheat and the total production of wheat, the ranking was similar, in the case of the average production, an indicator determined on the basis of the area cultivated and the total production obtained, the situation is slightly different. During the analyzed period, the first three are in this case Ireland, Belgium and the Netherlands, France is in seventh place, Germany is in fourth place, Poland is in 17th place, Italy is in 21st place and Romania is only 24th. three positions are Greece, Portugal and Cyprus. It is not enough for a state to have a large area cultivated with wheat, or for the total wheat production determined at the state level to be the highest, because in terms of average production, other factors come into play, such as This indicator can be seen by comparing this indicator with the rest of the indicators analyzed in terms of wheat cultivation, factors including pedo-climatic conditions, irrigation systems that a state has and last but not least, the concern that Member States' governments have in as far as this agricultural sector is concerned, even if, being states of the European Union, all 27 countries have to follow the regulations of the Common Agricultural Policy (Table 2).

Table 2. Analysis on the cultivated area with wheat, the total production and the average production of wheat at the level of 27 member states of the European Union in the period 2002-2020

Country	Cultivated area (thousand hectares)				Total production (thousand tonnes)				Average production (tonnes / ha)			
	Min/ Max	Avg	Std. Dev.	C.V.	Min/ Max	Avg	Std. Dev.	C.V.	Min/ Max	Avg	Std. Dev.	C.V.
France	4,512.4/ 5,542.2	5,254.7	231.5	4.4	29,316.3 /42,750	36,740.4	3,695.8	10.1	5.3/7.8	7	0.6	8.7
Germany	2,835.5/ 3,297.7	3,128.3	121	3.9	19,259.8/ 27,784.7	23,495.1	2,265	9.6	6.5/8.6	7.5	0.6	7.5
Poland	2,077.2/ 2,511.3	2,292.3	121.9	5.3	7,059.7/ 12,433.2	9,740.3	1,376.1	14.1	3.2/5.2	4.2	0.5	11.6
Romania	1,410.9/ 2,448.1	2,080.4	204	9.8	2,479.1/ 10,297.1	6,829.1	2,187.7	32	1.6/4.9	3.3	1	29.5
Spain	1,772.8/ 2,406.6	2,075	165.9	8	4,026.7/ 8,322.5	6,397.7	1,173.8	18.3	1.8/4.3	3.1	0.6	19.1
Italy	1,711.2/ 2,415.5	1,967.3	220.6	11.2	6,229.5/ 8,855.4	7,286	681.1	9.3	2.7/4.2	3.7	0.3	9
Bulgaria	841/ 1,368.6	1,150.5	120.2	10.4	2,003.9/ 6,319.6	4,508.3	1,192.7	26.5	2.2/5.4	3.9	0.9	22.5
Hungary	936.6/ 1,173.8	1,066.7	66	6.2	2,941.2/ 6,006.8	4,762.2	806.4	16.9	2.6/5.5	4.5	0.8	18.1
Lithuania	335.1/ 895.8	587.4	215.1	36.6	809.8/ 4,818.8	2,504.1	1,228.5	49.1	2.4/5.4	4.1	0.7	17.6
Czech Republic	648.4/ 863.2	818.1	45.9	5.6	2,637.9/ 5,454.7	4,444.4	729.2	16.4	4.1/6.5	5.4	0.7	13.5
Denmark	425.8/ 763.6	631.3	84.3	13.4	2,623.9/ 5,940.4	4,621	658	14.2	6.2/8.2	7.3	0.6	8.5
Latvia	153.5/ 498.2	324.4	118.7	36.6	468.4/ 2,659.6	1,309.5	697.6	53.3	2.8/5.3	3.8	0.8	20
Sweden	323.3/ 472	399.7	47.3	11.8	1,620.3/ 3,476.8	2,478.5	546.6	22.1	4.3/7.4	6.2	0.8	12.4
Slovakia	306.9/ 416.6	374.8	25.5	6.8	930.4/ 2,434.2	1,688.1	370.5	21.9	3/5.8	4.5	0.8	17.8
Greece	350.5/ 870	652.5	172	26.4	979.2/ 2,139.5	1,684.9	358.3	21.3	2/3.1	2.6	0.3	10.4
Austria	272/ 315.1	295	11.5	3.9	1,191.4/ 1,970.4	1,554.4	198.5	12.8	4.1/6.3	5.3	0.6	11.4
Finland	174.5/ 267.4	212.9	24.2	11.4	501.6/ 1,088.2	802.7	144.1	18	2.8/4.6	3.8	0.4	10.5
Belgium	191.2/ 217.1	204	7.1	3.5	1,400.1/ 2,019.3	1,768.1	153.4	8.7	6.8/10	8.7	0.7	7.9
Estonia	64.5/ 169.8	123.8	36.5	29.5	144.9/ 846.6	437.8	227.5	52	2.2/5.1	3.3	0.9	27
Croatia	118.4/ 204.5	161	20.4	12.6	506.2/ 999.7	794.4	132.1	16.6	3.2/5.9	5	0.7	14.3
Netherlands	108.9/ 156.5	137.1	14.7	10.7	931.8/ 1,402	1,180.9	147	12.4	7.3/9.4	8.6	0.6	6.5
Ireland	47/ 110.7	80.7	18.1	22.4	364.9/ 1,019.2	722.1	164.4	22.8	7.2/10.7	9	0.9	10
Portugal	27/ 230.7	78.1	59.9	76.7	51/413	129.5	95.3	73.6	0.7/2.8	1.9	0.6	32.9
Slovenia	26.7/ 35.7	31.6	2.8	9	121.9/ 188.1	149.4	17.7	11.9	3.5/5.8	4.7	0.6	12.1
Cyprus	5/12.5	7.9	2.4	30	2.5/35.4	15.9	9.2	57.9	0.5/3	1.9	0.7	37.2
Luxembourg	11.2/ 14.7	13.1	1.1	8	68.6/ 97.8	79.4	8.3	10.5	5.1/6.8	6	0.4	7
Malta	0/3	2.1	1	46.1	0/14.5	8.2	5.8	71.1	1/5	4.1	1.4	34.8

Source: Eurostat [5], Accessing and processing data in March 2022.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The coefficient of variation determined in the case of average wheat production does not exceed the threshold of 30% except in the case of Portugal, Malta and Cyprus, but also in their case does not exceed 40%, therefore we can say that in terms of average wheat production at the level of the 27 states analyzed, over the 19 years taken into account, the determined values do not show significant differences, a conclusion that can be strengthened after analyzing the values of the determined standard deviation, sufficiently small values that indicate that the degree of spread of the values around the determined average is very small (Table 2).

Sunflower

As regards sunflower cultivation, the analysis will be carried out over the same period as in the case of maize and wheat, respectively the years 2002-2020, but this time only 16 Member States of the European Union will be analyzed, the only ones for which data were available on Eurostat.

Regarding the area cultivated with sunflower, as well as the total production of sunflower, we can easily say that in the first place in the case of these categories is Romania, the country in which the maximum area cultivated with sunflower was recorded in 2019, as well as the maximum total sunflower production in the same year. The next ranked, regarding the area cultivated with sunflower are Bulgaria, whose average productions during the analyzed period represent 75% of the surface of Romania, on the third place is Spain, whose average represents 74% of the average calculated in Romania, and on the fourth position is France, a country whose average represents 66% of the average calculated in Romania. Given that data from Eurostat have shown that there is not enough data in Ireland to make a proper comparison, we conclude that the latest states in the ranking of the area cultivated with sunflower in the European Union are Poland and Slovenia, with incomparably lower averages than the first ranked. The coefficient of variation in the case of the area cultivated with sunflower in the case of the first ranked indicates that the data analyzed during the reference period did not change considerably, therefore the area cultivated with sunflower did not change significantly in the 19 years analyze, which is true for most states in the first half of the rankings. Higher values of the coefficient of variation were determined in the countries in which the area cultivated with sunflower were smaller. As it was mentioned earlier, Romania is the country in which case it was determinated the hightest value of the sunflower production, followed as the second ranked by France, whose average is with 20% lower than Romania’s average, then the third ranked is Bulgaria, with an average with 24% smaller than Romania, and on the fourth position is Hungary whose average is 28% lower than Romania’s. In this case, too, disregarding Ireland, as there is insufficient data to compare in this case, the last countries ranked in terms of average total sunflower production over the 19 years analyzed are Poland and Slovenia. Taking into consideration that in this case, the coefficient of variation reaches very high values, almost half from the analyzed countries have determinated coefficient of variation that exeeds 30%, so in the case of this states there is a rather large difference between the anual values, and also the fact that regarding the coefficient of variation determinated for the total production of sunflower the countries that have the largest production of sunflower are also the ones that have a huge coefficient of variation, we can say that the total production of sunflower is the one who has the most fluctuating values from the three cultures analyzed.

France is that one contry in case of which the coefficient of variation determinated is the lowest from the 16 states examed, so in case of France the values of the sunflower production recorded over the 19 years analized are the most similar, beeing the most stable, fact that is not aplicable for Romania in wich case the coefficient of variation is extremly high and also fo Bulgaria and Hungary whose coefficient of variation is a little bit lower than Romania’s.

We saw that the classification of the average production of wheat an maize is very different regarding the first positions, from the classification of the cultivated area and the total prodution and a similar thing is hapening also in the case of the sunflower culture. As far as it goes the average sunflower production, the highest value was recorded in Austria in 2016, Austria whose average area under sunflower is 2.5% of the Romanian average and was ranked in the ranking of area under sunflower on the 12th position, and whose average total production represents 3.6% of the average total production of the first ranked, Romania, being in the ranking on the total production of sunflower on the tenth position.

Table 3. Analysis of the area cultivated with sunflower, the total production and the average production of sunflower at the level of 16 member states of the European Union in the period 2002-2020

Country	Suprafața cultivată (mii hectare)				Total production (thousand tonnes)				Average production (tonnes / ha)			
	Min/ Max	Avg	Std. Dev.	C.V.	Min/ Max	Avg	Std. Dev.	C.V.	Min/ Max	Avg	Std. Dev.	C.V.
Romania	748.5/ 1,282.7	981.1	144.4	14.7	546.9/ 3,569.2	1,794.3	760.8	42.4	0.7/3	1.8	0.6	33.7
Bulgaria	471/ 898.8	739.5	109.8	14.8	564.4/ 2,057	1,443.2	480	33.3	0.9/2.5	1.9	0.4	22.6
France	519.5/ 778.4	648	74.2	11.5	1,172.4/ 1,880.7	1,495.1	185.2	12.4	1.9/2.7	2.3	0.2	8.6
Spain	516.2/ 862.9	725.5	87.5	12.1	381.3/ 1,090.2	815.5	156	19.1	0.7/1.4	1.1	0.2	14.7
Hungary	418/ 694.5	561.5	64.9	11.6	776.9/ 2,022.3	1,392.7	343	24.6	1.9/3	2.5	0.4	15.5
Italy	100.5/ 167.1	122.9	16.4	13.3	185.5/ 351	268.1	36.3	13.6	1.6/2.5	2.2	0.2	10.6
Greece	4.7/ 100.7	50.1	35.6	71.1	7.6/299	120.4	96.6	80.2	1.4/3	2.1	0.5	21.7
Slovakia	48.6/ 131	81.4	18.7	23	116.9/ 252.7	187.2	38.6	20.6	1.8/3	2.3	0.3	14.2
Croatia	20.6/ 49.8	33.9	6.7	19.9	54.3/ 130.6	91.7	22.6	24.7	1.6/3.2	2.7	0.4	14.6
Germany	16.7/ 37.2	24.5	5.4	22.1	35.3/73	51.9	11.5	22.1	1.8/2.7	2.1	0.2	10.6
Austria	18.2/ 34.6	24.4	4.1	16.8	38.1/ 84.6	64.1	12.1	18.9	2/3.3	2.6	0.3	12
Czech Republic	11.3/ 48.7	25.8	10.8	42	28.8/ 114.5	59.6	24	40.2	2/2.9	2.3	0.2	8.3
Poland	0.6/7.4	2.9	1.7	56.8	0.8/14.9	5.1	3.1	61.4	1.2/2	1.7	0.2	11.2
Portugal	6.4/ 37.6	18.1	9.1	50.5	2.4/26.2	14.1	6.4	45.1	0.3/1.7	0.9	0.5	52.1
Slovenia	0/0.4	0.2	0.1	47.1	0/1	0.5	0.3	61.9	1.1/2.9	2	0.5	26.8
Ireland	0/0	0	0	299.5	0/0.2	0	0	435.9	0/1.6	0.1	0.4	435.9

Source: Eurostat [5], Accessing and processing data in March 2022.

However, the highest average average sunflower production over the analyzed period was determined in the case of Croatia, which ranked ninth in the ranking of the analyzed Member States for the area cultivated with sunflower, the average cultivated area with the sunflower of this state representing 3.5% of the Romanian average and on the same position in the ranking based on the total sunflower production obtained, the average of the total sunflower production of Croatia representing almost 3% of the average total production of sunflower determined in Romania. Croatia is followed in this ranking by Austria in second place and Hungary in third. With the exception of two countries, without taking Ireland into account, the coefficient of variation determined did not exceed 30%, so it can be concluded that in most of the countries analyzed, the average values of sunflower production are quite stable, without significant differences were recorded over the years analyzed, a conclusion reinforced by the fact that the value of the coefficient of variation determined in 9 of the 14 states analyzed was below 15%.

CONCLUSIONS

After analyzing the main technical indicators of wheat, corn and sunflower crops, we can conclude that the size of the cultivated area and the total production obtained at the level of a state are not enough for it to be considered one of the giants of European agriculture. This conclusion is due to the fact that in the case of each of the three crops analyzed, the first three or four Member States ranked in terms of average total area or total production were almost never the first Member States ranked in terms of average of the average production obtained. Starting from the definition of average production, referred to in the statistical field as yield, this indicator representing the quantity of product obtained per unit of cultivated area [1], it is easy to understand that the states that occupy the first places in the ranking for cultivated area, such as were determined in the case of maize: Romania, France, Hungary, Italy, in the case of wheat: France, Germany, Poland, Romania and in the case of sunflower: Romania, Bulgaria, Spain, France, or the Member States which occupied the first place in the ranking in terms of total production obtained at state level, as determined for maize cultivation: France, Romania, Italy, Hungary, for wheat cultivation: France, Germany, Poland, Italy and for sunflower crops: Romania, France, Bulgaria, Hungary, can not be called the main dominators of the corn, wheat and sunflower crops sector, because the best yield ie the countries in which the highest average production values were determined were, in most other cases, in the case of maize: Belgium, Spain and Greece, in the case of wheat: Italy, Belgium and the Netherlands. , and in the case of sunflower cultivation: Croatia, Austria and Hungary. However, the interpretation remains debatable, because both aspects are of major importance, not being able to compare a state that benefits from a much larger area on which the three crops are cultivated and for which the total production will automatically be higher, with a state that has a smaller crop area, therefore a smaller yield, but whose average yield, so yield is much higher.

Although, as we mentioned throughout the paper, the European Union's Common Agricultural Policy obliges all Member States to comply equally with the terms and conditions imposed by this policy, there are differences that lead to questions about the most important countries of the european agriculture. Certainly, this discrepancy between the fundamental states, analyzing from the point of view of the three technical indices of the crops in question, comes from the differences of pedo-climatic conditions specific to each state, the way in which they are kept under control by implementing soil erosion measures, the need for irrigation or cooperation, existing there by 2020 (the last year in question) a large number of Member States in which farms in subsistence or semi-subsistence categories dominated.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the sectoral project ADER 23.1.1: “Technical-economic basis of production costs and estimates regarding the prices of capitalization of the main plant and animal products, obtained in conventional system and in organic farming” Subcontract no: 23.1.1./2-03.10.2019 contracted with the Ministry of Agriculture and Rural Development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE DEVELOPMENT OF APRICOT PRODUCTION AND FOREIGN TRADE IN THE WORLD AND IN TURKEY

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Abstract

In this study, the apricot market situation in the world and Turkey was examined. The study used the 1980-2020 period data of FAOSTAT and TURKSTAT institutions. It was determined that apricot production in the world and Turkey increased due to the enlargement of the planted areas in the examined period. Turkey, Uzbekistan, Italy, Algeria, and Iran have the highest apricot production. Turkey ranked first for apricot production and planting areas, and apricot yield was below the world average of 7,942 kg per hectare. Spain, Turkey, France, and Italy are the countries that export the freshest apricots. Of the 406 thousand tons of apricot exports globally, 54.84 percent belong to Spain, 21.69% to Greece, and 6.45% to Turkey. In the export of dried apricots, Turkey ranks first with a share of 67.6%. The essential dried apricot importing countries are the USA, Russia, England, and Kazakhstan. The important countries to which Turkey exports fresh apricots are Iraq (49.6%), the Russian Federation (29.8%), and Syria (5.2%). The important countries to which Turkey exports dried apricots are the USA (11.1%), France (7.7%), and Germany (7.4%). In the periods discussed, Turkey's apricot planted area increased by 185%, 368% in production, and a 64% increase in yield. Accordingly, the expansion in planted areas affected the production increase more. Apricot production in Turkey is concentrated in Malatya, Mersin, Elazığ, Iğdır, and Isparta provinces. Most of the apricots produced in Malatya are offered for consumption in dried form. As a result, world apricot production increased with significant improvements in planted area and yield. In Turkey, this situation mostly affected output because of the developments in the planted areas. The yield level of apricots, whose fruit and seeds are used in many fields such as food, medicine, and cosmetics in Turkey, should be brought to the average world level and prevent fluctuations in prices.

Key words: *apricot, production, foreign trade, Turkey, world*

INTRODUCTION

Although apricot is from the Rosacea family, it is called Prunus armeniaca L. (*Armeniaca vulgaris* Lam.). It is native to China and a fruit variety that can be grown in many countries and adapt to different climate types [2].

Apricots, offered for consumption in various forms such as dried, frozen, and canned by the industry sector, in terms of mineral substances, vitamins, and fiber content, are very important for a balanced and healthy diet for individuals [12].

Apricot cultivation is widely practiced in Afghanistan, Iran, Chile, Argentina, the USA, Australia and countries with Mediterranean coasts. Worldwide, 2/3 of the production is carried out in the Mediterranean Region [8]. Apricot, a fruit of temperate climate types, is a fruit variety that can be produced in a wide area by adapting to the climate types of different regions such as Central Asia, Russia, China, and Africa. It has a wide variety of varieties due to its ability to be grown from seed in different regions [6].

The most incurred cost elements for apricot production are spraying, irrigation, harvesting, and pruning. While the early variety of apricot cultivation positively affects the producer's income, the low yield due to adverse weather conditions directs the producers to reduce the cost elements to be incurred for the next production year [4].

Turkey has an important position in world apricot production and export. It ranks first in the world in production and export [9, 1]. Various economic studies have been carried out on apricots in Turkey. Such as [3] determined economic analyses of apricot in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Mersin. [5] examined the socio-economic characteristics of farms producing apricots in the province of İçel. [11] investigated the effect of using agricultural credits on the socio-economic indicators of apricot farmers in the Mut district of Mersin province. [13] reported that a significant part of the apricots produced in the district of Mut was evaluated in the domestic market and was mostly consumed fresh.

This study evaluated the development of apricot production, prices, and the import-export situation in Turkey and the world.

MATERIALS AND METHODS

The primary sources of this study was the data published by the Turkish Statistical Institute (TUIK) and the Food and Agriculture Organization (FAO). In addition, the data from a national and international thesis, articles, and reports about apricots were used. In this context, apricot planting areas, yields, production, and import-export data for 1980–2020 in essential countries for apricot production and data on provinces in Turkey were evaluated. Simple index and percentage values were calculated for apricot production areas, quantities, and foreign trade data in the world and Turkey. The current prices of the products in question were converted to real values using the Producer Price Index (PPI; 2003=100) calculated by TURKSTAT[17].

RESULTS AND DISCUSSIONS

Apricots are produced in 78 countries around the world. In 1980, there was 1.73 million tons of apricot production globally, and in 2020, it doubled and increased to 3.72 million tons. The most important apricot producing countries were Turkey, Uzbekistan, Iran, Algeria, Italy, Afghanistan, and Spain. Turkey ranked first with 833,398 tons of apricot production, Uzbekistan was second with 529,109 tons, and Iran was third with 334,408 tons (Table 1).

Table 1. Production amount in major apricot producing countries (tons)

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Turkey	160,000	202,000	300,000	250,000	530,000	860,000	450,000	650,000	760,000
Uzbekistan	-	-	-	55,000	68,000	170,000	325,000	384,079	426,000
Iran	55,000	100,823	85,474	208,299	249,700	275,578	388,049	345,801	309,908
Algeria	23,285	42,408	34,979	41,233	56,354	145,097	198,467	285,897	269,308
Italy	96,100	195,600	184,710	104,685	201,372	232,882	252,892	263,132	247,146
Afghanistan	47,500	40,700	36,030	37,500	42,840	49,623	66,560	67,995	83,500
Spain	113,800	150,664	119,600	138,700	142,498	137,167	78,715	86,880	118,114
Greece	96,000	131,329	113,211	42,810	83,634	73,613	62,705	66,790	79,457
Pakistan	35,768	53,800	81,000	190,634	125,889	197,239	190,174	189,420	178,489
Morocco	63,000	73,000	73,700	78,000	119,600	103,600	134,933	159,124	122,405
Other	1,044,103	1,038,561	1,160,406	941,846	1,243,123	1,381,168	1,155,947	1,312,877	1,267,440
World	1,734,556	2,028,885	2,189,110	2,088,707	2,863,010	3,625,967	3,303,442	3,811,995	3,861,767
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	Index (1980=100)
Turkey	780,000	278,210	696,100	730,000	985,000	750,000	846,606	833,398	520.87
Uzbekistan	480,000	547,000	606,000	569,000	532,565	493,842	536,544	529,109	962.02
Iran	380,032	241,569	252,000	239,712	330,553	314,012	329,638	334,408	608.01
Algeria	319,784	216,941	293,486	256,771	256,890	242,243	209,204	187,273	804.26
Italy	198,290	222,690	217,569	237,021	266,372	229,020	272,990	173,380	180.42
Afghanistan	90,000	90,000	87,686	17,894	131,816	109,086	129,363	131,788	115.81
Spain	131,800	136,446	153,667	139,605	162,872	176,290	145,830	128,700	113.09
Greece	74,718	90,038	94,799	94,630	113,782	108,600	118,340	125,640	130.88
Pakistan	177,630	170,504	172,933	165,918	141,721	107,986	94,410	97,045	271.32
Morocco	100,698	90,274	103,955	71,156	112,538	101,612	109,795	93,008	147.63
Other	1,356,800	1,257,336	1,274,292	1,679,659	1,756,741	1,258,047	1,250,162	1,086,225	104.03
World	4,089,752	3,341,008	3,952,487	4,201,366	4,790,850	3,890,738	4,042,882	3,719,974	214.46

Source: [7].

From 1980 to 2020, the country that increased its production the most (about ten times) was Uzbekistan. Algeria increased its production eight times, followed by Iran, which increased its production six times, Turkey five times, and other countries that have also increased their production (Table 1).

Turkey constituted approximately 22.40% of the world's apricot production in 2020. Uzbekistan followed Turkey with 14.22%, Iran with 8.99%, Algeria with 5.03%, Italy with 4.66%, and Spain with 3.46% (Figure 1).

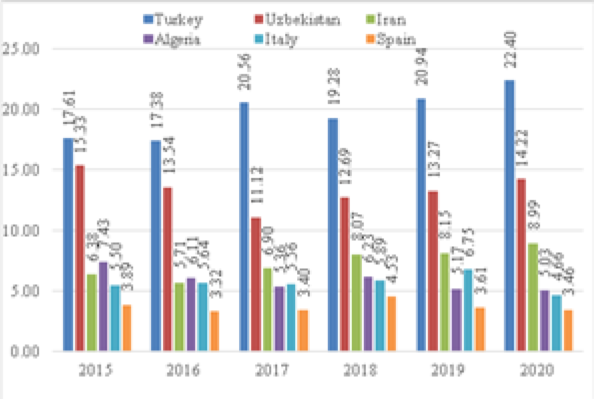

Fig. 1. Shares of major apricot producing countries in total production (%)
Source: Our calculation from FAOSTAT data [7].

While the total apricot planting area was 294,057 hectares in 1980, the total planting area increased by almost two times and reached 562,475 hectares in 2020. The countries with the highest apricot planting areas were Turkey, Iran, Uzbekistan, Algeria, Spain, and Italy (Table 2).

When the world apricot planting areas were analysed on a country basis, in the 2020 period compared to the 1980 period; the planted areas expanded in Pakistan five times, China four times, Iran five times, Algeria and Uzbekistan about four times, and Turkey three times. In addition, apricot planting areas decreased by 19% in Japan, 7% in the Russian Federation and 6% in France (Table 2).

In the 1980-2020 period, the world apricot planting area and production increased in general. Between 1980 and 2020, the highest apricot production was experienced in 2017, with 4,790,850 tons of apricot production from 558,352 hectares (Figure 2).

Table 2. Apricot planted areas (ha) in important countries

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Turkey	44,075	47,250	49,595	70,805	89,800	92,700	108,053	112,079	114,052
Iran	14,000	16,504	11,877	26,045	28,692	40,794	81,290	40,567	35,461
Uzbekistan				12,000	17,000	24,000	35,500	39,286	41,804
Algeria	7,700	13,000	14,010	13,040	13,390	22,888	49,495	49,191	47,376
Spain	19,300	20,000	22,800	22,500	23,487	19,249	18,333	18,729	18,542
Italy	13,000	14,470	14,042	14,187	15,340	17,318	19,543	19,595	19,186
China				4,000	7,000	11,000	15,250	15,315	16,131
Afghanistan	6,820	5,750	5,115	5,150	5,754	7,223	8,320	8,320	8,350
Pakistan	3,218	4,900	6,400	11,596	12,909	28,884	29,648	29,634	27,536
Japan					17,400	17,800	16,900	16,600	16,400
Syrian Arab Rep.	12,732	10,100	10,100	11,216	12,420	13,330	13,700	13,746	13,801
Greece	6,300	7,425	6,370	4,669	5,427	5,697	5,802	6,144	6,259
France	13,000	12,692	13,759	15,704	14,992	14,160	13,797	13,269	12,743
Russian Fed.				16,000	18,000	19,000	11,000	11,000	11,000
Other	153,912	161,933	162,463	173,317	153,923	146,565	137,808	142,401	143,331
World	294,057	314,024	316,531	400,229	435,534	480,608	564,439	535,876	531,972
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100)**
Turkey	115,613	117,907	123,176	123,805	125,049	125,756	131,178	132,748	301.19
Iran	53,205	53,624	54,500	42,313	54,640	52,879	56,575	58,515	417.96
Uzbekistan	44,616	49,153	52,258	47,432	41,711	38,694	43,464	44,262	368.85
Algeria	46,893	38,590	38,857	38,239	44,307	32,578	30,861	29,719	385.96
Spain	20,300	18,451	18,822	20,353	21,002	20,570	20,240	19,780	102.49
Italy	18,999	19,093	18,718	17,370	17,363	17,810	17,910	17,810	137.00
China	16,825	17,442	17,953	17,407	17,601	17,654	17,554	17,603	440.08
Afghanistan	9,005	9,005	9,116	8,595	18,067	18,510	17,719	17,481	256.32
Pakistan	28,578	26,950	25,746	24,940	22,715	18,629	16,177	17,062	530.21
Japan	16,200	16,200	15,900	15,600	15,100	14,800	14,500	14,100	81.03
Syrian Arab Rep.	13,780	13,783	13,752	13,502	13,655	13,707	13,438	13,984	109.83
Greece	6,518	7,022	7,314	7,760	7,992	7,940	8,350	12,240	194.29
France	12,176	12,207	12,014	12,177	12,197	12,270	12,280	12,190	93.77
Russian Fed.	11,000	11,400	11,300	11,110	9,321	11,326	11,639	11,923	74.52
Other	143,461	142,774	142,410	139,345	137,632	140,279	141,311	143,058	92.95
World	557,169	553,601	561,836	539,948	558,352	543,402	553,196	562,475	191.28

Source: [7].

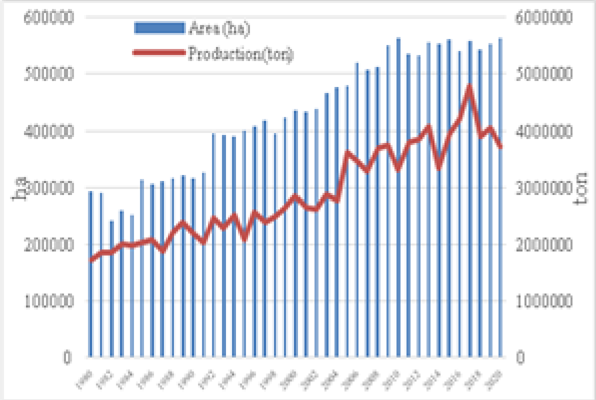

Fig. 2. Shares of major apricot producing countries in total production (%)
Source: [7].

Turkey constitutes approximately 24% of the world's apricot planting areas in 2020. Iran followed Turkey with 10%, Uzbekistan with approximately 8%, Algeria with 5%, and Italy and Spain with 3% (Figure 3).

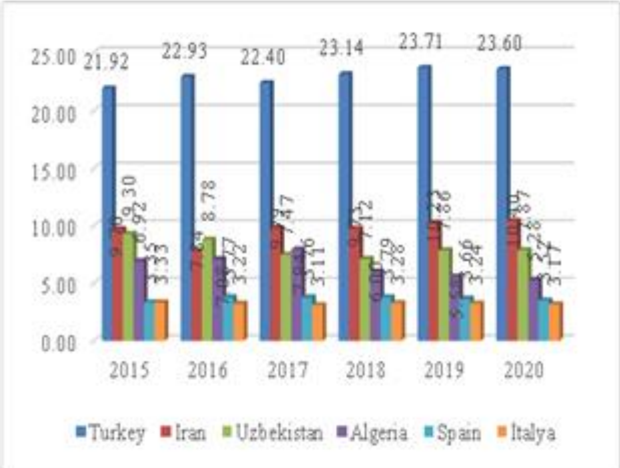

Fig. 3. Shares of important apricot producing countries in the world planted area (%)
Source: Our calculation from FAOSTAT data [7].

In the analysed period, the world average apricot yield per hectare in 1980 was 5,898 kg per hectare, and the country with the highest yield was Greece, with 15,238 kg per hectare, followed by Pakistan, with a yield of 11,150 kg per hectare, and Egypt, with a yield of 8,614 kg per hectare.
Turkey's yield was 3,630 kg per hectare. It was observed that there were fluctuations in apricot yield depending on natural conditions.
The world average apricot yield per hectare in 2020 was 6,613 kg per hectare.
Egypt ranked first with a yield of 16,545 kg per hectare, Albania ranked second with 14,864 kg, and Jordan ranked third with 14,483 kg per hectare.
Romania, Turkmenistan, Uzbekistan, Argentina, Switzerland, and Greece were the other essential countries producing yields above the world average.
Turkey's yield was 6,278 kg per hectare (Table 3).
In the period under consideration, Albania's apricot yield experienced an increase of 8 times, Turkmenistan 4 times, Jordan 4 times, Uzbekistan about three times, and Turkey twice.
There was a 72.94% increase in apricot yield in Turkey and 12% in the world in 2020 compared to the 1980 period.
Apricot yields in Turkey increased in the examined period in general.
It happened in countries that experienced increased productivity and countries that experienced a decrease in productivity.
Greece experienced a decrease in yield by 33% and Switzerland by 24% (Table 3).
In the lead position in the apricot planting area, Turkey did not reach the desired yield level by remaining below the world average yield.
This situation did not change in 2020, and Turkey, which ranks first in production, remained below the average with a 6,278 kg per hectare yield.
The highest apricot yield in Turkey, which is above the world average yield, was experienced in 2005 at 9,277 kg (Figure 4).

Fig. 4. World and Turkey apricot yield development (hg per hectares)
Source: [7].

Table 3. Apricot yield per hectare in the world (kg/ha)

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Egypt	8,661	10,952	14,271	18,250	12,624	9,733	14,854	15,470	16,121
Albania		1,887	4,381	1,813	2,018	5,000	12,668	13,000	14,718
Jordan	4,057	1,800	3,145	7,948	5,837	8,524	7,568	8,685	8,841
Romania		5,313	6,076	2,361	6,469	12,626	9,092	13,249	11,631
Turkmenistan				3,333	11,333	10,370	12,885	12,885	12,885
Uzbekistan				4,583	4,000	7,083	9,155	9,765	10,190
Argentina	4,828	6,094	5,536	5,692	11,034	11,064	11,027	11,099	11,166
Switzerland		142,857	92,453	85,305	133,430	85,731	118,868	140,269	126,340
Greece	15,238	17,687	17,773	9,169	15,411	12,921	10,808	10,871	12,695
Italy	7,392	13,518	13,154	7,379	13,127	13,447	12,940	13,429	12,882
Morocco		5,935	5,459	5,693	8,591	8,633	11,020	12,725	10,013
Afghanistan	6,965	7,078	7,044	7,282	7,445	6,870	8,000	8,173	10,000
Spain	5,896	7,533	5,246	6,164	6,067	7,126	4,294	4,639	6,370
Algeria	3,024	3,262	2,497	3,162	4,209	6,339	4,009	5,812	5,684
Turkey	3,630	4,275	6,049	3,531	5,902	9,277	4,165	5,799	6,664
Iran	3,929	6,109	7,197	7,998	8,7028	6,755	4,773	8,524	8,739
Pakistan	11,115	10,979	12,656	16,439	9,752	6,829	6,414	6,392	6,482
World	5,899	6,461	6,9160	5,219	6,574	7,545	5,853	7,114	7,259
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100)**
Egypt	14,600	15,467	15,675	15,597	15,804	16,524	16,999	16,546	191
Albania	13,968	12,938	15,241	15,932	15,460	15,249	14,296	14,864	788
Jordan	8,918	8,856	11,685	12,467	12,289	13,789	16,799	14,483	357
Romania	9,982	14,614	11,827	13,992	16,043	17,477	14,422	13,187	248
Turkmenistan	12,885	12,885	12,904	12,904	12,904	12,933	13,260	13,176	395
Uzbekistan	10,759	11,129	11,596	11,996	12,768	12,763	12,345	11,954	261
Argentina	11,234	11,311	11,414	11,502	11,484	11,443	11,482	11,510	238
Switzerland	11,959	15,001	11,797	12,834	6,413	12,710	12,169	10,904	76
Greece	11,463	12,822	12,961	12,195	14,237	13,678	14,173	10,265	67
Italy	10,437	11,663	11,624	13,645	15,341	12,859	15,242	9,735	132
Morocco	8,188	7,304	8,366	5,489	9,855	9,111	9,916	8,779	148
Afghanistan	9,995	9,994	9,619	2,082	7,296	5,893	7,301	7,539	108
Spain	6,492	7,395	8,164	6,859	7,755	8,570	7,205	6,507	110
Algeria	6,819	5,622	7,553	6,715	5,798	7,436	6,779	6,302	208
Turkey	6,747	2,360	5,651	5,897	7,877	5,964	6,454	6,278	173
Iran	7,143	4,505	4,624	5,665	6,050	5,938	5,827	5,715	145
Pakistan	6,216	6,327	6,717	6,653	6,239	5,797	5,836	5,687	51
World	7,340	6,035	7,035	7,781	8,580	7,160	7,308	6,614	112

Source: [7].

World Apricot Prices

The prices of products obtained due to agricultural activities vary more than the prices of products produced in other sectors. There may be fluctuations in the prices of agricultural products from year to year and even from season to season.

Changes in product supply or demand cause such fluctuations.

The fact that the supply-demand elasticity of these products is relatively low also causes excellent fluctuations in prices [10].

When the apricot prices per ton are analysed, the highest price in 2010 belongs to Austria at $3,854. Israel followed Austria with $3,566 and Japan with $3,440.

Apricot prices in 2010 in Egypt, which ranks first in fresh apricot yield, were $522.

The highest price received by the farmer per ton in 2020 belongs to Japan, with an increase of 1.6 times and $2,171. When the situation in Turkey was analysed, apricot prices, which were $1,121 in 2010, decreased to $562 in 2020.

When the apricot prices in 2020 were examined based on 2010, Iran experienced an increase of 60%, Japan 54%, France 26%, Austria 23%, Israel 22%, and Germany 5%. Spain's most critical exporter country experienced a price decrease of 14%, Switzerland and Greece by 5%, and Turkey decreased by 50% in 2020 compared to 2010 (Table 4).

Table 4. Apricot prices received by farmers per ton in major countries ($)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Japan	3,440	3,720	4,511	1,882	1,815	1,680	2,644	3,492	2,655	3,770	5,300
Austria	3,854	3,759	4,299	4,037	4,514	3,906	3,910	3,679	4,703	3,150	4,744
Israel	3,566	2,285	1,739	2,960	3,386	3,089	3,654	2,445	4,768	3,184	4,366
Germany	-	-	3,323	3,585	2,939	2,733	2,146	3,221	2,835	2,260	3,495
Switzerland	2,618	3,176	3,052	3,301	2,795	2,664	2,694	2,854	2,454	2,415	2,503
France	1,718	1,692	1,309	1,924	1,358	1,358	1,738	1,527	1,723	1,448	2,176
Iran	1,350	1,086	1,374	1,499	2,027	1,236	984	865	1,082	1,571	2,171
Greece	945	1,234	723	907	1,027	682	587	593	791	654	901
Egypt	522	629	627	556	541	498	429	271	275	-	-
Turkey	1,121	1,015	672	618	1,017	959	759	546	476	521	562
Spain	918	1,037	922	1,063	931	888	957	839	779	688	794
Index (2010=100)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Japan	100.00	108.14	131.13	54.71	52.76	48.84	76.86	101.51	77.18	109.59	154.07
Austria	100.00	97.54	111.55	104.75	117.13	101.35	101.45	95.46	122.03	81.73	123.09
Israel	100.00	64.08	48.77	83.01	94.95	86.62	102.47	68.56	133.71	89.29	122.43
Germany	-	-	100.00	107.88	88.44	82.24	64.58	96.93	85.31	68.01	105.18
Switzerland	100.00	121.31	116.58	126.09	106.76	101.76	102.90	109.01	93.74	92.25	95.61
France	100.00	98.49	76.19	111.99	79.05	79.05	101.16	88.88	100.29	84.28	126.66
Iran	100.00	80.44	101.78	111.04	150.15	91.56	72.89	64.07	80.15	116.37	160.81
Greece	100.00	130.58	76.51	95.98	108.68	72.17	62.12	62.75	83.70	69.21	95.34
Egypt	100.00	120.50	120.11	106.51	103.64	95.40	82.18	51.92	52.68	-	-
Turkey	100.00	90.54	59.95	55.13	90.72	85.55	67.71	48.71	42.46	46.48	50.13
Spain	100.00	112.96	100.44	115.80	101.42	96.73	104.25	91.39	84.86	74.95	86.49

Source: [7].

Developments in World Fresh Apricot Exports

When the amount of exported fresh apricots between 1980 and 2020 is examined, there were fluctuations in the amount of exports over the years. According to FAOSTAT 2020 data, 359,867 tons of fresh apricot exports were made worldwide. The leading countries in exports were Spain, Turkey, and Uzbekistan. While Spain ranked first with 96,414 tons of apricot exports in 2020, Turkey, the leader in apricot production, ranked second with 64,694 tons of apricot exports, and Uzbekistan ranked third with 63,488 tons of exports (Table 5).

Table 5. Export amount of important countries in fresh apricot exports (tons)

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Spain	14,574	24,429	11,589	55,460	52,209	39,064	29,157	31,655	42,458
Turkey	181	2,571	1,641	681	3,689	9,844	25,845	28,489	56,302
Uzbekistan					1,288	11,827	20,551	26,629	14,262
Greece	28,535	26,128	12,321	10,523	12,317	14,901	16,868	14,597	25,868
Italy	7,817	10,141	13,166	11,690	15,310	14,432	22,570	20,333	31,442
Afghanistan	0	0	7	500	4,100	5,001	4,092	3,573	3,239
France	1,470	7,579	21,931	24,327	38,462	57,777	47,875	48,606	58,668
Kazakhstan				7	1,715	1,918	369	303	96
Kyrgyzstan					5,735	3,086	14,408	13,567	18,469
Armenia				218	129	690	1,971	6,573	12,318
Other	21,172	17,723	35,220	30,215	45,332	48,871	71,411	69,723	72,064
World	73,749	88,571	95,875	133,621	180,286	207,411	255,117	264,048	335,186
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100)**
Spain	61,793	56,491	79,835	79,318	89,318	109,297	93,379	96,414	662
Turkey	41,583	26,692	55,337	37,166	63,530	70,698	67,631	64,694	35,742
Uzbekistan	58,260	26,879	40,000	49,487	22,801	42,664	58,024	63,488	4,929
Greece	15,945	16,948	10,014	16,190	24,680	23,931	23,017	21,544	76
Italy	15,643	25,326	24,597	24,724	44,609	26,603	48,161	16,913	216
Afghanistan	8,728	7,075	4,822	7,066	7,004	782	18,181	15,448	220,686
France	45,304	63,364	52,539	42,174	56,411	28,276	21,768	11,409	776
Kazakhstan	356	325	472	4,198	3,787	8,434	9,088	11,386	
Kyrgyzstan	17,600	-	1,995	850	2,233	2,654	6,099	5,900	103
Armenia	20,524	1,734	16,510	3,160	3,905	7,215	3,667	4,820	2,211
Other	72,738	71,693	67,878	67,396	87,740	147,262	144,657	47,851	226
World	358,474	296,527	353,999	331,729	406,018	467,816	493,672	359,867	488

Source: [7].

While world fresh apricot exports were 73,749 tons in 1980, world fresh apricot exports increased approximately five times and reached 359,867 tons in 2020. When the developments in the export of fresh apricots were examined, the most considerable increase in 2020 compared to 1980 was in Afghanistan, increasing 2,207 times. Turkey follows Afghanistan with 357 times and Uzbekistan with 49 times. One of the essential apricot exporters, Spain, experienced an increase of approximately 6.61 times in 2020 compared to 1980 (Table 5).

Considering the change in the export rate of fresh apricots, the total amount of apricots produced in the world in 1980 was 1,734,556 tons, and 73,749 tons of this amount, 4.25% of the production, were exported. Greece produced 96,000 tons of apricots and exported 29% of it, or 28,535 tons, making it the country that exports the freshest apricots. Spain followed Greece with 12.81%, Italy with 8.13%, and France with 1.86%. On the other hand, Turkey exported 181 tons, or 0.11% of the apricots produced at 160,000 tons, and exported at a meagre rate in 1980. A total of 3,719,974 tons of apricots were produced in the world in 2020, of which 359,867 tons (9.67%) were exported. Kazakhstan and Kyrgyzstan made a breakthrough this year. Kazakhstan 49.31%, Kyrgyzstan 21.88%, Spain 74.91%, Greece 17.15%, Italy 9.75%, France 13.29%, Turkey 7.76% and Uzbekistan 12%.

According to Trade Map data (2022) [16], Turkey exported 69,959 tons of fresh apricots to 67 countries in 2021. The main export countries were the Russian Federation (53.53%), Iraq (24.46%), Germany (5.67%), Ukraine (5.39), Romania (2.77%), and the United Arab Emirates (1.83%).

Developments in World Fresh Apricot Export Value

Apricot exports are an essential source of income for countries in good standing in apricot production. According to their type and quality, apricots are sold abroad to provide foreign currency inflows to countries. While world fresh apricot exports were 48 million USD in 1980, they increased to 454 million USD in 2020. Countries with high export values of fresh apricots include Spain, Turkey, Uzbekistan, and Greece. With 21.86 million USD in 1980, Greece had the highest export value (Table 6).

Table 6. Export values of important countries in the export of fresh apricots (1,000 $)

Country	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**
Spain	7,967	14,396	12,345	69,193	37,752	46,516	49,799	55,836	69,520
Turkey	118	1,007	813	461	2,543	10,111	26,641	28,936	41,613
Uzbekistan				-	1,828	11,704	28,113	31,820	15,729
Greece	21,861	18,502	18,317	14,034	8,669	14,486	22,498	18,573	25,087
Italia	6,616	6,029	14,867	17,522	12,520	17,289	36,630	36,817	47,048
Afghanistan	0	0	4	90	600	641	2,455	1,793	1,584
France	1,936	5,488	31,688	46,623	46,791	89,295	105,601	105,983	107,552
Kazakhstan				1	354	571	166	166	21
Kyrgyzstan					315	435	4,260	5,141	12,178
Armenia				174	129	186	1,255	6,223	10,283
Other	9,507	8,040	21,275	32,659	39,504	60,395	108,467	115,128	120,997
World	48,005	53,462	99,309	180,757	151,005	251,629	385,885	406,416	451,612
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100**
Spain	122,861	108,769	127,110	126,486	123,286	168,875	131,550	170,067	2,135
Turkey	42,444	27,420	39,236	24,310	44,188	41,008	38,093	55,627	47,141
Uzbekistan	54,277	24,269	30,000	26,375	20,308	48,353	67,325	49,170	2,690
Greece	22,029	21,452	11,683	15,636	16,509	21,443	18,569	23,759	109
Italia	36,889	45,207	42,067	40,943	56,319	43,131	63,344	35,579	538
Afghanistan	3,678	5,885	4,437	6,536	7,069	813	12,453	11,001	275,025
France	111,845	118,961	94,889	84,458	83,224	50,598	36,565	29,247	1,510
Kazakhstan	111	51	15	65	76	1,636	2,940	298	29,800
Kyrgyzstan	10,100	-	1,430	551	1,785	2,018	2,912	953	302
Armenia	14,847	1,505	5,322	1,923	1,571	5,041	5,232	3,864	2,221
Other	119,293	115,323	94,998	97,973	108,425	120,143	107,394	74,460	783
World	538,374	468,842	451,187	425,256	462,760	503,059	486,377	454,025	946

Source: [7].

In 2020, this value was 23.76 million USD. One of the most important exporters of fresh apricots, Spain had an export value of 7.97 million USD in 1980 and ranked first with 170 million USD in 2020. Turkey was second with 55 million USD, and Uzbekistan was third with 49 million USD in export value (Table 6).

Compared to the 1980–2020 period, in 2020, the world's export value has increased nine times. The highest increase in export value was realised in Afghanistan, with a 2750x increase in value. Turkey follows Afghanistan with an increase of 471 times and Kazakhstan with an increase of 298 times. In Spain, which was the largest exporter of fresh apricots, there was a 21-fold increase (Table 6).

The shares of Spain, Turkey, Uzbekistan, Greece, Italy, and Afghanistan are the five essential countries that have a say in fresh apricot exports by selling the apricots they produce to foreign markets in the last five years are given in Figure 7. Accordingly, Spain has a share of over 25% in the analysed period. There was much variation in the shares of Turkey, Greece, Uzbekistan, Italy and Afghanistan. Uzbekistan's share rate, which has increased in general, decreased in 2020 and took a share of 10.83%. Looking at Turkey, while it had a share of 8.70% in 2015, this ratio increased to 12.25% in 2020 (Figure 5).

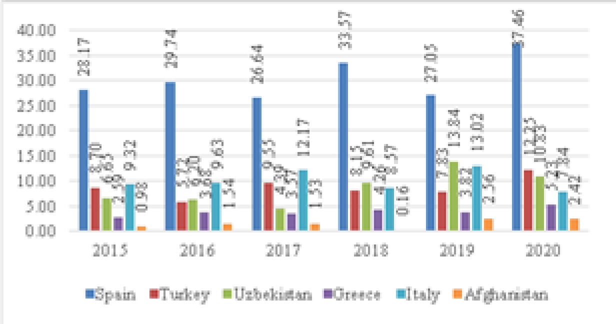

Fig. 5. Shares of major fresh apricot exporting countries (%)
Source: Our calculation from FAOSTAT data [7].

World dried apricot export situation

Turkey is the first country that comes to mind for dried apricots. For many years, Turkey alone met more than half of the world's dried apricot exports (Table 7).

Table 7. Export volumes of important countries exporting dried apricots (tons)

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Turkey	8,599	10,977	32,411	50,836	70,252	96,019	92,687	90,321	101,588
Kyrgyzstan				-	729	0	550	127	329
Uzbekistan				-	4,489	1,674	3,673	9,407	6,550
Tajikistan									
Myanmar									
Afghanistan	0	0	65	242	1,900	1,715	5,646	5,165	3,629
Belarusian				-	8	5	59	3	19
Spain	915	1,210	237	188	63	133	626	349	1,053
Germany	371	343	707	1,002	841	1,721	2,052	1,773	1,957
Netherlands	111	180	564	623	788	1,477	3,048	2,686	1,261
ABD	0	0	1,240	1,473	1,893	1,171	1,693	1,514	1,708
Greece	0	0	0	83	446	351	81	108	1,178
Other	1,127	2,096	4,247	4,803	9,348	10,810	8,299	13,897	19,052
World	11,123	14,806	39,471	59,250	90,757	115,076	118,414	125,350	138,324
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100**
Turkey	112,429	77,850	65,267	78,755	94,989	93,797	100,270	88,062	1,024
Kyrgyzstan	300	126	317	269	3,290	4,124	8,602	13,033	1,788
Uzbekistan	1,689	4,510	5,426	7,230	10,889	7,453	9,035	11,778	262
Tajikistan		32,637	20,381	20,896	15,587	10,904	8,048	11,110	34
Myanmar		410	613	9,123	300	0	615	5,721	1,395
Afghanistan	7,001	3,057	6,614	2,943	15,156	43,693	4,789	5,403	8,312
Belarusian	216	282	202	2,378	2,638	3,673	4,160	3,008	37,600
Spain	1,695	2,378	2,338	2,311	2,163	5,057	2,478	2,877	314
Germany	2,628	2,362	1,509	1,430	1,407	1,078	1,419	1,941	523
Netherlands	1,315	2,474	1,189	1,091	1,436	1,649	1,669	1,705	1,536
ABD	1,631	1,775	1,189	1,390	1,583	1,070	1,343	1,389	112
Greece	441	586	139	215	513	330	1,110	333	401
Other	17,928	17,848	14,533	8,939	9,085	8,578	8,492	7,929	703
World	147,273	146,295	119,717	136,970	159,036	181,406	152,030	154,289	1,387

Source: [7].

PRINT ISSN 2284-7995, E-ISSN 2285-3952

While the world's dried apricot export amount was 11,123 tons in 1980, it increased by 13 times and reached 154,289 tons in 2020.
While Turkey was in first place with 8,599 tons of apricot exports in 1980, this situation did not change in 2020, and it took first place by exporting 88,062 tons of apricots. Kyrgyzstan followed Turkey with 13,033 tons, Uzbekistan with 11,778 tons, and Tajikistan with 11,110 tons (Table 7).
When the developments in the exports of dried apricots were examined, the most significant increase in 2020 compared to 1980 was in Belarus, with 376 times. Afghanistan followed Belarus with an increase of approximately 83 times and Kyrgyzstan with an increase of approximately 17 times. In Turkey, there was an increase of 10 times (Table 7). According to 2020 data, Turkey makes 74% of the world's dried apricot exports. Turkey was followed by Belarus with a share of 27.11% and Afghanistan with a share of 5.99%.

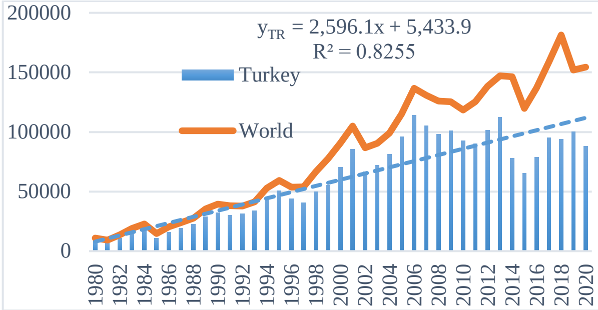

Fig. 6. Development of dried apricot exports in the world and Turkey (ton)
Source: Our calculation from FAOSTAT data [7].

While the world's dried apricot export value was 31.47 million USD in 1980, this value increased to 405.37 million USD in 2020. The countries with the highest export value of dried apricots from 1980 to 2022 were given in Table 8. The countries with the highest export value of dried apricots worldwide continue to be Turkey, Uzbekistan, Afghanistan, and Tajikistan. While Turkey's export value was 24.14 million USD in 1980, this value increased to 260.27 million USD in 2022 (Table 8).

Table 8. Export values of important dried apricot exporting countries (1,000 $)

Country	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**
Turkey	24,147	31,442	71,927	99,147	110,379	179,735	350,602	360,907	296,615
Kyrgyzstan	-	226	0	324	102	463	400	89	331
Uzbekistan				-	2,165	1,070	5,407	8,146	6,213
Tajikistan									
Myanmar									
Afghanistan	0	0	77	300	2,400	2,747	9,982	8,193	9,357
Belarusian				-	32	8	47	12	53
Spain	2,509	2,473	932	542	173	210	1,235	1,034	2,096
Germany	883	533	2,070	2,897	2,194	6,894	10,607	11,923	10,807
Netherlands	261	316	1,340	1,585	1,685	4,664	5,434	6,702	5,103
ABD	0	0	3,925	5,814	6,426	5,271	7,313	7,418	8,640
Greece	0	0	0	132	663	1,464	408	431	1,465
Other	3,668	3,800	12,702	16,230	20,469	36,911	38,038	45,413	41,776
World	31,468	38,790	92,973	126,971	146,688	239,437	429,473	450,268	382,456
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100)**
Turkey	314,134	344,297	302,689	288,793	266,879	253,351	255,989	260,278	1,078
Kyrgyzstan	203	2,490	2,588	4,484	7,029	1,953	3,129	1,891	837
Uzbekistan	2,753	10,256	10,332	8,123	10,494	7,387	8,506	16,992	785
Tajikistan		15,043	7,104	4,626	3,729	2,842	3,268	4,628	31
Myanmar		1,953	3,129	1,891	26		145	847	43
Afghanistan	16,365	11,092	11,403	6,454	32,362	38,835	15,625	10,972	14,249
Belarusian	265	349	173	1,350	1,684	2,701	3,317	3,175	9,922
Spain	3,684	4,580	4,091	4,386	3,318	7,389	3,383	4,765	190
Germany	13,145	15,639	11,208	9,152	8,050	6,119	7,161	9,176	1,039
Netherlands	4,967	7,110	6,335	5,267	5,728	6,259	5,905	7,084	2,714
ABD	8,109	9,884	7,829	8,023	8,711	4,877	6,493	5,544	141
Greece	664	950	498	789	873	751	1,673	804	609
Other	41,097	41,701	41,037	33,998	31,674	37,646	34,183	37,024	1,009
World	405,386	465,344	408,416	377,336	380,557	370,110	348,777	363,180	1,154

Source: [7].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

When the foreign exchange input development of the countries exporting dried apricots is analysed based on 1980, the world dried apricot export value increased approximately 12 times in 2020. The highest export value development was realised in Afghanistan with approximately 143 times. Belarus experienced an increase of 99 times and the Netherlands 27 times. In Turkey, the export value of dried apricots has increased approximately 11 times (Table 8).

According to Trade Map data (2022) [16], Turkey exported dried apricots to 112 countries in 2021. The main export countries and their export shares are USA 17%, France 8%, Germany 8%, United Kingdom 6%, Russian Federation 5%, and Australia 5%.

World fresh apricot import status

When the change in the amount of world fresh apricot imports was analysed, while the total amount of fresh apricots in the world was 78,345 tons in 1980, it increased by 4.5 times to 349,750 tons in 2020. When the fresh apricot imports of the countries were examined, it was seen that Germany ranked first with 22,923 tons of apricot imports in 1980. By 2020, the Russian Federation imported the most apricots, with 67,874 tons. Germany followed Russia with 46,654 tons and Kazakhstan with 35,614 tons of fresh apricot exports. When Turkey's imports of fresh apricots were analysed, there was no fresh apricot import in 1980, but 51 tons of fresh apricots were imported in 2000. This amount was 129 tons in 2020 (Table 9).

When the developments of the countries in the import of fresh apricots in the 1980–2020 period were examined, it was seen that there had been an increase in the number of imported apricots over the years. While the number of fresh apricot imports increased four times in the world in 2020, the highest fresh apricot import increase was realised in Kazakhstan with 1978 times. Ukraine followed with an increase of approximately 1635 times, Romania with a rise of 78 times, and Pakistan with an increase of roughly times. Looking at Turkey, there has been an increase of approximately 2.5 times.

Table 9. Import amount of important countries in fresh apricot (tons)

Country	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**
Russian Federation	-	-	-	-	10,215	32,923	54,850	61,915
Germany	22,923	25,003	29,787	36,650	42,782	50,192	45,702	44,282
Kazakhstan	-	-	-	18	1,495	30	5,000	17,682
France	9,503	10,238	5,200	17,385	14,371	10,297	11,087	10,736
Iraq								
Italy	13,232	12,825	11,081	20,793	27,782	20,441	16,036	23,782
Pakistan	852	1,710	632	341	4,146	4,923	1,224	5,351
Austria	9,535	8,588	12,286	8,170	10,718	14,872	14,226	11,468
Saudi Arabia	4,185	2,906	9,039	7,678	7,924	3,625	5,500	6,191
Romania	-	-	-	110	332	2,147	1,369	2,643
Turkey	0	0	0	0	51	7	9	9
Ukraine	-	-	-	-	-	5	2,725	2,547
Other	18,115	26,018	30,031	41,471	54,976	74,016	69,903	73,421
World	78,345	87,288	98,056	132,616	174,792	213,478	227,631	260,027
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Russian Federation	68,259	36,799	43,203	32,736	51,667	52,999	50,368	64,874
Germany	56,680	59,928	59,321	56,842	70,266	59,930	62,242	46,654
Kazakhstan	57,887	37,447	7,965	32,370	15,458	30,102	36,663	35,614
France	21,007	17,393	20,321	20,362	20,773	22,653	17,100	21,258
Iraq	-	-	18,956	22,776	32,931	37,672	35,887	20,519
Italy	26,342	28,116	32,205	22,890	21,901	20,141	16,140	18,037
Pakistan	3,102	6,960	6,519	1,206	13,804	25,369	17,831	14,992
Austria	11,933	9,318	11,525	13,309	18,422	13,469	15,404	12,041
Saudi Arabia	7,037	4,291	8,213	9,298	10,235	8,380	9,256	10,808
Romania	2,751	3,647	3,124	4,592	9,297	7,179	9,771	8,583
Turkey	1	1	13	5	45	36	96	129
Ukraine	3,792	2,582	842	992	3,120	2,106	7,529	8,176
Other	85,394	102,978	101,166	97,440	130,882	111,876	129,612	88,025
World	344,185	309,460	313,373	314,818	398,801	391,912	407,899	349,710

Source: [7].

When the shares of fresh apricot importing countries in terms of total apricot imports in 2020 are analysed, Russia has 19%, Germany 13%, Kazakhstan 10%, Iraq and France 6%, Italy 5%, Pakistan 4%, and Turkey 0.04%.

Developments in World Fresh Apricot Import Value

While world fresh apricot imports were approximately 64 million USD in 1980, they increased to 473 million USD in 2020. Countries with high world fresh apricot import values continue to be Germany, the Russian Federation, France, Kazakhstan, and Italy. The country with the highest fresh apricot import value in 2020 was Germany, with 102 million USD. Russia followed Germany with 57 million USD, and France with 35 million USD. When Turkey's fresh apricot import value is examined, it was realised as 3 thousand dollars in 2000 and 110 thousand dollars in 2020, while there was no import value in 1980 (Table 10).

When the development of fresh apricot import values in the 1980-2020 period of the countries is examined, there has been a 7-fold increase in import values in the world in 2020. The highest fresh apricot import value increase was realised in Kazakhstan, 3652 times. Ukraine followed Kazakhstan with a 1954-time increase, Romania with a 393-time increase, and Pakistan with a 40-time increase. Looking at Turkey, there has been an increase of approximately 37 times (Table 10). When the share of fresh apricot importing countries in total apricot import value in 2020 was analysed, Germany had 22%, the Russian Federation 12%, France 7%, and Turkey 0.2%.

Table 10. Import value of important countries in fresh apricot import (1,000 $)

Country	1980	1985	1990	1995	2000	2005	2010	2011	2012
Russian Feder.				0	9,790	25,965	72,302	74,370	73,782
Germany	18,676	15,268	41,704	55,661	42,219	70,521	94,236	95,603	105,371
Kazakhstan				4	169	10	3,900	13,782	20,467
France	9,448	6,373	6,856	24,243	12,737	14,821	19,657	18,763	26,779
Iraq									
Italy	12,143	6,244	14,245	30,376	24,957	26,600	27,344	38,328	27,571
Pakistan	288	441	106	52	557	672	677	953	5,532
Austria	6,246	4,099	9,957	10,117	10,453	21,479	30,232	27,248	27,396
Saudi Arabia	1,665	1,420	2,623	7,663	5,784	1,490	3,792	4,451	4,651
Romania	-	-	-	28	87	644	814	2,193	2,159
Turkey	0	0	0	0	3	4	4	7	55
Ukraine	-	-				4	2,731	2,065	12,563
Other	15,701	18,210	37,361	60,484	60,648	104,780	148,504	144,608	172,462
World	64,167	52,055	112,852	188,628	167,404	266,990	404,193	422,371	478,788
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Index (1980=100)**
Russian Feder.	70,859	45,232	36,344	18,342	44,747	42,014	49,447	57,390	586
Germany	133,307	122,377	109,088	109,246	109,275	112,254	100,908	102,776	550
Kazakhstan	52,668	33,571	12,879	18,891	13,889	30,718	24,636	14,610	365,250
France	44,055	35,184	36,011	36,251	31,015	35,895	23,675	35,312	374
Iraq			7,409	8,008	14,258	14,521	10,791	9,768	132
Italy	46,596	41,223	43,516	30,870	21,188	23,555	16,503	26,430	218
Pakistan	2,956	6,384	8,491	944	10,168	11,207	13,459	11,552	4,011
Austria	28,471	20,541	22,267	24,494	24,409	24,144	21,042	24,601	394
Saudi Arabia	4,539	3,988	7,110	7,536	7,325	5,893	6,934	7,559	454
Romania	2,224	2,813	3,344	4,494	7,552	7,609	8,536	10,993	39,261
Turkey	1	1	13	6	23	30	121	110	3667
Ukraine	4,578	2,644	895	1,003	2,601	2,142	8,398	7,816	195,400
Other	179,285	202,559	169,265	164,170	186,395	177,987	177,612	164,418	1,047
World	569,539	516,517	456,632	424,255	472,845	487,969	462,062	473,335	738

Source: [7].

Turkey Fresh Apricot Production

Turkey Fresh Apricot Production, Planting Area and Yield

Apricot is a fruit produced in almost every province except the high springs of the Eastern Anatolia region (which has harsh winters) and the eastern parts of the Black Sea region (which are pretty humid) [14].

Turkey ranks first in the world in apricot production and planting and twenty-eighth in apricot yield. According to the data of TUIK for the year 2021, the total area where fruits, beverages, and spices are produced is 35 million decares. The apricot production area is 1.34 million decares. When the change in the apricot production area is examined in the period from 2004 to 2021, it is seen that there is an increase of approximately 50% in 2021 compared to 2004. The total number of fruiting and non-fruiting trees in 2004 was 13 million. From 13 million in 2004, the total number of trees increased by 60% to 21 million in 2021. There were also fluctuations in apricot yield from year to year. In 2005, there was an increase of approximately three times compared to the previous year. The highest yield between 2004-2021 was obtained this year with 72 kg. The yield per tree was 45 kg in 2021. When the apricot planting area and production change were examined, there was an increase in the apricot production area over the years. Although there was an increase in the production area, it was seen that there were fluctuations in the production amount. These fluctuations were due to climatic conditions and newly planted trees. The adverse situation experienced by apricots during the flowering period due to late spring frosts adversely affects production and yield (Figure 7).

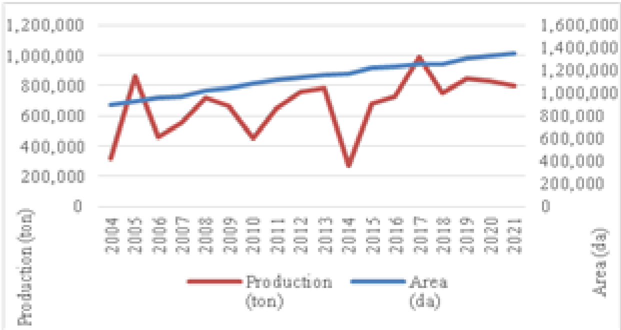

Fig. 7. Apricot production area and production amount in Turkey (2004-2021)
Source: [17].

Malatya is the first city that comes to mind when apricot is mentioned in Turkey. Approximately 50% of apricot production is realised by Malatya province. 90% of the apricots produced in this province are used for drying.

Table 11. Apricot area, production and yield of some important provinces in Turkey

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Malatya	Area (decare)	742,800	754,320	768,000	801,100	810,970	808,197	798,366	841,883	849,871	856,422
	Production (ton)	510,000	411,825	38,654	336,000	380,551	672,670	401,363	391,801	352,050	389,396
	Yield (kg per tree)	72	58	5	45	50	88	53	50	45	50
Mersin	Area (decare)	72,140	68,433	67,684	67,943	68,694	67,278	71,905	81,316	82,678	86,426
	Production (ton)	46,865	94,055	111,738	107,922	104,310	86,918	89,300	140,301	170,468	162,060
	Yield (kg per tree)	38	76	84	79	73	60	58	77	80	75
Iğdır	Area (decare)	18,572	18,822	19,786	27,126	27,276	32,300	34,070	35,600	35,300	38,540
	Production (ton)	17,755	20,342	0	37,544	31,329	31,416	36,194	39,658	159	42,989
	Yield (kg per tree)	117	132	0	178	147	127	141	139	40,207	153
Elazığ	Area (decare)	83,148	83,787	85,864	96,341	97,809	97,524	98,192	99,354	99,626	102,112
	Production (ton)	38,578	39,514	11,390	18,417	58,876	53,157	51,775	56,184	50,786	31,179
	Yield (kg per tree)	39	40	11	17	55	49	48	52	47	29
Isparta	Area (decare)	17,914	18,520	19,572	22,792	23,403	23,763	24,006	24,520	26,439	25,930
	Production (ton)	16,908	16,582	12,141	4,127	14,543	12,567	9,122	10,062	13,413	22,064
	Yield (kg per tree)	52	50	35	11	38	31	27	28	35	56
Hatay	Area (decare)	10,446	11,322	7,070	7,523	6,708	19,706	20,761	19,637	19,959	24,517
	Production (ton)	8,239	8,535	6,546	6,707	5,962	7,612	32,766	31,593	35,941	21,080
	Yield (kg per tree)	35	35	33	34	33	24	49	50	53	29
Antalya	Area (decare)	9,315	10,412	13,978	15,013	16,570	17,346	18,044	17,664	17,645	18,320
	Production (ton)	15,691	16,316	27,463	20,869	21,217	17,919	14,201	16,188	16,564	19,219
	Yield (kg per tree)	75	74	55	39	38	31	25	29	29	33
Kahramanmaraş	Area (decare)	91,730	92,468	91,560	88,880	89,470	88,111	89,328	89,218	89,145	88,822
	Production (ton)	12,521	78,620	994	80,444	33,169	25,689	29,778	65,454	65,477	18,626
	Yield	13	66	1	69	28	22	18	40	40	11
Kayseri	Yield (kg per tree)	5,954	6,109	6,116	6,151	6,502	6,393	6,432	6,432	6,428	6,399
	Production (ton)	13,683	13,323	1,478	4,392	10,913	13,154	9,311	12,548	5,780	16,581
	Yield (kg per tree)	46	43	5	14	35	41	29	39	18	52
Sivas	Area (decare)	12,140	12,239	12,656	10,828	11,202	11,865	11,267	11,359	13,806	13,910
	Production (ton)	4,267	4,327	1,267	4,536	4,549	4,142	11,164	11,160	7,672	2,205
	Yield (kg per tree)	24	24	7	22	20	18	48	48	33	9

Source: [17].

Apricot production is more common in the provinces of Mersin, Adana, Hatay, Antalya, İzmir, and Kars [14].

Hacıhaliloğlu, Kabaaşı, Hasanbey, Çataloğlu and Soğancı, Zerdali or Hüdai are apricot varieties grown in Malatya.

Hacıhaliloğlu is the most important dry apricot variety in the region. This variety constitutes 60-65% of the total tree number in Malatya [15].

The planted area in Malatya and other provinces has increased over the years. In 2012, 510 thousand tons of apricots were obtained from an area of 742 thousand decares in Malatya, while in 2021, 389 thousand tons of apricots and a 50 kg yield per tree were obtained from an area of 856 thousand decares. One hundred sixty-two thousand tons of apricots were produced in Mersin, 42 thousand tons in Iğdır, 31 thousand tons in Elazig and 22 thousand tons in Isparta in 2021 (Table 11).

Malatya took first place in the 10-year production period. Malatya is followed by Mersin, Iğdır, Elazığ, and Isparta.

In Figure 16, the production share of some essential provinces in apricot production in 2021 was shown. Apricot production, which is a total of 800,000 tons in Turkey, was produced by Malatya 49%, Mersin 20%, Iğdır 5%, Elazığ 4%, and Isparta 3% (Figure 8).

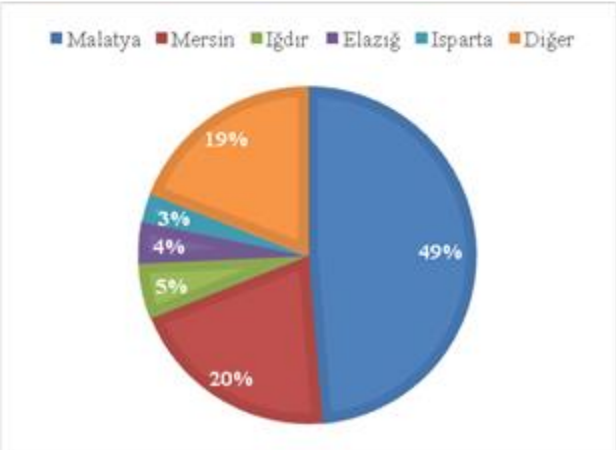

Fig. 8. Production share of some important provinces producing apricots (%, 2021)
Source: Our calculation from TURKSTAT data [17].

The highest yield between 2004 and 2021 was in Iğdır in 2015 with 178 kg. In 2021, there was a decrease in yield, and it was 153 kg. This year, Mersin 75, Isparta 56, the most important apricot producer, Malatya 50, Antalya 33, Hatay 29 and Kahramanmaraş 11 kg.

When current prices in the 1980-2021 period were examined, we calculated that the apricot prices received by Turkish farmers in 2021 increased by more than 27 million times compared to 1980. On the other hand, the Producer Price Index rose more than 17 million times in the same period. This indicates that the increase in apricot prices is higher than the increase in the index, thus favouring apricot producers. The coefficient of variation in current prices in the analysed period was found to be 135.89. The concepts of volatility and uncertainty express two basic meanings of volatility. Here, variability refers to all movements, and uncertainty refers to unknown actions [18]. The volatility in the current prices of apricots in the analysed period was calculated as 72.34%. Price volatility is defined as a significant economic problem. The high inflation rate in Turkey in the 1980s and 1990s was effective in this situation.

When examining real prices (2003 prices), while apricot prices were 593.62 TRY per ton in 1980 in Turkey, they increased 55.93% in 2021 and became 925.60 TRY. In Turkey, the highest price was 1,251.10 TRY in 1987, and the lowest price was 554.10 TRY in 2013 (Figure 9). In this period, the coefficient of variation in real prices was calculated as 22.40. As a matter of fact, this variation can be observed in Figure 9. Therefore, the interpretation is high in the years examined.

Apricot prices per ton received by the producers in 1980-1989 were 890.69 TRY on average. Prices followed a fluctuation between 593.62 TRY and 1,251.10 TRY and peaked in 1987, the second peak in 1984, and the lowest in 1980. The volatility in current prices was 80.33%. Real apricot price volatility was 35.05% in this period. During this period, prices hit two-year lows and peaks. Apricot prices per ton of producers in 1990-1999 increased to 1,036.73 TRY on average. Prices rose from 816.83 TRY to 1,179.27 TRY. It reached its peak value in 1996. In addition, there were four peak values in 1993, 1998, and 1999. Prices became more stable and on an upward trend. Although the volatility in current prices increased to 103.39%, the volatility in real prices decreased to 18.22%. From 2000 to 2010, the apricot price per ton fell to 955.78 TRY on average. Prices fell from 834.51 TRY to 1,063.90 TRY and showed a less volatile trend. As a matter of fact, the price volatility received by the producers in this period decreased significantly to 10.09%. The volatility in current prices was also reduced to 30.09%. It reached its peak value in 2004, 2003, and 2000. In the years 2011-2021, the price of apricots received by the producers was between 554.10 TRY and 1,055.88 TRY. It decreased to 779.70 TRY on average for this period. The bottom and top values in prices were at intervals of two or three years. As a matter of fact, the volatility in real prices rose to 28.37%. The volatility in current prices also increased to 37.08%. The real price of apricot reached its peak in 2015, reaching the second peak in 2014, the third peak in 2021, and the fourth peak in 2016. The high volatility of apricot current and real prices also caused significant risk and uncertainty in farmers' incomes.

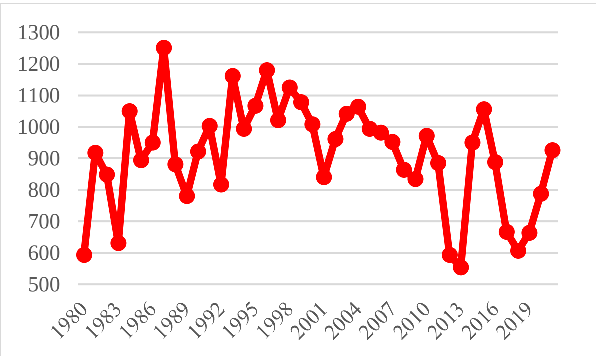

Fig. 9. Apricot real price per ton in Turkey (TRY)
Source: Our calculation from TURKSTAT data [17].

Turkey's export share of fresh apricots followed a fluctuating course. The percentage of fresh apricot exports has increased in general. Since 2015, the share rate has been above 10%. Turkey's apricot export share rate in 2020 was 17.98% (Figure 10).
The export share of dried apricots was 57% in the 1970s. In the following years, this ratio increased in general. The highest dried apricot export share was in 1995, with 86%. Since 2010, the percentage of dried apricot exports has been below 80% (Figure 11).

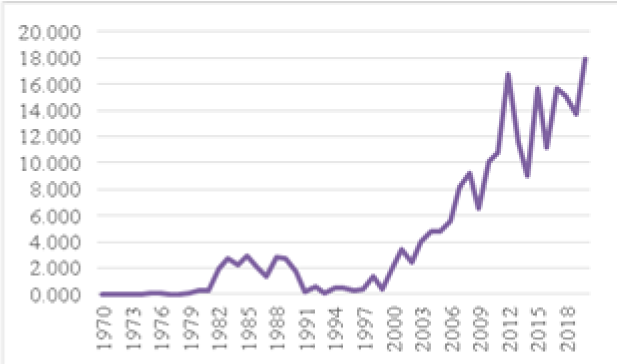

Fig. 10. Turkey's fresh apricot export share (%)
Source: Our calculation from FAOSTAT data [7].

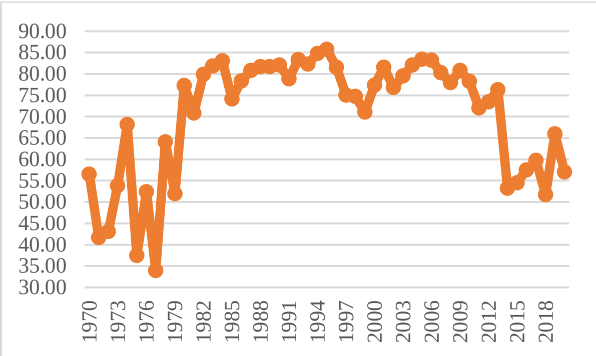

Fig. 11. Turkey's dry apricot export share (%)
Source: Our calculation from FAOSTAT data [7].

Turkey's apricot production share has fluctuated over the years. The most important reason for these fluctuations is late spring frosts.

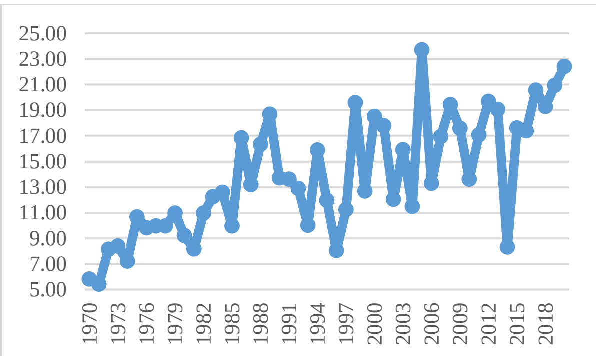

Fig. 12. Turkey's apricot production share (%)
Source: Our calculation from FAOSTAT data [7].

Adverse weather conditions, incorrect production techniques, and harvest time losses affect the production share. The share ratio, around 6% in 1970, increased to 23% in 2005, the most between 1970 and 2020. In the following years, this rate decreased. The share rate, which was 8% in 2014, increased to 22% in 2020 (Figure 12).

CONCLUSIONS

This study has tried to analyse the development of apricot production and foreign trade in the world and Turkey. In this framework, the production of apricots has doubled in the world during the 1980–2020 period. Both the planting area (2 times) and the yield (1 time) increases effectively increased production. The share of the expansion of planted areas in the rise in apricot production is quite large. Turkey takes first place in the production of apricots in the world. Turkey accounts for 22% of the world's apricot production. Uzbekistan follows Turkey with a share of 14%, Iran with 9%, Algeria with 5%, and Italy with 4%. Turkey experienced a 420% increase in production compared to 1980. This increase in production was primarily due to the increase in cultivation area (201%). The yield increased by 72%. Turkey ranks first in the world in apricot production and planting and twenty-eighth in yield. The total apricot production area in the world has increased by two times and reached 562,475 hectares. Turkey, Iran, Uzbekistan, Algeria, Spain, and Italy continue to be the countries with the highest apricot planting areas in the world. When the world's apricot planting areas are examined based on countries, in the 2020 period compared to the 1980 period, Pakistan expanded its fresh apricot production area five times, China four times, Iran five times, Algeria and Uzbekistan about four times, and Turkey three times. In addition, there was a decrease in apricot planting areas by 19% in Japan, 7% in the Russian Federation, and 6% in France. When the fresh apricot yields of the important countries are examined in the period under consideration, Albania experienced an increase of 8 times, Turkmenistan 4 times, Jordan about four times, Uzbekistan about three times, and Turkey two times. When the apricot prices in 2020 are examined based on 2010, Iran experienced an increase of 60%, Japan 54%, France 26%, Austria 23%, Israel 22%, and Germany 5%. The apricot price per ton in Switzerland and Greece fell by 5%, and in Turkey, there was a 50.13% price decrease in 2020 compared to 2010. The countries that export the freshest apricots are Spain, Turkey, Uzbekistan, Greece, and Italy. Turkey is also in first place in the production of dried apricots. In 2020, 3,719,974 tons of apricots were produced in the world, and 359,867 tons (9.67%) of these were exported. Spain exported 74.91% of its apricots, Greece 17.15%, Italy 9.75%, France 13.29%, Turkey 7.76%, and Uzbekistan 12%. The important countries in the export of dried apricots in the world are Turkey, Belarus, Afghanistan, Kyrgyzstan, and Myanmar. 74% of 2020 dried apricot exports belong to Turkey, 27% to Belarus, and 6% to Afghanistan. The countries that import the freshest apricots are the Russian Federation, Germany, Kazakhstan, Iraq, and France. According to the data of TUIK for the year 2021, the total area where fruits, beverages, and spices are produced is 35 million decares. The apricot production area is 1.34 million decares. When the change in the apricot production area is examined in the period from 2004 to 2021, it is seen that there is an increase of approximately 50% in 2021 compared to 2004. The highest yield between 2004-2021 was obtained in 2005 with 72 kg. In 2021, the yield per tree was 45 kg. 49% of apricot production, which is a total of 800,000 tons in Turkey in 2021, was realised by Malatya, 20% by Mersin, 5% by Iğdır, 4% by Elazığ and 3% by Isparta. Apricot's real price per ton in 2021 was 925.60 TRY.

As a result, apricot production has increased due to significant improvements in planted area and yield. In Turkey, on the other hand, it has increased with the expansion of the planted area. Most of the apricots produced in Turkey are offered for consumption as dried apricots. Apricots, which are not used for drying, are used in the table and fruit juice industries. The sweet ones of the apricot kernels are used as a snack, and the bitter ones are used in the pharmaceutical and cosmetic industries. Turkey's apricot yield, consumed and used in many areas, is below the world average. Turkey, the world leader in dried apricot exports, needs to take measures to increase productivity in apricot production, which is adversely affected by late spring frosts. Thanks to the measures taken, productivity should be brought to the world average, and above, fluctuations in prices should be prevented.

ACKNOWLEDGEMENTS

This paper was a part of Sultan Poyraz MSc. Thesis. This work was supported by Research Fund of the Isparta University of Applied Sciences. Project Number: 2021-YL1-0140.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

TRAINING AND EMPLOYMENT OF YOUNG SPECIALISTS IN THE AGRO-INDUSTRIAL COMPLEX OF THE REGION

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Abstract

Agriculture moved to a higher level of development of innovative technologies. The digital transformation of production and economic relations in the agro-industrial complex involves the formation of managers and specialists of a new formation and the creation of high-tech jobs for them. The implementation of the goals and objectives of the training and employment of young agricultural specialists is carried out through personnel policy. It acts as an instrument of state regulation and is associated with the formation and use of human resources focused on solving the problems of digitalization of the agro-industrial complex economy. The article analyzes the dynamics of the number of personnel of managers and specialists of the agro-industrial complex, the training and employment of young agricultural specialists in the Penza region. In the current research the authors based on statistical, computational and constructive methods, as well as systemic, structural, abstract-logical approaches. The authors summarize the conclusions made about the unsatisfactory quantitative and qualitative composition of the specialists observed. Recommendations are given for improving the process of hiring and supporting young specialists in the agro-industrial complex and developing the staff policy of the state.

Key words: *personnel policy, rural areas, young professionals, digitalization of the agrarian economy*

INTRODUCTION

The efficiency of the functioning of agriculture largely depends on staffing. Under the influence of the digital transformation of the agro-industrial complex, the functions, nature and conditions of the activities of specialists, the requirements for them are changing [1]. Until now, it has not been possible to solve the problem of the reproduction of highly qualified personnel in the countryside, which is inherent both in the entire economy of the agro-industrial complex of Russia and in the regional economy of the Penza region. So, if in 1991 16,450 people (managers and specialists) were employed in the agrarian sector of the region, as of January 1, 2021, their number was 2,965 people, or 18% of the pre-reform level. Including the number of chief specialists decreased over the thirty years under study from 2,595 people up to 587 people (in 4.4 times), industry specialists - from 10,626 people. up to 1,496 people (in 7.1 times), middle-level managers from 2,779 people up to 167 people (16.6 times). The unsatisfactory quality of life in rural areas, the underdevelopment of the social infrastructure of the village contribute to the formation of migratory moods of specialists, reducing the motivational aspect of their formation and use [2].

In this context, the purpose of the scientific research is to develop evidence-based proposals for improving the system of training and employment of young specialists in the agro-industrial complex. In accordance with the purpose of the study, the following tasks were set:

- to assess the current level of provision with highly qualified specialists of the enterprises of the agro-industrial complex of the Penza region (Russia);
- to carry out a statistical analysis of the system of training and employment of young personnel in the countryside;
- substantiate recommendations for improving the reproduction of highly qualified personnel in rural areas.

MATERIALS AND METHODS

The sources of data (2016-2021) were the materials of departmental statistical monitoring for the last five years, carried out by the Federal State Statistics Service of the Russian Federation. The indicators of the quantitative and qualitative composition of the observed specialists within the agro-industrial complex were considered.

The theoretical and methodological basis of the study was the works of domestic and foreign scientists on the problems of staffing of agricultural enterprises, as well as federal and regional legislative acts on these issues [5].

In the process of research, methods of systemic, structural, abstract-logical, comparative analysis, as well as calculation-constructive and economic-statistical methods were used [6].

RESULTS AND DISCUSSIONS

The agro-industrial complex of the Penza region at the beginning of 2021 is represented by 1,093 enterprises of various organizational and legal forms.

Their number over the past 5 years has decreased by 144 units, which is associated with ongoing processes of business consolidation.

The number of employees by level of education in the context of business entities is shown in Table 1.

It should be noted that the general decrease in the number of agro-industrial organizations did not affect the reduction in the number of employees in this area. On the contrary, their number increased to 21,444 people. However, in the structure of agribusiness entities, the dynamics of the number of different vectors. Thus, the number of employees in state unitary enterprises has almost halved over the past five years, in joint-stock companies - by 20%, in cooperatives - by 33.3%. In other organizations, an increase in the number of employees is observed. In the reporting period, 58.6% of agricultural workers were employed in limited liability companies. Their share over the past five years has increased by almost 8%. The smallest number of employees in municipal unitary enterprises (26 people in 2021).

An analysis of the qualitative composition of personnel by level of education showed that 83.2% of their number have vocational education. Almost 700 people the number of people with higher education increased (3,790 people in 2021), by 912 people – secondary vocational education (9,275 people in 2021).

The number of practitioners with primary education is decreasing, their number in the reporting period amounted to 4,788 people, which is 1,274 people less than in 2016.

The highly skilled specialists are employed in state and municipal unitary enterprises, as well as K (F) X, where respectively 22.4%, 23.0% and 22.6% of persons have higher education. The smallest percentage of the share of workers with higher education is inherent in joint-stock companies (12.5%), cooperatives (10.1%) and collective farms (5.2%).

In general, the quantitative and qualitative composition of the working personnel in agricultural area has improved over the past five years in most enterprises of various organizational and legal forms of management.

Education is the background the staffing of the agricultural sector is based on. In the region, highly qualified agro-industrial specialists are trained by the Penza State Agrarian University, which celebrated its 70th anniversary in 2021. Quantitative indicators of the release of specialists with higher education are shown in Table 2.

In the observed period, the University graduated 488 specialists, 63.7% of whom were full-time students. Almost 50% of graduates studied at the expense of the federal budget. It should be noted that a small proportion of graduates studied according to the company training system, or targeted contract training, (28 people, or 5%). The basis of this model is targeted training, which is carried out in relation to persons who have entered into an agreement with customers of targeted admission - an authority or an organization, the list of which is established by federal law. An agreement on targeted training should provide for measures of social support for the student, obligations to organize an internship, his employment, as well as the grounds for exemption from fulfilling the obligation to employment [17].

So far, this form has not become widespread. Critically small, in our opinion, is the number of people who have completed an internship abroad (8 people, or 1.6%). Interstate cultural, educational and economic bonds should be developed, which contributes to the growth of the professional development of young specialists.

Table 1. Information on the number and level of professional education of employees of agricultural organizations in the Penza region

Management and production structure	Number of organizations, units		Number of employees, people		have vocational education							
					Total		Higher		Average		Initial	
	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021
Total in the agro-industrial complex	1,237	1,093	21,415	21,444	17,403	17,853	3,038	3,790	8,363	9,275	6,062	4,788
including state unitary enterprises	3	3	82	49	82	49	12	11	62	35	8	3
municipal unitary enterprises	1	1	14	26	12	14	5	6	5	5	2	3
joint-stock companies	36	21	6,500	5,168	6,082	3,114	1,143	649	3,385	19	1,554	1,026
limited liability companies	155	173	10,885	12,570	7,731	11,293	1,356	2,521	3,369	6,293	3,006	2,479
collective farms	3	3	249	249	249	249	13	13	208	208	28	28
cooperatives	131	65	1,855	1,239	1,621	1,229	165	126	588	476	868	627
associations of peasant (farming) households	809	735	1,224	1,517	1,114	1,398	249	355	551	653	314	390
other organizations of the agro-industrial complex (including consumer cooperatives)	99	92	606	626	512	507	95	109	195	166	222	232

Source: Departmental statistical observation. Form No. 2-k approved by order of the First Deputy Minister of Agriculture of the Russian Federation dated January 9, 2001 No. 12 (Penza region. Main indicators of development from 2005 to 2020: a comprehensive statistical compendium) [12].

An analysis of the system of training and employment of specialists in the context of areas of training led to the conclusion that a third of the graduates received an agronomic education, 18.2% - engineering, 13.1% - economics, and 25.4% categorized as other specialties (technologists, land surveyors, forestry specialists, etc.). The percentage of employment in the agro-industrial complex in various specialties has a wide range from 85% for financiers, 82.7% for accountants to 72.1% for agronomists, 70% for livestock specialists and 55% for engineers [7]. Graduates of other areas of study in one way or another related to Agro-industrial complex have a very low rate of employment in rural areas (8%). It should be noted that the share of graduates of agricultural universities employed in the agro-industrial complex in Russia as a whole reached 78% in 2021, so Penza Agrarian University has to strive and improve the process.

Not only quantitative indicators of employment are important, but also the quality of trained specialists. Modern agricultural education, of course, should take into account current trends in the development of agriculture: the development of biotechnology, the use of breeding and genetic innovations, the development of the organic products market, the use of geopositioning systems, integrated fleet management, precision farming, digitalization of processes in order to form an export-oriented agro-industrial complex [14].

The use of an innovative approach in the development of human capital is a major national priority. According to [4], it is planned to accelerate the technological development of the country by accelerating the introduction of digital technologies in the economy and the social sphere and increasing the number of organizations that carry out technological innovations.

All these trends lead to the need to transform the education system and educational technologies. It is obvious that the transition of agricultural education and personnel training methods to new educational programs and standards, modern information platforms, technologies, information resources, allowing to manage smart agriculture in the future.

A system for recording agricultural land and tracking all goods produced in the agricultural sector is being created. The reimbursement of part of the costs for the purchase of software and equipment is being formed. Target settings for the introduction of digital technologies are associated with increasing the productivity of agricultural production and attracting young people to agribusiness.

At the same time, the pace of introduction of digital technologies in the agro-industrial complex is still quite low. The domestic agricultural sector is an outsider in terms of digital technology coverage of industries and complexes. Russia currently ranks 15th in the world in terms of digitalization in agriculture [16].

Table 2. Training and employment of agricultural specialists in the Penza region (01.01.2021)

higher education institution	Specialists trained						Employed in the organization of the agro-industrial complex of young specialists of the graduation of the reporting year					
	Total	full-time education	at the expense of the federal budget	within the company	trained abroad	part-time study	Total	within the company	trained abroad	left to work at the end of the observed year	by specialty	as a worker
Total released, people, incl. in the areas of training:	488	311	154	28	8	177	264	4	5	264	261	0
agronomic	158	72	69	7	0	86	114	2	0	114	114	0
zootechnical	15	27	26	1	1	23	35	0	0	35	33	0
engineering	89	58	58	18	5	31	49	2	5	49	49	0
veterinary	3	3	9	2	2	0	3	0	0	3	3	0
accounting, analysis and audit	29	9	0	0	0	20	24	0	0	24	24	0
finance and credit	20	11	0	0	0	9	17	0	0	17	16	0
management	15	7	0	0	0	8	11	0	0	11	1	0
jurisprudence	0	0	0	0	0	0	1	0	0	1	1	0
other	124	124	0	0	0	0	10	0	0	10	10	0

Source: Departmental statistical observation. Form No. 1-KMS approved by order of the First Deputy Minister of Agriculture of the Russian Federation dated January 9, 2001 No. 12 (Penza region. Main indicators of development from 2005 to 2020: a comprehensive statistical compendium) [12].

Negative aspects of the insufficiency of the resource base of digitalization are also characteristic of the agro-industrial complex of the Penza region [15]. So in 2020, there were 86,433 personal computers in the region in all business entities, incl. in the agro-industrial complex 2,277 units, or 2.6%. If in the region there were 46 units of personal computers per 100 employees, then in the agro-industrial complex - only 15. 92.8% of the total number of computers in the agro-industrial complex has access to global networks. In our country, only 10% of arable land is currently processed using digital technologies. Failure to use new technologies leads to a loss of up to 40% of the crop. Given the need to overcome the technological gap from developed countries, it is assumed that the market share of digital technologies in agriculture would grow every year [13]. By 2026 the market of information and computer technologies in the industry should grow almost five times [8]. The acceleration of digital transformations in agriculture, the formation of a digital agricultural sector of the economy would largely be associated with an updated system for training young specialists in the agro-industrial complex. So far, unfortunately, the regional agricultural university does not pay due attention to the introduction of new digital specialties, improving the system of training specialists in the field of digitalization of the economy.

In addition, problems with social security, the availability of educational and medical services, the quality of roads, the improvement of settlements and the development of infrastructure have not been resolved [9]. The public opinion about health care: the main factors of increasing satisfaction of the population with medical care). This leads to the fact that people who have received specialized education in agricultural universities do not seek to realize themselves in their chosen profession [10].

Measures for the formation and implementation of personnel policy could not give the desired effect without efforts to improve the social infrastructure of rural areas, its gasification, the construction of kindergartens, schools, maintaining roads in good condition, etc. [11].

Only targeted actions in all these areas would help change the situation with the labor resources of the industry for the better.

In 2020, the state program "Integrated Development of Rural Territories" was launched until 2025 [3].

CONCLUSIONS

Analysis of the presented material shows that there is a gap between the needs of the modern labor market and the existing system of training and employment of specialists. On the one hand, the unstable geopolitical situation forces us to raise again the issue of the country's food security and the need for sustainable economic growth. The latter is impossible without the introduction of innovations, digitalization and changes in the training system. On the other hand, young promising personnel do not want to live in rural areas, so many do not consider the possibility of obtaining a specialized agricultural education and returning home. It should also be noted that an important factor hindering the solution of the problem with personnel is the decrease in the prestige of labor in general and labor on the ground in particular. Market regulators of employment, most likely, could not be able to solve the problem that has arisen. A carefully developed personnel policy of the state in the agro-industrial complex is needed.

It is a logical continuation of the federal measures for rural development, implemented since 2002, and is aimed at social and infrastructural development of the village, diversification of the rural economy, increasing employment and incomes of the rural population.

Unfortunately, it lacks sections on improving the system of training and employment of young specialists in the agro-industrial complex, and the development of these provisions is long overdue.

The following can be distinguished as the main blocks of the state personnel policy in the agro-industrial complex:

-improvement of professional training and employment of agricultural personnel. It is necessary to update the types of academic programs in agricultural universities through the development and implementation of training areas that correspond to the processes of integration into the digital environment, rational environmental management (genetics in animal husbandry and crop production, specialists in digital agricultural technologies, microbiologists and biotechnologists, analysts for assessment laboratories quality, specialists in the economics of the agro-industrial complex, marketing, etc.);

-providing opportunities for professional retraining and advanced training of personnel of agribusiness enterprises;

improvement of social mechanisms for the professionalization of personnel in the agro-industrial complex.

In this way, the essence of the state personnel policy in the agro-industrial complex is to attract, consolidate and adequately use highly qualified specialists at the enterprises of the agro-industrial complex, to create conditions for them to realize their professional potential for the successful performance of their duties and to ensure the effective functioning of the agricultural sector of the economy on this basis.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC GROWTH OF THE AGRARIAN SECTOR AND IMPROVEMENT OF LIVING STANDARD IN THE REPUBLIC OF MOLDOVA IN THE CONTEXT OF THE SUBSIDY PROCESS

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Abstract

The Republic of Moldova is a country deeply dependent on agriculture holding sub-branches with most tangential areas, encompassing the economic and social sphere and defining the way of life in rural areas and the standard of living of the population. Subsidizing agriculture is one of the main mechanisms through which the state can promote its policies in this sector. The aim of this paper is to analyze the subsidy process and its impact on the economic growth of the agricultural sector. The research was carried out based on data provided by the Agricultural Intervention and Payments Agency and the National Bureau of Statistics. Several methods were used in this paper such as: comparison, average and relative magnitudes method, graphical and tabular, logical and synthetic analysis. Based on the results obtained, it was found that the impact of the subsidy process in the agricultural sector is positive, because through it, the state sends a clear message to agricultural producers regarding the priority directions of investment, which generating increased profits will result in an increase in the quality of life of the population.

Key words: *agriculture, quality of life, economic growth, agricultural producers, subsidies*

INTRODUCTION

Agriculture in the Republic of Moldova is a sector of the economy that is as much in demand as it is sensitive. Intensive work is being done at institutional and business level to reduce the effects affecting the expansion of this sector.

Bearing in mind that approximately one third of the population works in the agricultural sector, we conclude that agriculture is important for the socio-economic development of the country.

In all developed countries, subsidies are a considerable source of coverage of expenditure on agricultural production. This source is an important element in stimulating the development of agricultural production in all the countries, including in Republic of Moldova [6, 7, 24].

Financial support enables agriculture in its way to a sustainable development [18, 19, 20, 21] and implicitly, it also could contribute to the improvement of living standard and life quality [25].

Thus, in the Republic of Moldova, in 2010, by Government Decision no. 60/2010, the Agency for Intervention and Payments for Agriculture (hereinafter - AIPA) was created as an administrative body, subordinated to the Ministry of Agriculture and Food Industry, responsible for managing financial resources intended to support agricultural producers, monitoring their distribution and quantitative and qualitative evaluation of the impact generated by the measures of support to farmers by the state [14].

At the moment, AIPA is a public institution operating under Government Decision no. 20/2019, which is intended to manage the resources of the National Fund for the Development of Agriculture and Rural Environment (hereinafter FNDAMR), as well as the resources of development partners allocated for administration and to implement intervention measures for the agricultural sector.

The implementation of its mission focuses on the following areas of activity: ensuring the correct and legal conduct of operations for the management of funds allocated to support agricultural producers; controlling the use of funds allocated to beneficiaries; participating in the development of the directions subject to subsidy; continuous monitoring of compliance with eligibility criteria and contractual conditions for granting non-reimbursable financial aid by grant recipients; information, communication, presentation of innovations occurring in the process of activity [3].

Currently, the subsidy policy in the Republic of Moldova is regulated by the National Agricultural and Rural Development Strategy for 2014-2020 [13] and the Law No. 276/2016 on the principles of subsidy in the development of agriculture and rural environment [16], which provides for the improvement of the subsidy system for agricultural producers in the Republic of Moldova and its adjustment to European best practices [1].

Efficient allocation of subsidies to agricultural producers is a precondition for sustainable development of agriculture and technological modernization of entities in transition economies, such as the Republic of Moldova. Thus, increasing the efficiency of subsidy allocation is a key issue in the context of sustainable development of the agricultural sector. To this end, the state has proposed to develop agricultural policy by increasing financial allocations and granting subsidies to agricultural producers. Granting subsidies is an effective lever both for attracting investment in agriculture and for developing the sector [2].

The State, by Government Decision No 455/2017, provides for the distribution of the National Fund for Agricultural and Rural Development. This Regulation lays down the support measures, as well as the conditions, order and procedure for granting funds from the Fund, including the mandatory conditions required to obtain funds, eligibility criteria, the annual, maximum amount of financial support allocated, the procedures for receiving, inspecting, authorizing, accounting for payments.

The Fund means shall be used within the limits of the allocations approved annually by the State Budget Law, in accordance with the provisions of the Law on the principles of subsidizing agricultural producers and the provisions of this Regulation, which is valid for the period 2017-2022 [12].

At present AIPA implements three ways of subsidy from the National Fund for Development of Agriculture and Rural Environment, namely: Post-investment subsidies, provided for in Government Decision 455/2017 on the method of distribution of funds from the National Fund for the Development of Agriculture and Rural Environment [12], advance subsidies, approved by Government Decision 507/2018 approving the Regulation on the conditions and procedure for granting advance subsidies for start-up projects from the National Fund for the Development of Agriculture and Rural Environment [11] and direct payments, found in Government Decision 836/2020 approving the Regulation on the granting of direct payments per animal head [3].

Post-investment subsidies are non-reimbursable and non-taxable financial support granted from the National Fund for the Development of Agriculture and the Rural Environment to support investments made in the development of agriculture and the rural environment and which meet the eligibility criteria set out in the regulatory framework and, advance subsidies are non-reimbursable and non-taxable financial support granted from the said Fund, to be implemented by young and women farmers who start up projects for the first time in economic activity or in the development of rural localities and who meet the eligibility criteria set out in the regulatory framework [1].

MATERIALS AND METHODS

In this paper the research was carried out based on data provided by the Agency for Intervention and Payments in Agriculture and the National Bureau of Statistics.

Several methods were used to analyze the current status and efficiency of subsidy allocation such as: comparison, average and relative size method, graphical and tabular, logical and synthetic analysis. The period analyzed is the years 2020- 2021, using such indicators as: the volume of agricultural

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

subsidies allocated and their impact on overall agricultural production.

RESULTS AND DISCUSSIONS

According to the author Goian I. "business or entrepreneurship is the economic activity of market agents who take financial risks and who are registered in the established way, oriented towards the systematic achievement of profit through the use of goods or the provision of services" [8].

The stimulation of entrepreneurship in agriculture by the state requires the facilitation of the creation of a competitive sector, the clear separation of rural and social measures from agricultural policy measures and instruments, which would create a framework conducive to stimulating efficiency and competitiveness in the agrifood sector [23].

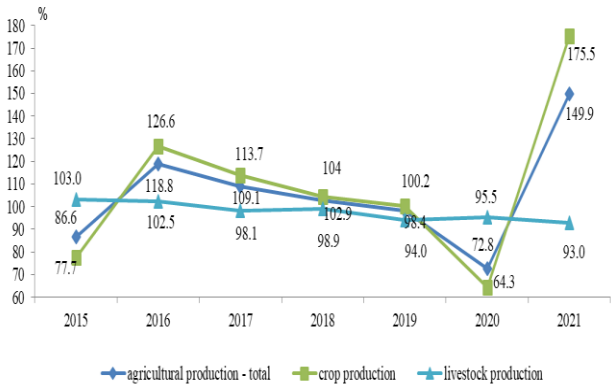

Fig. 1. Dynamics of annual indices of agricultural production volume in households of all categories in 2015-2021.

Source: Based on data provided by the National Bureau of Statistics [17].

According to the data of the National Bureau of Statistics, it is noted that the overall agricultural production in households of all categories (agricultural enterprises, peasant (farmer) households and population households) in 2021, according to preliminary estimates, increased by about 49.9% (in comparable prices) compared to 2020 (against the background of the reduction of the indicator in question in 2020 compared to 2019 by 27.2%). The increase in overall agricultural production was driven by the increase in crop production by 75.5%. In 2021 the share of crop production in total agricultural production was 81% (in 2020 - 69%), while animal production was 19% (in 2020 - 31%) (Figure 1) [17].

In the context of the above, it is understood that the modernization of the agro-industrial sector and the development of rural localities is ensured by setting the following priorities:

I. increasing the competitiveness of the agro-industrial sector through modernization and market restructuring;

II. ensuring sustainable management of natural resources in agriculture;

III. improving the standard of living in rural areas.

By allocating financial means from the National Fund for Agriculture and Rural Development, the following objectives are to be achieved:

- to increase the competitiveness and productivity of the agro-industrial sector;
- to encourage investment in the agro-industrial sector by creating rural infrastructure and modernising the material base of the agri-food sector;
- creating new jobs for the rural population;
- stimulating growth in high value-added production;
- equipping agricultural entities with high-performance agricultural machinery and equipment;
- establishing multiannual plantations;
- development of services in agriculture [2].

Drawing up priority directions, one of them was efficient agricultural activities in the plant and animal sector. In order to increase productivity and competitiveness in agriculture, stabilize the market, ensure food security and a fair income for farmers, direct payments were to be granted according to the agricultural crop, animal and poultry species, the average individual yield in case of correspondence with the regional one, as well as according to the actual area or the number of animals on the holding [5].

According to AIPA estimates, in 2021 the FNDAMR amounted to 1,100 million lei, subsequently increased to the amount of 1,535.0 million lei, increasing by 27.9% compared to the financial means allocated at

the beginning of 2021. FNDAMR was executed as follows:
- State contribution to the National Wine Fund - 26.1 million lei;
- commitments to agricultural producers who made investments in 2020 but did not receive subsidies due to the exhaustion of FNDAMR - 764.8 million lei;
- advance subsidies for young and women farmers for the development of start-up projects - 11.1 million lei;
- advance grants for the implementation of rural development measures - 56.5 million lei;
- direct payments per animal - 105,8 million lei;
- post-investment subsidy to agricultural producers based on applications received in 2021 - 480.1 million lei;
- drought compensation - 2.0 million lei, graphically represented as follows in Figure 2.

According to Timofti E., "the objective of integrating the Republic of Moldova into the European economic system, as a competitive partner, requires a change in the conditions of activity of agricultural units with various forms of ownership and legal forms of organization, which requires a new approach to research. The results of this research should not only determine the changes in the dynamics of enterprise development, the links between phenomena, but also serve as a basis for making important decisions in the field of forecasting the development of the agricultural sector" [22].

Despite the fact that in 2020 agricultural producers suffered losses due to natural disasters, the amount of subsidies claimed by agricultural producers in 2021 compared to the amount of subsidy claimed in 2020 increased by 132.7 million lei. From the financial sources of FNDAMR for 2021, AIPA paid as post-investment subsidies 1244.9 million lei or 81.1% of the fund's value.

As a result of the subsidies applied for this year, it was possible to attract investments in the agro-industrial sector and related branches of this sector of about 4.5 billion lei. The investments made by grant applicants have created 1,334 new jobs, of which 651 seasonal jobs. The distribution of the fund by support measures/sub-measures is shown in Table 1 [2].

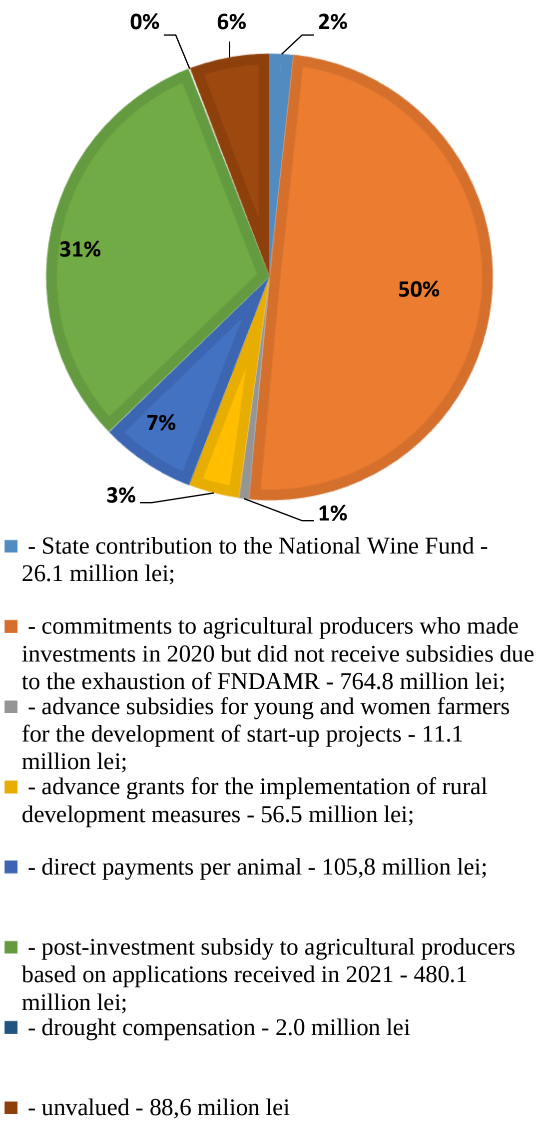

Fig. 2. Use of financial means allocated to FNDAMR in 2021
Source: According to AIPA estimates [2].

The state, through Law No. 179/2016 on small and medium-sized enterprises, aims to promote the sustainable development of micro, small and medium-sized enterprises by improving the legal framework and the economic environment in which they are created and operate [15].Thus, the AIPA, depending on the average annual number of employees, annual turnover or total assets they own, classifies grant applicants as micro, small or medium-sized enterprises.

Table 1. Number of files received/authorized by AIPA and amounts requested/authorized from NAMRF funds in 2021

Areas and forms of support	No. of dossiers received	Amount of grant requested, MDL million	No. of dossiers paid	Amount of grant paid, MDL million	Share of financial sources by area, %
Priority I. Increasing the competitiveness of the agri-food sector through restructuring and modernization					**87.13**
Production of vegetables and fruit on protected land	135	19.05	65	8.05	1.41
Stimulating investments for the establishment, modernisation and clearing of multiannual plantations	883	180.21	463	61.83	13.36
Stimulating investments for the purchase of agricultural machinery and equipment	2,414	297.38	1,278	154.23	22.05
Stimulating investment in equipment and technological renovation of livestock farms	234	76.75	84	10.86	5.69
Stimulating the purchase of breeding animals and maintaining their gene pool	57	22.8	21	12.97	1.69
Stimulating investment for the development of post-harvest and processing infrastructure	667	369.95	230	90.17	27.43
Lending to agricultural producers	2,775	157.21	531	38.69	11.66
Agricultural risk insurance	463	47.41	420	41.3	3.52
Stimulating the establishment and operation of agricultural producer groups	14	4.12	11	1.77	0.31
Stimulating promotion activities on external markets	7	0.31	2	0.03	0.02
Priority II. Ensuring sustainable management of natural resources					**9.20**
Stimulating investment in the purchase of irrigation equipment	353	75.42	167	24.23	5.59
Stimulating agricultural producers to compensate irrigation expenses	21	2.46	0	0	0.18
Stimulating investment in purchasing No-Till and Mini-Till equipment	261	38.78	133	19.17	2.88
Promotion and development of organic farming	59	7.48	11	1.25	0.55
Priority III. Increasing investment in physical and service infrastructure in rural areas, including infrastructure related to off-farm businesses					**3.66**
Improving and developing rural infrastructure	165	48.47	51	15.62	3.59
Advisory services and training	14	0.93	0	0	0.07
TOTAL subsidies requested in 2021	**8,522.00**	**1,348.73**	**3,467.00**	**480.17**	**100.00**

Source: AIPA ESBS as at 31 December 2021.

Note: From the amount of FNDAMR for the year 2021, in addition to the 3467 applications for financial support received in 2021, 5,356 applications for grants in the amount of 763.1 million lei were paid, which remained without financial coverage due to the exhaustion of the fund's means in 2020 [2].

In this sense, a small enterprise has from 10 to 49 employees, has an annual turnover of up to MDL 25 million or has total assets of up to MDL 25 million. Of the total number of subsidy applications, the number of small agricultural producers is on the rise, in 2021, they constitute 63% or 2,910 producers and applied for subsidy, amounting to 506.1 million MDL or 37.5% of the total amount of subsidy applications (Fig. 3).

In the context of AIPA reporting, it can be seen that medium-sized agricultural producers play a secondary role. In 2021, 1,337 agricultural producers applied for subsidies, which constitutes 29% of the total number of applicants, in the total amount of 543.2 million lei or 40.3% of the total amount of subsidy applications. Their number, compared to 2020, also increased by 93 producers.

In insignificant increase are also large agricultural producers. Thus, in 2021, the number of large agricultural producers constituted 7.8%, increasing compared to 2020 by 1.7% or 6 entities. The 361 large agricultural producers applied for subsidy in 2021 in the total amount of 299.3 million lei or 22.2% of the total amount of subsidy applications [2].

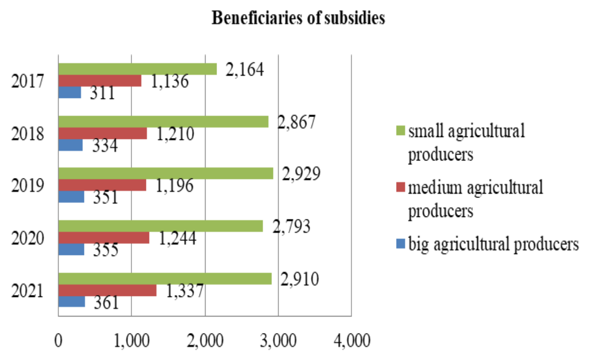

Fig. 3 Classification of subsidy beneficiaries according to the provisions of Law no. 276/2016
Source: AIPA's ESBS as of 31 December 2021 [2, 16].

At the same time, recently, the State, in the context of the implementation of the Government Decision No 476/2019 for the approval of the Regulation on the granting of subsidies for improving the living and working standards in rural areas from the National Fund for the Development of Agriculture and Rural Environment, annually, from the amount of the National Fund for the Development of Agriculture and Rural Environment, for each measure has directed up to 5% or 55 million lei for the granting of subsidies in advance. Thus, for the first time, in 2020, advance subsidies for improving living and working standards in rural areas have been allocated from the FNDAMR sources. The financial sources are directed towards the implementation of projects for the development of local infrastructure, as well as the diversification of non-agricultural activities and the subjects of the advance grants are both local public authorities and economic entities with a non-agricultural profile [10].

Thus from what AIPA reports, we can see that access/application for subsidies by agricultural producers is increasing. In 2021, the most investments were made by small and medium agricultural producers who will access 77.8% of the value of subsidies received. Similar situation is observed in the subsidies accessed by small and medium agricultural producers in 2019 -2020, when medium agricultural producers accessed 42.0% and small agricultural producers accessed 40% of the value of subsidies accessed by all subsidy recipients (Fig. 4).

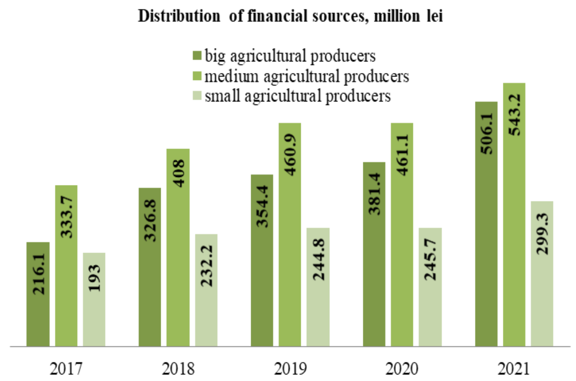

Fig. 4. Subsidies claimed by agricultural producers in 2021
Source: AIPA's ESBS as at 31 December 2021 [2].

Experts from the Food and Agriculture Organization of the United Nations (FAO) have assessed the effectiveness of subsidy activities in agriculture and rural areas. The study was based on a survey of about 200 farmers who received cash support in 2017-2018.

Thus, the authors argue that the majority of farmers surveyed are willing to invest their own financial resources and are not limited by credit constraints.

Similarly, according to the survey, the following categories of farmers are prolific:
- small-scale producers (19.9%);
- female producers (18.1%);
- producers aged between 40 and 49 (25.9%);
- members of associations (14%);
- those who invested in the measure "Stimulating investments for fruit and vegetable production on protected land (winter greenhouses, solariums, tunnels) in 2017" (40.2%) and in the measure "Stimulating investments for equipment and technological renovation of livestock farms in 2018" (23.6%);
- holders of quality certificates (29%).

At the same time, according to the data in the report, the state investments were effective, as the surveyed beneficiaries performed better in terms of profit which increased by 51.25%, i.e. from 209 million lei in 2016 (before investments) to 317 million lei in 2019 (after investments).

Other indicators highlighted in the survey are:

- Labour productivity increased by 20% from 2016 to 2019;
- household mechanisation has advanced by 30%;
- land under cultivation increased by 7%;
- productivity (tonnes/hectare) of main products has exceeded 14%;
- quality certificates generate positive effects for agricultural producers;
- business plan deadlines are met at a level of 83% in the population average, etc.

On the basis of the questionnaire, FAO experts have developed a monitoring tool to enable AIPA to assess the effects of the subsidy policy in the short term [4].

CONCLUSIONS

In recent years, AIPA has achieved positive results in ensuring transparency by providing comprehensive information on the management of financial resources allocated from the fund for subsidising agricultural producers and providing public interest information on the lists of agricultural producers - beneficiaries of subsidies. Similarly, the agency has ensured consultation and participation of representatives of the business community and civil society, other social partners in the design, development and implementation of public policies.

The trend of increasing the value of the FNDAMR from 1,100 million lei at the beginning of 2021 to 1,535 million lei by the end of the same year in 2020 is observed. As a result, new jobs are created and investments in the agro-industrial sector and its related branches are increased.

Approximately 78% of the FNDAMR sources are accessed by small and medium agricultural producers investing in the development of agriculture and rural environment, and 87% of the FNDAMR value is absorbed by priority I "Increasing the competitiveness of the agri-food sector through restructuring and modernization" of the National Strategy for Agricultural and Rural Development.

It is certain that for all sub-measures for post-investment subsidy, there was an increase in the number of applications submitted in the 2021 grant year compared to the 2020 grant year, i.e. the FNDAMR was 94.2% utilized in 2021.

Payments to farmers are authorized late due to the exhaustion of financial sources from the FNDAMR but also due to insufficient staff working in the Agency, thus causing great losses to beneficiaries.

It would be advisable to digitize by linking information systems with other competent institutions, being directly oriented towards facilitating the process of submitting grant applications.

In order to increase productivity and competitiveness in agriculture, stabilize the market, ensure food security and a fair income for farmers, it makes sense to grant direct payments according to the agricultural crop, animal and poultry species, the average individual yield if it corresponds to the regional one, and the actual area or livestock owned;

Quantitative and qualitative assessment of the impact of subsidies on the development of the agri-food sector, using a wider range of indicators, shows and illustrates the real effect of financial support from the state, which is reflected in increased productivity, production volume, sales revenue, value of exported production, new jobs, appearance of production and subsequently in a positive influence on the standard of living and an increase in the quality of life of the population.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CONSUMER BEHAVIOUR AND SENSORY TESTING OF HONEY BY ROMANIAN UNIVERSITY STUDENTS

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Abstract

Honey consumption has started to increase in recent years in Romania, according to statistics. In this context, the main objective of the paper was to study consumer behaviour and sensory perception of honey by Romanian young segment. The research was based on blind sensory testing of two honey samples (one commercial sample with country of origin indicated as "Blend of EU and non-EU honeys" and one from a local Romanian beekeeper). The sensory analysis was complemented with a questionnaire survey. In total, 100 university students from Cluj region participated. The results showed that the majority of participants consume honey only occasionally and their annual consumption is lower than 1 kg. Honey is mostly used as sweetener in beverages (tea, lemonades). The most preferred type of honey is acacia, followed by linden honey. Sensory testing showed that young people perceived the quality of honey and their preference by using mostly the taste. In addition, interesting results were acquired by respondents which decision was based also on aroma. Almost 83% of them indicated preference for honey from Romanian beekeeper.

Key words: *honey consumers, sensory attributes, youth, Romania*

INTRODUCTION

Nowadays, consumers are aware of the need to choose quality foods regarding their nutritional value and positive health effects due to changes in consumers' lifestyles and eating habits [4, 8, 10]. The mentioned can be considered a relatively new trend in the food market, in which the honey consumption is undoubtedly included [3, 16].

Honey has become more preferred among consumers in recent years and its consumption is constantly increasing [6]. This may be justified in particular by the fact that honey can be considered a complex food due to its significant nutritional value and biological variability. In addition, honey contains many vitamins, minerals, enzymes, amino acids as well as antioxidant compounds [2, 24, 37, 11].

The importance of honey is also growing mainly due to its perception as a natural sweetener and is accepted as a healthy alternative to sugar. Beside of the using honey as a food, honey also has other antimicrobial and medicinal properties. Honey is most often used to treat skin problems, but it also has anti-inflammatory, immune boosting property. Moreover, honey prevents and treats gastrointestinal disorders and poses prebiotic effects and promotes health of gastrointestinal tract [1, 14, 30, 38].

Furthermore, honey can also be used in apitherapy, which is an important part of complementary and alternative medicine [36, 32]. Honey, as well as other bee products such as propolis, bee venom, bee pollen, are commonly used in pharmacy as nutritional supplements or drug ingredients [16, 12]. Furthermore, honey, beeswax, bee pollen, propolis, royal jelly or bee venom can also be added to cosmetic products, which are increasingly used by consumers due to their exceptional effects on health and beauty [7, 15].

However, based on the mentioned properties of honey and the positive effects on health, honey is most often used and consumed primarily as food or an ingredient in various food recipes [5]. To support and increase honey consumption, nutritional marketing tools are used and they consist of principles 5N, namely nutritive qualities, nutritive quality, nutritive benefits, nutritive strategy and nutritive integration. Honey is considered a nutritious product and is very suitable for nutrition marketing applications. Analysis of nutritive qualities in honey and nutritive quality of honey (principles 1N and 2N) relate to the composition of honey and the qualitative aspects of honey. As mentioned above, honey contains important nutrients and is composed of 70 different substances, such as carbohydrates, enzymes, organic acids, amino acids, minerals, vitamins and so on [9]. Furthermore, honey is classified as a product with high energy and nutritional value. These components emphasize the nutritional quality of honey as a key aspect determining consumers when buying and consuming honey as a safe and good-quality food. Principle 3N (nutritive benefits of honey) represents the medical effects of honey, which is based on its antibacterial properties as well as the overall composition of honey. Due to its health benefits, it is suitable for daily consumption for all age groups of consumers [9]. However, its consumption is especially recommended in the diet of children, sportsmen, but also adults who work a difficult physical or mental job. The following principle 4N (nutritive strategy of honey) deals with the analysis of the competitive environment regarding the healthy food sector. It focuses on new ways of emphasizing nutritional properties, as well as emphasizing the importance of the relationship between companies' marketing campaigns and the healthy food industry [9].

The last principle 5N represents the principle of nutritional integration based on the exchange of ideas, opinions and innovations related to honey and its quality at the international level. In addition, the application of effective marketing and promotion processes aimed at honey production, composition and quality as key aspects for the consumer is an integral part of this principle. In this context, it is desirable to organize seminars, workshops and lectures focused on the sector of healthy food and its nutritional properties [9].

Even though interest in honey is constantly growing, younger consumers are indifferent towards honey [5] and in several countries there was founded a lower consumption of honey by the younger consumers compared to the older ones. [20] and [22] state that in Romania, young consumers aged 18 to 30 and the middle generation of consumers aged 31 to 45 are medium frequency consumers compared to the older generation of consumers aged 46 to 60, who have a higher frequency of honey consumption. Furthermore, [10] identified similar consumer behaviour of the young generation based on the conducted survey in Russia and Slovakia. They state that the annual consumption of honey by the younger generation of consumers is at a lower level compared to the older generations. Further research conducted by [27] in the Czech Republic showed that young consumers do not prefer to consume honey and it is therefore necessary in the future to focus on the youngest age group and emphasize the importance of honey consumption, its composition and quality in terms of the concept of nutrition marketing. [19], who examined consumer behaviour in Poland, emphasizes the need to advertise honey among young people because of low honey consumption by this social group. In this context, it is therefore possible to increase honey consumption among this generation of consumers by educating consumers to a healthy lifestyle [21].

In this context, the purpose of this study is to identify consumer behaviour of young honey consumers in Romania as well as to understand their perception of honey quality based on its intrinsic attributes.

MATERIALS AND METHODS

Research design is based on primary data obtained by conducting sensory blind testing complemented with questionnaire survey. The research was conducted in 2021 and 100 respondents participated.

In sensory blind testing, respondents evaluated two samples of honey (sample A was purchased directly from Romanian beekeeper and sample B was purchased in selected supermarket with country of origin indicated as "Blend of EU and non-EU honeys"). Respondents evaluated intrinsic attributes such as taste, colour, aroma and consistency without knowing any extrinsic attributes (price, brand, producer, label…). Evaluation was performed by applying 5-points scale. Afterwards, respondents were asked which sample they preferred more and based on which attributes they have decided. The similar research design was applied in Slovak honey market [28].

Questionnaire survey included mostly closed questions regarding honey consumption patterns, purchasing behaviour, consumer preference and consumer perception of honey as healthy food. The research sample included university students from Cluj region both males (68) and females (32). Respondents represented young segment (18 – 24 years), living in urban areas (57) with monthly net income less than 1,800 lei.

Results were analysed by using descriptive statistics and non-parametric tests such as Fisher's Exact Test, Friedman's test, Chi-square test of independence, Wilcoxon signed-rank test and Nemenyi's procedure. Data were processed by using Xlstat.

RESULTS AND DISCUSSIONS

Sensory blind testing revealed that honey purchased directly from Romanian beekeepers obtained better evaluation in all examined intrinsic attributes (Figure 1). In addition, by applying Wilcoxon signed-rank test were identified statistically significant differences in terms of taste (p-value = 0.000), aroma (p-value = 0.000) and consistency (p-value = 0.000). Colour was evaluated in similar way. However, only 59 respondents indicated preferences for honey from beekeeper (sample A) and 60 identified it as sample from beekeeper. Respondents mostly decided based on taste (88) and aroma (48). Aroma and taste are more dominant in case of honey purchased directly from beekeeper [26]. Interesting results were obtained by analysing only respondents who decided their preference based on aroma. Approximately 83% indicated preferences for domestic honey (sample A).

Furthermore, the influence of gender and place of residence on indication of preference was examined by Fisher's Exact Test. Results showed that there does not exist any statistically significant dependency both in case of gender (p-value = 0.568) and place of residence (p-value = 0.483).

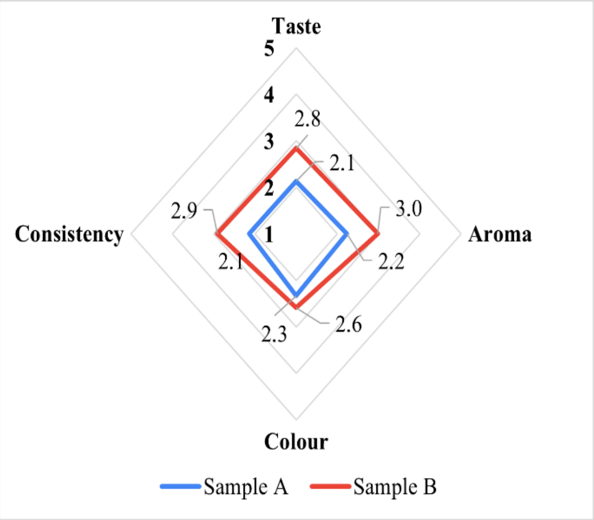

Fig. 1. Results of blind sensory testing
Source: own calculation.

The similar study was conducted in Slovakia with generation Z and generation Y. Results showed that young honey consumers were confused in sensory blind testing and only 53% indicated preference for local Slovak honey. Moreover, respondents who decided based on aroma attribute (>90%) identified local honey from Slovak beekeeper [28]. These results are in line with our study. Sensory testing in consumer research generates essential information towards consumer´s perception of product including its quality which provides important tool used for product policy development [34, 33].

Results of questionnaire survey identified profile of young segment in terms of consumer behaviour on honey market in Romania. It can be stated that honey is consumed both as food (92) and medicine (54) and only occasionally (36) or once a week/month (40). The majority of them indicated annual consumption of honey lower than 1 kilogram (77). The similar results were

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

acquired in case of Hungarian honey consumers who consume this product only few times per year or monthly [35]. Honey is mostly consumed during the winter period (66) as a sweetener to beverages such tea or coffee (40) in the morning (41) or in the evening (32). Despite the honey is mostly consumed by the whole family (64), annual consumption in family was indicated only up to 2 kilograms (58). Moreover, 58 answered that honey consumed on regular bases during their childhood. Chi-square test of independence confirmed dependency between consumption of honey in childhood and current annual consumption (p-value = 0.000). It can be stated that respondents who indicated regular consumption of honey in their childhood consume higher amounts of honey in their adulthood (Figure 2).

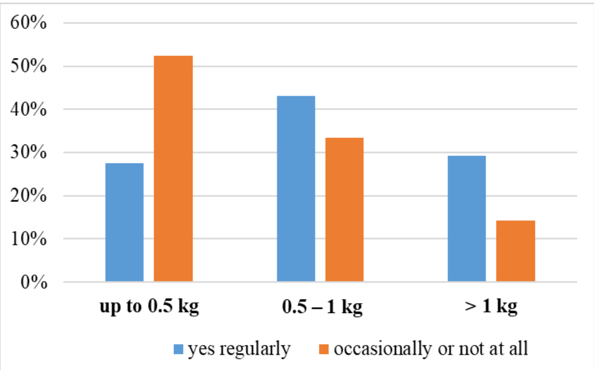

Fig. 2. Dependency between honey consumption in childhood and current annual consumption
Source: Own calculation.

Even though, honey is consumed by all respondents, only 45 purchased it. The rest of them stated that honey is purchased by other family member or is received as a gift. Honey is purchase if necessary (21) or once in 3 months (14). Moreover, respondents indicated that they mostly prefer 1 kilogram packaging (720 ml) as well as it represents the common amount of honey bought per one purchase. The most preferred packaging material is glass.

Respondents also evaluated selected factors which are considered during the purchase of honey. It was assumed, that there will exist certain differences in the level of importance among these factors. Friedman´s test confirmed these statistically significant differences (Table 1).

Table 1. Friedman's test

Q (Observed value)	**307,918**
Q (Critical value)	12,592
DF	6
p-value (one-tailed)	<0,0001
Alpha	0,050

Source: Own calculation.

Furthermore, a post hoc test Nemenyi's procedure were applied for multiple pairwise comparisons. Results showed that young university students perceived quality and honey taste as the most important factors during purchase (Figure 3). While honey labelling was evaluated as the least important factor. Price obtained the similar evaluation as country of origin and consistency. The optimal prices for this segment were stipulated between 24-27 lei per kilogram (53) or 28 – 45 lei (32). Study conducted by [29] reflected that generation Z (18-24 years) perceived the importance of those factors in similar way. Based on obtained evaluation, honey quality, its taste and country of origin created latent factor entitled as “factor of overall quality“. Another consumer study conducted in Hungary proved that region of origin, brand and certification are important however, country of origin was evaluated with higher importance [18].

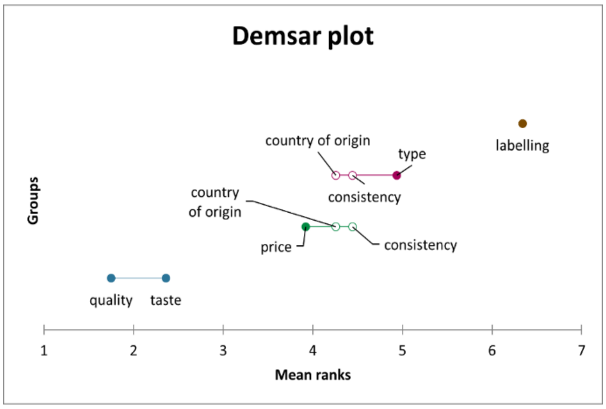

Fig. 3. Resulted groups from the Nemeny's pairwise procedure in Demsar plot.
Source: Own calculation.

However, consumer research in Ireland identified price and texture as the essential attributes of honey. Colour was evaluated as the least important attribute [17]. According to [13], Romanian honey consumers pay a very low attention to honey labelling especially to energy content. However, when honey is purchased in bulk, the quality of honey is based more on intrinsic attributes such as aroma, taste, thickness, and colour). Extrinsic attributes such as brand, warranties or country of origin are less important.

Honey is mostly purchased from beekeeper or from farmer markets. Purchase directly from beekeeper is the most common form of purchase both in Slovakia and Czech Republic [29, 25]. In terms of honey preference, respondents prefer in average honey of light colour (2.60), aromatic (1.99), liquid consistency (2.27), floral origin (2.23), domestic origin (1.78) purchased from beekeeper (1.69) and produced in conventional beekeeping (2.28). Preferences for honey price was indicated as indifferent. Acacia honey is the most preferred honey in Romania (68) followed by linden honey (26). Honeydew honey is not known among this segment (47), or they have neutral preference (37). Creamed consistence of honey is mostly not known among this segment (78). Regarding the honey with additions, it can be stated this segment stipulated preference for honey with nuts, bee pollen, honey with piece of honeycomb and honey with cinnamon. Honey with chilli, poppy and ginger was evaluated as not so attractive. The optimal price for 250 grams of honey with addition was determined as less than 23 lei (37) or between 24 – 27 lei (36).

The similar study was conducted by [31] where authors studied perception of young consumers between 18 – 24 years towards honey enriched with cocoa powder.

Results showed that this product was perceived as natural, innovative and the majority of young honey consumers would purchase it.

The optimal price was stipulated from 2 – 3 euros or even higher. In addition, it can be stated that most of the respondents thinks that honey possess healing effects and increases its consumption during illness period. The opinion towards honey being healthier than sugar was indicated by 90 respondents. Nevertheless, honey is used as alternative to sugar by majority only sometimes (68). The aforementioned is in line with previous research focused on young Romanian consumers between 18 – 30 years [23].

CONCLUSIONS

Acquired results provide important insight into consumer behaviour of Romanian generation Z towards honey. It can be concluded that this segment consumes low quantity of honey mostly during winter period in beverages as alternative sweetener to sugar. Honey is used both as food and medicine.

The most preferred honey is light aromatic honey in liquid form. Acacia honey is the most preferred monofloral honey.

The most important factors during purchase of honey are its quality and taste.

Honey is mostly purchased directly from beekeepers in glass packaging.

The optimal price per kilogram ranges from 24 – 27 lei.

Results of this study may serve as fundamental basis for producers to create effective product and communication policy as well as better product positioning aimed on young segment in Romanian honey market.

ACKNOWLEDGEMENTS

This paper was supported by the project VEGA No. 1/0415/21 “Interdisciplinary research on consumer behaviour on the honey market with an emphasis on its quality and nutritional value” from The Ministry of Education, Science, Research, and Sport of the Slovak Republic, by the Grant Agency of The Slovak University of Agriculture in Nitra, grant number 14-GASPU-2021 “Analysis of consumer behaviour towards honeys enriched with health-promoting substances” and by the Operational Programme Integrated Infrastructure within the project: Demand-driven research for the sustainable and innovative food, Drive4SIFood 313011V336, co-financed by the European Regional Development Fund.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE MECHANISM OF DIGITAL TRANSFORMATION OF AGRIBUSINESS IN RUSSIA

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Abstract

The analysis of publications of Russian and world scientists on the issues of digitalization of various sectors of the economy demonstrated a wide range of author's approaches to the sequence, speed and scale of the introduction of IT technologies, and also spectacularly showed the backlog of agriculture and the agroindustrial complex in the direction of introducing innovations. The purpose of the paper is to develop measures to accelerate and improve the efficiency of digital transformations in agriculture, the formation of the digital agricultural sector of the Russian economy. Research methods: monographic, logical, abstract-logical, computational-constructive, statistical-economic and comparative analysis. The main results of the study: the organizational and economic mechanism of digital transformation of an agricultural organization is proposed. The mechanism is a three-stage modernization process (starting, transit, terminal stages), implemented through organizational (management, administration, legal and regulatory support) and economic (costs, calculations, budget financing, subsidies) elements. Final conclusions: the development of the agroindustrial complex on the basis of the proposed mechanism will increase the efficiency and competitiveness of the products of Russian enterprises in the international market.

Key words: *agribusiness, digital transformation, mechanism, Russia*

INTRODUCTION

At the present stage of development, digitalization is a determining factor in the efficiency and competitiveness of activities, the organization of relationships with customers, service and supply organizations, and, accordingly, the success of the entire business of the enterprise. In Russia today, various digitalization projects are being implemented in many sectors of the economy and the agroindustrial complex (AIC), which requires the transformation of traditional methods of production and economic activity [10]. Among such state projects in the field of digitalization of the economy: the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030, the Strategy of Scientific and Technological Development of the Russian Federation, the National Program "Digital Economy of the Russian Federation", the National Technological Initiative (NTI) and the National Project "Science" [9, 3]. In the agricultural sector, the Ministry of Agriculture of Russia has been implementing the Departmental project "Digital Agriculture" since 2020. At the same time, in the process of studying the works of Russian and world scientists devoted to the digitalization of various sectors of the economy, agriculture and the agro-industrial complex as a whole, differences in the author's approaches to the sequence and breadth of innovation implementation and a common understanding of the term "digitalization of agriculture" were revealed. In a general sense, the digitalization of the agroindustrial complex can be defined as the process of integrating digital technologies (Artificial Intelligence (AI), the Internet of Things, unmanned technologies, Big Data, robotics, Data Science and others) into various elements of the activities of agricultural, processing, marketing, supplying and servicing organizations to create consumer value of products, starting from production planning and ending with the satisfaction of consumer demand. At the same time, the analysis of data on the level of digitalization of various sectors of the country's economy demonstrates that the development of digital technologies in Russia corresponds to the global average, and in some indicators is ahead of some developed countries [4]. But at the same time, agriculture lags far behind the leading industries in terms of digitalization, which opens up broad prospects for the introduction of information technology or IT. In this context, the purpose of the paper is to develop a unified organizational and economic mechanism for digitalization of the agro-industrial complex to improve the efficiency and organization of these processes taking place at the regional level. This mechanism should be considered as a dynamic process, including the main stages of its implementation and involving bifurcation in organizational (management, administration, legal and regulatory support) and economic elements (calculations, costs, budget financing and subsidies), as well as various levels of implementation of the proposed activities [2, 15]. Such a mechanism assumes a targeted purpose for implementation at the level of agribusiness management bodies, agricultural, processing, marketing, supplying and servicing enterprises of the regions [11]. And the result of the implementation of the mechanism in practice by reducing the costs of commodity circulation will create prerequisites and conditions for improving the efficiency of enterprises and the competitiveness of agricultural products. All of the above make the solution of the issue of streamlining the processes of introducing information technologies into the practice of enterprises through the development of a single universal mechanism for digitalization of the agroindustrial complex the most relevant and timely.

MATERIALS AND METHODS

When preparing the article, data from the Ministries of Economic Development, Agriculture, Science and Higher Education of the Russian Federation, the Federal State Statistics Service of Russia, information from higher educational institutions and scientific institutes around the world were used. The works of world scientists on various organizational and economic aspects of digitalization of various sectors of the economy, such as D. Tapscott [18], N. Lane [8], M. Smith, J. Beyley, E. Brynjolfsson [17], L. Margherio [12], R. Kling, R. Lamb [6], T. Mesenbourg [13]. Monographic and logical methods were used to study the theoretical and methodological foundations of digitalization of enterprises' activities. The study of the current state of information technology development of individual sectors of the Russian economy was carried out on the basis of statistical and economic analysis, as well as by the method of comparative analysis. The determination of the directions of digital transformation of the activities of agroindustrial enterprises was carried out using abstract-logical and computational-constructive methods.

RESULTS AND DISCUSSIONS

Currently, the processes of digitalization of the economy are actively underway in Russia, while one of the important obstacles is the high level of shortage of information technology specialists. In the whole country, the total number of people employed in professions related to the intensive use of information and communication technologies (ICT) in 2019 amounted to 8,598 million people. But among all types of economic activity in Russia, agriculture is still in last place in terms of the number of employed IT specialists (Table 1). According to the Ministry of Agriculture of Russia, there are half as many of them as in other countries with a traditionally developed agricultural sector. According to experts, the modern agricultural sector needs about 90 thousand IT specialists [7]. And without sufficient knowledge and experience of working with IT technologies, it is impossible to fully use software or hardware solutions, comprehensively reveal their potential, and, therefore, get the expected economic effect. Therefore, companies are forced to attract specialists from other industries who do not have experience in the AIC. This also contributes to the great popularity of outsourcing among agricultural enterprises, which prefer to transfer all digitalization activities to specialized information technology companies.

Table 1. Employed in professions related to intensive use of ICT, by type of economic activity in Russia in 2019 (in % of the number of employed)

Indicators	ICT specialists, %	Other specialists who use ICT intensively, %	Total specialists working in ICT, %
Information and communication activities	42.3	10.4	52.7
Financial and insurance activities	5.4	42.0	47.4
Professional, scientific and technical activities	6.1	30.9	37.0
Public administration and military security; social security	1.7	22.2	23.9
Energy supply	2.2	9.8	12.0
Wholesale and retail trade	0.9	11.1	12.0
Real estate transactions	1.0	11.0	12.0
Education	0.6	9.2	9.8
Manufacturing industry	2.6	5.7	8.3
Construction	0.9	6.2	7.1
Activities in the field of culture, sports, leisure and entertainment	1.3	5.5	6.8
Mining	1.8	4.9	6.7
Water supply, sanitation, organization of waste collection and disposal	1.8	4.6	6.4
Health and social services	0.7	5.2	5.9
Transportation and storage	1.3	4.0	5.3
Activities of hotels and catering establishments	0.3	4.3	4.6
Agriculture, forestry, hunting, fishing and fish farming	0.3	2.2	2.5
Total by industry	**2.3**	**9.7**	**12.0**

Source: Compiled by the authors according to the Higher School of Economics (HSE) [1].

Due to the significantly increased interest in digitalization at both the public and private levels in recent years, Russia's gross domestic expenditures on the development of the digital economy increased from 3.6% to 3.7% of Gross Domestic Product (GDP) from 2017 to 2019 – up to 63.34 billion US dollars. At the same time, the internal costs of organizations for the creation, distribution and use of digital technologies and related products and services increased from 1.9 to 2.2% of GDP, amounting to $38.62 billion [1]. Household spending on the use of digital technologies and related products and services increased from 1.3% to 1.5% of GDP, amounting to $24.71 billion.

Table 2 shows the structure of expenses of organizations and households in Russia for various elements of digitalization of business and everyday life.

Table 2. The cost structure of organizations and households in Russia for the creation, distribution and use of IT and related products and services in 2019

Purpose	Structure, %
Organizations	
Acquisition of machinery and equipment related to digital technologies	44.4
Acquisition of software, its adaptation and revision	24.5
Payment for telecommunication services	18.7
Research and development	0.8
Acquisition of digital content	0.6
Employee training related to the introduction and use of digital technologies	0.2
Other internal costs for the introduction and use of digital technologies	10.8
Total	**100**
Households	
Payment for telecommunication services	59.9
Purchase of mobile phones, smartphones	13.4
Acquisition of digital content	11.0
Acquisition of television and audio equipment	6.5
Acquisition of computer equipment and office equipment	5.2
Expenses for the operation and repair of ICT equipment	4.0
Total	**100**

Source: Compiled by the authors according to the HSE [1].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

It can be noted here that organizations in 2019 had the largest share of the costs of purchasing fixed electronics, and taking into account the shortage of semiconductor products, partly caused by the COVID-19 pandemic, in 2020–2021 their share should increase significantly. In second place are the costs of acquiring intangible assets in the form of various programs, and in third place are the costs of communication services. At the same time, the latter occupy more than half of the structure of household expenditures on the use of digital technologies. Then, just like for organizations, there are costs for mobile "hard" and entertainment "soft", respectively.

In general, today Russia occupies an average position in the world community in terms of the level of digital technology development, and even outstrips some developed countries in some indicators. Data from the Higher School of Economics (HSE) indicate that Russia (32) occupies an average position in the business digitalization index (for comparison, Romania has a value of this indicator of 27, Finland – 52) [1]. The same applies to the presence of websites in organizations: in Russia – 49% of enterprises maintain their own website, and in Finland – 96%. The main indicators of business digitalization in organizations of various sectors of the economy (Table 3) demonstrate that the telecommunications sector, trade, manufacturing, IT, hotel business and catering are leading in the business digitalization index.

Table 3. Indicators of business digitalization in organizations of various sectors of the Russian economy in 2019

Types of activities	Business Digitalization Index	Percentage of organizations with broadband Internet access, %	Providing employees with mobile devices to access the Internet:		Internet usage in organizations (% of all organizations)		The share of organizations using cloud services, %	The share of organizations using RFID technologies, %
			% of the total number of organizations	% of the total number of employees	for purchases	for sales		
Entrepreneurial sector, total (average)	**32.2**	**86.0**	**47.1**	**5.0**	**20.1**	**14.6**	**29.1**	**8.2**
Telecommunications	44.5	92.0	58.8	16.9	30.4	28.1	42.4	13.9
Wholesale and retail trade	39.2	90.0	56.8	9.2	18.2	21.7	37.8	9.0
Manufacturing industry	35.8	90.4	52.7	2.8	21.6	19.6	27.6	12.0
Information technology industry	35.6	95.7	57.2	21.7	24.0	11.4	38.3	9.1
Activities of hotels and catering establishments	34.1	81.5	47.1	3.5	26.4	20.7	35.5	11.9
Energy supply	30.2	87.4	47.7	3.2	34.2	13.1	20.9	8.7
Mining	29.4	82.6	51.2	3.1	16.8	8.7	20.7	12.2
Transportation and storage	29.3	80.8	44.6	3.3	23.0	11.7	22.9	11.1
Professional, scientific and technical activities	26.6	85.2	37.6	6.2	–	–	24.4	4.8
Construction	25.3	78.1	44.4	2.8	16.6	8.6	22.3	6.4
Water supply, sanitation, organization of waste collection and disposal	24.9	78.8	35.2	2.5	24.7	10.6	24.1	4.3
Real estate transactions	23.8	78.8	28.5	3.8	17.7	7.1	21.7	4.1

Source: Compiled by the authors according to the HSE [1].

The same sectors, with the exception of the last two, are ahead of the rest in terms of Internet availability. They, as well as the mining sector, are leading in providing employees with mobile devices. At the same time, according to the share of employees among the entire staff provided with mobile devices, enterprises in the field of information technology and telecommunications are out of competition. Energy and telecommunications companies most often use the Internet for purchases, the latter, as well as trade enterprises, hotels and catering, also lead in sales via the Internet. In Russia, 29% of organizations use cloud services, in Finland – 65%, and in France – 19%. Cloud technologies are most widely used by communication, IT, trade enterprises, hoteliers and restaurateurs. In terms of the use of wireless RFID technologies (Radio Frequency Identification), South Korea is the leader, where 46% of organizations use them, in Finland – 23%, and in Russia and the UK (8% each) wireless technologies have not yet found wide application. So, in our country, even in the leading telecommunications sector, only 13.9% of enterprises use them, followed by mining, processing, hotel organizations and catering.

If we consider in more detail the dynamics of the use of Internet technologies in the organizations of the Russian business sector (Table 4), it can be noted that all indicators have increased over 5 years. The share of enterprises using cloud technologies, broadband Internet, websites and servers has increased most significantly.

Table 4. Dynamics of the use of network technologies in organizations of the Russian Federation in 2015–2019 (as a percentage of the total number of business sector organization)

Indicators	Years					Change in 2019 to 2015 (+/–)
	2015	2016	2017	2018	2019	
The Internet	85.3	85.7	86.1	89.5	89.6	4.3
Broadband Internet	78.9	80.5	81.6	86.0	86.0	7.1
Servers	53.8	56.7	55.5	59.9	60.6	6.8
Website	41.4	43.4	44.0	48.7	48.5	7.1
Cloud services	18.4	20.5	22.6	27.1	29.1	10.7
Broadband Internet with access speeds ≥100 Mbit/s	9.1	9.0	9.3	10.4	11.2	2.1

Source: Compiled by the authors according to the HSE [1].

As a result, it can be noted that today there are active processes of digitalization of many sectors of the Russian economy, but the agroindustrial complex and agriculture are still in the rearguard of these trends. The current situation requires the formation of a set of effective measures to activate and streamline the processes of information technology implementation, one of which is the development of an organizational and economic mechanism for digitalization of the AIC at the regional level.

At the moment, in the Russian practice of digital transformation of the economy, there is no single proven organizational and economic mechanism for the transition of regional agribusiness to information technologies. In the process of digitalization of the agricultural sector, a significant role is assigned to public-private partnership, since the solution of such a large-scale task is impossible on the initiative of only one of the market participants, it will affect all levels with the involvement of private and public resources [14]. Comprehensive support by the authorities of the activity of agricultural organizations in the direction of the implementation of relevant projects (or startups) is especially relevant at the initial stages in the form of propaganda of the advantages of IT systems and consulting work on their design [16]. However, despite the noted significant role of the state, it is necessary to emphasize the importance of private initiatives, awareness by enterprises of the need to transform the business model in the direction of digitalization, advantages and benefits from the use of IT technologies [5].

Based on these postulates, a step-by-step organizational and economic mechanism of digitalization of agribusiness in the regions of Russia with functional bifurcation of the tasks being solved at the public and private levels was formed (Figure 1).

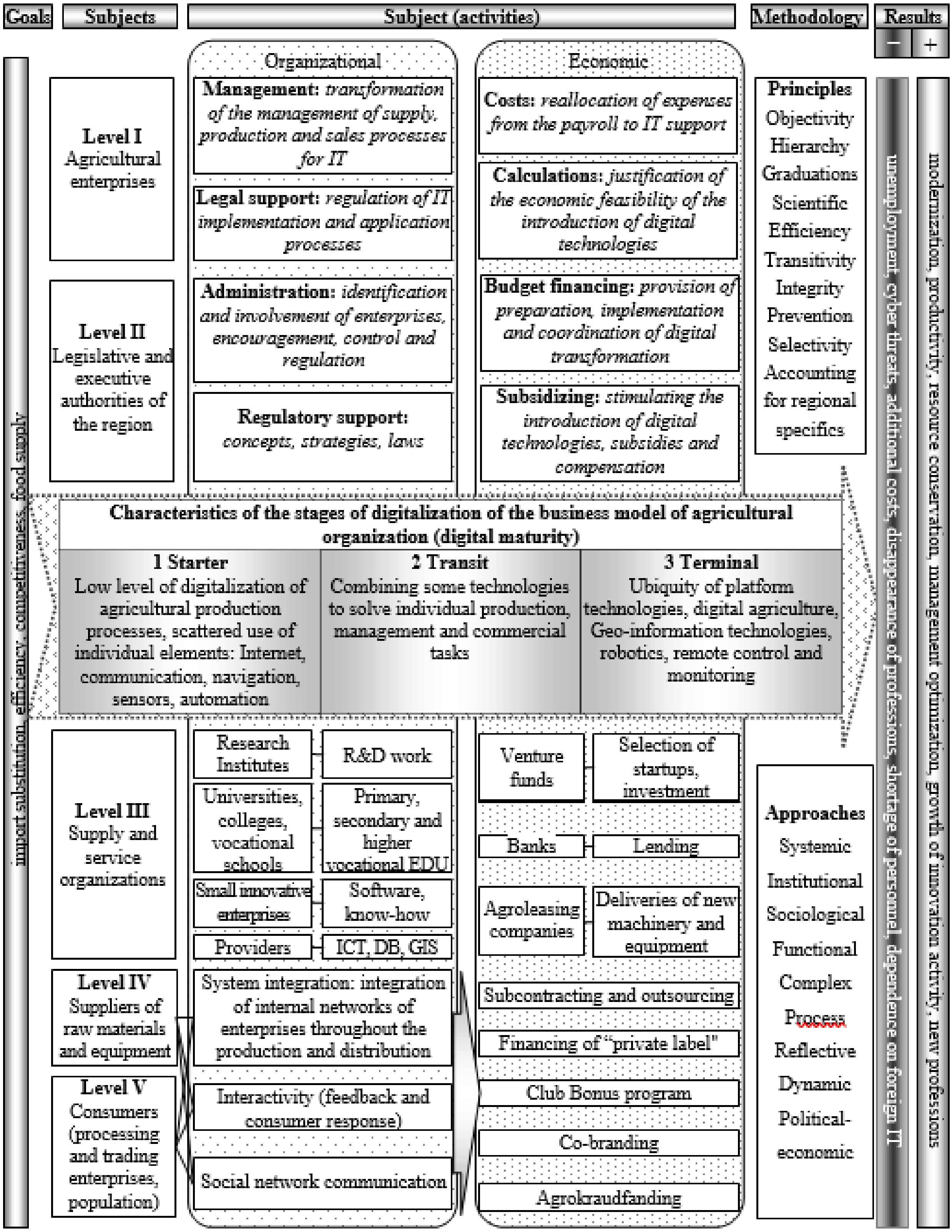

Fig. 1. Organizational-economic mechanism of digitalization of the agroindustrial complex
Source: Compiled by the authors.

At the same time, it is necessary to discretely consider the elements of the mechanism according to economic (monetary) and organizational (management, administration, legal and regulatory support) components, reflecting both the digitalization process and its internal structuring, as well as financial support for achieving targets (indicators or benchmarks). In addition, the mechanism of digital transformation of agribusiness in the region should spectacularly separate the roles of public and private structures in accordance with their powers and functions in the economy. It also determines their place in the structure and the relationship with the objects (processes) of the mechanism.

The main tasks solved by the agribusiness management bodies should be:

- promotion of the benefits of digitalization of agribusiness;
- development of regional concepts and programs for digitalization of the agroindustrial complex;
- formation of a working group on the implementation of the policy in the field of digitalization of agriculture;
- computational design of information systems and economic justification of the feasibility of their implementation;
- administrative and financial support for preparatory and organizational measures in the direction of digitalization;
- subsidizing and subsidizing digital business units.

The mechanism as a three-stage process of intellectualization of agribusiness from the disparate use of individual IT elements through the combination of some technologies to solve individual production, management and commercial tasks to the highest level of digital transformation of the agricultural sector - digital agriculture based on the ubiquity of platform technologies reflects in a temporary context all measures to form a digital business model of an agricultural organization.

The expected results of this process can be both negative and positive. Negative results include:

– the release of labor resources due to digitalization and the risks of increasing unemployment;
– risks of cybersecurity, biological, quarantine, genetic engineering security;
– additional costs for the purchase of hardware and software;
– the disappearance of individual professions;
– a high level of shortage in the industrial labor market of specialists who are able to work effectively with innovative digital technologies;
– increased dependence on foreign technologies.

Positive results will be:

+ technological renewal of agricultural enterprises;
+ increase of labor productivity at agricultural enterprises;
+ development of resource-saving adaptive technologies, reduction of anthropogenic load on the ecosystem;
+ optimization of the management decision-making process through dispatching, aggregation and optimization of data flows;
+ general increase in patent and innovation activity in the AIC;
+ involvement of workers of new professions in agricultural production.

Summing up, it can be noted that the developed unified mechanism of digitalization of the agroindustrial complex of Russia offers an effective and universal solution to the issue of streamlining the process of implementing information technologies at both the public and private levels. The organization of the process of digitalization of agricultural enterprises in the regions on the basis of the presented mechanism will accelerate the introduction of information technologies and bring the agricultural sector in line with the average level of the economy.

CONCLUSIONS

As a result, it can be noted that currently in Russia there are active processes of digitalization of various sectors of the economy. The agroindustrial complex does not lag behind other industries, where projects for the development of information technology have been developed and implemented in recent years. However, today the level of use of information technologies in agriculture in Russia is very low and is mainly reduced to the use of computers and general-purpose software for accounting and fixing commercial transactions. Some commodity producers use digital technologies, but mainly for monitoring the condition of fields, crops and animals. With the help of special software, some links of the agricultural process are monitored.

The long production cycle, exposure to natural risks, seasonality of work, crop losses during harvesting and storage have largely predetermined the restrained, but much-needed progress in labor productivity growth and innovation. There is an urgent need for digitalization of all spheres of activity of agricultural enterprises, which is due not only to the need to improve the quality and efficiency of production management, but also to increase investment attractiveness. At the same time, one of the obstacles to the widespread spread of IT in agriculture is the low interest of technology companies in working in rural areas, the main reason for which is the territorial dispersion of enterprises and the corresponding high level of costs for creating IT infrastructure.

There is an urgent need to digitalize all aspects of enterprises' activities and attract IT specialists to the agricultural sector, which is due to the need to increase the investment attractiveness of agriculture, organization and management of the Russian agroindustrial complex. It is necessary to solve the tasks set at the public and private levels in accordance with a clear and consistent organizational and economic mechanism of digitalization. The prospective development of the AIC on the basis of the proposed mechanism will contribute to improving the efficiency and competitiveness of agricultural producers and their products. The additional effect of introducing new technologies, creating jobs and increasing tax revenues from IT enterprises makes it obvious that digitalization of the agroindustrial complex of Russia is an effective means of strengthening innovation orientation and stimulating regional development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FORMATION OF DIFFERENTIAL LAND RENT AND DIFFERENTIAL RENTAL INCOME ON SOILS OF UKRAINE

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Abstract

The article examines the essence, peculiarities and factors of forming differential land rent and differential rental income, as well as the methodological aspects of their determination on individual soils by economic indicators of growing small-grain crops (without corn) in the current economic conditions of agricultural production in Ukraine. These economic categories are allotted important role of land relations regulation and the effectiveness of agricultural land use assessment. Differential land rent and differential income it is necessary to install market value of agricultural land. The possibility is shown of using the standards of small-grain crops, production costs for their cultivation and the stock-exchange price of grain sales for a specific year as input data in determining the earning yield of arable land. Identified are the parameters and patterns of the formation of differential land rent (I and II) and differential rental income (I and II) for soils of different genetic nature according to yield standards and production costs for growing grain and leguminous crops in case of natural and potential fertility. The paper presents methodological aspects of distinguishing forms of differential land rent (I and II) obtained during the cultivation of crops with applying fertilizers in accordance with current standards. Differential rent income II under the studied conditions is formed only on soils with higher fertility, and differential rent II — on the least fertile soils.

Key words: *differential rental income, differential land rent, natural soil fertility, potential soil fertility, standard yield*

INTRODUCTION

Differential land rent is a regulating factor of land relations and an economic form of realization of land ownership rights. Understanding of the nature, methods for determining and distinguishing various forms of differential land rent and differential rental income, which is considered in its context, is necessary to ensure the effective development of agricultural land use. This includes improving the methodology for monetary valuation of agricultural land, justifying measures to improve land relations and increase the environmental and economic efficiency of land use. The rental nature of land relations is also important to consider when developing ways of regulating the agricultural land market, fiscal and budgetary policies of the state at the present stage of market transformations.

The study of the causes and role of differential land rent in pricing for crop production was started by representatives of the school of physiocrats. Thus, W. Petty [11] considered rent (excess profit) in monetary terms as the difference between the cost of product produced on a land plot and the total cost of its production, including the rate of payback, the rate of return on capital and the profit of the producer. A. Smith [13] and J. Anderson (1777) [1] revealed a significant dependence of the value of land rent on the price of agricultural produce. D. Ricardo [12] pointed out the important role of land fertility level in the rental value.

Differential land rent by fertility level is based on the income that the landowner receives when his land plot is used for growing agricultural crops. The size of income will be lower with extensive farming and higher in the case of systematic implementation of intensification measures [4]. The classical theory of rent relates its emergence to the land scarcity, the monopoly of ownership of it, as well as to the specific features of agricultural products pricing [10].

According to modern ideas, the nature of differential land rent by fertility as a difference in income determines the existence of its forms I and II. With equal production costs, on the land plots of the best and medium natural fertility, a surplus product is created which, in the case of its realization, takes the form of differential land rent I. In the process of intensification of agriculture, with the growth of additional investments in the land plot, differential rent II arises which is based on differential rent I [2].

The relationship between these types of rents lies in the use of natural and artificial soil fertility. Differential rent II differs from differential rent I in that it arises not because of differences in the level of natural soil fertility of land plots, but because of the artificially achieved difference in fertility between the soils of individual land plots due to successive investments.

Differential rental income and differential land rent are regarded as identical concepts [16], or from the standpoint of their conditionality, in particular differential rental income - as the material basis of differential land rent [18], and differential land rent I and differential land rent II - as its constituents [14]. Thus, differential land rent (rental income) by fertility is considered to be as additional net income which is associated with the use of medium and best quality soils for cultivation of crops.

In Ukraine, while working on the economic (1988) and regulatory monetary valuation (1995) of agricultural lands, differential rental income was determined by the economic indicators of agricultural enterprises for growing grain and leguminous crops [3]. In modern conditions, to obtain initial values for calculating differential rental income on agricultural lands, it is proposed to use data on the standard crop yields and technological costs for their cultivation on individual soils [8] .

Thus, according to the results of economic activities for growing crops, it is possible to determine the actual values of differential land rent and differential rental income, and by the standards of crop yield and costs of crop cultivation - their standard values. Natural, organizational, economic and other factors are responsible for the differences between their actual values and the standard ones.

The purpose of the article is to establish the formation patterns for differential rental income and differential land rent for natural and potential soil fertility of different genesis.

The subject of the study is the processes of origination of differential land rent and differential rental income on arable land according to current standards for growing grain crops.

MATERIALS AND METHODS

To study the processes of formation of differential land rent and differential rental income, soils of various genesis and fertility levels were selected: Retisols - sandy, clay-sandy, sandy loam and light loamy; Phaeozems - sandy loam, light loamy, medium loamy, heavy loam, and light clayey; Chernozems - light loamy, medium loamy, heavy loam, and light clayey [17].

As the initial data for calculating the differential rental income and differential land rents, we used the standard (reference) yield of grain crops which is formed on a particular soil due to its natural fertility and the yield formed with the application of mineral fertilizers, that is, due to potential soil fertility. These yield standards for different types of soils were obtained by research institutions of Ukraine based on the results of field experiments conducted in different natural and climatic zones [7]. Production costs were determined according to standard flow process chart for growing grain crops [15].

The differential rental income most comprehensively quantitatively reflects the difference in economic effect from the use of land of varying quality, taking into account both the quality of the land and the level of agricultural intensity. It was determined by the difference between the cost of agricultural produce and the total cost of its production and standard profit:

$D=Y \cdot P-C-C \cdot Kr$ ....(1)

where:
D - differential rental income, $EUR \cdot ha^{-1}$;
Y – crop yield, $t \cdot ha^{-1}$;
P - the price of product sales, $EUR \cdot t^{-1}$;
C - production costs for cultivation of crops, $EUR \cdot ha^{-1}$;
Kr – profitability rate ratio (0.35).

To convert the differential rental income measure into physical terms, as well as to determine gross output, the average grain selling price for the corresponding period is used - 120 $EUR \cdot t^{-1}$.

The value of differential rental income, determined by the actual indexes of crop yield and production costs for their cultivation reflects the efficiency of the economic activity of the producer. The calculation of this indicator according to the standards of productivity and production costs for growing crops allows determining the value of the land plot potential with natural and potential fertility. Involvement of soils to economic use leads to the introduction of artificial fertility. In this case, the differential rental income includes both form I and form II.

The calculation of differential rent I (for natural fertility) and differential rent I + II (for potential fertility) on soils of different genesis was carried out according to the method of consumer value on the basis of normative initial data. It involves determining the amount of crop yield on the worse quality soil, which is considered a normal yield. On any other soil, differential rents I and I + II were calculated by the difference between its standard and normal yield.

RESULTS AND DISCUSSIONS

The current production cost standards in the case of natural fertility differ significantly between soils of different genetic nature and are quite close in the case of potential fertility. It was found that the application of fertilizers on different soils in accordance with current standards increases the yield of grain crops by 16-99% compared to the natural fertility level (Table 1). Its greatest increase was observed on Retisols - by 52 - 99%, depending on the textural composition. On more fertile soils Phaeozems, this increase is 21-41%, while on Chernozems the yield increase was the lowest - 16-24%. This difference is due to unequal fertilizer application rates which depend on the value of standard additional costs on different soils. In particular, the standard costs for potential soil fertility (i.e. fertilizer application) exceed the norms for natural fertility on Retisols by 84-136%, and on Chernozems - by only 28-54%.

Table 1. Standards of economic indicators for growing grain crops on soils of different genesis, $EUR \cdot ha^{-1}$

Textural soil composition	Natural fertility		Potential fertility	
	gross output	production costs	gross output	production costs
Retisols				
Sandy	199.4	135.6	397.7	320.6
clayey sand	224.6	148.8	402.5	321.3
sandy loam	249.9	162.2	408.5	321.9
light loam	275.1	175.9	419.3	322.9
Phaeozems				
sandy loam	267.9	169.1	377.3	311.3
light loam	301.6	189.5	398.9	320.6
medium loam	328.0	203.2	422.9	322.9
heavy loam and light clayey	370.1	230.6	448.1	323.5
Chernozems				
light loam	341.2	210.0	422.9	322.9
medium loam	378.4	230.6	452.9	323.5
heavy loam and light clayey	416.9	256.4	484.2	323.6

Source: Standards in force in Ukraine, published by Solovyanenko [15].

It is found that attributable profit grows with an increase in the level of natural soil fertility, and within each group of soils - with an increase in the weight of soil particles. Its minimum value was noted for Retisols, and the maximum - for Chernozems (63.8 and 160.5 $EUR \cdot ha^{-1}$, respectively). However, it is inappropriate to argue that such an increase occurred only due to the difference in the natural fertility of various soils. On soils with heavier textural soil composition, according to the current standards, the cost of growing crops also increases.

With the application of fertilizers (that is, in the case of potential soil fertility), growing crops turned out to be less profitable than without applying them. The only exceptions are the least fertile soils - sandy and sandy loamy Retisols, as well as heavy-loam Chernozems, where profit growth was noted by 20.7, 6.5, and 0.001%, respectively. On other soil varieties, its value is lower by 1.4 - 33.5% compared to natural fertility.

The differential rental income for natural fertility normally increases with an increase in the standard yield of grain crops, which occurs with weight increase in textural soil composition within each reference soil group. From sandy to light loamy varieties of Retisols, its value increases by 0.17 $t \cdot ha^{-1}$, from sandy loamy to heavy loamy and light clayey varieties of Phaeozems - by 0.16 $t \cdot ha^{-1}$, and from light loamy to heavy loamy and light clayey varieties of Chernozems — by 0.32 $t \cdot ha^{-1}$ (Table 2). This is due to the high natural potential of heavier granular composition of the soils. On typical medium-humic heavy-loam chernozems and light clayey soils, the highest normative differential rental income (0.797 $t \cdot ha^{-1}$ of grain) is obtained.

Table 2. Standard indexes of grain crop yields, differential rental income and differential rent for natural soil fertility, $t \cdot ha^{-1}$

Textural soil composition	Yield	Income	Differen-tial income	Differen-tial land rent I
Retisols				
sandy	1.66	63.8	0.135	-
clayey sand	1.87	75.8	0.197	0.100
sandy loam	2.08	87.6	0.256	0.199
light loam	2.29	99.2	0.313	0.295
Phaeozems				
sandy loam	2.23	98.8	0.330	0.292
light loam	2.51	112.0	0.379	0.401
medium loam	2.73	124.8	0.446	0.507
heavy loam and light clayey	3.08	139.4	0.487	0.629
Chernozems				
Light loam	2.84	131.2	0.479	0.561
Medium loam	3.15	147.8	0.558	0.699
heavy loam and light clayey	3.47	160.5	0.797	0.966

Source: Own calculation on the basis of data the table 1 and standards of yield, which are force in Ukraine [7].

The size of the land rent by fertility can be influenced by both natural and historical factors (quality and level of cultivation of soils, hydrothermal conditions of the growing season), as well as economic (achieved level of economic intensity).

The level of production costs, the amount of the crop yield and the sell price determine the value of differential land rent. The economic condition for the realization of land rent is considered to be the same price level for agricultural produce from land plots of different quality. Fertility differential land rent will increase in case of crop yield growth, reduction of production costs for its cultivation and increase in sell prices.

When setting purchase prices for crop products taking into account the price of their production on land plots with poorer soil quality and worse location, the price of products obtained from medium and best quality land plots becomes artificially inflated in terms of its value [5]. The worse lands on which, at a given grain price, its production is expedient are called marginal lands. Differential land rent is defined as the difference between the income from the sale of crop products obtained from non-marginal lands and income from marginal lands [12].

In our case, differential land rent I is not formed on Retisols on sandy sediments, where grain yields are the lowest – 0.166 $t \cdot ha^{-1}$. It was found that the value of rent within each reference group of soils naturally increases with an increase in the weight of granulometric soil composition, and hence with an increase in the level of natural fertility. The highest differential rent I is formed on Chernozems of heavy loamy and light clayey soils – 0.804 $t \cdot ha^{-1}$ of grain. Thus, the different values of differential rent I and differential rental income on the same soil types is due to differences in calculation methods. At higher natural soil fertility, the differential rent I value is higher than the differential rental income I, but at a lower natural fertility - vice versa.

Differential rental income for potential soil fertility, according to current standards, is formed only on heavy loamy and light clayey varieties of Phaeozems, as well as on medium loam and heavy loam and light clayey varieties of Chernozems - 0.09, 0.13, and 0.39 $t \cdot ha^{-1}$, respectively (Table 3). It is several times lower than for natural fertility. Differential rental income, as well as differential rent, determined by index of standard yield, reflect the natural potential of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

the land, and not the ability of the land user to farm.

With additional capital investment in a land plot, differential rent II arises. Unlike differential rent I, it can also be obtained on land plots with a low level of fertility. It is believed that the formation of differential rent II is due to differences in the levels of return on successive costs for the same land plot [9]. The amount of this rent is limited by the operation of the law of diminishing soil fertility [6]. It is advisable to increase investment in the intensification of land cultivation until the moment when the next investment of capital increases the gross profit, that is, as long as the marginal cost of capital is less than the price of the product.

Table 3. Standard indexes of grain crop yields, differential rental income and differential rent for potential soil fertility, $t \cdot ha^{-1}$

Textural soil composition	Yield	Income	Differential income	Differential land rent I
Retisols				
sandy	3.31	77.1	-0.294	0.093
clayey sand	3.35	81.2	-0.262	0.127
sandy loam	3.40	86.6	-0.219	0.171
light loam	3.49	96.4	-0.139	0.254
Phaeozems				
sandy loam	3.14	66.0	-0.360	-
light loam	3.32	78.3	-0.294	0.103
medium loam	3.52	100.1	-0.109	0.284
heavy loam and light clayey	3.73	124.6	0.093	0.489
Chernozems				
Light loam	3.52	100.1	-0.109	0.284
Medium loam	3.77	129.4	0.133	0.528
heavy loam and light clayey	4.03	160.6	0.393	0.788

Source: Calculated by the author using data the table 1 and standards of yield, which are force in Ukraine [7].

In our opinion, the return on one-time investments (those that exceed the cost of growing crops when using only natural soil fertility) in the land plot also leads to the formation of differential rent II - differential rental income. It was determined by the current standards of yield and the costs of growing cereals with potential soil fertility.

The application of mineral fertilizers on medium and high quality soils provides an increase in the crop yield above the level which is formed due to the natural fertility of the soil. Thus, differential rent for potential fertility includes the first and second forms. In this case, according to current regulations, the Phaeozems sandy loam turned out to be rentless soil, since the yield on it is the lowest of all options – 3.14 $t \cdot ha^{-1}$. On soils of the Retisols group, the total rent value, depending on the textural soil composition, is 0.093-0.254, the Phaeozems group – 0.103-0.489, and the Chernozems group -0.284-0.788 $t \cdot ha^{-1}$. It should be noted that the value of rent for potential fertility exceeds rent for natural fertility only on two soils (sandy and clayey-sand) of the Retisols group which have the lowest level of natural fertility among the soils of the entire sample. This may be due to the high level of standard costs for fertilizing precisely on these soil types - 185.0 and 172.5 $EUR \cdot ha^{-1}$, which caused a high increase in the yield of grain crops – 1.65 and 1.48 $t \cdot ha^{-1}$.

CONCLUSIONS

Based on the outcome of the study, according to the standards of economic indicators for growing grain crops in Ukraine.

Tthe concept of land rent, which is the basis of the entire system of land relations and methodology for assessing agricultural land, makes it necessary to address the problem of its definition. Under current conditions for agricultural production in Ukraine, the initial data for establishing differential rental income and differential land rent can be the standards of yield and production costs for growing crops on individual soil types and the exchange price for selling grain.

According to the current standard indicators, the differential income for natural fertility is formed on all the soils under investigation, and its value increases with the increasing level of their fertility. The standard differential rental income for potential fertility is formed only on soils with higher natural fertility, but its values are several times lower than in the case of natural soil fertility.

The values of differential land rent I, calculated according to standard indicators of yield and production costs for natural fertility by the method of consumer value, are close to the values of differential rental income in magnitude and have a similar growth trend in the case of increasing weight of textural soil composition.

The increase in production costs for cultivating crops, which is stipulated by the current standards, on most soil types does not provide adequate increase in yield and the formation of differential rental income II and differential rent II. The standard differential rental income for potential soil fertility (Form I + Form II) is formed only on highly fertile Phaeozems heavy-loam, Chernozems medium-loam and Chernozems heavy-loam and light clayey, however, its values are several times lower than on the corresponding soils in the case of natural fertility. The standard differential land rent II is formed only on soils with a low level of natural fertility - Retisols sandy and clay-sandy on sandy sediments.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESEARCH ON THE BEHAVIOR OF CORN CULTIVATED ON A CHERNOZEM TYPE SOIL FROM BOURENI-BAILESTI AREA- DOLJ COUNTY, ROMANIA, DEPENDING ON AGROFUND

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Abstract

Many factors influence the performance of the agricultural activity within a farm. From this multitude of factors, one of the most important and taken into consideration are the climatic condition and the fertilization plan projected and implemented by the managerial team of the farm. In this matter, this paper presents the experimental results of these factors on the performance of the agricultural output on a specific geographic area in Boureni-Bailesti area in Southern Romania. The experiment has researched the influence of the climatic condition and the fertilizers on the level and the quality of the yields. In this manner, the grain yields have ranged between 8,040 and 10,260 kg/ha, the grain output for 1 kg of fertilizer being between 10.7 and 16.8 kg and the protein content in function of the fertilization was 12.4-12.7%.

***Key words*:** *corn, fertilizer, hybrid, protein*

INTRODUCTION

In order to ensure the food for the population that is in a constant increase, the agricultural production must keep the rhythm, both in our country and elsewhere [8].
Due to the fact that the increase of the cropping land is no more available, the main purpose of increasing the yield is the outturn [7].
Maize is a top crop in Romania's agriculture with high importance for food security and South West Romania is recognized as an area with high production potential [5]. Varieties, fertilization and irrigation are among the most important technological factors which have to be used and adapted to the local soil and climate conditions in order to increase yields. The literature contains an extensive number of studies regarding the effects of external and internal factors on the agricultural performance of several common crops, depending on: the irrigation system [10], the applied fertilizers in various areas of the globe [3, 9], the applied fertilizers and amendments [4], based on a fertilizer management plan [1].
All these activities show that the importance of the fertilizer plan and the climate factors are key influencers on the yield of the crop production [6], especially on corn.
The present paper is trying to bring a small contribution to the behavior of the corn crop in the climatic conditions of Boureni-Bailesti area from the Southern Oltenia in order to obtain high and constant yields, respectively, of good quality by using fertilizers [2].
The key novel points of this paper are determined by the location of the experiment and the study of the produced quantity combined with the nutrient concentration of the final product.

MATERIALS AND METHODS

The experiment was located on a cambic chernozem from Boureni-Bailesti zone (40 km South-Vest away of Craiova) within the 2017-2019 years being organized after the latin square method.
The experiment has unfolded on the same plot in rainfed conditions using the wheat-corn crop rotation.

The drilling was performed during the second half of the April at 70 cm distance between rows, at 45,000 plants per hectare and the corn hybrid was Olt of the FAO group 450 that is very well adapted in this zone.

The weed control was performed using the Dual preemergent herbicide 1 liter per hectare and Guardian 2.5 liters per hectare (the first one incorpored by a harrow and the second one was left the soil surface) and during the vegetation period there was applied Oltisan at 4-6 leaves of the corn plant, with Oltisan 1 liter per hectare plus Lontrel 0.33 liter per hectare. During the vegetation period there were done 2 mechanical hoeings between rows. The soil type of the experiment was cambic chernozem, with a pH of 6.9-7.1 the humus content was of 3.46-3.72% within the arable layer, 0.183-0.196% total nitrogen, a low phosphorus content – 15 ppm and a high available potash – 240 ppm. The rainfall, the temperature and the air moisture during the experiment have been close to the 60 years average values, (of 525 mm, 10.2^{0}C and 72%).

The experiment has researched the influence of the fertilization on the yield, both quantitatively and qualitatively using, on the 60kh/ha phosphorus background, 10t manure per hectare, different nitrogen fertilizer doses (N_{50}, N_{100}, N_{150}, N_{200}) in comparison with the control variant that was not fertilized by nitrogen yet fertilized by manure and phosphorus.

RESULTS AND DISCUSSIONS

Within the first table there are presented the yielding results, the synthesis of the experimental cycle that show that the yields of the researched variants were between 8,040 kg/ha and 10,260 kg/ha that emphasize the favourable reaction of the Olt hybrid to fertilization.

The applying of the nitrogen fertilizers, on 10t/ha manure and P_{60} background has determined the increasing of the grain yield by 812 kg/ha and this difference is significant.

The doubling of the nitrogen dose to N_{100} has amplified the yield output to 19% and, respectively, that has conducted to a yield of 1,491 kg/ha and this difference is very significant.

Table 1. The synthesis of the yielding results in function of the fertilization recorded at Boureni-Bailesti in the experimental cycle 2017-2019

Variant	Yield Kg/ha	%	Difference	Significance
10t/ha, manure+ N_0P_{60}	8,040	100	-	-
10t/ha, manure+ $N_{50}P_{60}$	8,852	110	812	x
10t/ha manure+ $N_{100}P_{60}$	9,531	119	1,491	xxx
10t/ha manure+ $N_{150}P_{60}$	9,858	123	1,818	xxx
10t/ha manure+ $N_{200}P_{60}$	10,260	128	2,220	xxx

DL 5%=568 Kg/ha
DL 1%=973 kg/ha
DL 0,1%=1,079 kg/ha
Source: Own results.

Very significant statistically differences have been achieved with the N_{150} variant (23%, of 1,818 kg/ha).

The highest yield has obtained with the variant that received the highest nitrogen dose (N_{200}), of 10,260 kg/ha, the yield output being of 28% which meant a very significant difference of 2,220 kg/ha.

Figure 1 presents the grains output per 1 kg of nitrogen active ingredient that was recorded in the experimental cycle 2017-2019 at Boureni-Bailesti. There can be noticed that yield output given by 1kg nitrogen active ingredient was of 16.8 kg grains at N_{50} dose, 14.98 kg with the N_{100} dose, 12.8 kg at N_{150} dose and of 10.7 kg with the N_{200} dose.

The protein yield of the experimental cycle 2017-2019 is given in the second table.

Within the fertilizer research at 10 t/ha manure + P_{60} and different nitrogen doses from N_0 to N_{200}, the protein yield has ranged between 981 kg/ha (N_0) to 1,305 kg/ha (N_{200}). In this way there was recorded an increase by 12 % with the N_{50} variant, 21 % with N_{100} variant, 26 % with N_{150} variant and 33% with N_{200} variant. The protein differences were significant at the N_{50} dose level and very significant with the N_{100} – N_{150} – N_{200} doses.

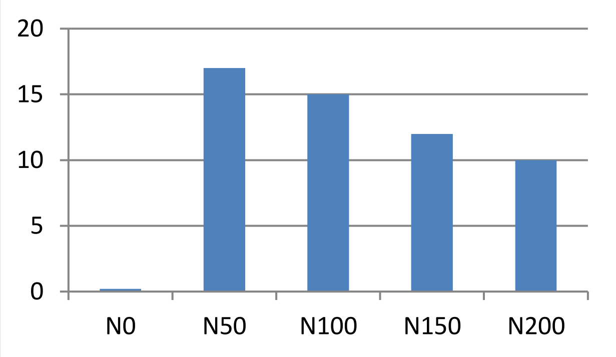

Fig. 1. The grains output per 1 kg of nitrogen fertilizer active ingredient recorded at 2017-2019 experimental cycle
Source: Own results.

Table 2. The protein yield in function of the fertilization doses within the 2017-2019 experimental cycle

Variant	Yield Kg/ha	%	Difference	Significance
10t/ha,manure+ N_0P_{60}	981	100	-	-
10t/ha, manure+ $N_{50}P_{60}$	1,098	112	117	x
10t/ha manure+ $N_{100}P_{60}$	1,187	121	206	xxx
10t/ha manure+ $N_{150}P_{60}$	1,232	126	251	xxx
10t/ha manure+ $N_{200}P_{60}$	1,305	133	324	xxx

DL 5% = 88 kg/ha
DL 1% = 124 kg/ha
DL 0.1% = 146 kg/ha
Source: Own results.

The results on the influence of fertilization on the protein content during the 2017-2019 experimental cycle are presented in Figure 2.

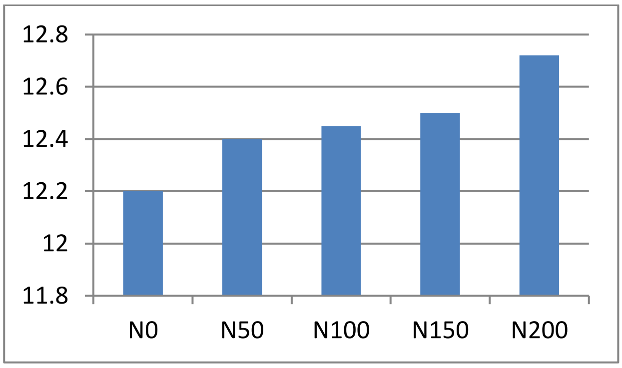

Fig. 2. The result on the influence of fertilization on the protein content during the 2017-2019 experimental cycle
Source: Own results.

At the researched nitrogen doses there was recorded an increase of the protein content from 12.40% (N_{50}) to 12.45% (N_{100}), 12.50% (N_{150}) and, respectively, 12.72% with the N_{200} variant.

CONCLUSIONS

By applying nitrogen doses on P_{60} and 10 t/ha manure background within the experimental field Boureni-Bailesti there were obtained a ten percent output with N_{50} (8,852 kg/ha with yield difference of 1,491 kg/ha over the control), 19% with the N_{100} dose (9,531 kg/ha with yield difference of 1,491 kg/ha over the control) , 23% with the N_{150} dose (9,858 kg/ha with a yield difference of 1,818 kg/ha over the control) and, respectively, of 28% with N_{200} dose (10,260 kg/ha with a 2,220 kg/ha over the control variant).

The grain output per 1 kg Nitrogen active ingredient that was applied on the above background has been of 16.80 kg grains with N_{50} dose, 14.98 kg with N_{100} dose, 12.80 kg with N_{150} and 10.70 kg with N_{200} dose.

The protein content has increased along with the nitrogen dose form 12.20% (N_0) to 12.72% (N_{200}) and the protein yield has increased from 963 kg/ha (N_0) to 1,235 kg/ha (N_{200}).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE IMPACT OF IMPLEMENTING THE FARM TO FORK STRATEGY REGARDING THE USE OF FERTILIZERS AND PESTICIDES IN THE EU

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Abstract

This paper analyzes the existing situation in Romania, Germany, France, Poland, Hungary and the United Kingdom, European countries cultivating cereals, technical plants and oleaginous plants, in the period 2010-2019, regarding the quantities of fertilizers and plant protection substances This analysis has responded to the requests from farmers' associations regarding the effect of the FARM TO FORK strategy, as a essential element of the European Green Pact, has serious implications within the agricultural sector. Agricultural producers question the survival of the agricultural sector as the implementation of the Farm to Fork strategy will lead to a significant decrease in agricultural production in the EU and an increase in food prices. In the present study, a descriptive research was performed on the situation existing in each studied country, using the bibliographic method but also the processing of statistical data, using the correlational method, this aspect directing the study to a predictive research, thus establishing how the quantities of fertilizers and pesticides used in different crops in the EU member states will be allocated, if the Farm to Fork strategy is applied in the current form, the conclusion being that their reduction should be applied to the European average of consumption in the EU member states.

Key words: *Farm to Fork Strategy, cultivated surface, chemical fertilizers, pesticides*

INTRODUCTION

In October 2021**,** the European Parliament debated the report on the *"Farm to Fork Strategy - for a Fair, Healthy and Ecological Food System 2020-2060"* [6, 10].

This strategy sets the global standard for safe and high-quality food based on the outcome of previous years of EU policy making, combined with the efforts of all actors in the entire food chain.

There is a discussion of safe, sustainable food for the planet, people, farmers, fishermen and processing factories, but the question is how and when the new strategy will be applied [7].

The transition to resilient and nature-friendly food systems is a well-known EU initiative, but integral change lacks perseverance, commitment, ambition and the courage to change.

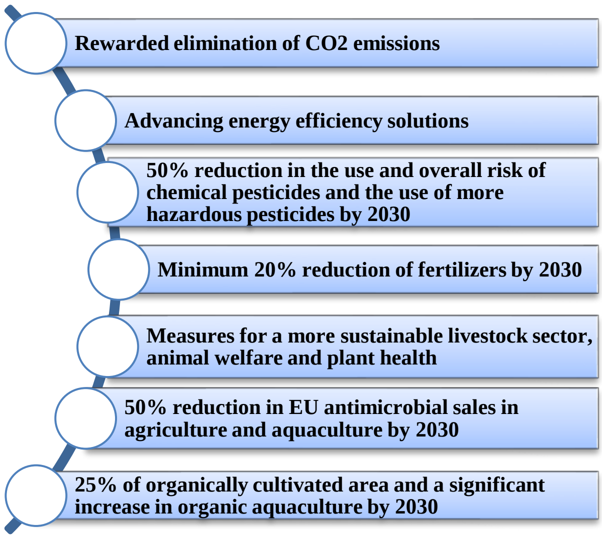

Fig. 1 Farm to Fork strategy
Source: Our figure based on Farm to Fork strategy [6, 10].

The Farm to Fork strategy establishes ambitious EU-wide targets for the use of pesticide, chemical fertilizers, antimicrobials and the enlargement of organic farming, all

based on the latest available evidence, the agreed targets becoming legally binding [9].
Thus, the Joint Research Centre (JRC) study and other recent studies present arguments for improving existing models, without being able to guess the changes in demand or the production losses that will be caused by climate change and the loss of biodiversity. [8, 17]. Fertilizers are an important factor in modern day agriculture [4] The established targets set the direction and send a strong signal, not only in Europe, but also globally. Under the Common Agricultural Policy, Member States are invited to establish explicit national values that contribute to the implementation of EU objectives, taking into account the specific situations in each country, in order to allow the assessment of the contribution of national strategic plans to EU environmental and climate legislation and commitments. This transition can turn the challenge into a real opportunity. In order to bring about change, the EU needs the support of other global players, through trade and partnership agreements, development policy, international standard-setting bodies and green alliances.

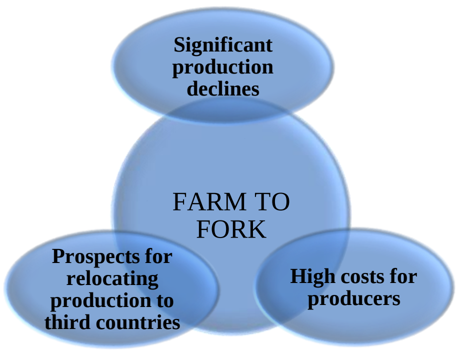

Fig. 2. Position of COPA and COGEGA member farmers regarding the FARM to FORK Strategy
Source: [3].

However, the position of EU farmers and agricultural cooperatives, members ***Copa and Cogeca*** [3] on the strategy ***Farm to Fork,*** as a fundamental element of the ***European Green Pact***, with significant implications for the agricultural sector, aims at the survival of the agricultural sector and calls for further consultations arise, as the measures included in this strategy will lead to a significant decrease in agricultural production in the EU and an increase in food prices. Crop fertilization with adequate fertilizer application rates for obtaining maximum and economically optimum yields, the best use of nutrients and gaining high quality harvests [1, 16].
A research conducted by the Institute of Agricultural Economics of the University of Kiel, Germany [12] regarding cereals, oilseeds and beef, highlighted that the impact of applying a "farm to fork" strategy would diminish production by about 20%, which would increase EU's agricultural products prices (10-20% of fruits and vegetables, oilseeds and cereals), and if all Farm to Fork procedures were implemented simultaneously, grain exports would fall sharply and become reliant on imports. The EU's agricultural cooperatives (Copa and Cogeca) have called on the European Commission to conduct an impact assessment on the agricultural sector.
Each EU Member State has incorporated country-specific aspects in its ***National Strategic Plan*** and has interventions, targets and phase-related outcomes and indicators for each intervention, as well as the planned annual productions and unit amounts per intervention [7].
Nevertheless, at EU level, all actors of the food chain agree on the general principles contained in the Farm to Fork strategy being fully conscious of the need for constant and generous major improvements to assure the sustainability of the agri-food systems.
However, certain recently published researches on the "farm to fork" strategy suggest that the present targets will impose significant costs on the EU.
In this context, the purpose of the paper is to analyze the quantities of fertilizers and plant protection products used in Romania, Germany, France, Poland, Hungary and the United Kingdom and the expected impact of reducing these quantities in agriculture.
In Table 1, it is presented a synthesis in the authors' vision regarding the key studies conducted on the Farm to Fork strategy.

Table 1. Studies conducted on the Farm to Fork strategy

Crt. no.	Study	Results
1.	**JRC Study** [8]	The reduction in greenhouse gas emissions of 40-60% of European agriculture resulting from the implementation of the objectives of the FARM to Fork strategy will lead to the outsourcing of European agricultural production, including its emissions, to third countries.
2.	**Study of the University of Kiel** [12]	Europe could become a net importer of food, in direct contradiction with the open strategic autonomy promoted by the European Commission during the COVID crisis.
3.	**USDA Study** [18]	The objectives established in the FARM to Fork strategy could lead to food insecurity for 22 million people.
4.	**Study from Wageningen** [2]	It addresses different scenarios, and clearly highlights that the assessment has been isolated in terms of the effects of the FARM to Fork Strategy and provides a partial picture of the cumulative reality faced by farmers and agri-food actors on the field. The cumulative impact of the targets will lead to an average decrease in production of 10-20%, with a reduction of up to 30% for certain crops. Also, a decrease in beef, pork and dairy products production, an increase in prices for consumers and unforeseen effects on livestock farmers' incomes.

Source: Own conception based on [8, 12, 18, 2].

MATERIALS AND METHODS

The paperwork is elaborated on a vast documentary basis, by using the bibliometric method, bringing to the foreground the results of extensive researches carried out regarding the implications of the application of the Farm to Fork Strategy on agricultural production, farmers' incomes and food security. The statistical analysis of the data extracted from FAO (www.fao.org) regarding the cultivated agricultural areas and the obtained productions, as well as their correlation with the quantities of chemical fertilizers and pesticides used in the countries included in the study, highlighted aspects that justify the recommendations made, namely that the reduction of the fertilizers and plant protection products should be made taking into account the European average of the quantities used.

RESULTS AND DISCUSSIONS

In order to highlight aspects related to the use of chemical fertilizers and pesticides in the agriculture of Romania, France, Germany, Italy, Spain, Poland, Hungary and the United Kingdom, in the period 2010-2019, the main groups of chemical fertilizers and pesticides used in the period 2010-2019 in these countries were analyzed. The need to apply chemical fertilizers resides from the increase in water retention in soil [19]. Likewise, the application of pesticides is also intended to repel, destroy or control any pest or to regulate the growth of plants. There are obvious differences in the application of chemical fertilizer and pesticides in the agriculture of the European countries surveyed, differences demonstrated by the analysis of the existing statistical data on www.fao.org. To this purpose, account has been taken of the areas under cultivation in these countries, as well as of the total quantities of fertilizers and pesticides consumed in agriculture, and in addition the division by types and destinations. The land resource in our time is limited and, thus, the attention has been directed towards technological intensification, in order to significantly increase the agricultural yield, but not enough as to ensure a decent food supply for the entire population of the Earth [13].
An analysis of the acreage of the major European countries cultivating cereals, technical plants and oleaginous plants, for the period 2010-2019, reveals that France has the widest area cultivated with a multi-year average of 19,299.38 thousand ha, pursued by Spain with 17,080.92 thousand ha, Germany with an average annual cultivated area of 12,013 thousand ha, Poland with 11,306.30 thousand ha, Italy with an average cultivated

area of 9,254.27 thousand ha, Romania with 9,234.80 thousand ha, the United Kingdom with 6,144.83 thousand ha and Hungary with an average cultivated area of 4,522.40 thousand ha (Fig. 3).

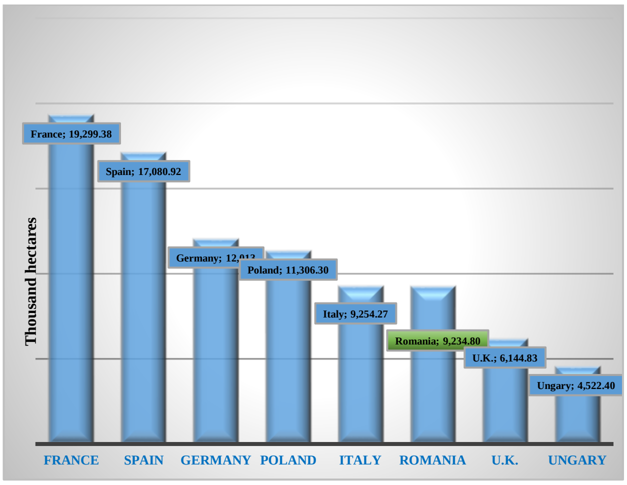

Fig. 3. Cultivated areas – multiannual average
Source: Own calculations and figure [11].

Romania occupies the 6th place in terms of average cultivated area (9,234.80 thousand ha), respectively 47.85% of the cultivated area in France, 54.06% of the average planted area in Spain, 76.87% in Germany, 81.67% in Poland and 97.78% of the area cultivated by area cultivated in Italy. On the other hand, the U.K. manages 66.54% of the area cultivated by Romania and Hungary utilises 48.97% of the area planted by Romania.

Chemical fertilizers are a crucial farm input for increasing productivity in conventional agricultural system, but with a negative impact on environment. [14] Regarding ***the consumption of chemical fertilizers with nitrogen in agriculture***, ***France*** is the largest country consuming fertilizers with nitrogen, with a multiannual average of 2,138,482.40 tons, a quantity correlated with the large cultivated area, respectively 19,299.38 thousand ha. It is noted that Romania consumes 16.67% of the quantity consumed by France. ***Germany*** is the second largest consumer of nitrogen fertilizers, with a multiannual average of 1,615,427.70 tons in the period 2010-2019, quantity correlated also with the large cultivated area, respectively 12,013 thousand ha. ***Romania*** consumes 22.06% of the quantity consumed by Germany. ***Poland***, the third consumer of nitrogen fertilizers, with a multiannual average of 1,087,981 tons in the period 2010-2019, quantity correlated also with the cultivated area, respectively 11,306.30 thousand ha. Romania consumes 32.76% of the amount of fertilizers used in Poland. ***United Kingdom***, the next country consuming nitrogen fertilizers, with a multiannual average of 1,028,400 tons in the period 2010-2019, at the average cultivated area, namely 6,144.83 thousand ha. Romania uses 34.66% of the amount used by the United Kingdom in agriculture, although the UK cultivates 66.54% of the average cultivated area in our country. In ***Spain,*** the average multiannual amount of nitrogen fertilizers used was 986,893.60 tons per cultivated area of 17,080.92 thousand ha. Romania uses in agriculture 36.12% of the quantity used in Spain. ***Italy*** used in agriculture a quantity of 578,128.30 tons of nitrogen fertilizers, on a cultivated area of 9,254.27 thousand ha, an area with 2.22% higher than the cultivated area of Romania, but in terms of consumption of nitrogen fertilizers, Italy consumes 38.34% more than Romania.

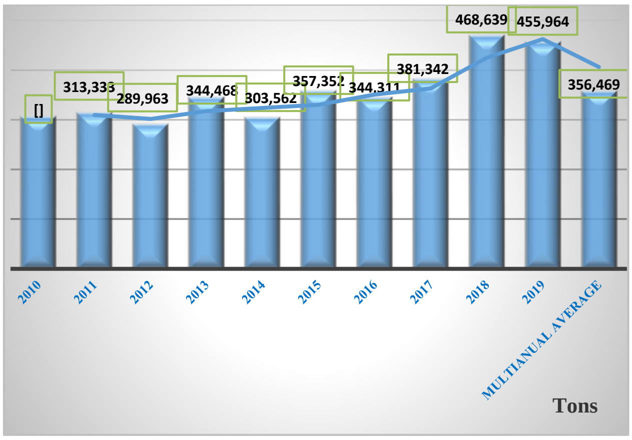

Fig. 4. Nitrogen fertilizer consumption (N) in Romania
Source: Own calculations and figure [11].

Hungary has a multiannual consumption similar to that of ***Romania***, respectively 356,606.40 tons, for an average multiannual area cultivated of 4,522.40 thousand ha, respectively 48.97% of the area cultivated in Romania. It is noted that ***Romania*** has the smallest amount of nitrogen fertilizers used in agriculture, with a multiannual average of the quantities consumed in 2010-2019 of 356.469,10 tons.

Regarding the ***consumption of chemical phosphorus fertilizers in agriculture***, the use of these fertilizers has contributed [5] ***Spain'***s leader position and multiannual consumption of phosphorus fertilizers used during 2010-2019, respectively 407,646.89 tons on a cultivated area of 17,080.92 thousand ha. ***Romania*** uses in agriculture 34.06% of the quantity used in ***Spain***, and the area cultivated in ***Romania*** represents 54.06% of that of Spain. ***France*** consumed an average multiannual quantity of phosphorus fertilizers in the period 2010-2019, of 402,884.28 tons, a quantity correlated also with the cultivated area, respectively 19,299.38 thousand ha. It is highlighted that ***Romania*** utilizes 34.46% of the quantity consumed by ***France***, and the area ***of Romania*** represents 47.85% of that of ***France***. ***Poland***, used a multiannual average quantity of phosphorus fertilizers, of 349,539.90 tons in the period 2010-2019, at an average multiannual cultivated area, respectively 11,306.30 thousand ha. ***Romania*** consumes 39.72% of the amount of phosphorus fertilizers used in ***Poland,*** and the multiannual cultivated area of ***Romania*** represents 81.67% of the area of ***Poland***. ***Germany*** consumed in the period 2010-2019 a multiannual average amount of phosphorus fertilizers, of 257,907 tons, on a multiannual average cultivated area, namely 12,013 thousand ha. ***Romania*** utilizes 53.83% of the quantity consumed by ***Germany,*** and the multiannual cultivated area of ***Romania*** represents 76.87% of the area of Germany. ***United Kingdom***, the next country included in the analysis, used an average multiannual quantity of phosphorus fertilizers, of 192,100 tons during 2010-2019, on the average cultivated area, namely 6,144.83 thousand ha. ***Romania*** uses in agriculture 72.28% of the amount used by the ***United Kingdom***, although it cultivates 66.54% of the average cultivated area in our country. ***Italy*** used in agriculture a quantity of 172,278.70 tons of phosphorus fertilizers, on a cultivated area of 9,254.27 thousand ha, 2.22% larger than the cultivated area of ***Romania***, but in terms of phosphorus fertilizer consumption, Italy consumes 19.41% more than Romania. ***Romania*** is on the penultimate place in terms of quantities of phosphorus fertilizers used in agriculture, with a multiannual average during 2010-2019 of 138,846.70 tons, followed by ***Hungary*** with 83,369.50 tons.

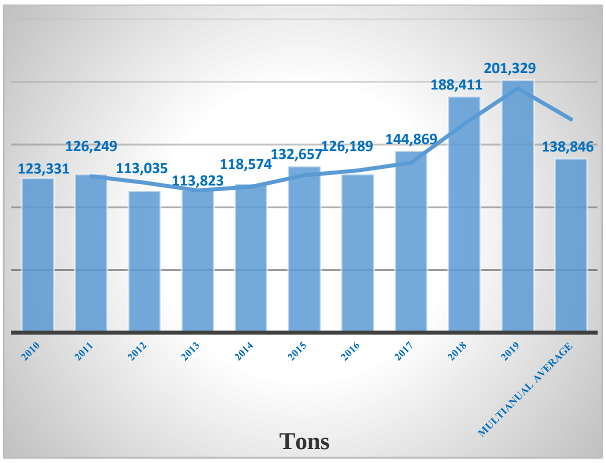

Fig. 5. Consumption of phosphorus fertilizers (P_2O_5) in Romania
Source: Own calculations and figure [11].

Regarding ***the consumption of chemical potassium fertilizers in agriculture***, ***Poland*** is the first country consuming potassium fertilizers, with a multiannual average quantity of 502,200.90 tonnes in the period 2010-2019, on a multiannual average cultivated area, namely 11,306.30 thousand ha. ***Romania*** consumes 9.89% of the amount of potassium fertilizers used in ***Poland,*** and the area cultivated by Romania on a multiannual basis represents 81.67% of Poland's area. ***France*** consumed in the period 2010-2019 a multiannual average amount of potassium fertilizers of 448,942 tons, a quantity correlated also with the cultivated area, respectively 19,299.38 thousand ha. It is highlighted that ***Romania*** consumes 11.07% of the quantity consumed by ***France***, and the area of ***Romania*** represents 47.85% of that of France. ***Germany*** consumed in the period 2010-2019 a multiannual average amount of potassium fertilizers of 420,675.30 tons, on a multiannual average cultivated area, namely 12,013 thousand ha. ***Romania*** consumes 11.81% of the quantity consumed by ***Germany***, and the multiannual cultivated area of ***Romania*** represents 76.87% of the area of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Germany. ***Spain*** had a multiannual consumption of potassium fertilizers, in the period 2010-2019, of 364,002.60 tons on a cultivated area of 17,080.92 thousand ha. Romania uses in agriculture 13.65% of the amount used in Spain, and the area cultivated in Romania represents 54.06% of that of Spain. ***United Kingdom*** consumed in the period 2010-2019 a multiannual average amount of potassium fertilizers, of 269,100 tons, on the average cultivated area, namely 6,144.83 thousand ha. ***Romania*** uses in agriculture 18.46% of the amount used by the United Kingdom, although the latter cultivates 66.54% of the average cultivated area in our country. ***Italy*** used in agriculture a quantity of 127,185.6 tons of potassium fertilizers, on a cultivated area of 9,254.27 thousand ha, an area 2.22% higher than the area cultivated in ***Romania***, but in terms of potassium fertilizer consumption, ***Italy*** consumed 60.93% more than Romania. ***Hungary*** has a multiannual consumption of potassium fertilizers of 82,805.5 tons, respectively 39.98% more than in ***Romania***, on an average multiannual cultivated area of 4,522.40 thousand ha, respectively 48.97% of the cultivated area in ***Romania.***

Romania is on the last place in terms of quantities of potassium fertilizers used in agriculture, with a multiannual average between 2010 and 2019 of 49.695 tons.

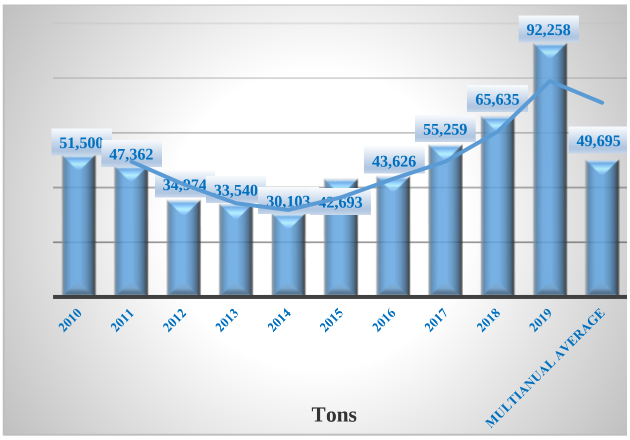

Fig. 6. Potassium fertilizer (K_2O) consumption in Romania
Source: Own calculations and figure [11].

The EU regulations regarding pesticides imposes a strict control and use of the approved pesticides for compiling with the European the Green Deal [15]. Regarding ***the consumption of pesticides in agriculture***, ***France*** consumed during 2010-2019 an average multiannual quantity of pesticides-total, of 70,882.50 tons, per cultivated area, namely 19,299.38 thousand ha. It is highlighted that ***Romania*** consumes 9.07% of the quantity consumed by ***France***, at an average area cultivated in Romania of 47.85% of that of France. ***Italy*** used in agriculture a quantity of 60,218.90 tons of pesticides-total, on a cultivated area of 9,254.27 thousand ha, an area with 2.22% higher than the area cultivated in ***Romania,*** but in terms of pesticide-total consumption, Italy consumed 89.31% more than Romania. ***Spain*** had a multiannual consumption of pesticides-total used in the period 2010-2019, namely 56,101.90 tons on a cultivated area of 17,080.92 thousand ha. ***Romania*** uses in agriculture 11.47% of the quantity used in Spain, and the area cultivated in ***Romania*** represents 54.06% of that of ***Spain***. ***Germany*** consumed during 2010-2019 an average multiannual quantity of pesticides-total, of 45,332.50 tons, at an average multiannual cultivated area of 12,013 thousand ha. ***Romania*** consumes 14.19% of the amount consumed by ***Germany***, and the multiannual cultivated area of ***Romania*** represents 76.87% of the area of ***Germany. Poland*** consumed a multiannual average quantity of 22,987.90 tons in the period 2010-2019, for a cultivated multiannual average area, namely 11,306.30 thousand ha. ***Romania*** consumes 27.99% of the pesticide-total used in ***Poland***, and the multiannual cultivated area of ***Romania*** represents 81.67% of the area of ***Poland. United Kingdom*** consumed during 2010-2019 an average multiannual quantity of pesticides-total, of 18,251.90 tons, on the average cultivated area, namely 6,144.83 thousand ha. Romania uses 35.25% of the amount used by the United Kingdom in agriculture, although the latter cultivates 66.54% of the average cultivated area in our country. ***Hungary*** has a multiannual pesticide consumption-total of 8,904.50 tons, respectively 27.74% more than in ***Romania***, at an average multiannual cultivated area of 4,522.40 thousand ha, respectively 48.97% of the cultivated area in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Romania. ***Romania*** ranks last in terms of quantities of pesticides used in agriculture, with a multiannual average over the period 2010-2019 of 6,434 tonnes.

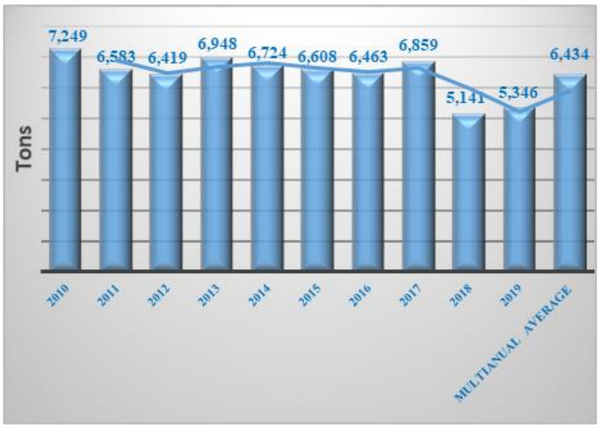

Fig. 7. Pesticide consumption in Romania
Source: Own calculations and figure [11].

Regarding the groups of pesticides, it is highlighted that Romania ranks last in the consumption of herbicides with an average multiannual consumption of 3,525.6 tons, as well as in the consumption of fungicides and bactericides, with an average multiannual consumption of 2,070.10 tons, but on the penultimate place in the consumption of insecticides, with an average multiannual consumption of 838.3 tons during 2010-2019.

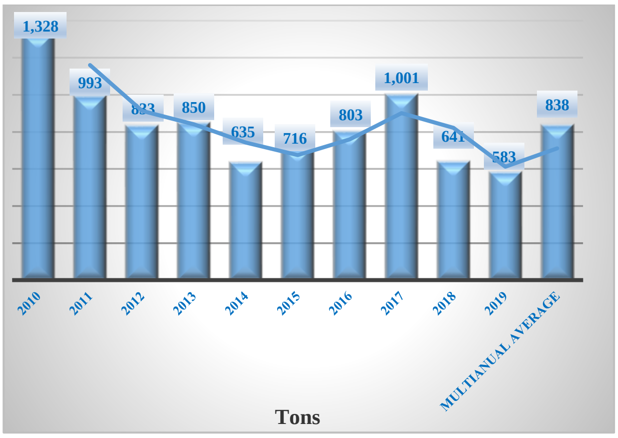

Fig. 8. Insecticide consumption in Romania
Source: Own calculations and figure [11].

In order to establish the average multiannual quantity of chemical fertilizers used per hectare cultivated in the main European countries included in the study, the quantities of fertilizers consumed in agriculture and the total area cultivated each year of the analysis period, namely 2010-2019, were taken into account.

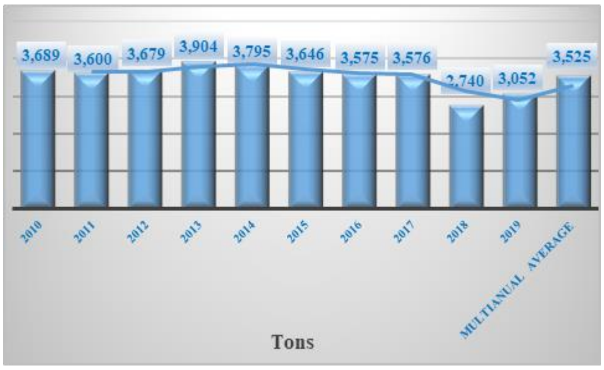

Fig. 9. Herbicide Consumption in Romania
Source***:*** Own calculations and figure [11].

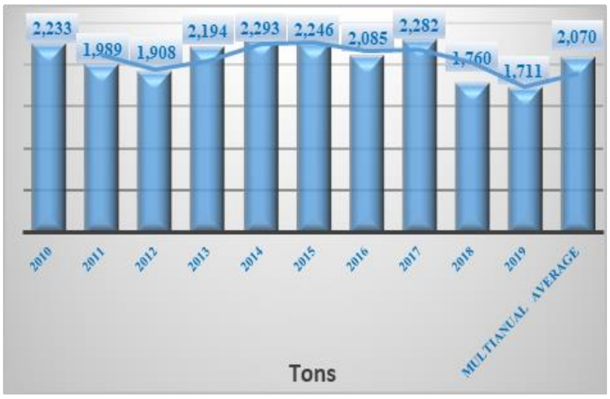

Fig. 10. Consumption of fungicides and bactericides in Romania
Source: Own calculations and figure [11].

Correlating the ***average multiannual quantity of chemical fertilizers with nitrogen*** with ***the average multiannual area,*** it is found that in the period 2010-2019, *Romania* has the lowest quantity consumed among the countries included in the study by 76.93% lower than the largest consumer of nitrogen fertilizers (N), respectively ***United Kingdom***, which recorded a consumption of an average multiannual quantity per hectare of 167.36 kg/ha. ***Germany*** has an average multiannual consumption of nitrogen (N) during the analysis period of 134.47 kg/ha, 71.29% more than the average multiannual amount per hectare used in ***Romania***. ***France*** has an average multiannual consumption of nitrogen (N) during the analysis period of 110.80 kg/ha, with 65.16% more than the average multiannual amount per hectare used in ***Romania***. ***Poland*** has an average multiannual consumption of nitrogen (N) during the analysis period of 96.23 kg/ha, with 59.88%

more than the average multiannual amount per hectare used in ***Romania. Hungary*** has an average multiannual consumption of nitrogen (N) during the analysis period of 78.85 kg/ha, 51.05% more than the average multiannual amount per hectare used in ***Romania***. ***Italy*** has an average multiannual nitrogen (N) consumption during the analysis period of 62.47 kg/ha, 38.21% more than the average multiannual amount per hectare used in ***Romania. Spain*** has an average multiannual consumption of nitrogen (N) during the analysis period of 57.78 kg/ha, 33.19% more than the average multiannual amount per hectare used in ***Romania.***

Regarding ***the multiannual consumption of chemical fertilizers with phosphorus***, it is found that in the period 2010-2019, ***Romania*** has the lowest quantity used among the countries included in the study and has 51.89% less than the largest consumer of phosphorus fertilizers (P_2O_5), respectively ***United Kingdom***, which recorded a multiannual average quantity per hectare of 31.26 kg/ha. ***Poland*** has a multiannual consumption of phosphorus (P_2O_5) during the analysis period of 30.92 kg/ha, 51.35% more than the average multiannual quantity per hectare used in ***Romania***. ***Spain*** has an average multiannual consumption of phosphorus fertilizers (P_2O_5) during the analysis period of 23.87 kg/ha, 36.99% more than the average multiannual amount per hectare used in ***Romania. Germany*** has an average multiannual consumption of phosphorus fertilizers (P_2O_5) during the analysis period of 21.47 kg/ha, 29.94% more than the average multiannual amount per hectare used in ***Romania. France*** has a multiannual consumption of phosphorus fertilizers (P_2O_5) during the analysis period of 20.88 kg/ha, 27.97% more than the average multiannual amount per hectare used in ***Romania. Italy*** has a multiannual consumption of phosphorus fertilizers (P_2O_5) during the analysis period of 18.62 kg/ha, 19.23% more than the average multiannual amount per hectare used in ***Romania.***

Regarding the ***multiannual average quantity of chemical fertilizers with potassium (K_2O),*** it is found that in the period 2010-2019, ***Romania*** has the lowest, 5.38 kg/ha consumed among the countries included in the study and has 88.89% less than the largest consumer of potassium fertilizers (K_2O), respectively ***Poland***, which recorded a multiannual average quantity per hectare of 44.42 kg/ha. ***United Kingdom*** has an average multiannual consumption of potassium fertilizers (K_2O) during the analysis period of 43.79 kg/ha, 87.71% more than the average multiannual amount per hectare used in ***Romania. Germany*** has an average multiannual consumption of potassium fertilizers (K2O) during the analysis period of 35.02 kg/ha, 84.63% more than the average multiannual amount per hectare used in ***Romania. France*** has an average multiannual consumption of potassium fertilizers (K_2O) used in the analysis period of 23.26 kg/ha, 76.87% more than the average multiannual amount per hectare used in ***Romania. Spain*** has an average multiannual consumption of potassium fertilizers (K_2O) used in the analysis period of 21.31 kg/ha, 74.75% more than the average multiannual amount per hectare used in ***Romania***.

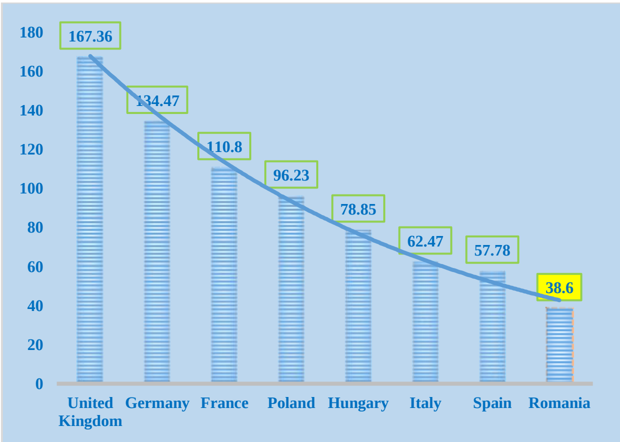

Fig. 11. Multiannual average consumption of nitrogen fertilizers (2010-2019)
Source: Own calculations and figure [11].

Soil moisture plays an important role in the mobility of potassium, with a positive impact on production [1]. ***Hungary*** has an average multiannual consumption of potassium fertilizers (K_2O) used in the analysis period of 18.31 kg/ha, 70.62% more than the average multiannual amount per hectare used in ***Romania***. ***Italy*** has an average multiannual consumption of potassium fertilizers (K_2O) used in the analysis period of 13.74 kg/ha, 60.84% more than the average multiannual amount per hectare used in ***Romania.***

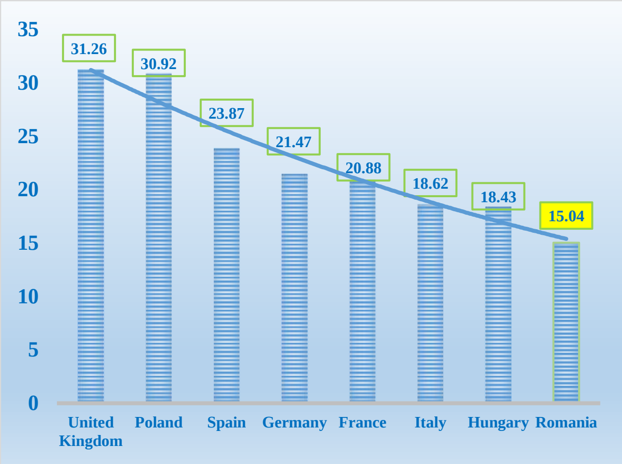

Fig. 12. Multiannual average consumption of phosphorus fertilizers (2010-2019)
Source: Own calculations and figure based on the data from [11].

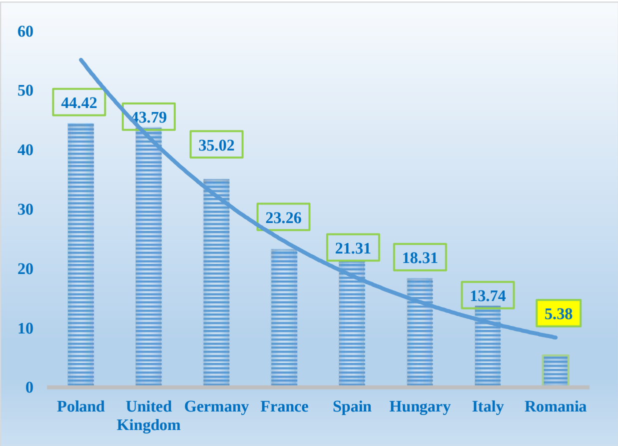

Fig. 13. Multiannual average consumption of potassium fertilizers (K_2O) (2010-2019)
Source: Own calculations and figure based on the data from [11].

In order to establish the multiannual average quantity of pesticides used per hectare cultivated in the main European countries included in the study, the quantities of pesticides consumed in agriculture and the total area cultivated each year from the analysis period, namely 2010-2019, were taken into account. In terms of the multiannual average quantity of pesticides used, it is found that, during 2010-2019, ***Romania*** recorded the lowest value, 0.70 kg/h, compared to the values recorded in the countries included in the study and has 89.24% less than the largest consumer of pesticides, namely ***Italy***, which recorded a consumed multiannual average quantity per hectare of 6.51 kg/ha. ***Germany*** has a multiannual average pesticide consumption of 3.77 kg/ha, 81.43% more than the multiannual average amount per hectare used in Romania. ***France*** has a multiannual average consumption of pesticides of 3.67 kg/ha, 80.93% more than the multiannual average amount per hectare used in Romania. ***Spain*** has an average multiannual consumption of pesticides of 3.28 kg/ha, 78.66% more than the average multiannual amount per hectare used in Romania. ***United Kingdom*** has an average multiannual pesticide consumption of 2.97 kg/ha, 76.43% more than the average multiannual amount per hectare used in Romania. ***Poland*** has an average multiannual pesticide consumption used of 2.03 kg/ha, which is 65.52% bigger than the average multiannual amount per hectare used in Romania.

Hungary has an average multiannual pesticide consumption during the analysis period of 1.97 kg/ha, 64.47% more than the average multiannual amount per hectare used in Romania.

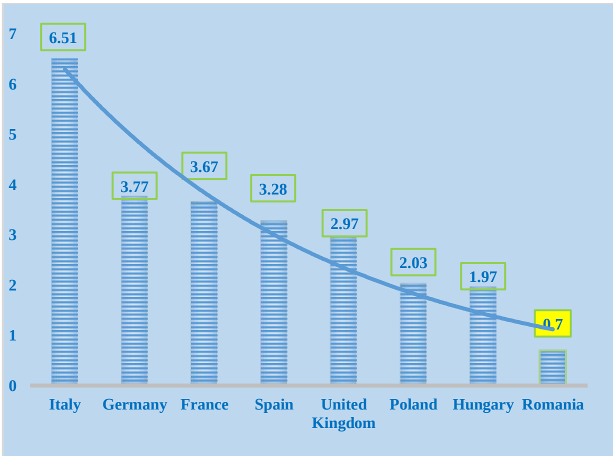

Fig. 14. Multiannual average pesticide consumption-total (2010-2019)
Source: Own calculations and figure based on the data from [11].

CONCLUSIONS

The conclusions of the study conducted by us, "The socio-economic impact of implementing *the Farm to Fork Strategy in agriculture and its transposition in Romania"* highlighted the following:

-*The average cultivated area* in the period 2010-2019 in the countries under study, have positioned *Romania* on the 6th place among the countries under study (9,234.80 thousand ha).

-*The consumption of fertilizers and pesticides in Romania* is low, and this country occupies the last positions in the ranking of the countries under study, a situation that has a negative influence on the productions made in the analyzed crops.

-Correlating *the average multiannual quantity of chemical fertilizers and pesticides* with *the average multiannual area*, it is found that in the period 2010-2019 *Romania* has the lowest quantities consumed per cultivated areas amongst the countries included in the study. Reducing the amount of fertilizers and plant protection products will lead to a significant decrease in yields.

-The reduced consumption of *chemical fertilizers with nitrogen* along with other limiting factors, places Romania on the last places in terms of average yields/ha for the main crops.

-Also, the consumption of *chemical fertilizers with phosphorus* highlighted that Romania ranks 3rd in maize and potato crops, 4th in wheat and 5th in barley. For sunflower, rapeseed and soybean crops, the consumption of chemical phosphorus fertilizers placed Romania on the 6th place.

-Consumption *of chemical fertilizers with potassium,* places Romania on the last place in the hierarchy of the countries under study (8th place).

-Similarly, the average consumption of pesticides ranked Romania the last in the hierarchy of the countries studied (8th place).

Thus, the study has strengthened the existing ideas in other previous analyses, namely the use of fertilizers and pesticides in Romania is below the average of the quantities used by the countries included in the study. As a result, although the areas cultivated with cereals and technical plants in Romania are significant, the average yields/ha achieved are much lower compared to those recorded in the main producing countries mainly because Romanian farmers consume the lowest average quantities of fertilizers and pesticides per hectare, are largely dependent on climatic factors, use less advanced technologies (irrigation, modern machines, precision agriculture, performant seeds obtained by modern improvement techniques, etc.). The total yields are dependent on cultivated areas and average productions. As a result of the fluctuation of the two components, the total yields are also fluctuating, but again we note that the variability is higher in Romania for all the crops considered mainly due to the variability of the average yields per hectare. A special remark should be made for the production of maize in Spain. Spain grows the smallest area of maize in the studied countries but obtains the highest average yields per hectare. This is possible because genetically modified maize resistant to the attack of *Ostrinia nubilalis* is grown in Spain, and because maize is grown only on irrigable areas. Thus, we consider that it is necessary that the reduction of the quantities of fertilizers and pesticides used in EU agriculture and, implicitly, in Romania, as a result of the transposition into work of the Farm to Fork Strategy, to be carried out by reference to the European average, to the level of access/use of the elements of technological progress in the concerned country and to be taken into account the impact on the average yields, respectively total yields, for the main crop plants.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the project no. 182/23.11.2021 Impactul socio-economic al aplicării strategiei FARM TO FORK în agricultură și transpunerea în România/"The socio-economic impact of implementing the FARM TO FORK Strategy in agriculture and its transposition in Romania" contracted with the "Asociația Producătorilor de Porumb din România"/"Romanian Corn Producers Association".

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVOLUTION OF THE LIVESTOCK SECTOR OF THE REPUBLIC OF MOLDOVA

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Abstract

The livestock sector of the Republic of Moldova has been in a continuous decline since the collapse of the USSR, with sharp reductions in the production of pork meat (by 2.5 times), beef (by 13 times), poultry (-50%) and milk (by 5.2 times). Revitalization of the livestock sector has become of the priorities of the current public policies implemented in the country, new measures of public support like direct payments per head of livestock being implemented in order to boost the sector's performance. The paper aims to analyse the current state of the livestock sector in the Republic of Moldova, with an emphasize on the subsectors with the most competitive potential that require an improved or additional public support. The descriptive, comparative and analytical research methods have been used in order to develop conclusions and recommendations with respect to the further development of the livestock sector in the Republic of Moldova.

Key words: *livestock, Republic of Moldova, production, public support*

INTRODUCTION

The climatic conditions of the country and fertile soils are favourable for the livestock production that is one of the oldest occupations of the rural population. Livestock products represent an important part of the diet of the Moldovan population. The cattle growing is the main branch of livestock production in Moldova, providing the highest amounts of animal production as milk and meat [6].

Livestock production in the Republic of Moldova has always been an important part of the total agricultural output, which in recent years, with regret, has reduced its presence in agriculture. Thus, if at the beginning of 2010 the value of livestock production had been about 30% of the total value of total agricultural output, then in 2021 its share decreased to an extreme minimum value of about 20% of the total value of the output.

However, this decrease is not entirely due to the reduction in livestock production, but rather to the increase in plant production which is also vulnerable to climatic conditions, given the geographic location of the Republic of Moldova. A simple comparison of the year 2020 - a year with severe drought and 2021 a year that was quite favourable in terms of climatic conditions shows us how the ratio changes in the structure of agricultural activity. At the same time, the effects of drought from 2020 which affected the crop sector have extrapolated to the livestock sector in 2021, thus contributing to its decrease.

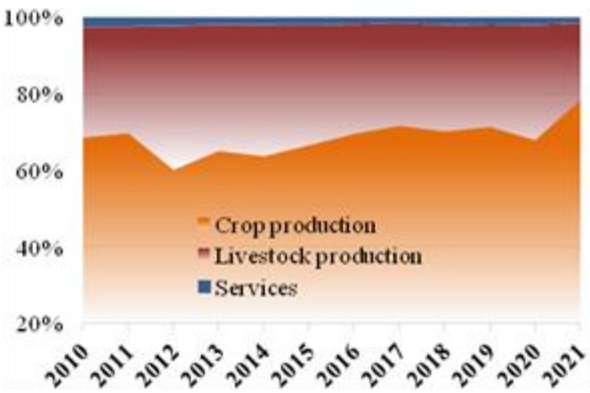

Fig. 1. Value of total agricultural output divided by branches, 2010 - 2021, %
Source: National Bureau of Statistics, 2022 [8].

The livestock sector suffered the biggest losses during the process of transformations in the agricultural sector. The overwhelming majority of the animals was moved from large to individual farms, where are practiced mostly the extensive production technologies of cattle and poultry [9], which led to a sharp decline in production volumes [7].

At the same time, it is good to have an idea of the components of the livestock sector and the role of each product in its structure, which is presented in the table below and reflects an approximate average of each production in the livestock sector output for the analysed period.

Table 1. Structure of agricultural output and livestock production in particular, average values, 2010 – 2021, %

Total agricultural output	100
Crop production	68.6
Livestock production, of which:	31.4
Production of cattle and poultry of which:	17.8
cattle	1.6
pork	9.3
sheep and goats	0.4
poultry	6.2
Milk production	9
Eggs production	3.4
Wool production	0.1

Source: National Bureau of Statistics, 2022 [8].

However, the monetary values and the increase of the price do not fully reflect the situation of the livestock sector and, in order to make a more comprehensive analysis, it is worth paying special attention to the natural values of the given sector and their sources of origin.

In this context, the purpose of the paper is to analyze the dynamics of livestock in the Republic of Moldova and identify the directions for its revitalization as a priority in the current agricultural policies which need public support.

MATERIALS AND METHODS

The paper is focused on the analysis of the evolution of the livestock sector of the Republic of Moldova for the period 2010 – 2020, with some incursions in the period 2000 – 2010, as well as some latest available data for 2021.

The main data source is provided by the National Bureau of Statistics, Un Comtrade database [10] and WITS database.

Aspects and data related to public support is extracted from the Annual reports provided by the Agency for Intervention and Payments in Agriculture.

RESULTS AND DISCUSSIONS

The cattle sector

The cattle sector in the Republic of Moldova in the last 22 years has registered a considerable decrease of about 3.9 times in the number of heads. This decline is closely related to the decrease in the number of heads in households, which in the given period has decreased by about 4.1 times. At the same time, enterprises and peasant households have also experienced a reduction with attempts of recovery in the last 8 years (Figure 2).

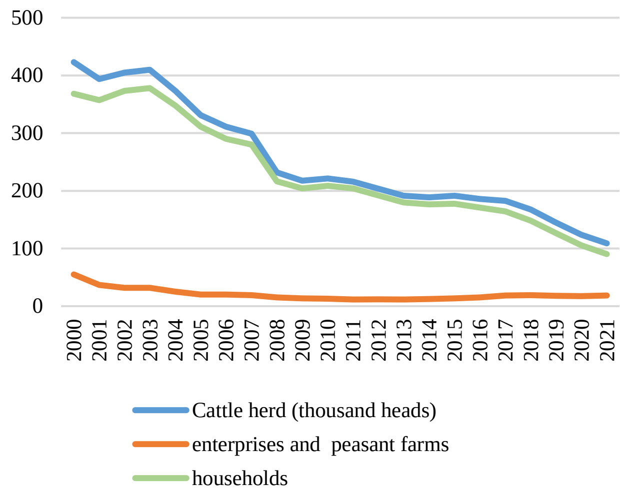

Fig. 2. Evolution in the number of cattle during the years 2000 - 2021, thousand heads
Source: National Bureau of Statistics, 2022 [8].

Moreover, the decline in the number of cattle herds has inevitably led to a reduction in both meat and milk production (Figure 3).

Although the beef production is decreasing, an important share of it goes to export in the form of fresh, chilled or frozen meat. The trade balance with beef is positive, with decreasing values of export. In 2020, for the first time in the last 9 years, the import values have overtaken the export ones (Figure 4).

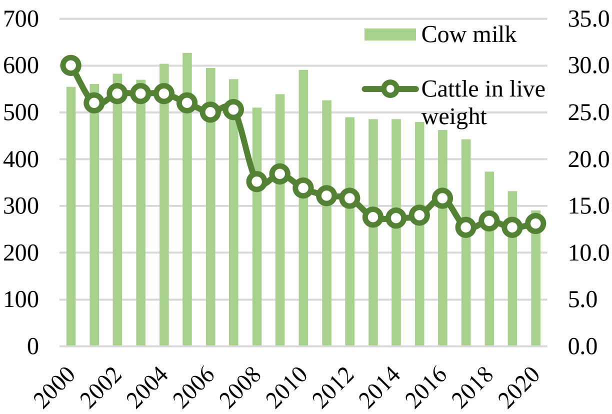

Fig. 3. Meat and milk production, 2000 - 2020, thousand tons
Source: National Bureau of Statistics, 2022 [8].

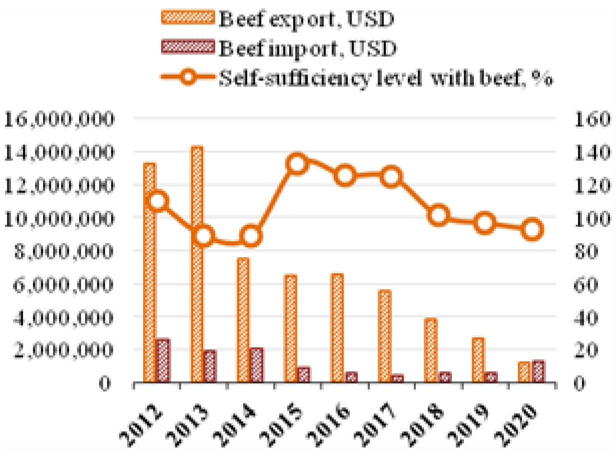

Fig. 4. Import and export of beef and the levels of self-supply of the Republic of Moldova, 2012 - 2020, thousand USD
Source: National Bureau of Statistics, 2022[8], UN Comtrade database, 2022 [10].

The Netherlands and Germany are the main import partners of live bovine animals during the period 2010-2020. However, the main importing partners for fresh refrigerated or frozen beef are from neighboring countries, namely Ukraine and Romania. In the case of exports of live bovine animals, the main partners of the Republic of Moldova are the countries of Lebanon, the Syrian Arab Republic and Jordan, which in the last three years have a share of about 98-99% of total exports of live bovine animals. In terms of exports of fresh chilled or frozen beef, the Russian Federation is the main partner, where is noticed a steady decline in exports throughout the years 2010-2020.

As with meat products, milk and sour cream were also negatively affected by the reduction in the number of cattle. This phenomenon has led to a reduction in the level of self-sufficiency in milk and sour cream, a figure that in the early 2010s was below the required value. This situation has created new opportunities for importers of these products which have intensified their presence on the domestic market in recent years (Figure 5).

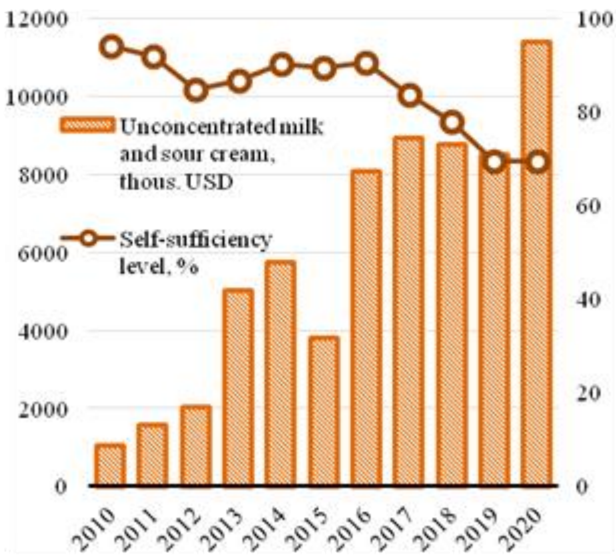

Fig. 5. Self-sufficiency level and import of milk and dairy products in the Republic of Moldova, 2010 – 2020
Source: National Bureau of Statistics, 2022[8], UN Comtrade database, 2022 [10].

The main exporters in the Republic of Moldova of unconcentrated milk and sour cream are Ukraine, Romania and more recently, Poland, which cumulatively for the year 2020 account for about 83% of the total milk products imported by the Republic of Moldova.

Compared to imports, the value of exports of unconcentrated milk and sour cream in the analyzed period is significantly lower. Although the European Commission has approved the Republic of Moldova for the placing on the European Union market of raw milk and dairy products, our country does not have the necessary production capacity and volumes to allow an increase in exports to both EU and other countries as a result of declining of the cow herd and milk production. At the same time, more attention must be paid to compliance with quality standards so that they meet the requirements of the international market.

In order to revitalize the cattle sector, the state provides a series of subsidies through measures such as stimulating investment for the use and technological renovation of livestock farms, namely for farms intended for raising and maintaining cattle. The amount granted can reach a value not exceeding 50% of the value of the investment and the maximum subsidy threshold should not exceed 5 mil. MDL. In order to stimulate the purchase of breeding animals and the maintenance of their genetic fund, the state provides support for investments for the purchase of these animals in an amount not exceeding 50% of the investment cost or the maximum ceiling of up to 2.5 mil. MDL [4].

Direct payments per head of bovine animals (*Bos taurus*) are also granted. The amount per head of purebred cattle is 5,000-7,000 MDL [5].

For primary processing, packaging, refrigeration, freezing and storage of meat and milk, the state provides support amounting to 50% of the value of equipment and machinery but the value of support should not exceed the established ceiling of 5 mil. MDL.

The pork sector

Although in the Republic of Moldova, growth of pigs during the period 2010 - 2021 has a somewhat oscillating character, there is noticed a reduction in the number of heads in the last 4 years. Although during the analyzed period the agricultural enterprises and peasant farms have increased their number of pigs more than 2 times and have reached a share of approximately 57.9% of the total pigs in 2021, somewhat during this period it is observed an increased dependence of the total number of pigs on pigs kept in households (Figure 6).

During the analysed period, there is observed that the pork meat production is kept within the limits of 60 - 65 thousand tons (except for the years 2015, 2016) but the import has an oscillating character and only in the last four years it has stabilized registering a slight decrease (Figure 7).

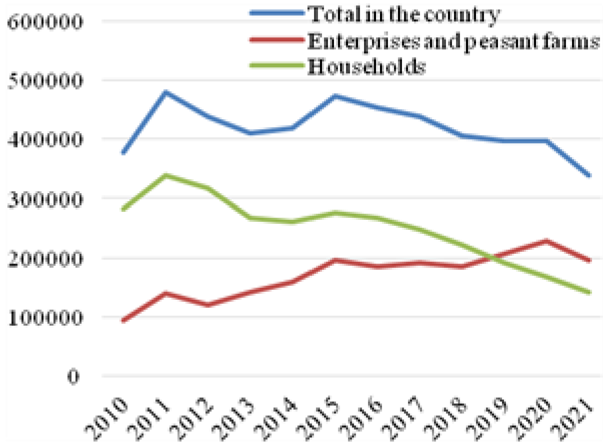

Fig. 6. The number of pigs in the Republic of Moldova by categories, 2010 – 2021, units
Source: National Bureau of Statistics, 2022 [8].

Against the background of the stabilization of pork production, namely the reduction of imports in the last four years of the analysed period led to the increase of the level of self-supply of the given product which was below the necessary limit for the Republic of Moldova. As far as the production of pork does not meet the needs of the internal market, exports of the product during the considered period are in very small quantities and do not deserve to be taken into account.

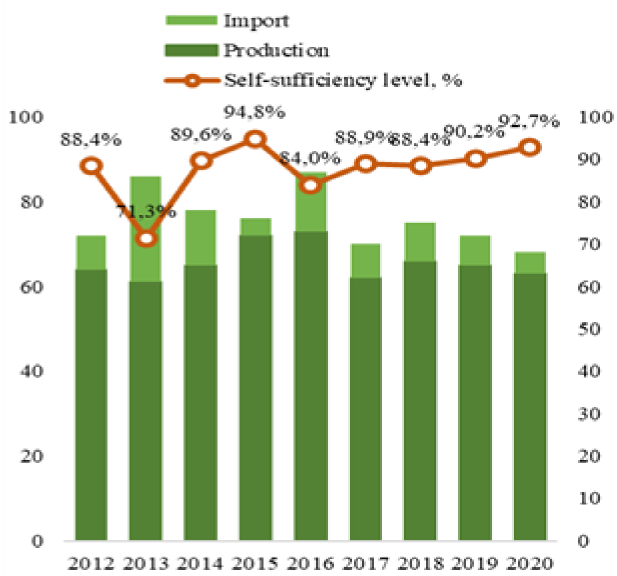

Fig. 7. Production, import and self-supply level of pork in the Republic of Moldova 2012 - 2020, thousand tons
Source: National Bureau of Statistics, 2022 [8].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In order to revitalize the given sector, the state through the Agency for Intervention and Payments for Agriculture (AIPA) [1] provides support in the form of subsidies to stimulate investments for the use and technological renovation of pig farms up to 50% of the investment value. Within the measure dedicated to stimulation of the procurement of breeding animals and the maintenance of their genetic fund, provided subsidies are up to 30% for boars aged 4 to 8 months and sows aged 5 to 8 months. The maximum amount of the grant must not exceed 500,000 per beneficiary. Also, for equipment and machinery intended for primary/finished processing, packaging, refrigeration, freezing, processing and storage of meat, granted subsidies must not exceed 50% of the value of the investment.

Sheep and goat sector

Growth of sheep in the Republic of Moldova during the years 2010 - 2021 decreased by about 40%, but this decrease did not have a continuous and constant trend. The reduction was slow in the period 2014-2018 and with a more pronounced reduction in the years 2019-2021. Of course, these reductions also affected wool production, which decreased by about 30% between 2010 and 2020n (Figure 8).

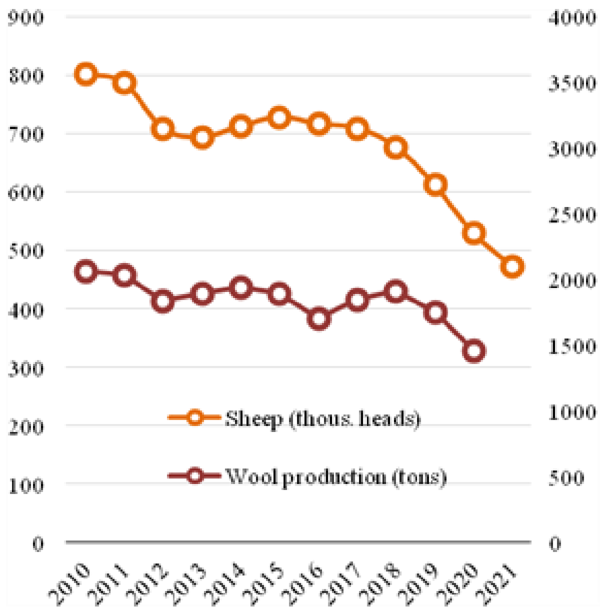

Fig. 8. Sheep breeding and wool production in the Republic of Moldova, 2010 – 2021
Source: National Bureau of Statistics, 2022 [8].

Compared to the sheep breeding, the goat breeding had an ascending character during the years 2010 - 2018, which then changed its growth vector and had 3 consecutive years of decrease (Figure 9). Also, the given results are noticed due to the households that hold a share of over 99% of all goats in the Republic of Moldova over the years.

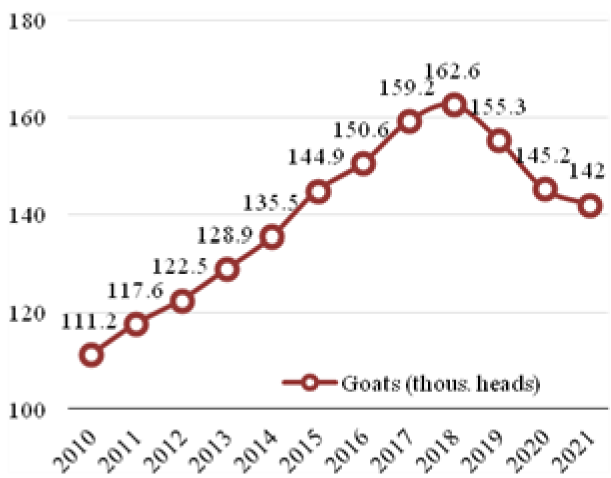

Fig. 9. Goat breeding in the Republic of Moldova, 2010 – 2021
Source: National Bureau of Statistics, 2022 [8].

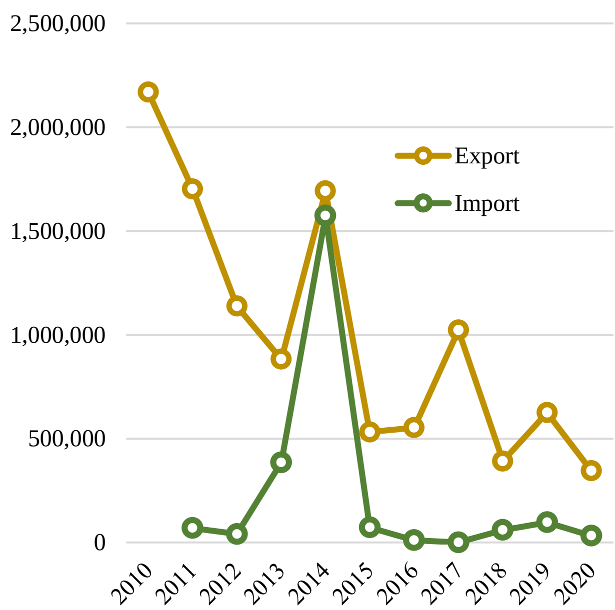

Fig. 10. Import and export of live sheep and goats, USD
Source: UN Comtrade database, 2022 [10].

The value of imports of sheep and goats during the analysed period was small compared to the one of exports, except for 2014 when imports of sheep and goats reached a value of about 93% compared to the

value of exports. At the same time, during the analysed period, there noticed, with large fluctuations, a gradual decrease in the values of exports of live sheep and goats (Figure 10).
As well as the export of live sheep and goats, the export of the meat of the given species significantly prevails over imports. Although in the years 2010 - 2012 there was an increase in the export values of meat of sheep and goats, in the next four years 4 years they had a diametrically opposite situation with the most pronounced reduction in 2015, 2016. In 2017 is already noticed a restoration of the situation regarding the exports that are relatively kept for the rest of the analysed period, however registering a reduction in the 2020 (Figure 11).

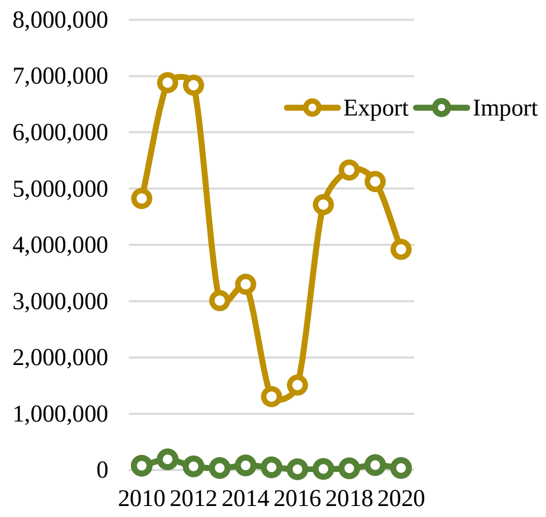

Fig. 11. Import and export of sheep and goats meat, USD
Source: UN Comtrade database, 2022 [10].

In order to support the sector, the competent state authorities grant subsidies to partially compensate for the investment in the purchase of breeding animals from breeding farms, ie 50% of the cost for rams and goats aged between 6 and 20 months, but the value of the subsidy should not exceed the amount of 200,000 MDL per beneficiary and for the purchase of lambs and goats from breeding farms aged between 6 and 20 months in an amount of 50% of the purchase cost.

The beekeeping sector

Contrary to the general situation in the livestock sector, beekeeping in the analysed period had an increasing character. The number of bee families in the given period, with small oscillations, was in a continuous increase and in 2021 registered an increase of approximately 45% compared to 2010, thus reaching a sum of approximately 184.9 thousand bee families (Figure 12).

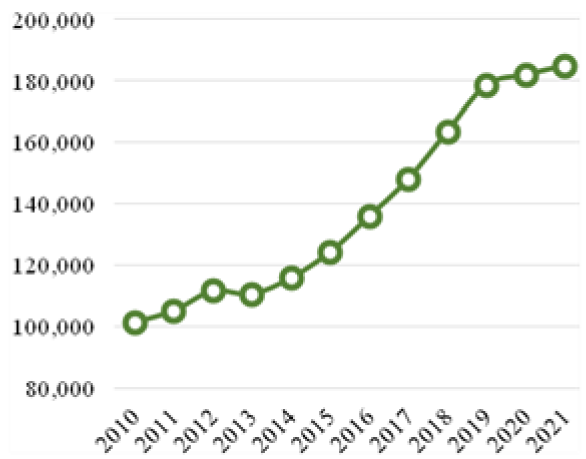

Fig. 12. Number of bee families in the Republic of Moldova, thous. Families
Source: National Bureau of Statistics, 2022 [8].

Overall, the obtained results are due to households, which if at the beginning of the analysed period had a share of about 95.1% of all bee families in the Republic of Moldova then during the period only strengthened their positions and in 2021 had a share of about 98.7%.
The number of bees is closely correlated with honey production, but there are other factors that can positively or inversely influence honey production, including: the strength of the bee family, the age of the bees, the location of the hives, the slower arrival of the warm season, low temperatures, unfavourable weather conditions, etc. During the analysed period there is a gradual increase in bee honey exports which covered the period 2010-2017, when bee honey exports increased about 11.7 times. Unfortunately, this increase in exports was not closely linked to the economic advantage of beekeepers, although throughout the analysed period, with small fluctuations, there is noticed a decrease in the price which at the end of the period became with 28% cheaper compared to 2010 (Figure 13).

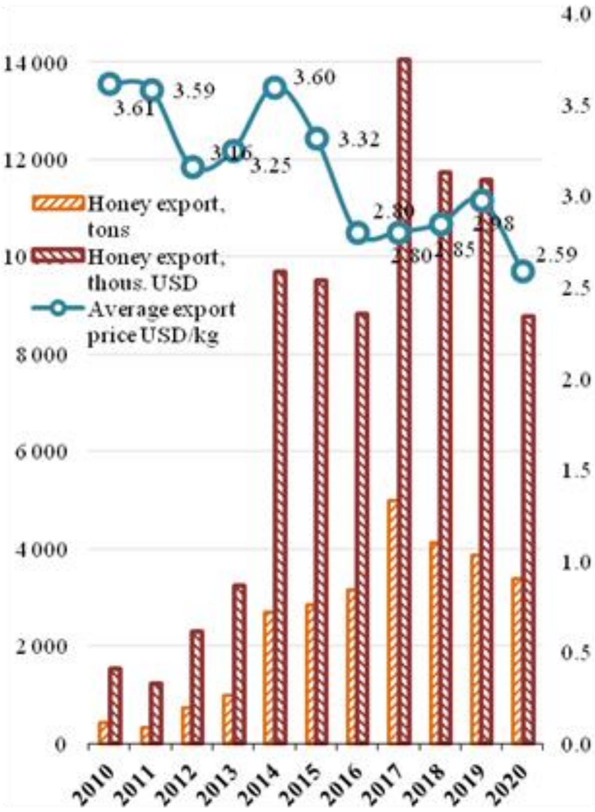

Fig. 13. Export of honey, 2010 - 2020
Source: UN Comtrade database, 2022 [10].

The public authorities also support this direction for the development of animal husbandry and by subsidizing several stages of beekeeping activities such as: granting compensation for the purchase of new technological equipment for the endowment and modernization of beekeeping farms; provision of support for partial compensation for the purchase of queen bees from hatchery farms up to 3 months old; providing support not exceeding 50% of the value of equipment and machinery intended for primary / finished processing, packaging and processing of bee honey Also, for farmers who are registered in the organic farming system for the period of conversion and maintenance of organic beekeeping is granted 300 MDL for each family of bees.

Poultry sector

In terms of poultry production during the years 2012 - 2020 in the Republic of Moldova there has always been a negative balance. Although the deficient level of the product given in 2012 constituted 31.6% of the total necessary resources and which was replaced by imports, the relative increase in poultry production that rose between 2017 and 2020 did not solve this problem, the reason being the increase in demand on the local market and therefore the increase in imports which in turn decreased the level of self-sufficiency even more reaching 66.6% by 2020 (Figure 14).

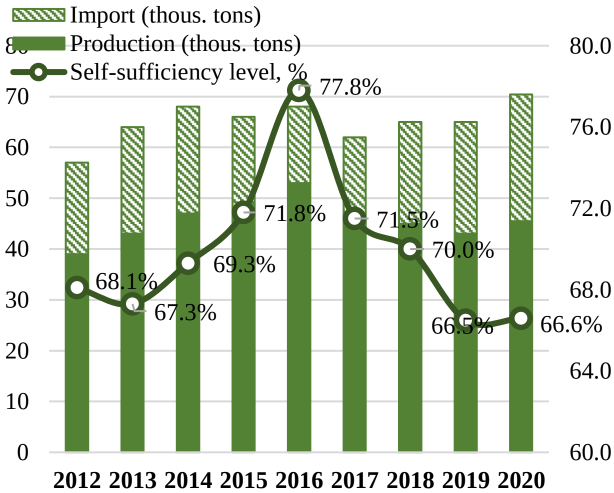

Fig. 14. Production, import and self-supply of poultry meat in the Republic of Moldova, 2012 – 2020
Source: National Bureau of Statistics, 2022 [8].

Like poultry production, egg production between 2012 and 2020 is oscillating. The biggest interest in the analysed period is shown by egg exports, which in 2012 accounted for only 0.5% of total poultry egg resources, then the peak quantity exported was recorded in 2017 and accounted for 9.7% of total egg resources for that year, afterwards decreasing gradually to a share of 2.4% of total poultry egg resources for 2020.

At the same time, during this period imports experienced an increase, being used predominantly for incubation.

But all these fluctuations influenced the level of supply which, although in 2012 it was at the limit but had positive values of 102.2% then in 2020 it registers a negative value of 97.9% (Figure 15).

Therefore, foreign trade with agricultural products is facing an unbalanced ratio between exports and imports as affirmed other authors in their studies in the Republic of Moldova [2, 3].

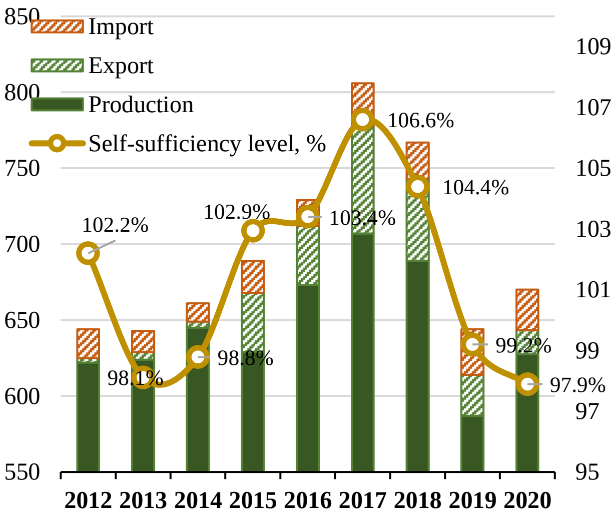

Fig. 15. Production, import and self-supply with eggs in the Republic of Moldova, 2012 – 2020
Source: National Bureau of Statistics, 2022 [8].

In order to support this sector, the public sector provides financial aid in the form of subsidies for the purchase of equipment and technological renovation of livestock farms. Also, in order to stimulate investments in primary processing, packaging, refrigeration, freezing, processing and storage of meat, the public administration provides financial support in the form of subsidies not exceeding 50% of the investment cost.

CONCLUSIONS

Many sectors of the livestock complex are dependent on households, namely their migration from urban to rural areas or abroad has led to a reduction in animal production.
The livestock sector of the Republic of Moldova experiences decreasings in all sub-sectors, except for beekeeping.
State aid by allocating subsidies in different directions of development of the livestock complex are of course favorable for their development but they are more aimed at stimulating agricultural enterprises and peasant farms, rather than households, which, as mentioned, have a still quite important role in the given complex.
The reorientation of subsidies in this direction can stimulate the exit from the shadow of the records of households.

ACKNOWLEDGEMENTS

The paper has been developed in the framework of the State Program "Development of new economic instruments for assessing and stimulating the competitiveness of agriculture in the Republic of Moldova for 2020-2023" (code - 20.80009.0807.16) funded through the National Agency for Research and Development of the Republic of Moldova.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

INCLUSIVE EDUCATION IN UKRAINIAN RURAL AREAS: PROBLEMATIC ISSUES AND SOLUTIONS ON THE EXAMPLE OF THE TERRITORIAL COMMUNITY IN THE VILLAGE OF KURYLIVKA

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Abstract

The article proposes the definition of the essence of inclusive education and its compliance with the civilizational strategies of the XXI century. In the framework of the research project, the authors analyzed the European and world experience of implementing inclusion in the educational space. The main models and legal aspects of the implementation of inclusive education in Ukraine are considered. The authors of the article identified key issues that hinder the successful integration of inclusive education into the national education system (on the example of the village of Kurylivka) Mechanisms of effective implementation of the inclusive component of the national education system (for example, the village of Kurylivka) are proposed. General and special methods of cognition, namely institutional, systemic, structural-functional, statistical, analytical, comparative and descriptive, became the theoretical and methodological basis for the study of inclusive education in rural areas of Ukraine.

Key words**:** *social inclusion, rural areas, territorial community, tolerance, social policy*

INTRODUCTION

In the modern world, the educational system is the basis of intellectual, cultural, spiritual, social, political and economic development of society and the state. Education is an important social institution that reflects social relations functioning in its structure, influences the processes of socialization, social continuity, is responsible for the succession of generations, for training and involving people in full functioning of society, enriches the intellectual, creative, cultural potential of the people, provides cities and rural areas with highly qualified specialists. During the years of independence, the education system in Ukraine has significantly transformed, becoming more open, humanistically oriented, one that develops in line with progressive world trends and is part of the European and world educational space [8]. According to the requirements of time, needs and public demand, the modern educational paradigm is aimed at ensuring that everyone, regardless of health, physical or intellectual disability, has the right to obtain quality education. This is especially true given the fact that according to the World Health Organization (WHO) only 20% of all born children are considered conditionally healthy, others - whether suffer from mental and physical disabilities, or are in a state between health and disease [18]. Recognition of the rights of children with special needs to education, realization of the right to obtain it at the place of residence, assistance in the process of socialization and choice of professional activity is a key vector of development not only of modern education but also of humanitarian policy in all democratic countries. Under such conditions, inclusive education, which involves the education of a child with special educational needs in a general education establishment, becomes especially important. One of the main tasks of inclusion is to respond to a wide range of educational needs, both inside and outside the school environment, to create conditions in which all participants of the educational process have equal access to education, including children with special educational needs. After all, inclusion implies active, equal participation in the process of acquiring knowledge, involvement in social life of all categories of people, regardless of their physical, mental, intellectual or other characteristics, thereby reducing the manifestations of social segregation and inequality. Inclusive education is based on the principle of eliminating all discrimination, ensuring equal treatment for all but creating special conditions for people with special needs by developing appropriate curricula, taking organizational measures, developing teaching strategies, arranging premises and surrounding areas accordingly, using government resources and partnerships with urban and rural communities. Thus, the implementation of the principles of inclusive education requires changes and modifications of the content, approaches and structure of educational strategies, taking into account the recognition of equal value of each individual for society, creating conditions for their successful development and self-realization.

In this context, the purpose of the paper is to study the essence and features of social inclusion in the educational space of modern Ukrainian society (on the example of the territorial community of the village of Kurylivka.

MATERIALS AND METHODS

General and special methods of cognition, namely institutional, systemic, structural-functional, statistical, analytical, comparative and descriptive, became the theoretical and methodological basis for the study of inclusive education in rural areas of Ukraine.

The basis of the methodological tools of the study is the legal framework of Ukraine, which aims at supporting and developing rural areas, primarily the Law of Ukraine "On the priority of social development of rural and agro-industrial complex in the national economy" amended by the Order of the Cabinet of Ministers № 1239 from 14.12.2020 [11], Ordinance of the Cabinet of Ministers of Ukraine of September 23, 2015 № 995-r "On approval of the Concept of rural development" with changes made in accordance with the Order of the Cabinet of Ministers № 1239 of 14.12.2020 [1].

In addition, the regulatory framework of the study is a number of orders, resolutions, decisions and other legislative acts of Ukraine, which regulate the mechanisms of implementation and realization of the national project of the education system reforming in accordance with the standards of inclusive society of the XXI century [22, 25, 19, 24, 23, 20, 13, 12, 15].

The information and statistical resource of the research is the data of the Ministry of Community and Territories Development of Ukraine [16], data of the State Statistics Office [26, 27], as well as information resources of territorial communities [3, 4, 5, 6].

The case of the territorial community of Kupyansk district Kharkiv region was taken to analyse the network of Inclusive Resource Centers (IRC) [9], which play a key role in providing comprehensive assistance to children with disabilities, their parents and teachers-assistants, and on the basis of which the strategies of effective. The concept of implementation of inclusion in the educational space of rural areas is in the focus, as according to the obtained results it has strategic importance for the development of the Ukrainian state.

The study analyzed the works by E.Derunov, N.Kireev, O.Pruschak, A.Michael, T.Stoev, M.Shishkov, R.Condei, C.Tindeche, E.Sima, Sh.Kroker, Dz͡h.Lupart, A.Kolupai͡eva, O.Taranchenko, S.Carrington, A.Anderson, B.Furlonger, T. Dehti͡arenko, S. Lytovchenko, M.Vasylʹi͡eva, I.Omelʹchenko, N. I͡Esina, O.Strelʹnikova and others, who contributed to the identification of problematic aspects of inclusive education in rural areas of Ukraine, and most importantly – contributed to the determination of a strategy of primary and urgent measures to create an inclusive educational space for children living in rural areas.

However, despite the presence of significant scientific achievements on this topic in the academic space, there is a shortage of works that thoroughly and comprehensively study the specifics of the implementation of inclusive projects for rural communities. After all, despite the global trend towards urbanization, for many countries around the world, including Ukraine, a significant proportion of the population living in rural areas remains traditional (30.46% according to the official data of the State Statistical Service of Ukraine) [26]. Romanian researchers [21] also point out this in their research, emphasizing specific recommendations for the inclusion of rural residents in the state program of social inclusion and social equality. “For its implementation, there were established important measures aiming the knowledge transfer and innovation in agriculture and rural areas, the promotion and implementation of the modern technologies destined to increase farm viability and competitiveness, the setting up of producers' organization and co-operation in agriculture and forestry, the reorganization of the food chain and the establishment of new quality systems for the agricultural and food products, the effective use of resources under the climate change conditions, the promotion of social inclusion, the reduction of poverty and the economic development of the rural areas by investing in fixed assets, creating basic services in the local communities and renewing the communes and villages, and increasing the living standard of the rural population”. [21, p.346].

RESULTS AND DISCUSSIONS

According to the draft of the Law of Ukraine “On Territorial Infrastructure Planning”, a rural area is an area with clearly defined boundaries and the share of the population (in its total number) that exceeds 15-50%, so it can be argued that Ukraine is a country with a predominance of rural areas [6].

Thus, as of January 1, 2021, the share of the rural population in its total population was 30.4% (Table 1).

Table 1. Population by regional level (at 01.01.2021)

	Population, persons			**Share of the population in the total, %**	
	Total	*Urban*	*Rural*	*Urban*	*Rural*
Ukraine	**41,588,354**	**28,959,536**	**12,628,818**	**69.6**	**30.4**
Vinnytsya	1,529,123	795,837	733,286	52.0	48.0
Volyn	1,027,397	537,242	490,155	52.3	47.7
Dnipropetrovsk	3,142,035	2,642,094	499,941	84.1	15.9
Donetsk	4,100,280	3,728,069	372,211	90.9	9.1
Zhytomyr	1,195,495	711,127	484,368	59.5	40.5
Zakarpattya	1,250,129	465,330	784,799	37.2	62.8
Zaporizhzhya	1,666,515	1,291,103	375,412	77.5	22.5
Ivano-Frankivsk	1,361,109	605,411	755,698	44.5	55.5
Kyiv	1,788,530	1,109,294	679,236	62.0	38.0
Kirovohrad	920,128	585,056	335,072	63.6	36.4
Luhansk	2,121,322	1,848,299	273,023	87.1	12.9
Lviv	2,497,750	1,526,767	970,983	61.1	38.9
Mykolayiv	1,108,394	761,278	347,116	68.7	31.3
Odesa	2,368,107	1,591,976	776,131	67.2	32.8
Poltava	1,371,529	859,042	512,487	62.6	37.4
Rivne	1,148,456	545,767	602,689	47.5	52.5
Sumy	1,053,452	733,310	320,142	69.6	30.4
Ternopyl	1,030,562	472,540	558,022	45.9	54.1
Kharkiv	**2,633,834**	**2,140,944**	**492,890**	**81.3**	**18.7**
Kherson	1,016,707	624,661	392,046	61.4	38.6
Khmelnytskiy	1,243,787	718,063	525,724	57.7	42.3
Cherkasy	1,178,266	673,511	504,755	57.2	42.8
Chernivtsi	896,566	388,398	508,168	43.3	56.7
Chernihiv	976,701	642,237	334,464	65.8	34.2
The city of Kyiv	2,962,180	2,962,180	x	100.0	X

Source: SSSU, 2021 [26].

In the regional context, the Kharkiv region, within which the study was conducted, also belongs to the rural area with a rural population of 18.7% of its total number according to these parameters (Table 1).

Rural development is a priority for both the European and Ukrainian communities. Back in 2014, within the framework of the Association Agreement between Ukraine and the EU, among the many crucial issues for the Ukrainian state, attention was paid to issues of cooperation in rural development. [10, p. 16]. Ukraine also has a legal framework focused on both support and development of rural areas, including, for example, the Law of Ukraine "On the priority of social development of rural and agro-industrial complex in the national economy" as amended by the Cabinet of Ministers Resolution № 1239 of 14.12.2020 [1], Order of the Cabinet of Ministers of Ukraine of September 23, 2015 № 995-r "On approval of the Concept of rural development territories" with changes made in accordance with the Cabinet of Ministers Resolution № 1239 of 14.12.2020 (implementation is designed for the period up to 2025) [1]. These regulations are aimed at supporting rural areas in various areas, including the social sphere.

In the context of globalization, there is a redistribution of responsibilities for local development between the state, regions and the community. It is the territorial community that becomes the primary subject in the implementation of social policy on the ground, in the development of rural areas. Deputy Minister of Development of Communities and Territories of Ukraine V. Negoda emphasized: "Residents of villages, local business representatives should be maximally involved in the development of territories where they live, be active and feel responsibility for the future of their community". [Ministry of Community Development].

One thousand four hundred thirty nine territorial amalgamated communities were created as part of the decentralization reform in order to develop local self-government in Ukraine, 56 of them are within the boarders of Kharkiv region [3].

In terms of the total population, 2,633,834 people (according to the State Statistics Office [26]), Kharkiv Oblast is one of the largest. For today it consists of 7 districts (Kupyansk, Chuguiv, Kharkiv, Krasnograd, Bohodukhiv, Lozova, Izyum), in which there are 1,746 settlements located on the territory of 31,415 km^2 [4].

At the same time, in Kharkiv region there are areas where the population density per km^2 is not very high. This area includes Kupyansk district with a total population of 135,270, which occupies an area of 4,612.9 km^2. The population of Kupyansk district is united into 8 territorial communities, of which one is urban, three are in small towns and four communities are rural, in general there are 269 settlements (Table 2) [5, 6].

Table 2. Territorial communities of Kupyansk district

Community name	Community type	Population	Number of settlements	Availability of inclusive resource centers
Kupyansk	Urban	55,544	12	+
Kurylivka	Rural	9,766	13	—
Petropavlivka	Rural	5,245	16	—
Shevchenkovo	Settlement	19,392	60	+
Velykyi Burluk	Settlement	14,776	51	+
Vilkhuvatka	Rural	6,107	30	—
Dvorichna	Settlement	16,270	55	+
Kindrashivka	Rural	6,085	32	+

Source: Decentralization, 2021 [26].

Due to this specificity (uneven distribution of population in a certain area) "new regional development policy" is implemented at the state level, in particular, it is presented in the Regional Development State Strategy for 2021-2027 (hereinafter the State Strategy) [1].

In this strategy, priorities are given to territorial communities, which face the task of strategic development planning, resource management. The main focus of this State Strategy is aimed at ensuring a better quality of life regardless of place of residence – reducing the disproportionate distribution of indicators of both economic development and quality of life, improving partnerships between regions. Today we see a negative trend towards the growth of people with disabilities (Table 3). In the regional context, the highest percentage of children with disabilities in relation to the total number of persons with disabilities is recorded in Zakarpattia, Rivne, Kherson and Chernivtsi regions (9.25%, 8.82%, 8.04% and 7.8% respectively). Against this background, in Kharkiv region, the percentage of children with disabilities in relation to the total number of people with disabilities is 5.63%, which is the "average" indicator [27].

Table 3. Number of persons with disabilities in Ukraine (At 01.01.2021; thousands of people)

	2019	2020	2021
Total	2,659.7	2,703.0	2,724.1
Of these, children	161.6	163.9	162.9

Source: SSSU, 2021 [27].

In the context of this trend, it can be argued that among the pressing issues of social security, correlating with the general setting of the State Strategy, is inclusion, namely inclusive education, that is creating of a common approach to teaching a child with special educational needs in an inclusive educational environment [17, 28]. The main responsibility for the implementation of state social policy, including the field of inclusive education, lies with the amalgamated territorial communities. The degree of their responsibility extends to the determination of budget expenditures in this area, management and coordination of educational institutions and government agencies at various levels for the implementation of social support programs for people with special needs (people with disabilities). Given the rather broad concept of inclusive education, and, accordingly, a wide range of its objects – children with somatomental disabilities, disabled children, refugee children, migrant children, members of national minorities, religious minorities, children from families in difficult life circumstances, homeless children, orphans or children deprived of parental care, etc., in our study we will focus on children with special educational needs who have developmental disabilities (disabled). According to Kharkiv Regional State Administration, at the beginning of 2022 we have the following distribution of children with special educational needs in the districts of Kharkiv region, including Kupyansk disabilities, disabled children, refugee children, migrant children, members of national minorities, religious minorities, children from families in difficult life circumstances, homeless children, orphans or children deprived of parental care, etc., in our study we will focus on children with special educational needs who have developmental disabilities (disabled). According to Kharkiv Regional State Administration, at the beginning of 2022, it was the distribution of children with special educational needs in the districts of Kharkiv region, including Kupyansk district as presented in Table 4.

Table 4. Distribution of children with special educational needs by districts of Kharkiv region

Districts of Kharkiv region	Number of children
Bohodukhiv	128
Izyum	178
Krasnograd	98
Kupyansk	159
Lozova	194
Kharkiv	531
Chuguiv	162

Source: SSSU, 2021 [26].

Full "inclusion" of these children in the educational environment and public life requires the development of legal framework aimed at supporting children with special educational needs and their parents, the development of specialized institutions and qualified staff. In recent years, we have seen progressive dynamics on this issue. Thus, according to the Directorate of Preschool, School, Extracurricular and Inclusive

Education, in 2018-2019 academic year the number of general secondary education institutions with inclusive classes in Ukraine was 3,790 institutions, then in 2020-2021 academic year there were already 6,394 of them; the number of inclusive classes also increased – from 8,417 in 2018-2019 academic year to 18681 in 2020-2021 (Table 5) [7, p. 150, 153].

Table 5. Dynamics of inclusive education in Ukraine

	2018-2019 academic year	2019-2020 academic year	2020-2021 academic year
Number of students enrolled in inclusive classes	11,866	18,643	25,078
Number of students with special educational needs enrolled in inclusive classes	1,301	2,404	3,847
% of students with special needs from the total number of students in inclusive classes	11%	12.9%	15.3%
Number of secondary schools with inclusive classes	3,790	5,331	6,394
Number of inclusive classes in secondary schools	8,417	13,497	18,681

Source: SSSU, 2021 [7, p. 150, 153].

A specialized network of services – inclusive resource centers (IRC) – has been established to support and supervise children with special educational needs in Ukraine. These structural units are focused on identifying children with the appropriate status, providing psychological and pedagogical services, supporting both children and parents, and one of the main principles in the functioning of these centers is territorial proximity to the place of residence of this category of children.

In this context, our study focused on the Kurilivka Territorial Community, which is consulted on issues that arise with regard to children with special educational needs by Kupyansk and Kindrashiv IRCs. Since the key role in the implementation of social and educational inclusion is assigned to inclusive resource centers, it is considered appropriate to describe the regulatory framework of Ukraine that regulates their activities. It includes Resolution of the Cabinet of Ministers № 545 of 12.07.2017, Decision of the CMU № 711-VII of 01.03.2018, Order of the Ministry of Education and Science № 447 of 03.05.2018, Resolution of the Cabinet of Ministers № 765 of 21.07.2018, Resolution of the Cabinet of Ministers № 617 of 22.08.2018, Order of the Ministry of Education and Science № 977 dated 06.09.2018, Letter of the Ministry of Education and Science № 1/9-498 dated 05.08.2019, Letter of the Ministry of Education and Science № 1/9-495 dated 31.08.2020, Letter of the Ministry of Education and Science № 1/9-638 dated 19.11.2020 on IRCs as to the actions of Resolution of Cabinet of Ministers № 983 of 21.10.2020, Letter of the Ministry of Education and Science on the work of the IRC in connection with the adoption of Resolution of the Cabinet of Ministers № 765 of 21.07.2021 [2, 12, 14, 15]. IRC is a unified network of inclusive centers, with an emphasis on territorial accessibility and provision of qualified psychological and pedagogical support for children with special educational needs (SEN) and their parents. Under the auspices of the central authorities of Ukraine and with the assistance of urban and rural communities a large-scale inclusive project was to launch in order to build a national network of IRCs, which as of January 1, 2021 has 633 IRCs (01.01.2019 – 522, 01.01.2020 – 635 IRCs) [7].

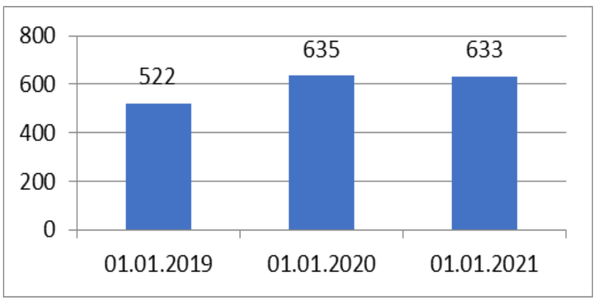

Fig. 1. Dynamics of the number of inclusive resource centers in 2019–2021, units

Source: Education in independent Ukraine: development and competitiveness: information-analytical collection, 2021 [7].

There are 35 IRCs in Kharkiv Oblast, 5 of which are in Kupyansk District.

The work of Kupyansk IRC is a structural unit with highly qualified personnel and material resources, which offers residents of 8 territorial communities of Kupyansk district, Kharkiv region, a catalog of educational services that allow to solve problems of timely assistance to children in general education system and have special educational needs. For example, there is a set of correctional and developmental classes (services) for children with special educational needs who have musculoskeletal disorders [9].

Table 6. Correctional and developmental program for children with SEN who have musculoskeletal disorders

Basic educational services	**Additional educational services**	**Specialists**
Development correction	Development of cognitive activity Art correction Sensorimotor development Lego design Formation of graphic skills in children Montessori therapy	Defectologist, speech therapist
Speech development	Fairy tale therapy	Speech therapist teacher
Rythmics	Logarithmics Breathing exercises Dance movement therapy Music therapy	Rhythm teacher, physical education instructor
Exercise therapy	Correction of deficiencies in physical development; Correction of movement disorders (coordination disorders, spatial orientation, accuracy in movement, balance, etc.); Elimination of shortcomings in the development of motor and other functions (strength, speed, coordination, endurance, flexibility, etc.); Correction and development of psychomotor skills; Formation of a healthy lifestyle and further socialization.	Physical education teacher, exercise therapy instructor

Source: Kupynsk IRC, [9].

There are 26 children registered with Kupyansk IRC of Kupyansk City Council Kharkiv Region (7 people are of preschool age, 19 people are of school age, 9 people with special educational needs who are attending correctional and developmental classes).

Additional educational services are a powerful methodological tool for children with special educational needs, their parents and teachers/assistants who work with these children.

These services aimed at corrective development of cognitive, emotional and volitional spheres, positive personality traits, which would allow the most of children with special educational needs to study in a secondary school, to form an active child's personality, able to learn about the environment, develop, acquire knowledge and skills, play and practical skills, accessible and interesting for a particular child, taking into account his age and individual development.

Regarding the number of educational institutions, as of January 28, 2022, there are 322 general secondary education institutions in Kharkiv region, which include inclusive classes for people with special educational needs.

In particular, there are 34 general secondary education institutions in Kupyansk district Kharkiv region, which have inclusive classes for children with special educational needs, 5 of which belong to Kurylivka amalgamated territorial community (Fig. 2).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

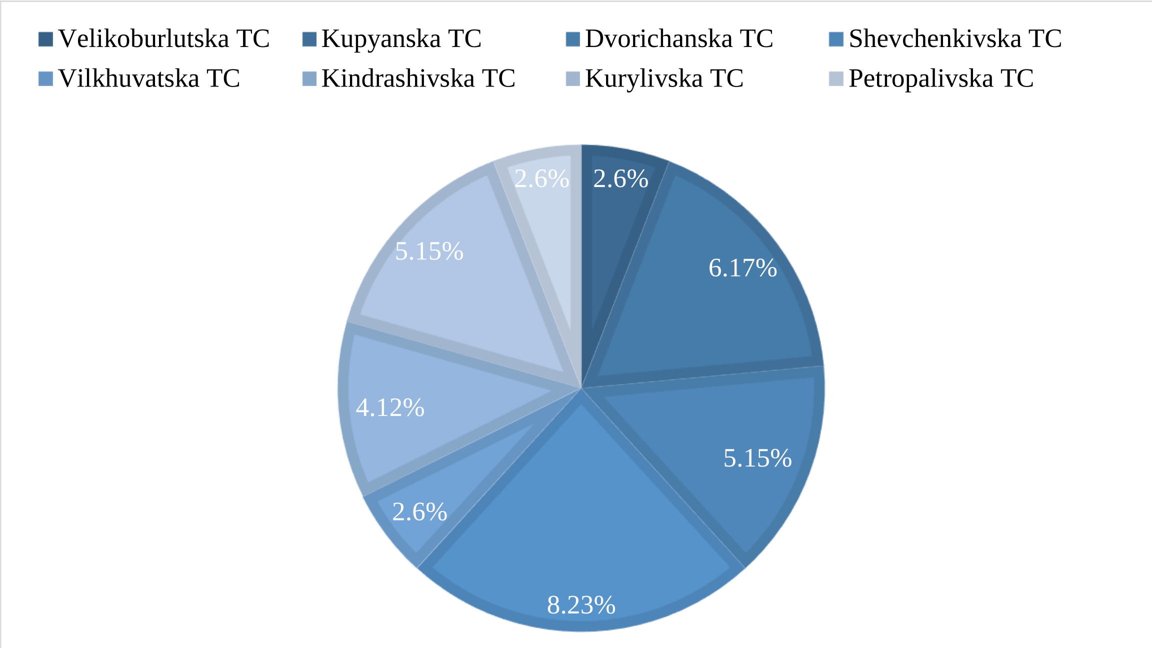

Fig. 2. Distribution of schools with inclusive education by amalgamated territorial communities of Kupyansk district
Source: SSSU, 2021 [27].

There are 7 general secondary education institutions on the territory of Kurylivka ATC (as of January 28, 2022), which provide services for the acquisition of new knowledge and skills to 1,148 people. Approximately 2% (20 people aged 8-18) of the total number of children obtaining general secondary education in general secondary educational institutions of Kurylivka territorial community are people with special educational needs. The distribution of persons with special educational needs by educational institutions and classes is shown in Fig. 3.

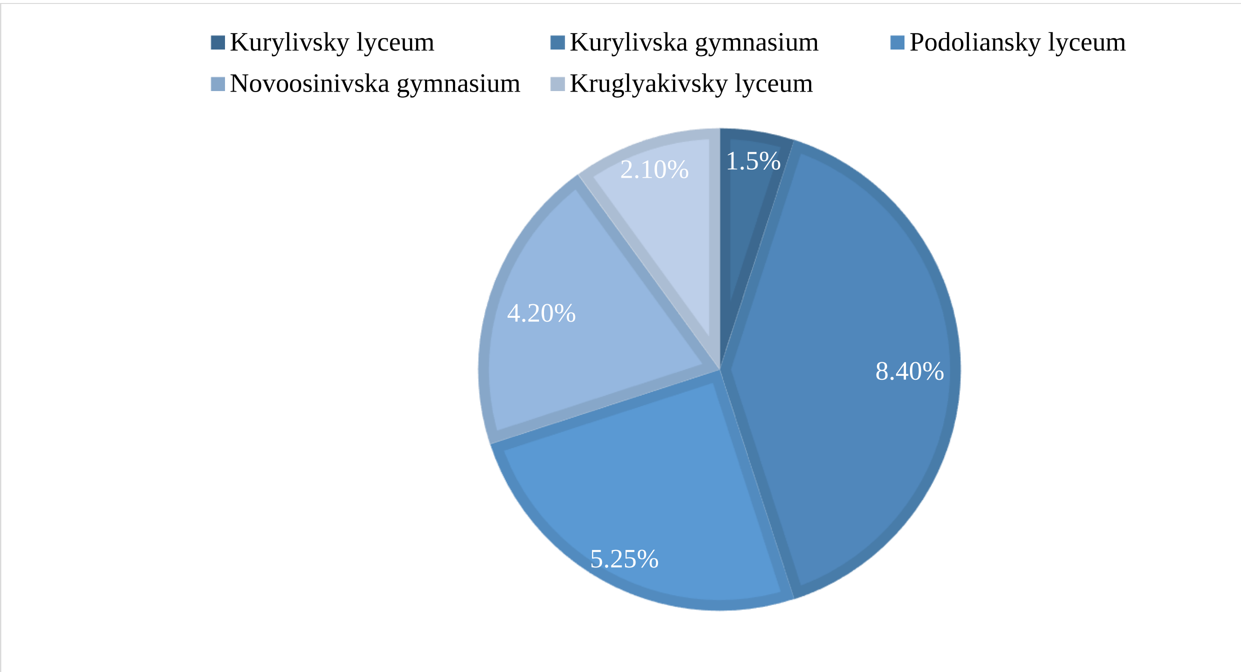

Fig. 3. Distribution of persons with special educational needs in secondary educational establishments of Kurylivka territorial community
Source: SSSU, 2021 [27].

Twelve teaching assistants provide assistance to school staff and parents of children with disabilities during their studies in general secondary education institutions. Other specialists, such as a rehabilitation specialist, speech pathologist, speech therapist, etc., are not available at all in Kurylivka community. Therefore, referring to the findings of leading Western and Ukrainian researchers, it should be emphasized that the involvement of highly specialized and highly qualified specialists in the inclusive spectrum is a primary and effective tool for working with children with special educational needs in general education institutions. As amalgamated territorial communities is becoming one of the main actors of implementing social inclusion through primary education, any assistance in the implementation of their functions, such as national support, socially responsible business, grant projects, etc., becomes extremely important locally. Therefore, in order to create an effective educational system that can meet the needs of all applicants, regardless of their level of psychophysical development, it is necessary to provide general secondary educational institutions with various assistance (logistical, informational and advisory, etc.), which would fully enable the rights of all applicants to education, personal development, professional activity, participation in public life, etc.

CONCLUSIONS

Summing up, it should be noted that social inclusion is not a new phenomenon for Ukrainian society. The need to comprehensively promote the involvement of every member of society in active life, to ensure and create equal conditions for such activities in all spheres of society, was realized in the early 2000s. As of today, the most common in the Ukrainian scientific discourse is the attempt to explain the essence of the concept of «social inclusion» through the availability of education for all citizens of Ukraine. Access to education is an urgent task at all levels of acquiring knowledge and skills, starting with preschool and covering all others, and throughout the country, in cities and in rural areas. In this sense, social inclusion is in fact identified with educational inclusion.

In 2008, with the approval of Regulations on Special School (Order of the Ministry of Education and Science of Ukraine of September 15, 2008, №852) by the Ukrainian state, significant changes were made in the process of acquiring education by each member of society. This process is based on universal and personal values, namely on humanity, democracy, personal orientation of education and its accessibility, which takes into account the needs and abilities of each person seeking education. The analysis of the legal framework showed that in modern Ukrainian society there are quite a number of laws («On Education», «On Complete General Secondary Education», «On Preschool Education», «On Vocational (Technical) Education», «On Higher Education», etc.) and a number of resolutions of the Cabinet of Ministers of Ukraine, which enable the organization and implementation of the process of education in preschool, vocational (technical), higher and extracurricular education on the principles of equality and accessibility.

The analysis of statistical and theoretical materials allowed us to state that the creation of appropriate conditions, preparatory measures for society’s acceptance and direct acceptance of all its members on the principles of equality and humanity, with equal opportunities for education, is characteristic of all levels of the Ukrainian education system and is carried out both in cities and in rural areas. It is found out that one of the most effective models of inclusive education is the model of cohabitation of persons with special educational needs and persons without such needs, which should further be transformed to an inclusive society, providing equal access to material and social benefits, ability to engage in certain professional activities, to be fully involved in all spheres of society, etc. for each of its members. The creation of any other, different, “special” conditions threatens the realization of the child's rights to education, and in the future the realization of general human rights in whole.

Thus, social inclusion in modern Ukrainian society acquires the features of a certain mechanism, a tool aimed at overcoming restrictions and barriers to social welfare, which radically changes the existing state policy. In fact, social inclusion can be defined as a desirable situation in which all members of society, regardless of the presence or absence of special needs, living in urban or rural areas, etc., have sufficient resources and opportunities for equal participation in all spheres of society life. Social inclusion is inherent in all social processes and in fact contributes to the establishment of social equality in modern Ukrainian society, which corresponds to the civilizational strategies of the XXI century.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPROVING THE SYSTEM FOR ASSESSING THE EFFECTIVENESS OF THE FINANCIAL MANAGEMENT OF AGRICULTURAL ORGANIZATIONS

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Abstract

The article discusses cost models for assessing the effectiveness of financial management based on the MVA method of market value added, the EVA method, the SVA method of equity value added. The authors assessed the elements of the financial management of an agricultural organization for 2015-2019, including an evaluation of the state of fixed assets, inventories, accounts receivable, analysis of cash flows, sources of financing assets, liquidity of the balance sheet, financial stability, business profitability and business indicators of activity. For a comprehensive assessment of the effectiveness of the financial management of an agricultural organization, it was used a methodology based on the relationship of indicators, in which the indicator of economic value added acts as a criterion for the level of efficiency of financial management. A scale for quantitative and qualitative assessment of the level of financial management efficiency has been developed.

Key words**:** *financial management, efficiency, agricultural organizations, added value, assessment methodology*

INTRODUCTION

Evaluation of the effectiveness of financial management exists to varying degrees in each enterprise. Most often, the final results of the activity are the priority of efficiency. Without the use of theories and methods of financial management, this assessment could not be complete.

The evaluation of financial management effectiveness makes it possible to compare the final company results and the costs required for this. Based on the results of these indicators, the most appropriate way to increase its efficiency should be chosen.

To analyze the effectiveness of financial management, the “classical model” is most often used, based on the interpretation of profitability and financial stability of an enterprise, and the cost model (the concept of Value Based Management), which takes into account such criteria as added value (market, capital, monetary, economic, intellectual and etc.) [12]. At the same time, it is necessary to develop appropriate analysis tools, which should be based on aggregate indicators that would characterize the actual changes in the structure of strategic targets and take into account the possible interaction between them [10]. The proposed structural-dynamic tools are based on the methodology of modeling the structural dynamics of [11], further expanded by many authors [7]. This methodology is based on modeling in ordinal scales, which makes it possible to identify discrepancies between the normative and actual dynamics (structure) of the ratios between the growth rates of the analyzed indicators.

When using the methodology of forecasting structural dynamics, the emphasis is made on the analysis of the enterprise as an entire financial and economic system. This approach makes it possible to take into account its emergent properties, which, first of all, reflect the results of managerial influences on the processes that took place within the enterprise, and are a consequence of the interaction of components at the system level.

The MVA (Market Value Added) method considers value creation as capitalization (market value of shares multiplied by the number of shares outstanding) and book value of the company. Consider and as a discounted flow of EVA and reflects the creation of value for shareholders in the long term [9].

The EVA (Economic value added) method allows you to evaluate the increase in the value of an enterprise over a certain period of time [5]. This method is quite simple, so it is widely used in practice. Its calculation boils down to subtracting the cost of capital from operating income.

The SVA (Shareholder Value Added) method evaluates equity capital gains and is based on investment. This indicator is calculated as the difference between the shareholder value of capital formed by future investments and the shareholder value of capital formed by previous investments. The calculation is based on discounting cash flows [10].

The shareholder value of the company is influenced by the following factors: the growth rate of revenue, profit from operating activities, the growth of investments in fixed and working capital, the tax rate, the cost of capital [8].

To obtain an objective result of the effectiveness of financial management, it is often not enough to use only classical approaches. This is explained by the desire of the owners to study not only quantitative, but also qualitative results of management [10].

The aim of the current research is to develop a methodology for assessing the effectiveness of the financial management in agricultural organizations using quantitative and qualitative indicators, where economic value added acts as an efficiency criterion.

MATERIALS AND METHODS

The empirical basis of the study was the data of the annual accounting (financial) statements of Petrovsky bread JSC.

JSC "Petrovsky bread" is an agricultural organization specializing in the production of crop products.

The method of comparative analysis, coefficient method, tabular and graphical methods were chosen as research methods. In the process of comparative analysis, the data available at the reporting date are compared with similar data for the past period, in our case the previous two years.

Financial ratios are relative indicators that are calculated on the basis of the organization's reporting. Many of them have normative values.

Tabular and graphical methods are used for presentation and greater clarity of the results.

The method of regression analysis was used to assess the factors influencing the economic value added. For its implementation, data of the organization for 10 years were used. This method allowed us to identify the factors that have the greatest impact on the level of efficiency of the financial management of an agricultural organization.

To assess the qualitative indicators of the effectiveness of financial management, a survey of the company's specialists was used.

RESULTS AND DISCUSSIONS

The problem of assessing financial management is inherent in all business entities, including agricultural ones.

Joint stock company (JSC) “Petrovsky bread” is a medium-sized agricultural organization. The specialized branch is the plant growing branch. The largest share in this industry is occupied by grain - an average of 69%. The share of whole milk decreases over the years and averages 9%. In the study period, there was a multidirectional change in revenue; the value of this indicator varied from 292,175 thousand rubles up to 404,593 thousand rubles. During the analyzed period, the change in the financial result from sales amounted to 48,385 thousand rubles. In general, over the past 5 years, the organization has been making a profit from the sale of agricultural products, however, the amount of profit in dynamics allows us to conclude that there has been some reduction in the activities of JSC “Petrovsky bread” [4].

The data of the analysis testify to the prevailing share of current assets in the structure of the property of the organization. Average for 2015-2019 the share of current assets accounts for 70.5% of all assets, therefore, non-current assets - 29.5%.

The organization's own funds occupy a significant share during the study period - more than 50% and are mainly represented by retained earnings. The composition of borrowed sources of financing is dominated by short-term funds, the share of which varies from 20.63% in 2019 to 38.95% in 2016. The company's accounts payable have a fairly low share and by the end of 2019 amounted to 14,226 thousand rubles or 2.91%.

On average, for the period under study, the following structure of assets has developed: fixed assets - 29%, inventories - 40.4%, accounts receivable - 15.9%, financial investments - 7.4%, cash - 4.4%. In the structure of liabilities for 2015-2019 retained earnings accounted for an average of 43%, accounts payable - 15.2%, borrowed short-term funds - 13.1%, long-term - 2.6%.

The authors assessed the elements of financial management in nine sections for 2015-2019 and within the sections for each indicator, the best year is selected to be adopted as a measure of performance (Table 1).

Table 1. Evaluation of financial policy indicators

Indicator	2015	2016	2017	2018	2019
Valuation of fixed assets					
Wear factor	0.46	0.34	0.52	0.58	0.64
Refresh rate	0.11	0.17	0.09	0.05	0.10
Retirement rate	0.07	0.39	0.05	0.02	0.07
Assessment of the state of stocks of inventory items					
Raw material inventory turnover ratio	27.44	23.65	31.74	5.98	21.75
Work in progress turnover ratio	4.57	6.09	5.36	3.34	3.25
Finished goods turnover ratio	3.96	1.53	4.00	2.52	2.28
Assessment of the state of receivables (structure in percent)					
Current accounts receivable	48	43	54	51	34
Overdue over 45 days	12	16	10	14	20
Cash flow analysis					
Operating net cash flow, RUB thousand	34,221	-120,941	109,810	-34,901	32,032
Financial net cash flow, thousand rubles	-9,122	188,577	-113,217	92,803	-75,971
Investment net cash flow, thousand rubles	-19,355	-60,677	-673	3,328	-10,182
Analysis of asset financing sources					
Autonomy coefficient	0.62	0.50	0.69	0.64	0.71
Sustainable finance ratio	0.24	0.39	0.22	0.32	0.21
Balance liquidity analysis					
Current liquidity ratio	2.36	1.92	3.05	2.35	3.63
Quick liquidity ratio	0.95	0.75	1.14	0.96	1.41
Absolute liquidity ratio	0.26	0.44	0.37	0.51	0.44
Financial stability analysis					
Working capital ratio	0.58	0.48	0.67	0.57	0.72
Equity maneuverability ratio	0.54	0.72	0.66	0.68	0.76
Analysis of business profitability, in percent					
Profitability of sales	26.53	28.70	9.11	11.88	14.42
Return on equity	22.19	24.82	6.93	5.83	2.93
Analysis of business activity indicators					
Asset turnover period in days	496.85	501.66	511.59	631.16	621.15
Inventory turnover period in days	209.18	266.20	236.36	304.02	318.29
Duration of the financial cycle in days	169.87	153.28	162.47	335.44	402.60
Economic effect from the acceleration of the turnover of current assets, thousand rubles.		100,475.4	33,173.8	70,126.4	9,592.6

Source: Compiled by the authors on the basis of accounting data and financial statements of JSC "Petrovsky bread".

Section I characterizes the state of fixed assets in the organization. At the end of 2019, depreciation of fixed assets is 64%, and the value of this indicator has a growth trend. The maximum values of disposal and commissioning of fixed assets were observed in 2016.

Section II - Assessment of the state of stocks of inventory items.

For almost all types of stocks, there is an increase in the duration of turnover, which is considered as a negative fact. The best results in terms of inventory turnover were achieved by the organization in 2017.

Section III - Assessment of the state of receivables. The data of the analysis testify to unsatisfactory work with debtors. Along with the positive moment - the absence of long-term receivables, in the structure of short-term debt, the share with a delay of more than 45 days accounts for 20% in 2019. In general, 58% of buyers are late with payment.

Section IV - Cash flow analysis. The maximum result was achieved in 2018, however, this was due to a positive balance in financial activities, while the current activity of the organization was negative. This may also indicate difficulties in working with debtors - shipped products are not paid on time. In our opinion, 2017 can be recognized as the best result, when operating activities brought 109,810 thousand rubles. net income, while in 2019 it was only 32,032 thousand rubles. or 70.8% less. A significant amount of payments for financial activities in 2019, despite receiving a loan in the amount of 170,525 thousand rubles, led to a final negative balance for the organization. Receipts from all types of activities in 2019 amounted to 91% of payments.

Section V - Analysis of sources of financing assets. In general, the structure of asset financing sources is optimal - more than half of all assets are financed from their own funds, and by 2019 this figure has increased to 71%. Current assets are formed at the expense of short-term liabilities by an average of 40%, the rest is accounted for by the organization's own funds.

Section VI - Analysis of balance sheet liquidity. At the end of the analyzed period, the current liquidity ratio was 3.63, which exceeds its normative value. The quick liquidity ratio amounted to 1.41, exceeding the standard value by 0.61 points, which indicates that the organization has liquid assets that can be used to repay the most urgent obligations. For the entire period under study, the absolute liquidity ratio increased by 0.18 points.

Section VII - Analysis of financial stability. The ratio of own working capital has a growth dynamics and at the end of 2019 amounted to 0.72, providing an increase of 0.14 points over 5 years. The coefficient of capital maneuverability during the study period is significantly higher than the normal value for this industry. Its value varied in the range of 0.54-0.76. In almost all periods, borrowed funds were less than own funds, only in 2016 their values were approximately equal. The values of the calculated indicators indicate the stable financial stability of the organization under study.

Section VIII - Analysis of business profitability. Return on sales for the last year amounted to 14.42%. That is, each ruble of the proceeds of JSC “Petrovsky bread” contained 14 kopecks profit from sales. Over the past year, each ruble of the organization's own capital has brought 2.93 rubles. net profit. The decrease in return on equity for the entire period under review amounted to 19.26 percentage points. Over the past year, the value of return on equity can be considered unsatisfactory.

Section IX - Analysis of indicators of business activity. The turnover of the organization's assets is quite low, which is confirmed by the duration of their turnover of 533 days. Expenses for ordinary activities amounted to the average annual inventory balance for 264 days. The duration of the financial cycle increases, which is associated with a slowdown in turnover inventories and receivables. The positive value of the economic effect indicates an additional attraction of current assets into circulation as a result of a decrease in the intensity of their use.

The methodology for assessing the elements of financial management of JSC “Petrovsky bread” allowed to identify its shortcomings and develop areas for improvement.

The following should be noted as shortcomings in the financial management of JSC “Petrovsky bread”:

-The fixed assets of the organization need to be updated, the source of financing of which can be both own funds and additionally attracted long-term sources of financing;
-Current asset management policy needs to be adjusted in order to optimize inventories, as well as receivables by revising the organization's credit policy in relation to buyers;
-The funds available on the current account of the organization must generate income, and therefore it is advisable to invest them in an amount in excess of the optimal amount in highly liquid securities or purchase fixed assets;
-The main effective indicators of the organization's activities (revenue, costs, profit) have a negative trend, and the rate of decline in revenue exceeds the rate of cost reduction, and therefore it is necessary to control the expenditure of the organization's funds and find ways to optimize them.
For a comprehensive assessment of the effectiveness of the financial management of an agricultural organization, we have proposed a methodology based on the relationship of indicators.
The indicator of economic value added (EVA) was used as an indicator of the level of financial management efficiency (Figure 1).

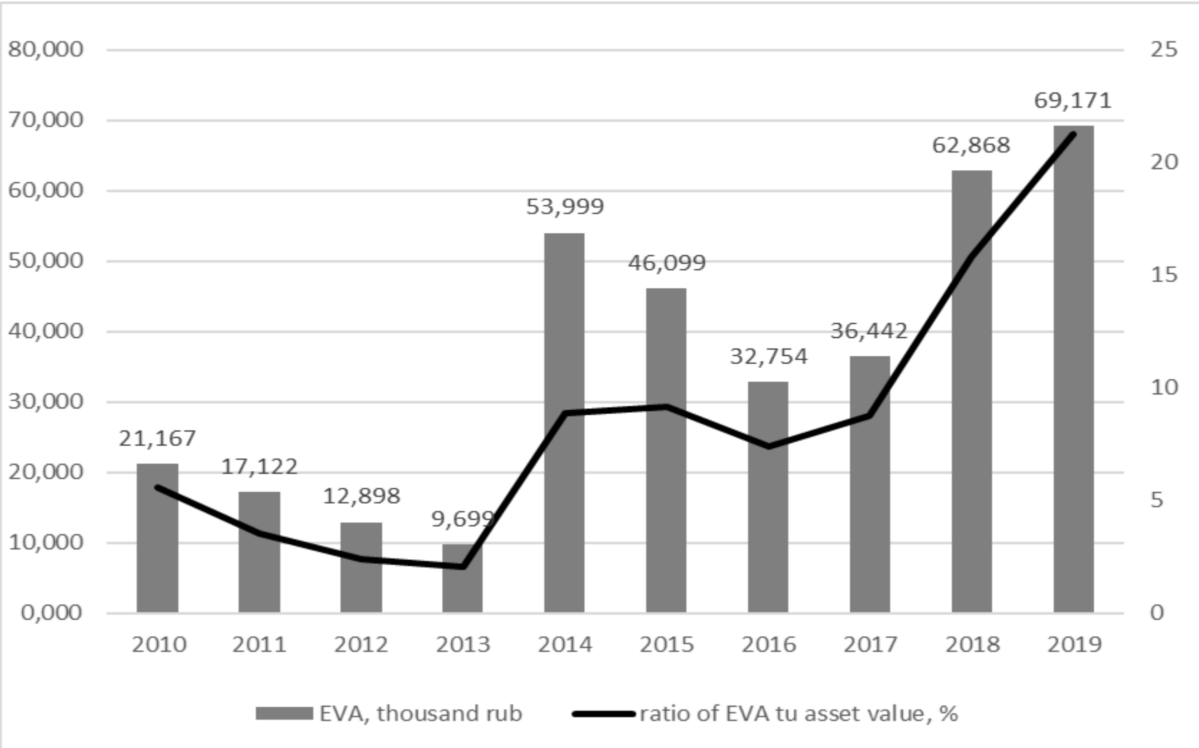

Fig. 1. Dynamics of the indicator of economic value added
Source: Compiled by the authors on the basis of accounting data and financial statements of JSC “Petrovsky bread”

Positive values of the EVA indicator deal with an increase in the value of the company.
The undoubted advantage of this method is the ability to assess the effectiveness of financial management based on the analysis of financial and tangible assets, as well as the intellectual capital of the organization. In addition, using this method, you can evaluate each business unit of the organization.
To develop a scale for assessing the level of financial management efficiency, we used the indicator of the ratio of economic value added to the value of the organization's assets (Table 2).

Table 2. Financial management efficiency scale

The range of the value of the return on advanced capital	Level of financial management efficiency
Less than 4.8%	extremely low
4.8%< E<9.6%	low
9.6%< E<14.4%	average
Over 14.4%	high

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

In order to determine which factors, have the greatest impact on the effectiveness of financial management, the method of regression analysis was used.

The main indicators characterizing the areas of financial management were used as variables.

As a result, we got the following regression equation:

$$Y=34.2+22.66x_1+0.32x_2-21.71x_3+39.42x_4+9.68x_5+3.97x_6+0.003x_7,$$

where:

y - the ratio of EVA to the value of assets;
x_1 - coefficient of renewal of fixed assets;
x_2 - turnover ratio of stocks of raw materials;
x_3 - share of current receivables;
x_4 - ratio of inflows and outflows;
x_5 - coefficient of autonomy;
x_6 - current liquidity ratio;
x_7 - turnover period of current assets.

For our analysis, the determination index equal to 0.97 indicates that these seven factors have the greatest impact on the level of financial management of the organization. The most significant factors were the fixed asset renewal ratio, the level of receivables and the ratio of cash inflows and outflows. In addition, the coefficient of autonomy and current liquidity have a positive effect on the effectiveness of financial management.

Calculations showed that the actual value of the level of financial management differs from the predicted indicators by no more than 2.05% per year.

Recently, the owners of the company are more often concerned about the qualitative indicators of the effectiveness of financial management. Considering it important to evaluate these indicators, we are faced with the problem of their choice and evaluation methods. We came to the conclusion that a certain integrated indicator is needed, which includes various qualitative aspects of financial management [3].

This stage includes determining the values of private financial management coefficients. Based on the expert assessment, the value of each of the presented private indicators is calculated. The assessment range is from 0 to 3 points.

The proposed scale for the qualitative assessment of financial management:

-High level of financial management - 13-18 points;

-Average level of financial management - 7-12 points;

-Low level of financial management - 0-6 points. The enterprise under consideration can be classified as having an average level of financial management.

A company can achieve maximum efficiency in its work only if competent management of the formation and management of assets, control of financial results, business value, competitiveness of goods and services and business activity is carried out. Each of these components is very important (Table 3).

Table 3. Calculation of partial coefficients of financial management

The name of the private coefficient of financial management quality	Points
Philosophical aspect The company has long-term and short-term financial planning.	2
Information aspect The information base on all elements of production and financial activities (debtors, creditors, suppliers, consumers, competitors, etc.) is constantly updated	2
Aspect of the operating principle Systematic analysis of the financial position of the company, comparison with standard indicators and competitors, identification of the causes of deviations	2
Aspect of differentiation The company is developing new market instruments	1
Organizational aspect Number of investment projects for the reporting period with a positive economic effect	1
Personnel management aspect The presence of a financial service, the level of qualification of specialists involved in financial management	2
Total	10

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In order to determine the optimal size of stocks of raw materials and supplies, a standard was determined for each type of agricultural product. Optimum availability of working capital in stocks of seeds 7,519 thousand rubles. The standard for work in progress would include costs for next year's harvest, namely for winter wheat, and will amount to 4,870 thousand rubles.

The paper determines the optimal amount of cash using the Baumol-Tobin model [1]. It would amount to 659 thousand rubles. We propose to use part of the funds that exceeds their optimal balance for the acquisition of fixed assets, namely 15,568 thousand rubles.

To form the material and technical base, we propose the creation of an accumulation fund.

In the coming year, we plan to distribute profits as follows: - between the founders (25%); - reinvestment (65%); - accumulation fund (10%).

As a result of changes in some areas of financial management, the performance indicators of JSC "Petrovsky bread" could increase (Table 4).

Table 4. Results of adjusting the areas of financial management of JSC "Petrovsky bread"

Indicator	2019	Forecast 2022
Investment and depreciation policy		
Refresh rate	0.10	0.14
Retirement rate	0.07	0.07
Ratio of renewal and retirement rates	1.48	2.0
Inventory management policy		
Stock of raw materials in days	16.78	29.07
Work in progress in days	112.47	7.30
Current asset management policy		
Turnover period of current assets in days	467.13	363.43
Inventory turnover period in days	318.29	218.05
Profit management policy		
Return on costs, %	16.85	17.03
Return on sales, %	14.42	14.55

Source: Compiled by the authors on the basis of accounting data and financial statements of an agricultural organization.

An increase in the fixed asset renewal ratio of only 0.04 points will improve the efficiency of financial management by 1 percentage point or would give an additional increase in the value of the company by 2,955 thousand rubles.

CONCLUSIONS

Thus, the assessment of the effectiveness of the financial management of an economic entity allows you to see problem areas in the organization's activities and develop directions for its adjustment.

The development and implementation of a current asset management policy involves the choice of a policy for the formation of current assets [2]. At the current stage of development in JSC "Petrovsky bread" moderately conservative policy of financing current assets. At this stage of development, it is possible to recommend the use of an aggressively moderate policy for managing the formation and financing of assets for JSC "Petrovsky bread", which will increase the profitability of operations by attracting long-term sources of financing without losing the required level of liquidity and financial stability [6].

The company should rationally deal with the formation of current assets, in correlation with them it would be possible to recommend the use of rationing for the main types of crop products.

The creation of a consumption fund would allow the organization to update fixed assets in a timely manner without engaging borrowed sources of financing.

In addition, the organization should improve the quality indicators that influence on the effectiveness of financial statement and management. Moreover, it is necessary to introduce innovative techniques into their activities and master new market instruments.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

USING MACHINE LEARNING METHODS FOR PREDICTION OF DURABLE ECONOMIC DEVELOPMENT: ROMANIA CASE STUDY

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Abstract

Emerging economies tend to be impacted most by fluctuations in the global economy, due to their relatively low degree of economic stability. The actors from within these economies must consider various parameters of the economy and tackle many different aspects regarding inputs, methodologies and economic strategies. Thus, besides the obvious target of economic development, these economies must consider the alignment with the external factors, the social movements regarding workforce and social welfare, as well as the efficient usage of resources for production branches of the economy. The economy can be characterized by both quantitative and qualitative indicators, linked to Gross Domestic Product (GDP), but also to enterprise health status, thus related to the turnover, profitability and number of enterprises. The sustainability of a healthy economy is also shown by the concern related to the employment status, human development index (HDI) and the general consumption of the population at a national level. Last, but not least, the economy is durable related to resources issues, the impact of the economic branches on the environment (air, water, soil and biodiversity) being one of the major concerns in the context of a turbulent climate debate. In this paper, we will present the correlations between the economic development, the social climate and the economic environment impact in Romania. After using traditional statistic methods for presenting these correlations, we will create trend predictions using Machine Learning (ML) methods using the traditional ML methodology. The results will be then compared to the usual methods used for prediction in statistics.

Key words: *economic development, sustainability, machine learning, society*

INTRODUCTION

The health of a national economy relates to all the aspects that are involved in the production processes. This paper shows the correlations between economic indicators and entrepreneurial and social aspects, as well as the impact on the environment.

The whole market is an open space influenced by numerous and various parameters, each one of them adding their contribution to the general dynamic of the economy. Moreover, global movements can be started from actions of people, individuals or small enterprises.

Nowadays, market pleads for an integrated approach on the production of economic goods, which leads to a more efficient allocation of resources, happier customers, more engaged employees and better policies regarding the environment, leading to the increase of efficiency of the economic system. European environment policy rests on the principles of precaution, prevention and rectifying pollution at source, and on the 'polluter pays' principle. Multiannual environmental action programs set the framework for future action in all areas of environment policy. They are embedded in horizontal strategies and considered in international environmental negotiations. Last but not least, implementation is crucial.

The European Union legislation has a strong point in relation to environmental issues. Thus, the main laws regarding Articles 11 and 191 to 193 of the Treaty on the Functioning of the European Union (TFEU) [12]. The sustainable economic development is based on the key concepts of sustainability [13] and compliance to the ecology [4], environmental laws and resource efficient use. Extended explanations regarding sustainability of the economic development [7] are shown in the works of [1] and [9].

This paper presents the general impact of the economic performance on the social factors and environmental components in Romania, the correlations between certain indicators of these and their dynamic during a decade (2007-2017). The general purpose of this presentation is to describe the economic and social environment and, based on this description, to use the ML techniques in order to predict the behaviour of the economic system in an integrated manner, using and processing the trained and tested historical data. In this matter, section 2 presents a literature review regarding the economic development and methods used in the literature for predictions. In section 3, we will present the methods that base the results obtained in the paper. Section 4 is the section regarding the Discussion area on the resulted data linked to the section 5 regarding the Results obtained for the ML-based methods.

MATERIALS AND METHODS

Presentation of main indicators

We will present some economic, social and environmental indicators for Romania in the period 1995-2019. These indicators consist in:

-***The Gross Domestic Product***, showing the increased value of the economy (Figure 1).

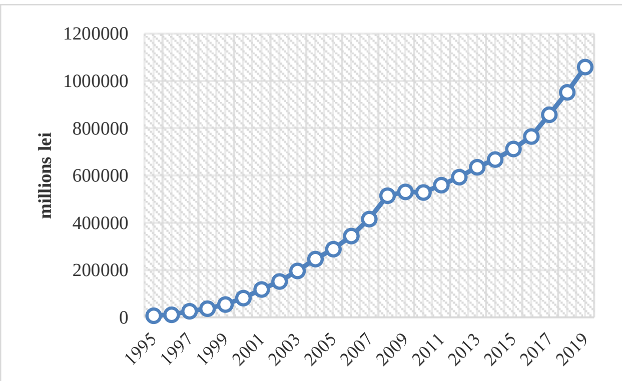

Fig. 1. GDP in Romania in the period 1995-2019.
Source: NIS, Tempo online [5].

- ***The economic indicators of the enterprises***: the turnover, showing the total value of the production within an enterprise for industrial and services branches, the profitability and the number of enterprises, showing the degree of atomicity within the economy (Figure 2, a, b, and c).

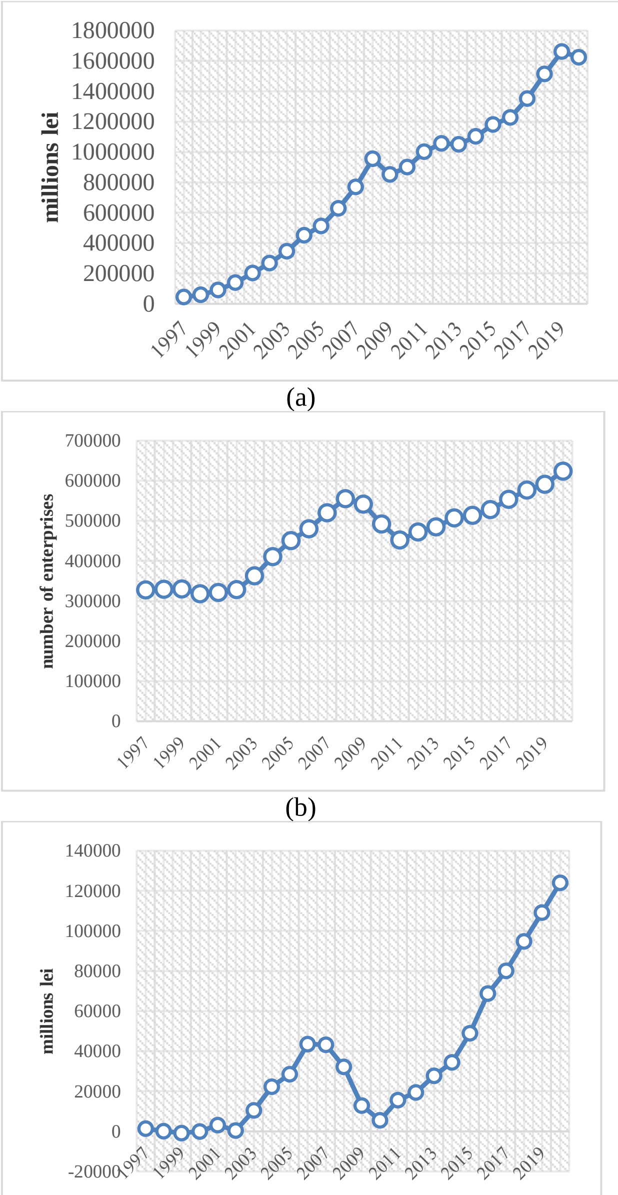

Fig. 2. (a) Total turnover in Romania for industry and services; (b) the number of enterprises; (c) the yearly result (profit/loss).
Source: NIS, Tempo online [5].

-***The social indicators of the economy***: the employment statistic, showing the number of people involved in the economy as employees, and the human development index (HDI), an index cumulating factors of human welfare (Figure 3, a and b).

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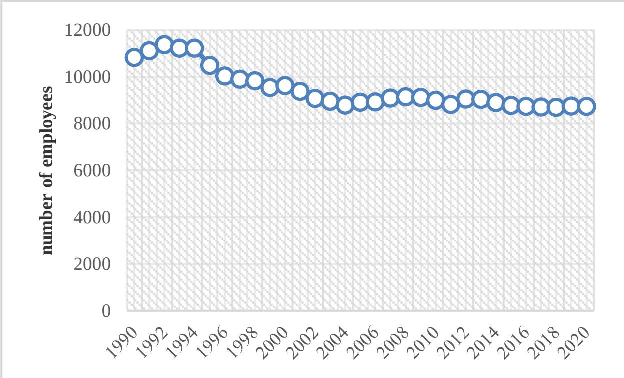
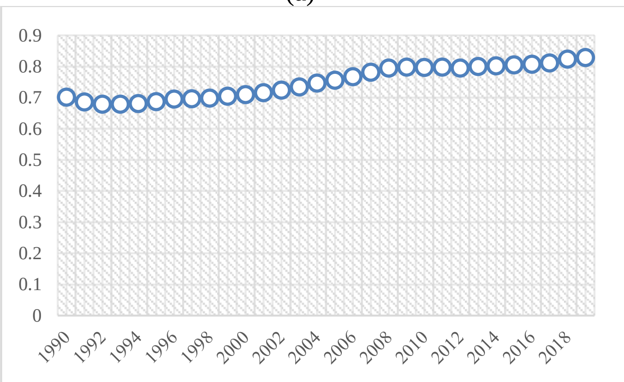
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952



(a)



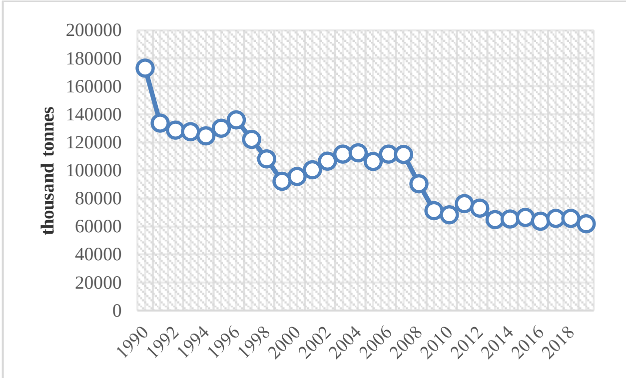
(b)

Fig. 3. (a) The employment statistic in Romania; (b) The Human Development Index
Sources: NIS, Tempo online and United Nations Development Programme, Human Development Reports [5, 14].

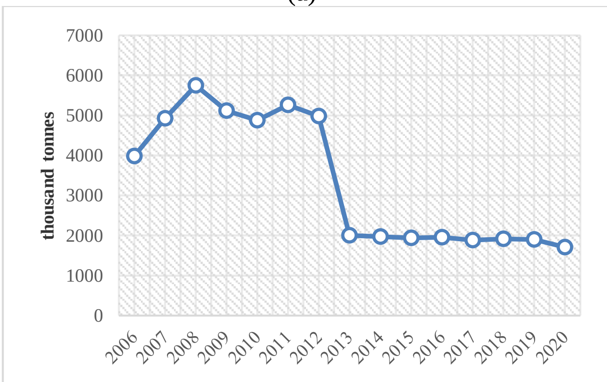
-***The environmental indicators***: the emissions of carbon dioxide, the wastewater quantity, and the costs regarding environmental impact for the four factors (water, air, soil and biodiversity) (Figure 4, a, b and c).

For some of the values, the lack of necessary data for training of the used instruments led to choosing more specific ones (e.g., the turnover for specific branches of the economy was taken into consideration), which shifted the objectives of the research to slightly different hypotheses.

For example, one of the most important one consisted in the need of the agricultural processing methods for obtaining raw materials for the other branches of the economy.



(a)



(b)

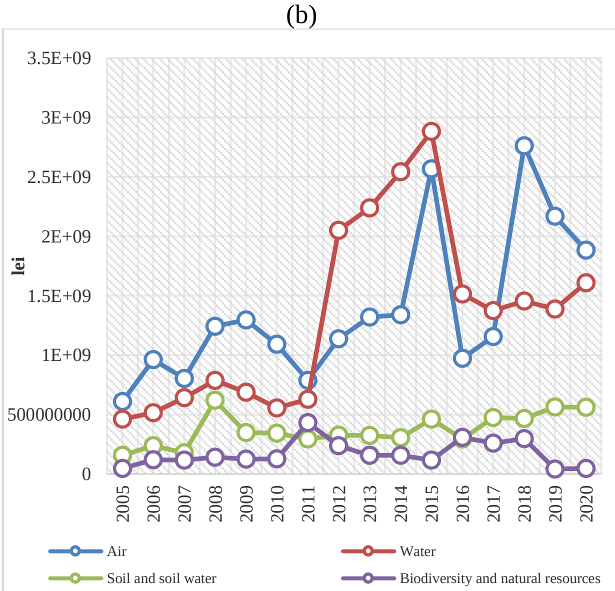


Fig. 4. (a) The CO_2 emissions in Romania; (b) The quantity of wastewater; (c) Costs related to environmental impact.
Source: NIS, Tempo online [5].

Using Linear Regression

We will use the linear regression model in order to show some correlations between the parameters listed in the previous subsection. The linear regression is a common-used approach in order to show the dependency of an independent x-value for a y-value that is considered to be influenced by the x-value.

Presentation of Machine Learning (ML) methods

Machine Learning is used in a variety of domains, such as economy [11], technology, networks and traffic [6], architecture [10], arts [2], education [8] and the list can be countless. For the dataset some Machine Learning methods were applied: firstly, they were trained, then used for prediction after checking them using some random test data. The methods chosen to be applied are:

-***Linear regression*** - Linear regression is an attractive model because the representation is so simple. The representation is a linear equation that combines a specific set of input values (x) the solution to which is the predicted output for that set of input values (y). As such, both the input values (x) and the output value are numeric. The linear equation assigns one scale factor to each input value or column, called a coefficient and represented by the capital Greek letter Beta (β). One additional coefficient is also added, giving the line an additional degree of freedom (e.g. moving up and down on a two-dimensional plot) and is often called the intercept or the bias coefficient.

-***K-means clustering*** - K-means clustering is a type of unsupervised learning, which is used when you have unlabeled data (i.e., data without defined categories or groups). The goal of this algorithm is to find groups in the data, with the number of groups represented by the variable K. The algorithm works iteratively to assign each data point to one of K groups based on the features that are provided. Data points are clustered based on feature similarity.

-***KNN - K nearest neighbors*** is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure (e.g., distance functions). KNN has been used in statistical estimation and pattern recognition already in the beginning of 1970's as a non-parametric technique. A case is classified by a majority vote of its neighbors, with the case being assigned to the class most common amongst its K nearest neighbors measured by a distance function. If K = 1, then the case is simply assigned to the class of its nearest neighbor.

-***SVM - A Support Vector Machine (SVM)*** is a discriminative classifier formally defined by a separating hyperplane. In other words, given labeled training data (supervised learning), the algorithm outputs an optimal hyperplane which categorizes new examples. In two-dimensional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side.

We have made some correlations between economic parameters and those related to enterprise statistics, as well as the ones related to social and environmental aspects, using the classical linear regression method. The results are presented in Table 1 and they were obtained using PAST software [3].

It was considered that the economic dynamics can be resumed using the GDP indicator, the enterprises statistics by the total turnover, the profit and the number of enterprises, the social aspects by the number of employees and the Human Development Index and the environmental impact by CO_2 emissions, quantity of waste water and the costs related to environmental issues for four factors (air, water, soil and biodiversity).

RESULTS AND DISCUSSIONS

The linear regressions resulted above were obtained using classical statistical model. The model of linear regression can be extended using machine learning methods.

In this matter, we applied the machine learning methodology for the data series described above.

Regarding the training phase, the resulted plot for the Turnover-GDP correlation is shown in Fig. 5 (a and b).

While the number of statistical instruments for the analysis of the correlation of parameters have multiplied recently, the machine learning approach has the advantage of a better prediction based on historical data.

In Figure 5, the training phase is presented and shows the representation of the correlation between (a) the turnover and GDP and (b) GDP and CO_2 emissions. While the Turnover-GDP correlation is strong, given the low distance of the points to the mean, the second plot (b) shows a weaker connection

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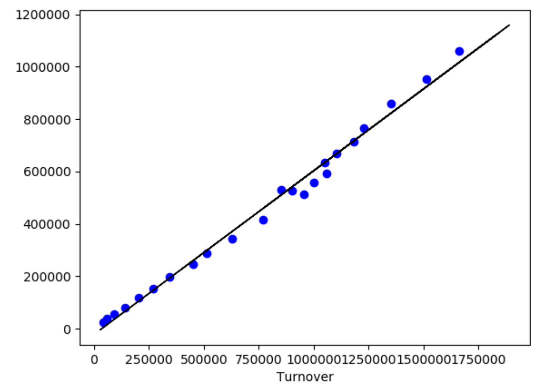
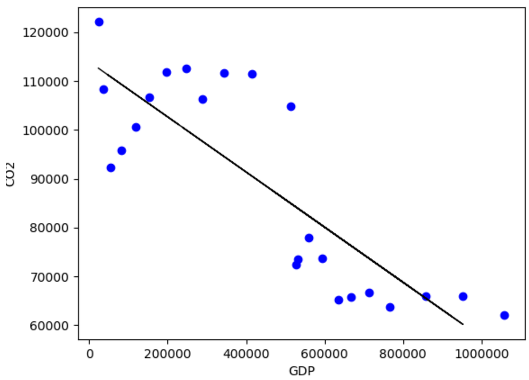
PRINT ISSN 2284-7995, E-ISSN 2285-3952

between the parameters taken into consideration.



(a)



(b)

Fig. 5. Turnover-GDP correlation plot using machine learning method: (a) Turnover; (b) CO_2 emissions.
Source: own determination.

In order to follow all the ML-based method phases, we used Python language and math-based libraries in order to train the data, test and predict.

```
''' Train with existent data '''
x_train =
f_data['Turnover'].values[:,numpy.newaxi
s]
y_train = f_data['GDP'].values

''' Apply regression '''
lm = LinearRegression()
lm.fit(x_train, y_train)

''' Generate 10 sample random data for
Turnover '''
x_test = numpy.random.randint(2000000,
size=(10, 1))
print(x_test)

''' Calculate prediction data for GDP
for the generated sample data '''
predictions = lm.predict(x_test)
print (predictions)

''' Plot data '''
plt.scatter(x_train, y_train, color='b')
plt.plot(x_test, predictions,
color='black', linewidth=1)
plt.xlabel('Turnover')
plt.ylabel('GDP')
plt.show()
```

For prediction, we have used randomly generated numbers for the turnover. The resulted values are shown in Table 1. Even if the data taken into consideration is random, the results show a close relationship between the historical data and the predicted data.

Table 1. The resulted data for GDP for random values of turnover based on ML prediction

GDP	Turnover
226,121.34	396,990
674,300.69	1,114,695
1,127,204.72	1,839,966
996,377.47	1,630,462
462,606.88	775,693
1,159,185.27	1,891,179
-4,399.98	27,838
272,926.61	471,943
1,116,937.31	1,823,524
463,009.04	776,337

Source: own determination.

We have applied the same algorithm for a GDP-CO_2 emissions correlation value. The values are shown in Table 2. The same remark can be given as for the previous data in Table 1.

```
''' Train with existent data '''
x_train = f_data['
GDP'].values[:,numpy.newaxis]
y_train = f_data['CO2'].values

''' Apply regression '''
lm = LinearRegression()
lm.fit(x_train, y_train)

''' Generate 20 sample random data for
GDP '''
x_test = numpy.random.randint(1000000,
size=(20, 1))
print(x_test)
```

```
''' Calculate prediction data for CO2
emissions for the generated sample data
'''
predictions = lm.predict(x_test)
print (predictions)

''' Plot data '''
plt.scatter(x_train, y_train, color='b')
plt.plot(x_test, predictions,
color='black', linewidth=1)
plt.xlabel('GDP')
plt.ylabel('CO2')
plt.show()
```

Table 2. The resulted data for CO_2 emissions for random values of GDP based on ML prediction

CO_2 emissions	GDP
70,595.55	768,482
68,001.32	814,456
70,157.05	776,253
69,179.09	793,584
92,573.99	378,988
100,552.14	237,602
66,968.01	832,768
81,935.41	567,521
87,661.24	466,050
72,045.64	742,784
70,059.54	777,981
66,517.21	840,757
60,189.58	952,893
87,079.69	476,356
61,792.87	924,480
111,326.20	46,668
102,125.25	209,724
101,053.79	228,712
101,992.92	212,069
112,637.48	23,430

Source: Own results.

We have also generated a cluster-based organization of some of the indicators taken into consideration, in order to show the level of each value of these indicators in correlation with others.

The chosen indicators were obviously measured using the same measure unit (million lei): GDP, turnover, profit and costs related to environmental impact. The results are shown in Fig. 6. The K-means clustering can be helpful in situations such as labelling unknown data, where certain values are given and the indicator of that value is unknown.

We have also made some correlations between economic parameters and those related to enterprise statistics, as well as the ones related to social and environmental aspects, using the classical linear regression method.

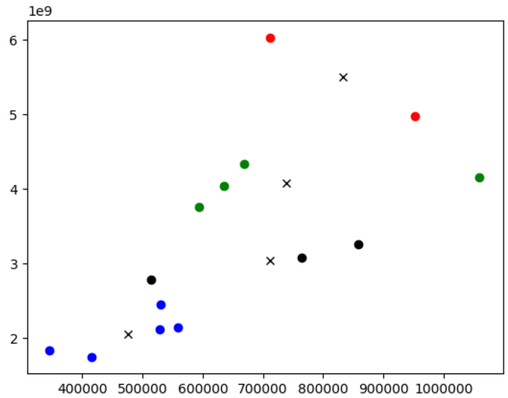


Fig. 6. K-means clustering for the presented values. Each colour represents the general cluster for each indicator

Source: own determination.

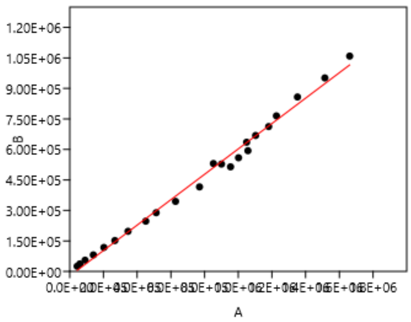
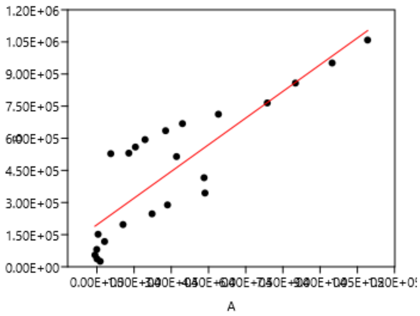
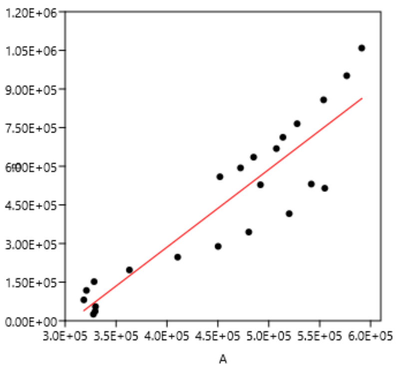
The results are presented in **Error! Reference source not found.** and they were obtained using PAST software (Hammer, Harper, & Ryan, 2001).

It was considered that the economic dynamics can be resumed using the GDP indicator, the enterprises statistics by the total turnover, the profit and the number of enterprises, the social aspects by the number of employees and the Human Development Index and the environmental impact by CO_2 emissions, quantity of waste water and the costs related to environmental issues for four factors (air, water, soil and biodiversity).

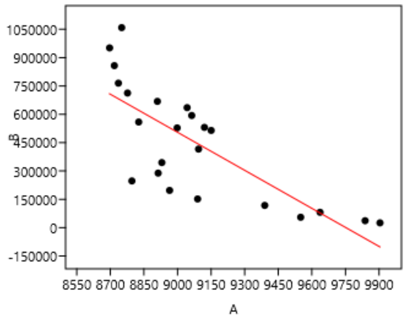
Firstly, the correlation plot (a) that highlights the behavior of the Turnover-GDP correlation shows that the two variables are strongly and positively correlated, which is shown by the high value of the correlation coefficient (0.9959). The correlation also has a high degree of trust, given by the value of R-squared coefficient (0.99181).

The positive correlation is somehow expectable, due to the same trend that both had during the period and the inclusion relation that can be established between them.

Table 3. Results of correlations between selected parameters

Correlation variables	Plot	Correlation for linear regression
(a) Turnover-GDP		Ordinary Least Squares Regression: A-B Slope a: 0.62446 Std. error a: 0.012381 t: 50.435 p (slope): 2.1169E-23 Intercept b: -21,784 Std. error b: 11,068 95% bootstrapped confidence intervals (N=1999): Slope a: (0.60352, 0.65435) Intercept b: (-36,170, -2,326.7) Correlation: r: 0.9959 r2: 0.99181 t: 50.435 p (uncorr.): 2.1169E-23 Permutation p: 0.0001
(b) Profit - GDP		Ordinary Least Squares Regression: A-B Slope a: 8.3059 Std. error a: 1.0939 t: 7.5927 p (slope): 1.8835E-07 Intercept b: 1.9627E05 Std. error b: 47,533 95% bootstrapped confidence intervals (N=1999): Slope a: (6.5981, 9.8886) Intercept b: (9,3441, 2.8033E05) Correlation: r: 0.85615 r2: 0.73299 t: 7.5927 p (uncorr.): 1.8835E-07 Permutation p: 0.0001
(c) Number of enterprises – GDP		Ordinary Least Squares Regression: A-B Slope a: 3.0177 Std. error a: 0.29198 t: 10.335 p (slope): 1.0841E-09 Intercept b: -9.2113E05 Std. error b: 1.3526E05 95% bootstrapped confidence intervals (N=1999): Slope a: (2.5335, 3.6138) Intercept b: (-1.1523E06, -7.1342E05) Correlation: r: 0.91417 r2: 0.8357 t: 10.335 p (uncorr.): 1.0841E-09 Permutation p: 0.0001

(d) Number of employees – GDP



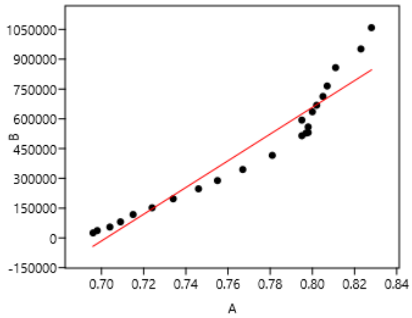
Ordinary Least Squares Regression: A-B

Slope a: -671.18
Std. error a: 121.36
t: 5.5305
p (slope): 1.7326E-05
Intercept b: 6.5455E06
Std. error b: 1.103E06

95% bootstrapped confidence intervals (N=1999):
Slope a: (-856.96, -406.73)
Intercept b: (4.1392E06, 8.2997E06)

Correlation:
r: -0.77001
r2: 0.59291
t: -5.5305
p (uncorr.): 1.7326E-05
Permutation p: 0.0001

(e) HDI – GDP



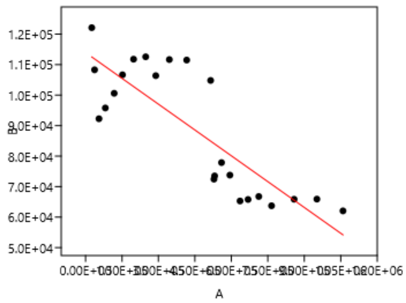
Ordinary Least Squares Regression: A-B

Slope a: 6.7295E06
Std. error a: 4.4069E05
t: 15.27
p (slope): 7.6194E-13
Intercept b: -4.7257E06 Std. error b: 3.3943E05

95% bootstrapped confidence intervals (N=1999):
Slope a: (5.7591E06, 7.6523E06)
Intercept b: (-5.4046E06, -3.9671E06)

Correlation:
r: 0.9578
r2: 0.91738
t: 15.27
p (uncorr.): 7.6194E-13
Permutation p: 0.0001

(f) GDP – CO_2 emissions



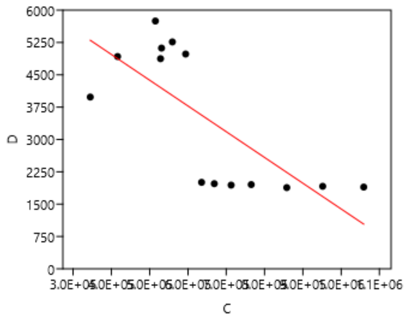
Ordinary Least Squares Regression: A-B

Slope a: -0.056428
Std. error a: 0.0081636
t: 6.9122
p (slope): 7.8866E-07
Intercept b: 1.1396E05
Std. error b: 4413.5

95% bootstrapped confidence intervals (N=1999):
Slope a: (-0.068003, -0.039971)
Intercept b: (1.0461E05, 1.2175E05)

Correlation:
r: -0.83347
r2: 0.69467
t: -6.9122
p (uncorr.): 7.8866E-07
Permutation p: 0.0001

(g) GDP – Wastewater



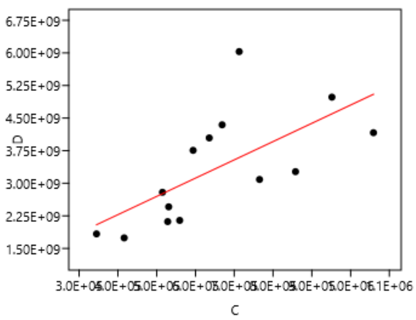
Ordinary Least Squares Regression: C-D

Slope a: -0.0059706
Std. error a: 0.001564
t: 3.8175
p (slope): 0.0024506
Intercept b: 7359.4
Std. error b: 1064.9

95% bootstrapped confidence intervals (N=1999):
Slope a: (-0.0078092, -0.0014593)
Intercept b: (4478.6, 8941.9)

Correlation:
r: -0.74055
r2: 0.54842
t: -3.8175
p (uncorr.): 0.0024506
Permutation p: 0.0018

(h) GDP – Environment costs



Ordinary Least Squares Regression: C-D

Slope a: 4204
Std. error a: 1371.8
t: 3.0645
p (slope): 0.0098166
Intercept b: 5.9587E08
Std. error b: 9.3405E08

95% bootstrapped confidence intervals (N=1999):
Slope a: (371.71, 6043.6)
Intercept b: (-7.8053E08, 2.6012E09)

Correlation:
r: 0.66259
r2: 0.43902
t: 3.0645
p (uncorr.): 0.0098166
Permutation p: 0.0104

Source: Own determination.

The p-value for the regression is lower than 0.05, meaning the correlation is extremely strong.

The Profit-GDP correlation analysis (b) shows a lower, but still strong degree of connection between the behaviour of the GDP and the profit trend. This means that the GDP values are influenced also by other parameters of the economy, namely production costs or any other external factors and, thus, the influence of the profit on the dynamics of GDP is slightly weaker than the previous one. While the p-value is higher than at the plot (a), it still classifies the correlation as valid and possible to be taken into consideration.

The Number of enterprises – GDP (c) correlation is studied regarding the influence of the number of enterprises on the GDP dynamic. The p-value of the correlation shows that the correlation is strong, and the measurement is valid. The high values of the correlation coefficient and the R-squared coefficient show that the number of enterprises influences positively the increase of GDP values. This fact may indicate that, in an emergent economy, the small and medium enterprises must be encouraged in order to create a more dynamic character to the economy. This behavior is a normal one, due to the effects of the small and medium enterprises on a national economy.

The plot (d) highlighting the connection between the number of employees and GDP shows that the correlation between the two parameters is a negative one. However, the value of R-squared coefficient is relatively low, meaning the relation is a weaker one than the previous. The p parameter has a small value, given the correlation is a strong one. The negative correlation coefficient shows that a lower number of employees lead to an increase in GDP, which may lead to the conclusion that the dynamic of the number of employees influences the GDP values in an opposite way.

Regarding the Human Development Index – GDP correlation (e), the increase of the HD index influences positively the increase of GDP. This fact shows, in this manner, that the human welfare regarding the improvement of the economic, educational and social aspects of life leads to the increase of the value of GDP. The values of the correlation parameters make the results of the analysis more stable and trustable. This may stand as a good motivation for improving the social and economic policies and those related to human welfare, due to the good impact of the human welfare on the economic increase.

We will discuss now the impact of the economic increase on the environmental factors. Firstly, the impact of the GDP on the CO_2 emissions (f) in the studied period tends to be inversely proportional, the CO_2 emissions lowering as the GDP increases. This shows that an increase in costs related to CO_2 emissions policies and technologies reflected in the final value of products leads to a reduction in carbon dioxide emissions. The linear regression can still be improved, as shown by the R-squared coefficient and the values of the p parameter, which lead to the impression of a better approximation of the real correlation behavior. This also happens for the wastewater quantity (g), in this case an extra parameter that must be considered is the fact that not all the economic entities have water as production wastes. As expected, an increase in GDP reflects also in the costs related to environment protection (h).

Another point of research consisted in the dependance of GDP indicator by the Turnover, Profit, Number of enterprises and Number of employees indicators. In order to solve that point, a multiple linear regression was generated. The characteristics of the regressions were:

- the dependent variable: GDP
- the dataset volume (N): 23
- multiple R: 0.99758
- multiple R^2: 0.99516
- multiple R^2 adjusted: 0.99409

The ANOVA interpretation had the following characteristics:

- F: 925.91
- df1, df2: 4. 18
- p: 1.4419E-20

The values are shown in **Error! Reference source not found.**.

Table 4. The results of the multivariate linear regression

Variable	Slope	Error	Intercept	Error	r	p
CO_2 emissions	-0.067171	0.017104	1.2107E05	11,646	-0.74993	0.002009
Waste water quantity	-0.0059706	0.001564	7,359.4	1,064.9	-0.74055	0.0024506
Costs with the environmental impact	4,204	1,371.8	5.9587E08	9.3405E08	0.66259	0.0098166

Source: Own determination.

Overall, an implication that can be extracted from the regression is that the GDP has a mild effect on the environmental indicators.

Authors should discuss the results and how they can be interpreted in perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

CONCLUSIONS

Machine Learning can be successfully used as an analysis method for datasets regarding various economic developments and its sustainability. In this paper, we have shown that an increase in the investments regarding environmental protection can lead to better values regarding the value of the production. Also, the human welfare has the tendency to increase the GDP values, as a direct result of the mechanisms related to human behaviour and its influence on the economic production.

Also, one of the main conclusions is centered on the fact that, because turnover from industrial and services branches of the economy were taken into consideration, the further processing of the agricultural products must be made in order for an economic development to be obtained.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE CONCEPT OF THE MECHANISM FOR THE CONSOLIDATION OF AGRICULTURAL LAND

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Abstract

Purpose of the paper is to form a mechanism of consolidation of the agricultural land on the basis of benchmarking of foreign experience. For research used methods of scientific abstraction, analysis, synthesis, comparison, monographic. The scientific novelty of the research consists in the offer the concept of the mechanism of consolidation of the agricultural land which is directed to creation of norm for constructive interaction of authorities and other participants of the land relations in the sphere of effective management of the agricultural land. The concept provides existence of legislative justification, definition of subjects of the mechanism of consolidation, decomposition of elements on organizational and economic, algorithmization of process of consolidation of the agricultural land. SMART-purpose of consolidation consists in providing the land owner with close located land plots of the established size in concrete time. The practical value of the work is that its results contributes improvement of management of land resources in agricultural industry on a national level, increase in economic interest in intensive agricultural production on a private level. The development of mechanism of consolidation of the agricultural land are recommended for agricultural organizations of various legal forms of ownership, executive authorities and management of the agro-industrial complex at the federal, regional, municipal levels. This mechanism are significant for scientific community in terms of development of the sphere of the land relations, defragmentation of the agricultural land.

Key words: *mechanism, consolidation, agriculture, land, SMART*

INTRODUCTION

Consolidation – strengthening, association, integration something [16]

According to the Food and Agriculture Organization (FAO) [6], consolidation of lands – legislatively adjustable procedure which is carried out by public authorities and applied to correction of structure of property in rural areas by complex redistribution of the land plots which is coordinated with owners and users of the land to reduce fragmentation of lands, to promote integration of the agricultural enterprises and (or) achievement of other public purposes, including restoration of natural objects and construction of infrastructure [14].

Land consolidation is aimed at implementing measures to reduce the fragmentation of land plots of one farm, to level the boundaries, to improve the configuration of land plots, to reduce the territorial remoteness of part of the farm land from production centers, farms, and reduce the distances for transporting products and raw materials. Consolidation provides reduction of a large number of the small and tiny plots belonging to individual land owners, turns them into large arrays located if it is possible, in one place [15].

It assumes association of the fragmented land plots of farmers with receiving compensation by them in the form of new farmlands that provides mutually advantageous decisions for farms and the state [7]. The complex of the spatial and planning, legal, organizational, economic, technical, biological, ecological actions undertaken for the purpose of improvement of an order of the property relations, living conditions and work in rural territories is considered consolidation of lands [2, 9]. As a result of it the land plots allocated on account of land shares unite, there are land massifs of the optimum size and a convenient configuration that allows to introduce modern methods of management, to reduce production expenses [12, 13].

As the category consolidation of lands is widely applied to the description of measures for correction of structure of the property rights by means of coordination between owners and users, includes redistribution of sites for elimination of consequences of fragmentation [6].

The idea of creation of the mechanism of consolidation of the agricultural land consists in involvement of instruments of initiation of voluntary exchange of plots for formation of large units taking into account spatial and territorial conditions, the areas, forms of the land plots.

The mechanism of consolidation of the agricultural land is set of the ways of management of land resources realized by a private property institution, informal institutes on a voluntary basis under control of institute of public administration, directed to reduction of excessive fragmentation, optimization of a relative positioning, the sizes of the land plots (including land shares).

MATERIALS AND METHODS

Development of the mechanism of consolidation of the agricultural land is carried out on the basis of system, functional, information approaches, the accumulated practical experience in voluntary association of the land plots with application of methods of abstraction, scientific idealization, monographic, induction, deduction, the analysis, synthesis, structurization, systematization, modeling, etc.

RESULTS AND DISCUSSIONS

Traditionally organizational and economic mechanism includes the following structural elements: internal environment (subject, object), purpose, tasks, actions (function), output results, external environment. The offered mechanism of consolidation of lands in territorial subjects of the Russian Federation is aimed at integration of allotments, reduction of a strip farming, optimization of expenses owing to change of location of agricultural production, regulation of the relations of property between owners of land shares, tenants and land users.

At creation of the mechanism of consolidation of lands the basic principles have to be considered:

– logic of exchange – drawing up the map of redistribution of lands (land shares) taking into account the shortest distance between the land plots of one agricultural production, preservation of their sizes, satisfactions of needs of participants;

– a contractual basis – signing of the contract of sale (rent) of the land plot (share), the obligatory agreement on monetary compensation of voluntary granting unclaimed lands of one of the parties;

– the state protection of interests – legal and consulting support of the transaction, settlement of controversial issues on the value of lands;

– an exception of a corruption component – prevention of danger of illegal use of powers of authority for personal benefit;

– establishment of concrete terms – restriction of the period of carrying out consolidation of lands, elimination of the reasons of delay in process, respect for seasonality of agricultural production.

Each subject of the mechanism of consolidation of the agricultural land acts according to its organizational and economic components (Table 1).

In public sector of economy at the regional level the Government of the Saratov region, the Ministry of Agriculture of the Saratov region, the Ministry of Economic Development of the Saratov region, the Committee on management of property of the Saratov region, the Management of the Federal Registration Service across the Saratov region, the offered Management of the land relations in agriculture of the Saratov region, the Department of consolidation of lands of the Saratov region, department of consolidation of the agricultural land have to exercise control of consolidation of the agricultural land. Owners, land users, land owners, tenants also can initiative of fragmentation reduction.

Mission of the mechanism of consolidation of lands is creation of the effective norm allowing to provide constructive interaction of authorities and other participants of the land relations in the sphere of effective management of the agricultural land.

Legal basis for its realization are the Constitution of the Russian Federation [1], the Land Code of the Russian Federation [5], the Federal Laws "About Development of Agriculture" [3], "About land turnover of agricultural purpose" [4], the State program of development of agriculture and regulation of the markets of agricultural products, raw materials and food [10], the State program of effective involvement in land turnover of agricultural purpose and development of an ameliorative complex of the Russian Federation [11], the Law of the Saratov region "About land" [8], etc.

Table 1. The offered mechanism of consolidation of the agricultural land

	Sector of economy	
	State	private
Subjects	▪ government; ▪ ministries of agriculture; ▪ territorial authority of Federal Registration Service (Rosreestr); ▪ management of the land relations in agriculture; ▪ department of consolidation of lands	▪ firms which are carrying out activity in the sphere of researches, geodesy, land management and the cadastre; ▪ estimated companies; ▪ owners, land users, land owners, tenants; ▪ investors
Purposes	▪ effective management of land resources in agriculture	▪ increase in level of interest in effective agricultural production
Organizational elements of the mechanism	▪ research of prerequisites and problems of consolidation of lands; ▪ development of Strategy (Concept) of consolidation of the agricultural land; ▪ administration of the program of consolidation of lands; ▪ modernization of an institutional matrix; ▪ control and coordination of consolidation at all stages of process	▪ mapping of the territory; ▪ reduction of dissociation and dispersion of land resources in agriculture; ▪ use of digital instruments of consolidation of lands
Economic elements of the mechanism	▪ financing of projects of consolidation, development of the electronic tools which are simplifying implementation of the corresponding procedures; ▪ compensation of expenses to the owners of land shares who are not planning to carry out production activity, but persons interested to participate in exchange of lands; ▪ establishment of temporary tax preferences to participants of process of consolidation of the agricultural land	▪ assessment of the landed property; ▪ increase in market value of the consolidated agricultural land; ▪ increase in efficiency of agricultural production; ▪ reduction of separate articles of material inputs; ▪ optimization of operation of soil-cultivating and sowing units

Source: Author's own elaboration.

Organizational components of the mechanism of consolidation of lands: development of new institutes, high-quality performance of functions of management, legal and information support, coordination and implementation of process. The Strategy of consolidation of the agricultural land offered by us provides introduction of legislative and legal regulation of the optimum amount of land use of agricultural producers. It has to consist of general provisions, assessment of international and domestic experience of consolidation, the purposes, tasks, actions for consolidation of the agricultural land, the list of possible risks, an expected result and the forecast of development of consolidation of lands. Duties of the Department of consolidation of the Saratov region, department of consolidation of the agricultural land will include performance, correction of Strategy, control, coordination of consolidation at all stages of process, granting the state subsidies to agricultural producers, to owners of the consolidated lands.

Economic components of the mechanism of consolidation of lands: increase in economic value of the agricultural land, compensation of costs of acquisition of the land plot, establishment of a monetary form of the rent, differentiation of land tax. Transfer of land shares to the consolidated sites, registration of the property right to them increase the economic value of lands owing to an exception of the expenses connected with territorial remoteness of objects and subjects. Rates of land tax depend on the cadastral cost of the site which overestimate reduces interest of agricultural producers in consolidation of lands. The solution of the specified problem is promoted by development and deployment of the method of updating of cadastral assessment of the agricultural land which is based on the theory of factors of production, the principle of share distribution of income.

The algorithm of this process is shown in Figure 1.

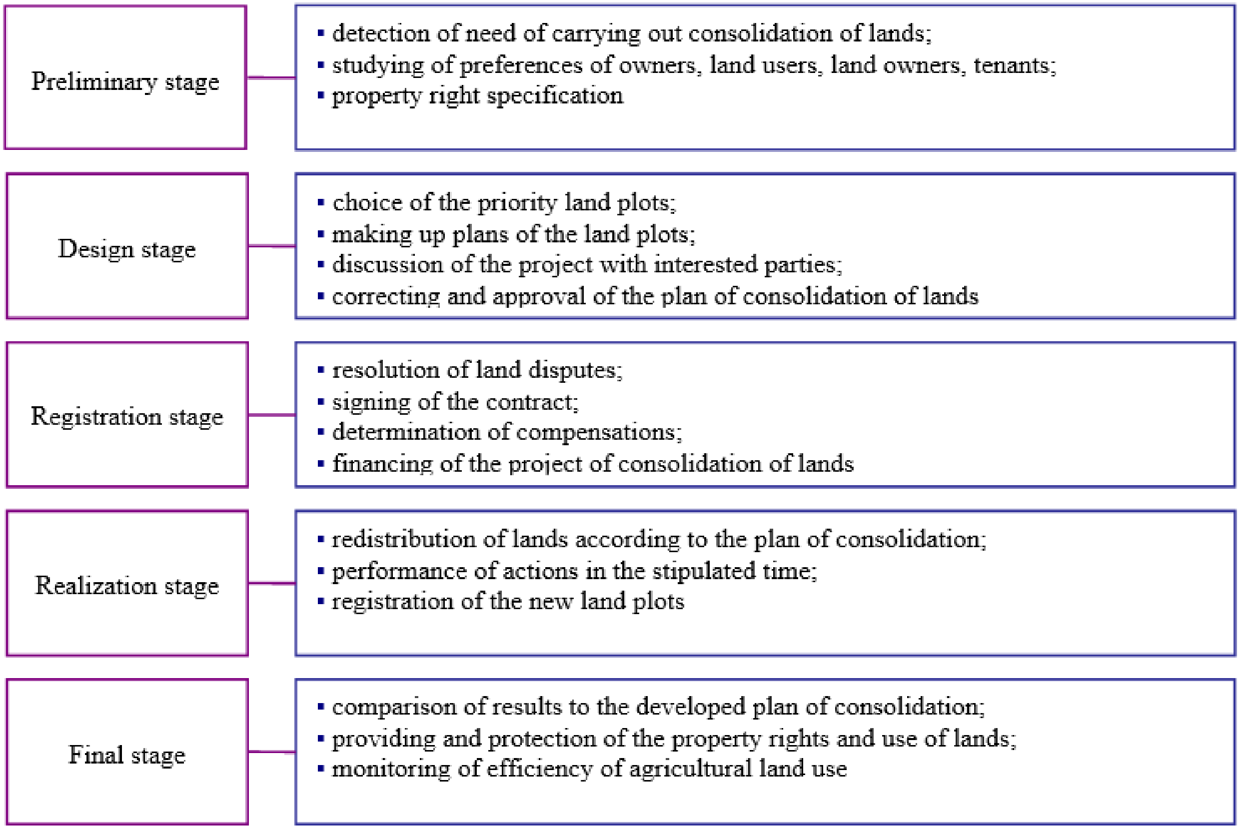

Fig. 1. The offered algorithm of consolidation of the agricultural land
Source: Author's own elaboration.

In our opinion, the order of carrying out consolidation has to provide preliminary studying of problems of land use, questioning of participants of the land relations, identification of owners, development and discussion of the plan of consolidation of lands, registration of the contractual relations, establishment of terms, involvement of the specialized organizations for financing and implementation of the project, realization of actions for consolidation of lands, assessment of planned and actual results, creation of the effective owner of the agricultural land.

Functioning of the mechanism of consolidation of the agricultural land has to correspond SMART-criteria (Figure 2).

SMART is the formalized representation of target indicators taking into account specific (S), measurable (M), achievable (A), relevant (R), time bound (T) [16].

For obtaining effective output results subjects of the mechanism have to carry out collection of information about a condition of objects, carry out situation analysis, institutional correction on the basis of support of adoption of management decisions.

Potential of consolidation of lands is shown in involvement of not used lands in economic circulation, creation of steady institute of management of land resources in agriculture.

The efficiency of consolidation of lands can be estimated by the number (area) of the defragmented land plots, level of transactional

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

costs, shares of own lands, profitability of agricultural production.

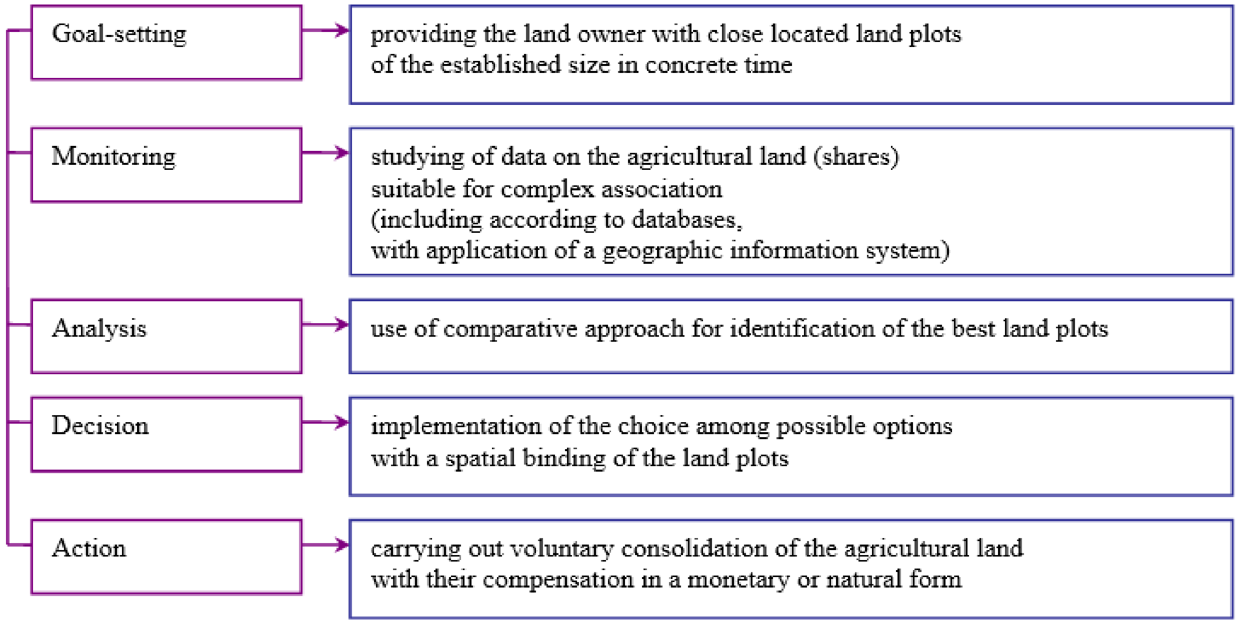

Fig. 2. SMART-purpose of the mechanism of consolidation of the agricultural land
Source: Author's own elaboration.

CONCLUSIONS

It is established that characteristic negative features of the landed property in the country and the world are the dispersion of the land plots, their remoteness from the main place of agricultural production, unreasonable parceling of agricultural land use, not demand of shares. Creation of the effective mechanism of consolidation of the agricultural land allows to correct current situation and by means of integration of lands to eliminate negative consequences of their fragmentation.
Thus, the concept of the mechanism for the consolidation of agricultural land has been developed. The organizational elements of the mechanism are the creation of new institutions, the high-quality performance of management functions, legal support, information support, coordination and implementation of the process. The economic components are an increase in the value of agricultural land, reimbursement of costs for the acquisition of a land plot, the establishment of a monetary form of rent, and differentiation of land tax. The mechanism purposes has to correspond SMART-criteria. At the state level they are effective management of land resources in agriculture. At the private level purposes are increase in interest in effective agricultural production.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE ROLE OF INFORMATION TECHNOLOGIES FOR THE DEVELOPMENT OF SMEs IN THE AGRI-FOOD SECTOR OF THE REPUBLIC OF MOLDOVA

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Abstract

The economic efficiency, the yield of the agricultural activities of the enterprise were the basis of some in-depth studies and researches, constituting the preoccupation of several scientists and specialists in the field. Currently, there are a multitude of scientific works on agricultural management, but there is very little research on the management of agricultural activities in terms of computerization, given that the process is relatively new, is being implemented and has not yet been completed, accumulated enough data to conduct scientific research. Despite the lack of data in agriculture, the computerization process has proven its importance in industry, services, etc. In this regard, it becomes useful to study the aspects of agricultural management in the context of economic computerization. The main purpose of this research is to identify opportunities for sustainable development of the agricultural enterprise by managing agricultural activities through the implementation of information technologies on the farm, taking into account the fact that many routine processes can be easily automated. General scientific research methods were used within the framework of comparative statistical analysis, as well as an analysis of the structure and dynamics, graphical interpretation of data on the informatization of agricultural enterprises at the international and national levels. In this research is noted the value of open, cooperative, publicly funded and locally funded data systems and technologies as first steps in supporting solutions that contribute to data justice for farmers. Greater economic barriers in agriculture certainly limit the extent to which digitalization can support the interests of marginalized farmers and food producers. Then is needed to work much more learned and pragmatically if we are to better understand what data justice means to the agri-food community and how it can be done sooner.

***Key words*:** *agricultural development, information technologies, economic computerization, management*

INTRODUCTION

Currently, we are witnessing the introduction of information technology in most areas of life. The availability of these technologies is enhanced and accelerated by the spread of the Internet. This tool is the result of a communication revolution both in the internal and external environment of companies, government agencies, and in the personal, social life of every person anywhere in the world.

Based on the statement of one of the latest DEX 2016 publications, informatization technology is the use of computer science in the process of solving many problems. And, accordingly, computer science is explained as a science that studies aspects of automatic processing and analysis of information. All this leads to the fact that economic computerization is considered in two directions: automatic data processing and calculation of economic indicators [4].

Informatization is an absolute need that we cannot get rid of, it has a very big role in most aspects of our lives, it answers most of humanity's problems. Technologies have evolved over the centuries. Their importance lies in the comfort of use in any form always aimed at making life easier.

Gradually, information technology seeped from everyday life into such important economic sectors as agriculture. This inspired scientists to intensify the use of these technologies in agricultural activities, which entails the facilitation and simplification of numerous field and production processes.

Computerization can help not only with the present, but also with the approximation of the future. Can calculate potential profits and losses. And based on that, we can create plans and a list of precautionary steps for the future of our descendants [12].

According to the United States National Food and Agriculture Institute, farmers no longer have to apply water, fertilizers and plant protection products evenly throughout the fields [14].

Instead, they can use the minimum amounts needed and target very specific areas or even treat different plants differently.

Analyzing the global demand and consumption of agricultural crops for food, feed and fuel, a significant increase has been observed recently. This demand for plant materials has been expanding for many years.

However, recent increases in meat consumption in emerging economies, together with the accelerated use of cereals for biofuel production in developed countries, have put new pressure on global grain supply.

Today, given the intensity of growth in global demand for crops, two main approaches to solving emerging problems are widely used: increasing the area under these crops and increasing productivity on existing agricultural land. At the same time, it is worth considering the fact that these approaches are increasingly used as complementary to each other. For example, both of them will be included in the additional production of more than 200 million tons per year of the necessary: corn (*Zea mays*) and wheat (*Triticum aestivum*), which are fundamental crops in most countries of the world [5].

Both options will change the ecological footprint of agriculture. Increasing productivity on existing agricultural land is preferable for these two options, as it avoids greenhouse gas emissions and large-scale disruption of existing ecosystems associated with bringing new land into production.

At the same time, the economic aspect of increasing crop productivity allows farmers to continue working, investing in processes of efficiency and computerization of agricultural activities.

In addition, robotic technologies allow for more reliable monitoring and management of natural resources, such as air and water quality. It also gives producers more control over cost planning, procurement of materials, such as seeds, plant protection products, fuel and lubricants, etc.

Sustainable agricultural activities must make full use of technology, research and development, albeit with a much greater integration of local knowledge, specific to each locality, than in the past. This will require new and stronger partnerships between technical, investment-oriented and investment institutions [15].

The analysis should focus on both production systems and basic natural and socio-economic resources.

Everyone knows the fact about the problems of existing reserves and utilization rates of available natural resources. In addition, these needs are increasingly exceeding the individual capabilities of both enterprises and individuals.

Thus, there is a need to organize and implement regional, national and international mechanisms and processes for everyone to work together to support sustainable growth and the equitable sharing of benefits in all agricultural sectors, protecting natural resources and discouraging collateral damage.

The aim of this research is to identify opportunities for sustainable development of the agricultural enterprise by managing agricultural activities through the implementation of information technologies on the farm, taking into account the fact that many routine processes can be easily automated.

MATERIALS AND METHODS

The field of study of this work is determined by the economic informatization of agriculture, which is studied and analyzed from the point of view of its impact on the financial statements of companies. Within the framework of the study, scientific works of agricultural production specialists, as well as reports and studies from international agencies and national institutions were used.

In a conceptual aspect, the object of this study is specified at the level of agricultural enterprises. In their activities, the introduction of information technology is given a particularly important place, and as a result, particularly high expectations regarding economic efficiency arise.

For modern research, the methodology of data processing and the introduction of information technologies in agricultural production is divided into several directions [9]:

1) Electronic maps of agricultural land are formed using images that are received continuously from the satellite. This allows you to control and effectively manage agricultural activities. In addition, volumetric electronic maps of agricultural land contribute to more efficient control of the entire territory of the agricultural enterprise.

2) Visualization, that is, photo and video filming by drones, which is carried out as planned throughout the entire crop growth cycle. This is necessary, since the obtained objective data contribute to a more accurate assessment of the plant growth process and the identification of emerging deviations and threats. Also, it allows you to analyze the quality of sowing work, to assess the degree of damage to crops in a certain period of the year.

3) Online monitoring of agricultural machinery. The satellite coverage system, as well as data transmission via GPRS, the GPS tracking device allows you to track the necessary parameters of a working vehicle: speed, distance traveled, cultivated and uncultivated area in the field, etc.

4) Audit of agricultural land - the process of accounting for industrial land allows you to collect complete information about land relations within the company. This module includes agricultural land, required documents and maps that reflect the respective lease periods. Color-coded plots make it easy to identify an area that has already expired and immediately find all the information you need about the owner of that plot.

5) Weather stations providing the necessary data on weather conditions for appropriate plant growth. The necessary, more accurate information on the amount of precipitation, as well as timely forecasts of non-volatile factors that limit the use of herbicides, frosts, data on soil temperature conditions, the supply of productive moisture in various soil layers, can qualitatively improve the management of the production process of agricultural enterprises of any format.

6) Agrochemical analysis of fields - at present, there are various methods of chemical research of soil and analysis of crops. In this process, the vital parameters present in the soil are established, such as: soil acidity, the amount of organic matter in various layers, the content of permitted forms of nitrogen, phosphorus, potassium, calcium, magnesium and iron.

The solution of the object set in this scientific work was carried out on the basis of the application of general scientific research methods in the framework of comparative and statistical analysis, as well as through the analysis of the structure and dynamics, graphical interpretation of data on the informatization of agricultural enterprises at the international and national levels.

RESULTS AND DISCUSSIONS

Historically, agriculture has undergone a series of revolutions that have determined efficiency, yield and profitability to unprecedented levels. Market forecasts for the next decade suggest a "digital agricultural revolution" will be the latest change, which could help ensure agriculture for the needs of the global population in the future.

The digitalization process affects and changes every part of the agri-food chain. The control and management of resources in the entire production system can become highly optimized, individual, intelligent and proactive. If successfully implemented, it will be efficient in real-time with hyper-connectivity and appropriate data management [11].

And as a result, value chains will become transparent and easily coordinated at the most detailed level. At the same time, the development of crops and animals can be precisely controlled according to their own optimal parameters and recipes.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Agriculture in digital format will create in the future various high-performance and predictive systems that can adapt to changes such as climate change. Going forward, this will lead to increased and sustainable food security and profitability.

Within the framework of the Sustainable Development Goals [2], digital agriculture can result in and cause economic benefits through increased agricultural productivity, increased profitability and improved market opportunities that will lead to social and cultural benefits.

All this will subsequently contribute to the expansion of communication and integration, which, in turn, will entail environmental benefits as a result of the use of economic resources and timely adaptation to climate change.

Even today, the potential benefits of digitalization of the food sector are clear, although this will require major changes and transformations in agricultural systems, in the entire rural economy, as well as in communities and natural resource management [13].

At the same time, it is becoming clear that this is not an easy task and will require a systematic, comprehensive and holistic approach if there are to be many potential benefits.

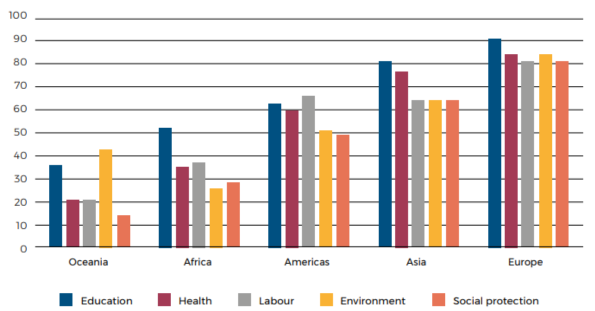

Fig.1. Government services provided by e-mail, SMS or RSS, % of field by continent
Source: UN Department of Economic and Social Affairs, 2018.

The spread and development of e-government services is generally very slow in the agriculture sector, and only a few frequency spectrum allocations are for radio frequencies that belong to other industries for communication between countries whose airlines provide e-agriculture services [6].

It is worth noting that countries and regions that pay significant, even priority attention to the introduction and development of information and communication technologies in the agricultural sector, have an improved business environment, the necessary regulatory framework for the agri-food industry. And this is most often associated with the use of information technology, and not with the quality of human capital or the contribution of the main sectors of the economy to the country's GDP.

Therefore, we analyze the results of the development and implementation of successful programs and strategies for digital agriculture in developed countries. This is achieved, most often, due to the fact that this sector is one of the key development goals in the respective national digital strategies, the task of which is to transform not only industry, but society as a whole [16].

Whereas, in developing countries, the basic services of technologically equipped agriculture are included in e-government programs and strategies. In addition, they are part of information and communication technologies, through which only the main parameters of e-agriculture are provided, which are related to early warning and general information about the state of agricultural land [6].

Today, the use of information technologies is important, which contributes to the need for policy development and effective regulation of the data generated [7].

In addition, standardization is important, the absence of which in many aspects, such as the format and ownership of the data provided, can provoke inconsistencies. Such situations arise when large multinational companies are skilled in digital agri-food production, and their partners in the form of smallholders and farmers can simultaneously use the same technologies, but at once to solve several problems that are important for both rural society and agriculture [8].

There are well-known predictions that as the world's population grows to 9.8 billion in 2050, living standards are also expected to rise in some regions and incomes in developing countries, which will provoke overall demand for food to increase by more than 50%. And the demand for animal products will grow by almost 70% [2].

But we must not forget that hundreds of millions of people are already starving today, and the agro-industrial sector already uses almost half of the world's land covered with vegetation. At the same time, agricultural production and general land use account for more than a quarter of annual greenhouse gas emissions.

In these circumstances, it is important not only to ensure the effective implementation of information technologies and to benefit from agricultural discoveries, but also to create conditions that would enable the world to achieve a sustainable food future by meeting the growing demand for food. In this direction, it is necessary to include such measures as: prevention of deforestation and reforestation, restoration of abandoned and unproductive lands, so that all this contributes to climate stabilization, and ultimately leads to economic development and stability, as well as poverty reduction.

A comprehensive solution to these problems requires the introduction of many innovations. It can be noted that the researchers have demonstrated good creative innovation potential in all required areas.

There are research findings that include crop characteristics and properties or additives that reduce methane emissions from rice and cattle, improved fertilizer forms and crop properties that reduce nitrogen leakage, solar-powered fertilizer manufacturing processes, organic sprays that keep food fresh for a longer period of time, and grass-fed beef substitutes [8].

The revolution in molecular biology opens up new possibilities for crop reproduction. Progress on the scale required will require significant increases in R&D funding and flexible rules to encourage private industry to develop and market new technologies [3].

Regulating the implementation of information technologies in the Republic of Moldova

In order to supervise and ensure the observance of the rights of all citizens of the Republic of Moldova according to the Constitution, the legislation and normative acts of the relevant agencies are to establish various mandatory requirements, restrictions and regulations. Currently, the Air Code of the Republic of Moldova no. 301/2017, in force since March 23, 2019, created the primary regulatory framework for unmanned aerial vehicles [1]. Thus, the Code expressly introduced the notion of unmanned aircraft, and Article 33 established that their flight may take place only with the permission of the Civil Aviation Authority, unless the flights take place in the specially reserved space, in accordance with the procedures in place for the allocation, reservation, segregation of areas of national airspace in which flight operations take place.

Also, in accordance with the provisions of art. 4 Law 143 on airspace control, the use of airspace of the Republic of Moldova for aerial photography and filming is carried out with the written permission of the Civil Aviation Authority and the mandatory approvals of the Ministry of Defense and the Intelligence and Security Service of the Republic of Moldova [10].

The principle of the use of remotely piloted aircraft (drones) must ensure a level of security equivalent to that of manned aerial operations and strict control over the protection of personal data and privacy.

The legal planning and conduct of remotely piloted flight activities is conditional on the written approval of the Civil Aviation Authority, the sole purpose of which is to ensure flight safety, aviation security, privacy and personal data [10].

Over time, it has been shown that the regulation of computerization is carried out last, after the exploitation of technologies for a period of time. Given that information technology is a new step in the development of society, computerization is a largely unknown field, many aspects are to be defined, implemented and capitalized at fair value. Thus, the state reacts late to the evolution of information technologies implemented in agriculture, intervening with certain standards, recommendations and

PRINT ISSN 2284-7995, E-ISSN 2285-3952

restrictions for each technology implemented or to be implemented.

Information technologies are being implemented in agriculture at a particularly frantic pace, including in the Republic of Moldova, where implemented technologies include:

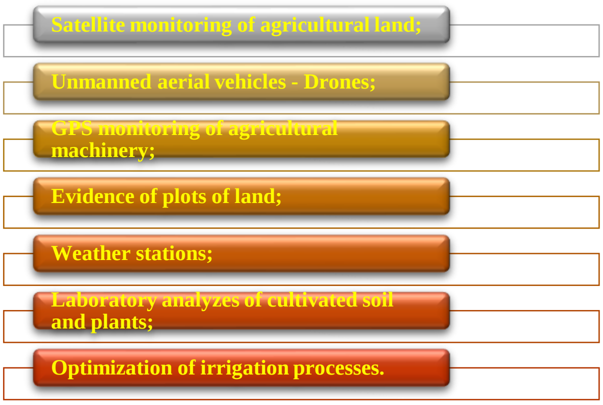

Fig.2. Digital technologies implemented in the agro-industrial sector in the Republic of Moldova
Source: Prepared by the authors.

Satellite monitoring allows you to quickly assess the state of agricultural land using satellite images based on a standardized indicator of vegetation differentiation for each field. With this indicator, you can assess the condition of each crop and adjust fertilizer plans. Thanks to high-resolution images, the quality and uniformity of plants that have emerged in the field can be remotely assessed, and then, if necessary, they can be moved to problem fields for further research.

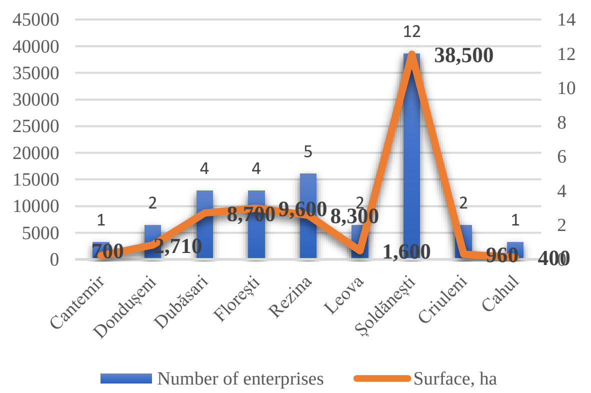

Fig.3. Territorial location of the entities in which the computerization is implemented in the Republic of Moldova in 2019
Source: Prepared by the authors on the base of SAS MD.

The uneven distribution of vegetation in the field from year to year indicates the presence of a biological problem. Also, the history of electronic maps of agricultural land allows a comprehensive analysis of world production obtained through the introduction of plant protection products and fertilizers. To access the monitoring platform, a farmer from the Republic of Moldova has to pay $2.5 per hectare.

The afore mentioned technologies are successfully implemented on a total area of 71,470 ha in the Republic of Moldova. The territorial location of the agricultural land areas is represented in Figure 3.

In addition to the parameters mentioned, an important aspect is the actual fuel consumption. Thus, with the help of an additional device, it is possible to control the actual operation of the engine of technical means by setting the actual fuel consumption and engine operating time. Connecting an additional device makes it possible to view on the electronic map all the moments when the combine used for harvesting is unloaded.

Another device used in agriculture in Moldova is an RFID assembly consisting of an RFID reader and an RFID tag. Thus, the personal card of the operator who has to perform a specific job is inserted into the RFID reader, and each RFID tag is tied to the serial number of the equipment. As a result, the kit allows you to visualize in the software the number of hours worked by the operator, the machined surface, the hours of use of the machine, the machined surface of the machine, etc.

But, one of the most important problems is that the equipment of a unit of agricultural machinery costs of an entrepreneur from the Republic of Moldova are in the amount of 500 US dollars.

This means that in addition to the advantages offered by the implementation of informatization in the management of agricultural activities, there are a number of shortcomings of the process. The ability of entrepreneurs to exploit the strengths of their technology enterprise for sustained economic development will depend on how quickly and

efficiently the weaknesses of the company's digitalization will be anticipated and taken. The following weaknesses were identified as the biggest obstacles to the implementation of computerization in order to meet the development challenge of agricultural entities:
-Outdated management supporters, organizational frameworks and human resource strategies of many agricultural and private sector producers in the agricultural field;
-Insufficient investment in employment training and poor continuing education and quality, especially at the enterprise level;
-Weak investments of Moldovan companies in production processes, installations and competitive equipment;
-Lack of civilian research and development intensity of economic activity and insufficient breadth of the civilian research and development portfolio, including reinvestment in high-risk or difficult-to-increase productivity technologies for individual farmers;
-Insufficient knowledge and interest in originating technology outside the companies researched by many agricultural enterprises;
-Lack of a strong institutional structure for technology policy in support of national economic development.

Today, farmers need to open up to the endless possibilities that technological advancement can bring to agriculture. Cultivation of agricultural crops according to traditional planting strategies is not enough, there is a need for involvement in researching new and improved cultivation methods, implementing good practices obtained during the study of aspects of crop development. Today's society can benefit from agricultural advances and live sustainable lives by improving production, harvesting methods and the distribution of agricultural goods. All these effects are possible through the successful combination of computerization also the agriculture, this is one of the reasons why farmers are increasingly encouraged to take part in this change of humanity.

CONCLUSIONS

The potential environmental, economic and social benefits are significant, but there are also associated challenges that may be some specific priorities for future work are:
• Facilitate the collection of data on digital technologies and digitization at local and national level and of the population, in particular to show differentiated information about urban and rural areas;
• Creating sustainable business models that provide viable digital solutions for the inclusion of small-scale farmers in the process of transforming digital agriculture;
• Creating a legislative framework in order to protect the data of agricultural enterprises;
• Creating a national indicator that takes into account the development of digital agriculture in the context of the cultural, educational and institutional dimensions of a given locality, both in terms of availability of basic conditions and for activators of digitization and potential economic, social and environmental impacts of the process. Such an indicator would help to create a context for the development of future digital agriculture strategies for the whole state, which begins with raising public awareness of the concept of digital agriculture and the importance of digital technologies for the food sector and continues with steps towards transforming digital agriculture. The analysis of these challenges is not intended to be exhaustive, but rather to outline and clarify some of the most widespread policy concerns at the sector level, in a way that is useful to a wide range of decision-makers and decision-makers. scientists. In particular, we note the value of open, cooperative, publicly funded and locally funded data systems and technologies as first steps in supporting solutions that contribute to data justice for farmers. Greater economic barriers in agriculture certainly limit the extent to which digitalization can support the interests of marginalized farmers and food producers. Then we need to work much more learned and pragmatically if we are to better understand what data justice means to the agri-food community and how it can be done sooner.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CHAIN MANAGEMENT - AN IMPORTANT STEP FOR A SUCCESSFUL BUSINESS IN THE COVID-19 CONDITIONS

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Abstract

Chain management is an important aspect of running any business. In this article, we look at advances in chain management. At the beginning we present basic definitions and key issues related to the types of channels, followed by a discussion of the degrees of complexity of the chain. We then discuss chain flows - a step forward in chain management, supply chain efficiency indicators and so on. Finally, a brief summary of research to date and a discussion of future challenges for supply chain management are presented. The outbreak of COVID-19 introduced an unprecedented and extraordinary situation of supply chains whose survival requires a large-scale resilience.

Key words*: *management, supply chain,, business, complexity

INTRODUCTION

In the globalized age, when business organizations are involved in various business activities, it has become inevitable that most of them perform all functions on their own. Companies do not manage supply chains themselves and rely on other companies. The successful and efficient combination of the operations of these companies provides the company with a competitive advantage in the market [2].

[8] emphasize the need for managers to understand the performance of all joint stock companies in the supply chain.

According to [10], this insight into the work of any company will allow managers to develop measures to meet customer requirements.

What is a chain?

A set of three or more organisations directly involved in the upstream and downstream flows of products, services, finances, information and/or knowledge from a source to a customer [9].

Direct chain: consists of a company, supplier and customer involved in the flow of product, service, finance, information or knowledge chains;

Extended chain: in addition to the above, it includes direct supplier suppliers and direct customer customers;

End-chain: includes all organizations involved in all flows in the chain of products, services, finance, information or knowledge from the end supplier to the end user.

This article presents one of the many business models for supply chain management, which is also a strategic position of modern companies. The authors review the development of the supply chain in business practice.

Supply chain management with their integration, responsiveness, financial complexity and globalization as drivers that drive the emergence of supply chain logic are also considered.

The article also provides an overview of current supply chain management issues. The overall goal is to provide a research framework that describes the logistical requirements for 21st century supply chains.

The outbreak of COVID-19 introduced an unprecedented and extraordinary situation for the resilience of SC [4], during which the survival of Supply Chains requires large-scale resilience.

In this context, the purpose of the paper is to provide an overview of current supply chain management issues. The overall goal is to provide a research framework that describes the logistical requirements for 21st century supply chains.

MATERIALS AND METHODS

The motivation for this study comes from the rapid changes in the business environment caused by disruptions in global business that have a strong impact on Supply Chains (SC). The situation requires a good knowledge of SC theory and practice.

This study examines a number of articles dealing with SC, their nature, types, connectivity and their manifestation during a pandemic. The study seeks to answer key research questions, namely: What are the factors that affect the efficiency of the supply chain, cause supply disruptions and SC flows and strategies for building SC capacity? How can decision makers use key interrelated factors to overcome this challenge?

Comparison is one of the main methods for learning about the surrounding reality and is used in the present study. The basis of this method is the definition and comparison of individual phenomena of social, economic, political or other nature in order to identify distinctive similarities and differences. The method of comparative analysis is directly related to the above and derives from the general scientific method of analogy. However, unlike the latter, the comparison uses elements of other methods, including analysis, methods of thinking, modeling, synthesis, induction, deduction and others. The purpose of the comparison is to obtain new facts different from the properties of the compared objects or phenomena, but also to analyze the existing relationships. Based on this, a general trend for their subsequent functioning and development can be outlined.

RESULTS AND DISCUSSIONS

It is crucial for business that managers continue to measure the effectiveness of different parts of the supply chain [3]. It is a proven fact that improving the performance of a company cannot be undertaken without improving the performance of its suppliers [8]. Planning and information gathering activities can be easily performed by operations managers and senior executives if they have up-to-date information on the work of different companies and stakeholders in the supply chain and the resources available to the company. The authors [6, 7 and 9]. view the supply chain as a set of firms involved in upstream and downstream products, services, information and/or finance. [9] describes the supply chain as "a set of three or more organizations directly linked by one or more of the upstream and downstream flows of products, services, finance and information from source to customer".

Thus, the nature of the supply chain is exhaustive, so that membership is not limited to a supplier, manufacturer and distributor, but is open to any company that provides different flow-related services [9].

The terms: logistics; supply chain (management); demand chain (management); value chain (management) are used interchangeably and confusingly.

They overlap and different actors define them in their own way.

Logistics: The process of planning, implementing and controlling the efficient flow and storage of products, services and related information through a business. Activities: transportation, warehousing, purchasing and distribution.

Focus: individual company First generation of supply chains were viewed as individual companies, customers and suppliers focusing on logistics integration.

Chains can focus on the effective physical supply of products or services (in this case, the risk of producing products that are not in demand on the market) = supply chain.

Market intermediation (adjustment of production to actual demand, which leads to a decrease in production efficiency) = supply chain.

Therefore demand chain means a shift in emphasis from efficient supply to meeting the needs of the customer.

A demand chain is a supply chain that emphasizes market mediation to a greater degree than its role of ensuring efficient physical supply of the products/services. Demand chain reflects the fact that the chain should be driven by the market, not by suppliers.

Demand chain starts with the customer and work backwards, instead of starting with the supplier/manufacturer and working forward.

Value chain: search for strategies that will provide superior added value for customers. First, the value can be created internally at company level, then via the chain.

The value is created not just by one company, but by several companies in the chain.

Figure 1 presents the complexity of the supply chain.

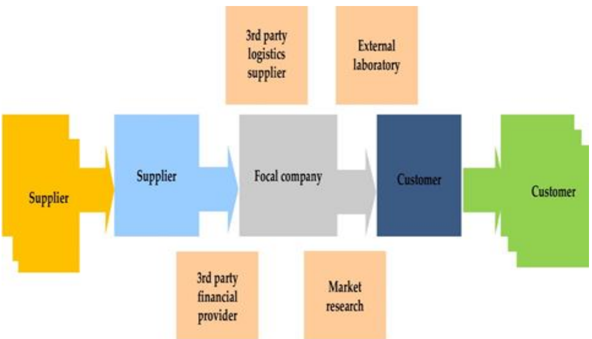

Fig. 1. Degrees of chain complexity
Source: [7].

The metrics for measurement of supply performance are:

Delivery reliability - describes supply chains' capability on delivering;

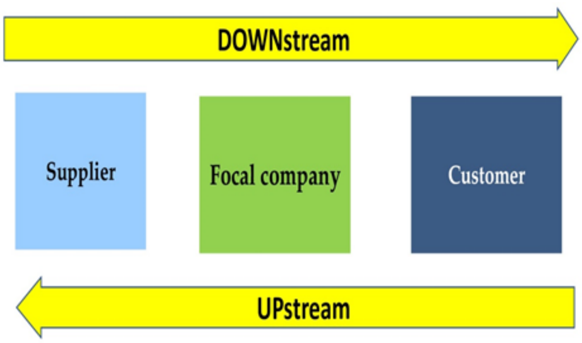

Fig. 2. Chain flows - a step forward to chain management
Source: [3].

Inventory - often described by the metrics inventory turnover (ITO) and inventory days on stock (DOS);

Cycle times - order cycle time (OCT) and supply chain cycle time (SCCT);

Capacity utilization - it sets the used capacity in relation with total installed capacity;

Supply chain cost - logistic costs + production costs + coordination costs.

The schema of chain flows is shown in Figure 2.

Supply Chain Management(SCM) is strategic thinking: Effective SCM improves both efficiency and effectiveness in a strategic context [11].

The supply chain management is presented in details in Figure 3, starting from shareholders, sales and product procurement, suppliers, manufacturing, warehousing, logistics, and finally consumers.

Fig. 3. Supply Chain Management Flow
Source: [12].

Chain flow

Product flow

The product flow represents the value-added movement and transformation of goods into the finished product from a supplier of raw materials to the end customer;

The product flow represents the organizations being involved in the upstream and downstream value added movement of products;

Traditionally it is rather downstream (from raw material to final product), but it also integrates customer returns (upstream);

Product flow activities include: transportation, logistics, inventory, enhancement and maintainance of quality, convertation into

final products, handling (e.g. cooling, sorting) etc.
Product flow covers: raw materials, work in progress, finished products, by products and all related inventories.
Service flow
The service flow represents the organizations being involved in the upstream and downstream flows of services;
Traditionally the service flow is very tightly tied to the product flow;
Service flow activities include: pest control, waste disposal, quality certification, laboratory testing, marketing support, market research, external R&D.
Services: intangible but provide value designed to be used (sold) in exchange for revenue (e.g. consulting service).
Information flow
Information flow represents the bi-directional exchange of transactional information among chain members;
Information flow activities include: forecasts, purchase orders, order acknowledgments, shipping and inventory information, invoices, replenishment requirements, status of delivery, demand, price, quality.
Link information systems between chain members in the area of product flow, service flow and financial flow.
Support the selling of products or services e.g. in the area of product flow: tracking and tracing.
Financial flow
The financial flow generally moves in the reverse direction of the value added activities (upstream)
Financial flow activities include: credit terms, payment schedules, and consignment and title ownership arrangements, sharing financial performance information across the stages or processes and participants in the chain. The financial flow indicates the payment in exchange of products, services and information [13].
Chain management
Chain management - involves coordinating and integrating flows in a chain consisting of a focal company, a supplier and a customer. The management of multiple relationships (accompanying products, services, finances, information and/or knowledge flows) – focusing on harmonizing the use of resources capabilities competencies along the entire food chain (instead of focusing on only on the individual steps) to deliver higher added value by improving the quality of chain relationships.
Resources at firm level
Resources: Inputs into a firm’s production process (capital equipment, skills of individual employees, patents, finance, and talented managers);
Tangible Resources – financial, physical, technological, organizational (assets, that can be seen and quantified);
Intangible Resources – human, innovation, reputation;
By themselves, resources do not create a competitive advantage for the firm.
Resources at firm level – examples
Financial: borrowing capacity, ability to generate internal funds;
Physical: firm's plant and equipment, access to raw materials;
Technological: technology, patents, trademarks, copyrights, trade secrets etc.;
Organizational: formal reporting structure and formal planning, controlling, and coordinating systems;
Human: knowledge, trust, mangers, organizational routines;
Innovation: ideas, scientific capabilities, capacity to innovate;
Reputational: reputation with customers, brand name, perceptions of product quality, durability, and reliability, reputation with suppliers.
Capabilities at firm level
Capabilities: Capacity to deploy resources that have been purposely integrated to achieve a desired end state;
Primary base for the firm’s capabilities is the skills and knowledge of its employees;
Just because the firm has a strong capacity for deploying resources does not mean it has a competitive advantage.
Capabilities at firm level - examples
Distribution: Effective use of logistics management techniques
Human resources: Motivating, empowering, and retaining employees

Management information systems: 1) Effective and efficient control of inventories through; point-of-purchase data collection methods, 2) Acquiring market information

Marketing: 1) Effective promotion; 2) Effective customer service; 3) Innovative merchandising.

Management: 1) Ability to envision the future of business; 2) Effective organizational structure.

Manufacturing: 1) Production skills yielding reliable products; 2) Product quality.

Research and development: Innovative technology.

Core competencies at firm level

Core competencies: Resources and capabilities can serve as a source of competitive advantage for a firm over its rival.

Not all resources and capabilities are core competencies.

Core competencies are the firm's innovatively bundled and leveraged resources and capabilities.

Core competencies may be in any area but are most likely to develop in the critical, central areas of the firm where the most value is added to its products, such as: Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales, Service, Procurement, Technological Development, Human Resources, Firm Infrastructure.

Core competencies must be distinctive:
- do better than competitors;
- be critical to long term growth;
- be competitively unique;
- not be easily duplicatable (costly to imitate);
- be valuable;
- be rare;
-not be substitutable.

Why core competencies?

-Your resources and your suppliers'/customers' capabilities can be a basis for a core competency of your relationship;

-Your capabilities and your suppliers'/customers' resources can be also a basis for a core competency of your relationship;

Chain management allows a company to rethink their and their suppliers' and customers' resources, capabilities and core competencies and to harmonize them.

Supply chain management (SCM)

Supply chain management is the management of the flow of goods and services and includes all processes that transform raw materials into final products.

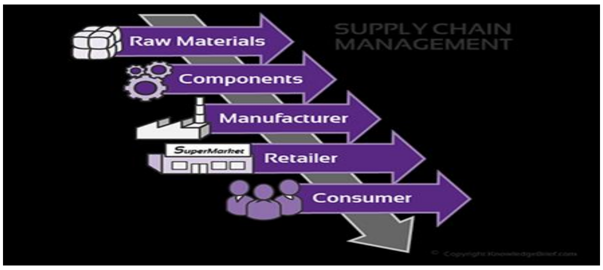

Fig. 4. Supply Chain Management
Source: [6].

SCM represents an effort by suppliers to develop and implement supply chains that are as efficient and economical as possible. Supply chains cover everything from production to product development to the information systems needed to direct these undertakings.

Supply Chain Management (SCM) is the "process of strategically managing the movement and storage (if necessary) of materials, parts and finished product from supplies, through the manufacturing process and on to customers or end user, as well as the associated information flows" [14].

"SCM is strategic thinking: Effective SCM improves both efficiency and effectiveness in a strategic context [11]".

An apart approach regards agri-food supply chains which have to be oriented towards a sustainable development, which means to ensure a balance between environmental factors and agricultural practices resulting the maintenance of ecosystems. Therefore, along the agro-food chain a special attention has to be paid to primary production, processing, distribution and retailing [5].

To improve the sustainability of rural areas, "regional differences between actors in supply chains, different types and organizational forms of SFSCs, as well as the requirements of consumers regarding the delivered food" must be taken into consideration [12].

From the consumers' point of view, short food supply chains have the advantages of "product quality, freshness, authenticity, traceability, which result in producer confidence" [1].

CONCLUSIONS

Supply chain management plays an important role in the success of any business. If companies want their products to reach consumers quickly and efficiently, they need to master supply chain management. Some advantages of supply chain management are:

The supply chain management process is important because it can help businesses be more efficient. It can reduce storage costs as well as the spread of waste that results from damage. If the goods arrive late, production and deliveries are stopped. When organizations manage their supply chains efficiently, it not only reduces delivery time, but also increases customer satisfaction, who will now receive items faster than expected.

Another advantage of supply chain management is that companies can buy products with the lowest price and highest quality. Taking the time to plan also means that you may be able to integrate recyclable materials such as paper, cardboard, plastic, which is good for the end result and the environment.

Supply chain management helps to avoid delays that may occur during product transfer. When delays start at one point in the chain, this tends to have an impact effect. If companies fail to meet delivery dates, they will eventually lose buyers, which will affect their profits.

The supply chain management process allows for efficiency in supply and transport, which are key business costs. It can also allow more secure shipments.

Supply chain management is gaining a particularly important role in the context of Covid-19 and helps organizations reduce the rate of errors and damage.

Without an effective supply chain management system, there is no way to ensure timely delivery of goods.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MARKETING STRATEGIES IN KOSOVO INSURANCE COMPANIES - CONCEPTS AND APPROACHES

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Abstract

In today's market conditions of living and working, the insurance market is constantly increasing in volume. As a result, competition is very high and the relationship between insurers is constantly changing. The strict approach to increasing insurance profits has shown insurers that they need to abandon the solid base offered to customers. The need for insurance service is constantly growing, so it is imperative that it is constantly improved and adapted to the conditions and needs of customers. For this reason, insurance institutions need to monitor and know what is happening in the insurance market in order to be able to respond in a timely manner to changes in the development of the insurance business. Increasing insurance profits is unthinkable without implementing a marketing strategy. The purpose of this article is to justify the need to develop marketing strategies in agricultural insurance activities in Kosovo. The research is carried out with a qualitative and quantitative method, or with the help of empirical parameters and indicators that the expert literature knows. The main conclusion that the authors make is that insurance is a complex category, as well as a profession. The reason is that it refers not only to the observance of methodological principles, but also to the ideas, enthusiasm and creativity of marketing in providing certain tasks in the field of insurance, especially in the field of agriculture.

Key words: *marketing strategies, approaches, agriculture, insurance market, insurance services*

INTRODUCTION

In today's working conditions, marketing orientation is a prerequisite for insurance companies in the highly competitive struggle in which they face the requirements of potential participants to succeed in the insurance market. In insurance companies, the key is to offer insurance services, and it can be said that there is a package of services that insurance companies offer in the insurance market. Namely, in the totality of market relations, market relations in the field of insurance are also realized. A more accurate prediction of the supply and demand of services in order to be realized in the field of insurance requires the implementation of a specific marketing concept (which in itself explores the market), due to the specificity of insurance compared to other activities.

When it comes to studying the application of marketing in the field of services that cover insurance, we believe that it is necessary to first consider the nature of the insurance market, and then insurance itself as a marketing service.

The development of modern marketing in insurance services has been happening in the last 10-15 years. Unlike the classic marketing approach to products, this philosophy has emerged as a continuation of that in manufacturing. Namely, when it comes to the service business, the marketing of insurance services is an innovative area where the service is treated as unique and specific. The authors are unanimous that this discipline contributes to a significant change in the way of thinking of those working in this field.

The purpose of this article is to justify the need to develop marketing in service activities, including insurance. This need is really great in the current market conditions of Kosovo [2]. The specificity and authenticity of insurance services, as well as the imposed need, require that marketing and agribusiness insurance be covered and applied in Kosovo.

MATERIALS AND METHODS

The goals set to solve these problems lead to the use of different methods in the study. In this type of research, it is inevitable not to use the dialectical method of research, regarding the problems we put under observation in their dialectical unity, in their mutual belonging and in their mutual conditioning. The research is carried out with a qualitative and quantitative method, or with the help of empirical parameters and indicators that the expert literature knows.

The research covers a process that is performed from the analytical to the synthetic part. In this way, complete findings about the problem we are researching can be obtained and thus certain conclusions can be drawn. Also, forecasting methods are of great importance.

The study uses the rules for methodological techniques or tools. The regulations contain 25 rules in which the topic is developed in the four elements of marketing. These rules are closed and respondents are offered more possible answers so that they can indicate only one or more answers.

Creating marketing strategies in the function of increasing the insurance profit is a complete process aimed at specific goals. By defining the research problem, the following hypotheses arise:

1. Basic hypothesis

- the implementation of appropriate marketing strategies by insurance companies gives a sure result for increasing the insurance profit.

2. Auxiliary hypotheses

- in the insurance companies marketing strategies are applied for organizing a marketing mix as a result of the general hypothesis;

-to date, no more appropriate marketing strategy has been applied to enable insurance companies to increase insurance profits.

RESULTS AND DISCUSSIONS

Concepts for managing and ensuring a stable rise in the development of insurance.When it comes to insurance, a large number of theorists and practitioners find a number of opinions, according to which insurance is a strong service activity in which the so-called. identification, risk management analysis. It is defined as a system for transferring the risk from the insured to the insurer and as such, the insurance determines the fate of the tertiary sector. This means that insurance, as an activity, belongs to the group of service activities. In more developed market economies, insurance as an activity is increasingly important in the overall socio-economic development. This is confirmed by the fact that the safety of property and individuals is increasing in the amount of gross national income. The number of insured persons and their property is constantly growing due to the growing need for insurance. At the same time, we ask ourselves whether the users of an insurance service (the insured) will provide this service in order to provide the same service to the insurance institutions (insurers). The answer to this question currently lies in the flexible development of the theoretical and applied approach by the insurance provider. As part of this, as a reflection of the development of market relations in general, the need for continuous improvement of marketing is currently prevalent, as well as the idea of ensuring the implementation of the concept of marketing in the field of insurance.

When talking about the need for continuous improvement and development of marketing in insurance, we believe that it is necessary to set out the following findings:

• insurance in general shows more dynamic development in relation to the overall development, especially in economically developed economies;

• the marketing concept in the field of insurance is still at the level of insufficient development, insufficient accuracy and often direct transfer to the marketing function of the market, which is found in material production;

• in the period from the end of the Second World War to the 1980s, as a result of the rapid revival of economic activities, new investments, increased international trade and rising living standards, conditions were created for the supremacy of the insurance market;

• this cannot happen without its positive and negative consequences.

The negative consequences consist in the involvement of insurers, reporting only their own problems, ignoring the requirements of the insured. This means that in this period the concept of sales in the management of insurance is manifested. The positive consequences consist in what is related to the general development of insurance and lead to the creation of a large number of insurance organizations with greater mutual competition. In this way, consumers of insurance services are in a more favorable role in terms of choosing the insurer and selecting and covering the risks that will be covered when choosing the appropriate insurance. This cannot but affect the institutions dealing with insurance and lead to a shift from sales to marketing concept of insurance. Apparently unfavorable conditions for carrying out activities in the field of insurance are caused by:

1) Economic downturn, general stagnation and decline in living standards;

2) Greater competition between insurance institutions; and

3) The creation of the so-called own companies (by large multinational companies), as a result of the independent action at that time of industrial and banking capital, with the desire to create their own financial base and funding base, caused a reduction in premiums, regardless of the risks, as and the emergence of insurance selectivity as to which insurance institution will be. All this has led to a certain transformation in the realization of the insurance market, the market of insurers and the market of insured persons.

These circumstances have led to the recognition that in the field of insurance, traditional management concepts are not able to provide a steady rise in the development of insurance. The prevailing recognition is that the concept of sales should be abandoned and the concept of insurance marketing should be adopted as soon as possible, the concept should be adopted, according to which insurance should be treated as a marketing service. In this context, it should be mentioned that insurance should start with the provision, from the point of view of marketing, more precisely, to use the term - marketing in the insurance market, instead of the terms: acquisition of insurance, placement of insurance, etc.

When we talk about marketing in the insurance market, as a set of measures and activities for the development of successful insurance, then we think of the perception of insurance as a scientific discipline, and of course, as a concept of insurance operations. on a platform for unique and integrated marketing within the insurance. In implementing such a concept in the field of insurance marketing, we encounter a number of factors:

1. It is not possible to develop the insurance business without considering and getting to know the insurance stakeholders - the users of the insurance, the usefulness and the advantages of what the different types of insurance have. If this is unknown, no increase in insurance contracts can be expected, and thus no increase in the protection of property and people;

2. Stakeholders and consumers of insurance and insurance services must be aware of and motivated by the benefits conferred on them by insurance and insurers, as one of the participants in insurance;

3. The need for constant promotion of the relations on the part of the insurance institutions with the citizens, the state and private enterprises;

4. It is not possible to develop modern insurance as a service without achieving well-thought-out advertising; and

5. The organizational structure of insurance institutions should be considered: branch, representative office, branches, etc.

In the context of what has been said so far, it is concluded that the concept of insurance marketing is defined as a concept of insurance activity from the standpoint of its function, which will depend on its existence and development [7]. This essentially means that in the practice of insurance, the insurance service is a specific phenomenon that appears on the side of the insured in view of the need, in the form of desire or expressed willingness to buy this service under certain conditions and quality and the price, which are entered in the insurance premium. Accordingly, the concept of insurance marketing is based on the insured, as the main and unique consumers and holders of total consumption, called insurance. This means that the purpose of the modern concept of marketing will meet the needs of insured persons and thus achieve optimal income as a prerequisite for sustainable development of insurance institutions. Accordingly, the system of marketing in insurance consists in adopting the concept of marketing in the system of work and attitude of insurance institutions.

Approaches to formulating marketing strategies in insurance companies

The creation of strategies is based on analyzes (diagnostics and forecasts) and certain goals of insurance companies. The role is taken over by the company and the sector in which it works. An appropriate strategy is required that will increase insurance profits. The strategy should contribute to the fulfilment of the role that the company has taken, as well as to coordinate and direct all activities towards achieving this goal. It must also be possible to save resources and efforts and allocate them to the safest field of activity of the insurance company.

The marketing strategy must be rational in terms of providing an effective way to use the tools of the marketing mix [5].

Rationality not only means finding optimal combinations of marketing mix, but also applicability through the implementation of certain solutions that contribute to the achievement of goals [6]. The strategy must be in line with the company's position in the economy. Marketing strategy is a logical approach to problem solving and decision making. Strategic decisions are made on the basis of knowledge or forecasts of the decisions and actions of other participants in the insurance market and, above all, of competing insurance companies. A state of competition exists when two or more insurance companies want to achieve the same goal and assume that all companies will be able to achieve the goal. The result of the strategic decision stems from the alleged actions and reactions of competing insurance companies.

When choosing an appropriate strategy, it should be preceded by an analysis of alternatively possible directions in the action of the insurance company. It is necessary to analyze a number of alternatives that lead to the realization of a certain goal to increase insurance profits. The strategy must meet external factors - demand and competition, not only at the time of decision-making, but also in the expected period of its implementation. One of the criteria for the rationality of the chosen strategy is that it meets the capabilities of the insurance company (financial and human resources). Without the possibility to create adequate marketing efforts, the justification of the proposed strategy is called into question. If the proposed strategy requires more marketing effort and the reactions in the field of competition and demand are more difficult to predict, the degree of risk that the insurance company has taken in choosing the strategy is greater and vice versa. The period for which the bet will be chosen is long, as many alternative strategies compete for limited funds and therefore the more adapted alternative has an advantage over others.

[9] gave a useful approach to the development of goals and strategy, starting with the goal of the insurance company. The feasibility guidelines show that it is possible to change the objectives and the process of determining their implementation (taking into account market opportunities and factors beyond the company's control that have acted on market opportunities).

People who do marketing in insurance companies need to understand the basic elements of effective communication. Two models are used: macro-model and micro-model. The macro-model of the communication mechanism will describe the macro-model of communications with nine elements: the directions of the communication side: the recipients and the receiver; basic communication tools: message and media; main communication functions: encoding, decoding, response and feedback. The last element in the system is noise (random and

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

competing messages that may interfere with the intention to communicate) [10, 3].

The marketing of micro-products for marketing communications focuses on the specific responses of consumers.

All of these models assume that potential insurers have a cooperative, sensitive, and behavioural phase in the process. This series is suitable when potential insurers actively participate in the category of services that are perceived as having high differentiation.

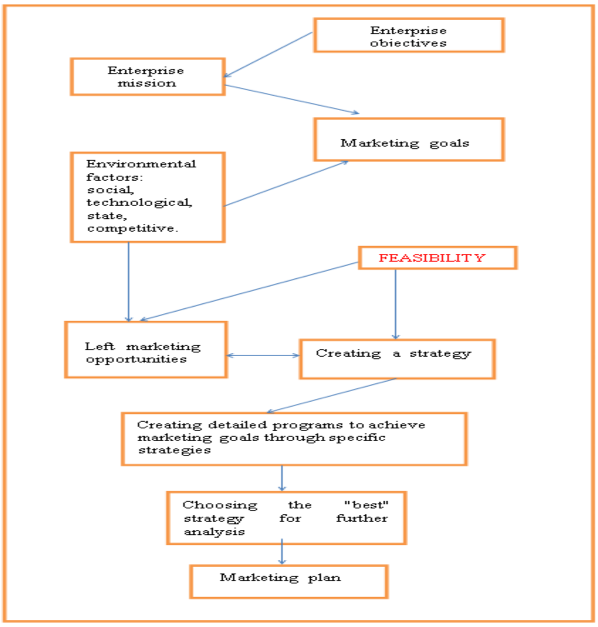

Fig. 1. Approach to the development of the insurance company's goals and strategy
Source: [2].

In a similar way, the strategy regulates and preserves market opportunities in two directions - adaptation, without finding a suitable alternative. After selecting the "best", detailed alternatives are formulated to achieve the goals through the strategy.

After choosing the right marketing strategy, it cannot be assumed that the strategies are mutually exclusive. When creating a comprehensive strategy, sometimes additional strategies are created, such as combinations of existing ones, to obtain the so-called synergistic effect. The strategy must be widely disseminated so that it does not apply to an inconsistent strategy. Strategies are interdependent. Often the effectiveness of one strategy determines the effectiveness of another.

There is no single approach to strategy formulation [4]. By recognizing them individually, the insurance company can choose and customize the most appropriate one.

Specificity of insurance system and strategy for agricultural companies

The agriculture is an important branch of the economy in any country as it assure food, employment, raw materials for processing industry, export revenues and contribute to GDP. Compared to other sectors of the economy, agricultural production is dependent on natural conditions, which determine its seasonal characteristics, high risk and uncertainty, and a limited control on production and agricultural market.

Droughts, heavy rainfall, hail, frost, fullness, storms, floods, fires, pest attack, diseases etc produce important damages and losses both in crop and animal sectors, making production uncertain and risky [1].

To reduce the risks and uncertainties, the producers must be assured. Agricultural insurance is the basis of this insurance system and its purpose is to cover the losses registered in agriculture [12].

Agricultural insurance can perform the role of development stimulus, improvement in quality and improvement in the degree of agribusiness modernisation, and, as a consequence – growth in its competitive capacity on the market [11].

But, many times, there are registered regional differences in potential consequences of natural risks. As a consequence, the analysis of the aggregated data at the level of a country does not reflect the variability of local losses and also creates a hazard of inadequate determination of the potential effect of natural hazards on agriculture, and hence the adaptation needs towards natural disasters [8].

For these reasons, policymakers and insurance companies have to take measures to design better risk management tools of mitigating natural disaster losses in agriculture taking into consideration the regional disparities regarding the causing factors of damages and losses and setting up individualized strategies for each region to eliminate or diminish the natural risks on agricultural production [11].

Marketing strategies of service companies

In the past, service companies lagged behind manufacturing companies in the use of marketing, as they were small or professional companies that did not apply marketing, or did not meet the huge demand, or weak competition. Today, things have certainly changed.

Special discounts - companies decide to increase fees and reduce services for those consumers who pay for their services, and they consider large consumers in order to maintain their patronage for as long as possible. Consumers with high consumption receive special discounts, promotional offers and many special services, consumers with low non-profit consumption can receive higher taxes, reduced services and voice messages to be processed when they pay.

Changing the attitude towards consumers - the companies did not invest in providing excellent service to all buyers. In many service activities, users complain about inaccurate information, irresponsible, rude and poorly trained staff and waiting too long to be served.

Empowering consumers - consumers are becoming more demanding about buying services. They may require special prices for each element of the service and the right to choose the element they want. Consumers are also increasingly collaborating with a number of service distributors. Most important is the fact that consumer empowerment is also supported by the Internet, which allows them to express their satisfaction with the service or reward the best services and with just one click to direct them around the world.

Most of the companies respond to the requests immediately, and some need only one hour. Much more important than sending a response to dissatisfied users is to stop the dissatisfaction in the future. This can mean finding time to train staff on their relationships with consumers and putting consumers' attention on a real person.

CONCLUSIONS

In principle, it can be concluded that insurance is a complex category, as well as a profession. The reason is that it refers not only to the observance of methodological principles, but also to the ideas, enthusiasm and creativity of marketing in providing tasks in the field of insurance, especially in the field of agriculture. The insurance industry is undergoing significant change. In recent years, there has been a significant erosion of traditional insurance coverage, as a number of important players have withdrawn from normal employment due to negative results and certain constraints, or this sector has become less attractive due to loss of rating and risk in agriculture.

Developed market economies attach much more importance to marketing channels in agribusiness than in our country. Marketing channels inevitably allow for effective agricultural, rural and overall economic development. The structural changes occurring in developed countries are characterized by a significant change in the relations between the participants in the marketing channels. The changes are characterized by strengthening the position of retail outlets.

In Kosovo, the analysis of agribusiness development is in most cases limited to taking into account comparative but not competitive advantages. The low level of competitiveness and profitability of marketing channels, including in the insurance business, directly affects the structure and volume of exports of agricultural food products.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

URBAN AND RURAL AREAS: THE SEARCH FOR GREATER HARMONY

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Abstract

The paper aimed to present some aspects of the evolution the development of spatial model of the national concept. Bulgaria has a convincing historical experience in centralized creation and management of spatial models for development at three levels - municipal, regional and national. With the abolition of centralism, Bulgaria moved to the other pole - complete deregulation of spatial development. Urban and rural areas are two main concepts affecting the balanced spatial development of the country. The choice of a model for spatial development is influenced by a number of factors - social, geopolitical, economic, climatic and others. As a conclusion, the National Concept Programme of Development (NCPD) adopts the approach to rural and cross-border areas of the Territorial Program of the European Union (TA 2020), which to the polycentric spatial and integrated urban development adds concern for the preservation of the vitality of small settlements. The comparative method with its concepts and categories is the main research method in the present work. The spatial model for the development of the national territory is multi-layered and synthesizes different layers with information, functions, processes and priority elements of different hierarchical ranks. In Bulgaria there are visible/intensive processes of spatial polarization and movement towards monocentric models of development.

Key words: *urban, rural, city, spatial models, Bulgaria*

INTRODUCTION

Economic development takes place in a certain area and varies considerably. It is a common observation, as stated in the 2009 World Development Report [13], that the location of people is the best predictor of their income**.**
Urban and rural areas are two main concepts used by politicians, researchers, national administrations and international organizations such as the Organization for Economic Co-operation and Development (OECD), the UN and the EU. These two terms are easy to understand by the general public, but there is no clear definition at the international level. For example, the UN publishes data on cities, urban areas and rural areas, but relies entirely on national definitions. The principles and recommendations of the United Nations are stated that due to the different characteristics of urban and rural areas around the world, it is not possible to reach more than one common definition. The main differences between rural and urban areas are to be found in population density, lifestyle, population culture, level of health and education, economy, politics, wildlife, water and climate management. Rural and urban are two different places. Rural areas are often more traditional places such as small towns in the country or old farms on the outskirts of smaller towns, where it is cozy and children play outside and people are friendlier. The other places are the cities, where it is very modern, where people are always on their phones, listening to their music or watching YouTube, and they themselves are more tense and have less smiles.
The choice of a model for urban development requires to consider alternative opportunities for the future development of the urban network of the country and to look for the appropriate, desired, but also realistic option that can be achieved. This model requires the

establishment of harmony between urban and rural areas in order to achieve a model of "moderate polycentrism" in the foreseeable future.

In this context, the purpose of the paper is In this context, the aim of the article is to analyze the most important features of urban and rural areas and on this basis to show the most appropriate models for spatial development of Bulgaria.

MATERIALS AND METHODS

The main tool in the development of this article is the National Concept for Spatial Development and the related Geographic Information System with the proposed structured geospatial database, which is used for analysis, verification of models, assessment of territories and centers and visualization of results.

The vision of the National Concept for Spatial Development of Bulgaria focuses on short but clear messages related to characteristics that reflect the identity, history and core values of society, and on expected changes in the future. It is a synthesized description of the general idea of the development of the national space of Bulgaria until 2025 and plays a unifying role for the national priorities and the factors that are expected to be of key importance for the spatial development of the country [10].

The influence of the main geopolitical, global, social, economic and environmental factors on the spatial development is analyzed and the most important challenges that the country will face are highlighted. One of the most serious problems in the coming decades will be the demographic crisis with its multifaceted manifestations. Europe's population will continue to shrink and age, and Bulgaria is no exception, so all possible demographic scenarios envisage population decline.

Comparison is one of the main methods of knowing the surrounding reality and it is used in existing work. The basis of this method is quite simple: the definition and comparison of individual phenomena of social, economic, political or other nature to find distinctive similarities and differences. The method of comparative analysis derives from such a general scientific method as analogy. However, unlike the latter, the comparison involves the use of elements of other methods, including analysis, methods of thinking, modeling, synthesis, induction, deduction, etc. The main purpose of the comparison is to obtain new facts not only from the various properties of objects or phenomena that are compared, but also to analyze their various relationships. Based on this, a general trend can be drawn for their subsequent functioning and development.

RESULTS AND DISCUSSIONS

Definition of urban

The term 'urban' can refer to a region or region that has a higher population density and has the hallmarks of a man-made environment. The people who live in this area are usually engaged in trade and services. There is also industrialization in this settlement, which increases employment opportunities. The urban settlement is not limited to cities, but also includes cities and suburbs. Urban areas have many benefits of living - easy access to various amenities, better transport facilities, opportunities for entertainment and education, health facilities. Of course, there are some disadvantages, such as pollution caused by greater industrialization and the means of transport used, such as buses, trains, cars, etc., which increase the health problems of people living in the area.

Definition of rural areas

The term "rural" can be defined as an area located on the outskirts. It is usually a small settlement that is outside the boundaries of an urban, commercial or industrial area. It may include rural areas, villages with natural vegetation and open spaces. Population density is low. The main source of income of the population is agriculture - agriculture and animal husbandry. The production of houses is also a major source of income here.

In India, a city with a population of less than 15,000 is considered rural, according to the planning committee. Gram Panchayat is responsible for caring for such areas. In addition, there is no municipal council in the villages and the maximum percentage of the male population is engaged in agriculture and related activities [11].

Based on population density, development, amenities, employment opportunities, education, etc. human settlement is divided into two categories: urban and rural.

The city refers to the settlement where the degree of urbanization and industrialization is high. On the other hand, in a rural settlement, one in which the pace of urbanization is quite slow.

Another important difference between the two settlements is that while urban areas are highly populated, rural areas have a relatively smaller population than urban areas. Read this article in which we have made an important point to distinguish between the two.

Differences between urban and rural area are presented in Table 1.

Table 1. Comparison between urban and rural features

Basis for comparison	Urban	Rural
Meaning	A settlement in which the population is very high and has the characteristics of a built environment is known as urban.	The suburban area is known as rural.
Includes	Cities and towns	Villages and neighborhoods
Life	Fast and complicated	Simple and calm
Environment	Greater isolation from nature.	Direct contact with nature.
Connected with	Non-agricultural work, ie trade, trade or provision of services.	Agriculture and livestock.
Population size	Densely populated	Poorly populated
Development	The planned settlement exists in urban areas, which are developing in accordance with the process of urbanization and industrialization.	Developed arbitrarily, based on the presence of natural vegetation and fauna in the area.
Social mobility	Very intense	Less intense
Division of labor	Always present at the time of the division of labor.	There is no such division.

Source: [11].

Based on the already mentioned differences, the human settlement is divided into two categories: urban and rural. The city refers to the settlement where the degree of urbanization and industrialization is high. On the other hand, in a rural settlement, the pace of urbanization is relatively slow. The main differences between urban and rural areas are discussed in the following points:

A settlement where the population is high density and has the characteristics of a built-up environment (an environment that provides basic facilities for human activity) is known as urban. Rural is the geographical area located in the peripheral parts of cities.

Life in urban areas is quite different - faster and more complicated, while rural life is relatively quiet. Cities are included in the urban settlement. On the other hand, the rural settlement includes villages and hamlets.

In urban areas, isolation from nature is much greater due to the built-up environment. Rural areas are in contact with nature as they are closer to it. Urban people are engaged in non-agricultural activities, ie. trade and services. In contrast, the main livelihood of people in rural areas is agriculture and animal husbandry. The population is educated cities are densely populated, which is based on urbanization.

Urban areas are developed in a planned and systematic way, according to the process of urbanization and industrialization. Rural development is rarely based on the presence of natural vegetation and fauna in the region.

When it comes to social mobilization, urban people are very intense, as they often change their profession or place of residence in search of better opportunities. However, in rural areas, people's occupational or territorial mobility is relatively less intense.

The division of labor and specialization is always present in the urban settlement during the division of labor. Unlike rural areas, there is no division of labor.

The challenges of integrating urban and rural areas are specific and constructive ways need to be found to address the problems. As a solution to strengthen the urban-rural link, the FAO (Food and Agriculture Organization) defined the term “urban food systems” in December 2013. A comprehensive network of actors, processes and relationships related to production, processing, marketing and the consumption of food that exists in a geographical region that includes a more or less concentrated urban center and the surrounding suburban and rural hinterland; regional a landscape through which flows of people, goods and ecosystem services are managed [6].

In Bulgaria, the development of the rural areas is sustained by Rural Development Program [8].

Main challenges and development potential of the national space

The National Concept for Spatial Development of the Republic of Bulgaria, 2013 - 2025 is the first document for spatial planning in the last three decades, which is develops for the whole national space under completely different political and socio-economic conditions, the country's membership in the European Union and changed attitude to the content and role of spatial planning. It is the most important medium-term strategic document that should harmonize sectoral policies, to coordinate private and public interests in the restoration of land and forest ownership in all its forms, increased number of participants in the planning process and territorial management and a more democratic decision-making process [4].

Bulgaria has significant historical experience in regional and spatial planning at the national level. The territorial administrative organization of Bulgaria was established in 1995 according to the Law on the Administrative-Territorial Organization of the Republic of Bulgaria, Prom. DV. No. 63 of July 14, 1995 [9].

The new concept of Spatial Development builds on and orients to the new global challenges related to resource conservation and adaptation to climate change and complies with the basic principles of modern policy for sustainable territorial development.

The National Concept for Spatial Development for the period 2013-2025 (NCPD) has been developed in the context of the main documents of the European Union for sustainable development spatial and urban development. It provides guidelines for a balanced structure, smart governance and integrated conservation of the country's resources in in line with the objectives of the Europe 2020 Strategy for the Development of a Competitive Knowledge and Innovation Economy, for Reducing Resource Dependence and Energy Consumption, for Economic, Social and Territorial Cohesion [2, 3].

The chosen model for spatial development of the country is inspired by the priorities for achieving these goals, adopted in the Territorial Agenda of Europe 2020 (TA 2020) "Towards Inclusive, Smart and Sustainable Europe” [12], which build on the ideas of the European Spatial Development Perspective (1999), the Lisbon Strategy (2000) and the Gothenburg Strategy (2001) [5].They promote polycentric and balanced territorial development, integrated economic, social and environmental renewal and development of cities, rural areas and regions with specific characteristics, territorial integration and policy coordination, protection of natural and cultural values and adaptation to global climate change.

The most important formulations and approaches of spatial planning, included in the pan-European documents that will shape our national policy and practice at all levels in the future, represented in the National Concept for Spatial Development for the period 2013-2025 [10] are the following:

1.Supporting balanced territorial development by maintaining a hierarchical system of city-centers at national and regional level as a means of reducing the pronounced territorial imbalances in economic development. Such imbalances are reported mainly in countries like ours, where, regardless of demographic decline, there is a significant growth of the capital at the expense of the rest of the national territory. The role of cities as engines of growth and as centers of creativity and innovation is emphasized. The creation of innovative networks between cities to compete at European and global level is encouraged. A significant role is assigned to small and medium-sized cities. Strategies for "recovery of the urban economy" are being developed, the economy of knowledge, creativity and innovation is being stimulated.

2. Strengthening the links between urban and rural areas at all levels, by improving accessibility and employability and planning

specific measures in support of peripheral and sparsely populated rural areas.

The main responsibility for the development of the periphery lies with the metropolitan urban areas. Interactions and partnerships between urban cores and rural areas are being strengthened, with the development of small towns strengthening their role as organizing centers.

3.Ensuring better accessibility and connectivity of cities and regions by improving their transport and communication links, by developing regional and local transport networks and connecting them to the European transport network. Improving transport links in peripheral areas, both within the EU and with neighboring countries, is particularly important for building broken links and integrating remote areas. Improving access to electronic communications networks and the provision of "universal service" in sparsely populated areas improves access to infrastructure, information and knowledge. Providing access to broadband is an important prerequisite for increasing competitiveness business and especially SMEs and is a condition for reducing the digital divide, as well as another opportunity to improve the skills of people of working age and increase their chances of entering the labor market. "

4. Careful planning of sustainable urban development by applying an integrated approach to urban reconstruction and renewal. Consistently coordinated solutions to economic, environmental, social and cultural issues arising in cities by concentrating resources on lasting improvement of the urban environment and quality of life. In parallel with the projects for physical improvement of the environment, measures are being implemented to stimulate social integration and cohesion, which enable the fight against spatial segregation and social marginalization. Mixing functions and social groups, especially in large cities, reduces the risk of social exclusion and exclusion for a large part of the population and preserves the vitality of cities. For more effective land use planning, integration of suburban areas of large cities into spatial development strategies and plans is sought.

Models for spatial development

Spatial models

Bulgaria has a convincing historical experience in centralized creation and management of spatial models for development at three levels - municipal, regional and national.This was the model of settlement systems, striving for even and balanced development throughout the territory. It has been realized through networks of social service, labor employment and public transport, covering the entire national territory and articulated according to the hierarchical structure of settlements (functional type). This was an ideal model (similar to the neighborhood and the area of a residential complex) with centralized (and absolute) management of all its essential elements (jobs - people - housing - transport). The main disadvantage of the model is the adequate attitude towards the village. The process of "urbanization" was also artificially created and misunderstood, the consequences of which can still be traced in a significant part of the settlements in the country from the lower hierarchical levels.

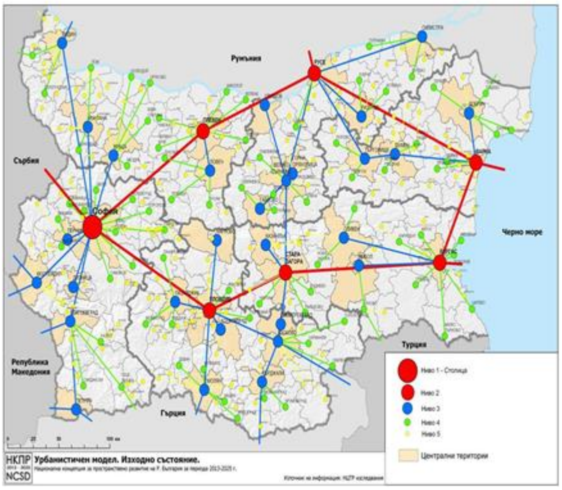

Fig. 1. Urban model of Bulgaria
Source: National Concept for Spatial Development for the period 2013-2025 [10].

With the abolition of centralism, our country moved to the other pole - complete deregulation of spatial development. Regional development is also part of it. The only regulators were the spontaneous forces of the emerging markets - employment, services, real estate. After 20 years of "inertial" spatial development, the analyzes of the municipal plans find strong polarity - over 90% concentration of people and activities in the municipal center. A similar picture is observed in the district strategies. Regional development plans reinforce the trend of growing inequalities. The National Strategy for Regional Development accepts this problem as a major challenge and directs an appropriate strategic package to it. Against this background, two clear ones emerge:

- In Bulgaria there are visible/intensive processes of spatial polarization and movement towards monocentric models of development at all levels - municipal, regional, regional, national;
- Bulgaria needs a turn to a polycentric model, but not at the expense of the energy of the established center, but through a supported opportunity to utilize its own resources on the periphery. "Supported opportunity" does not mean new direct state intervention in the desired process, but the effective implementation of regional policy, creating new competitive centers for choosing a place for investment, employment, education, recreation, career.

Spatial inequalities are known for a number of countries, there is a certain difference: Bulgaria's growth stems mainly from the fast-growing services sector. This is also shown in the work of [1], who write that production and services show many different patterns of spatial growth in the United States and Europe.

The National Concept of Spatial Development (NCSD) defines the territorial structure on a large national scale, in order to highlight the territorial differences and problems of development and structure and formulation of development policies for different types of territories. As the largest territorial structure can be indicated the typical for European countries have two main types of territories:

- highly urbanized, central areas with intensive socio-economic development,
- sparsely urbanized, peripheral areas with difficult socio-economic development,

The central highly urbanized areas are the territories of municipalities and groups of municipalities near large urban centers and their advantage, in contrast to the peripheral areas, is the opportunity for relatively close and convenient access to jobs, services, education, culture and all other values that big cities offer.

The core of the central regions are the urbanized territories of large and medium-sized cities (levels 1, 2, 3), their suburban areas (subject to suburbanization) and areas of influence (FUA, agglomeration areas). Outside of them, in the central regions (municipalities), there are also remote peripheral parts with small settlements or without settlements.

The peripheral sparsely urbanized areas are the territories of the municipalities, far from the big urban centers and from the services and jobs they offer. Peripherals regions in the country are external border peripheries and internal peripheries. The central and peripheral regions cover the territories of the formal territorial ones units - the municipalities, and thus distribute among themselves the entire territory of Bulgaria.

To the two main types of territories (central and peripheral), which determine the largest territorial structure, is added another type of territories, typical for Bulgaria:

- non-urbanized, natural areas for preservation of biological balance.

Natural territories occupy parts of the territories of the central and peripheral regions, are superimposed on them and thus form areas of informal character. In they include protected natural areas and protected areas under Natura 2000, protected under the Protected Areas Act (SG No. 133/1998) and the Protected Areas Act biological diversity (SG No. 77/2002) [7]. These include other areas without settlements occupied by forests, in the high parts of the mountains, by rivers, by the sea, parts of the water area. In the NCPD, they are defined as areas for preventive protection and conservation in their existing land use.

The main priorities of the Europe 2020 strategy for smart, sustainable and inclusive growth are protected in the NCPD 2013-2025 through the ideas of balanced distribution of priorities between urban centers and areas with good socio-economic development and the lagging behind, vulnerable to demographic and economic risks territories and settlements. The reasons for this approach are related to the findings for the successful development of medium-sized cities, which offer different scale and quality of life, avoiding some of the disadvantages of large cities and metropolises.

In addition, the polycentric network is being strengthened through targeted support for some important smaller cities in the country's spatial structure**.**

The NCSD adopts the approach to rural and cross-border areas of the Territorial Program of the European Union (TA 2020), which to the polycentric spatial and integrated urban development adds concern for the preservation of the vitality of small settlements. This differentiated approach is used in the proposals for targeted support for small towns and larger villages in rural areas and border areas and building broken links with them, while taking into account the specificities of different rural and mountainous areas and access to services offered by medium-sized cities.

CONCLUSIONS

The spatial model for the development of the national territory is multi-layered and synthesizes different layers with information, functions, processes and priority elements from different hierarchical ranks in a single dynamic system.

Alternative spatial models are based on the existing situation and possible changes in the polycentric structure of evenly distributed cities on the territory of the country.

The assessment of possible options of limited, moderately developed and highly developed polycentrism prove that the most suitable for the country is the model of moderate polycentrism, with opportunities for gradual development over time, depending on the influence of external and internal economic, geopolitical and hemographic factors. The general trend in the concept is to overcome the threat of targeting monocentrism, stimulating the movement from monocentrism to moderate polycentrism, which over time to expand and approach developed polycentrism.

Everything we talked about suggests that the spatial evolution of Bulgaria continues to favor areas with high levels of employment density.

This is obviously the case in services, and especially in the high-tech services and business services industries. After all, in the service sectors, agglomeration forces still dominate dispersion forces in high-density areas.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Scientific Research Foundation of Bulgaria.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

LAND MARKET OF LAND PLOTS OF LAND SHARE OWNERS IN UKRAINE: STATE AND INSTITUTIONAL PROBLEMS

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Abstract

During the research, it has been highlighted that there are no two countries in the world where the legal regulation of land relations would be identical, and the following four typical models of platform interactions have been established: closed market model, open market model, with some minor restrictions for agricultural and natural real estate (lands); closed for foreigners; open with restrictions. It has been substantiated that there is a stereotype in Ukraine as regards the efficiency of large-scale agriculture, and has been highlighted that most European countries prefer family farms, by ownership, and try to maintain small/medium-sized farm size, rather than increase the influence of monopolistic companies with large-size land use. Also, the paper highlights the factor of land consumption, in the process of which it has been found that in European countries this indicator is much better as compared to that in Ukraine. The authors' correlation analysis revealed a close relationship between these factors and the average value of agricultural lands. SWOT analysis tools have been applied to study the institutionalization of the land market. In addition, the authors have analyzed the average value of land plots of the owners of land shares(units) after the lifting of the moratorium on the turnover of agricultural lands, which allowed to state a significant regional difference in the value of these lands. Where twelve regions of Ukraine have a lower market value of land plots compared to the lowest limit of normative monetary valuation of arable lands. Using the diagram, the authors have shown the lack of mutual coordination between the indicators of the normative monetary valuation of arable lands and the average value of sold land plots of the owners of land shares (units).

Key words: *value of land plots, owners of land shares (units), turnover of land plots, normative monetary valuation, sustainable development*

INTRODUCTION

The land basis of the market economic system of Ukraine is subject to it when many more complex elements and mechanisms of this system have already developed and function. There is an institutional contradiction in the process of formation of the economic system of modern Ukraine, which determines its specific characteristics, and therefore has a significant heuristic potential. The formation of the market (turnover) of agricultural lands, in particular land plots of the owners land shares (units) affects the fundamental interests of Ukrainians, since it comes to a commercial turnover of the factor of socio-economic process, which the classics of political economy rightly described as a "mother of wealth" and, according to the Constitution of Ukraine, as "national wealth under special protection of the state" [18]. The issue of the market (turnover) of land plots of the owners of land shares (units) in the context of Ukraine's economic development has been covered in recent years more and more often, in particular, by the Ukrainian scientists such as E. Dankevych, V. Dankevych and O. Chaikin [8], O. Tomchuk, V. Kozhukhar [22], I. Zrybnieva and T. Zavolichna [24], R. Stupen and Z. Ryzhok [16], R. Stupen, M. Stupen and G. Dudych [17], V. Onegina and Y. Vitkovskyi [13], O. Borodina and V. Krupin [3]. However, despite the significant number of researches on the land market in Ukraine and the development of proposals for the formation and development of prospects for the turnover of land plots of the owners of land shares (units), the problem is still insufficiently studied, especially at present, after lifting the moratorium on turnover of the above land plots. In addition, in connection with the adoption of the Law of Ukraine "Amount Modifications of Some Legislative Acts of Ukraine Concerning Conditions of Circulation of the Lands of Agricultural Purpose" [21], the need for revising the basic conceptual principles of institutional development of the turnover of land plots of the owners of land shares (units) in Ukraine as one of the main bases of sustainable (balanced) development of agricultural land use in the country as a whole and its regions, as well as the territories of united territorial communities.

MATERIALS AND METHODS

The theoretical and methodological basis of the study is the analysis of the state and institutional problems of the agricultural land market in Ukraine, and also the impact of supply and demand on the cost of land use. In the process of work the authors used the following research methods for the article: monographic – in the process of analyzing scientific sources and normative legal acts relating to the object of research, for the systematization of publications on the land market of land plots of land share owners; analysis, synthesis, comparison – when comparing the land value in European countries and in Ukraine, and also in the analysis and comparison of land value according to OLX and Landlord platform, normative monetary valuation of land and land value after the end of the land moratorium; graphical method – for visualization of the average land value; abstract-logical – in the formation of theoretical generalizations and conclusions. The authors used data from the official websites of the State Service of Ukraine for Geodesy, Cartography and Cadastre and the State Statistics Service of Ukraine to reflect real quantitative indicators of the state of the land market in Ukraine.

RESULTS AND DISCUSSIONS

Studying the experience of foreign countries, it must be said that the land market abroad has been formed for a long time and is closely interconnected with the permanent existing land structure of the country. Its emergence is closely interconnected with the general processes of the formation of market economic relations, the functioning of private ownership of land and other natural resources, the formation of economic and legal foundations for the existence of the real estate market, in particular, agricultural, natural and material.

The main principles of the European Union's policy on land ownership, including agricultural land, are ensuring the right to free movement of capital, opening and running private business and avoiding discrimination. In most member states of the European Union there are no legal restrictions on the ownership of agricultural land (any individual or legal entity can legally purchase and own agricultural land). Legal restrictions on the ownership of agricultural land include limiting the number of potential buyers and competition from the agricultural land sales market. In countries that later became members of the European Union, restrictions on the ownership of agricultural land for foreigners (including citizens of EU member states) are usually introduced [20]. It should be noted that there are no countries in the world where the legislative regulation of land relations would be identical. At the same time, the scientific community distinguishes four typical models of platform interactions, which fall under almost all countries of the world:

1) closed market model – all operations with land are prohibited, both for residents of the country and for foreigners;

2) open market model, with some minor restrictions for agricultural and natural real estate (land) – practically does not limit the turnover of land resources inside the country and is open to foreigners;

3) closed for foreigners – the land market is closed for foreigners, namely, any operations with land are prohibited for them;

4) open with restrictions – despite the open market, there are certain restrictions, for example: the minimum sale price is set, the area of land owned by one person is regulated, etc., both for residents and foreigners.

Selecting the land market model gives impetus not only to the socio-economic development of land use of the respective territories, but also to the ecological, in particular rational and efficient, use thereof. At the same time, the establishment of restrictions and encumbrances with respect to the land market turnover depends on the factors of land structure [23]: on natural-economic zoning; by administrative-territorial division; forms of land ownership and their varieties; forms and methods of land use. In addition, the establishment of restrictions and encumbrances on the land market turnover leads to a situation when the price of land plots is underestimated due to the regulation of circulation or imperfection of its institutional environment and, accordingly, an artificial reduction in demand.

In order to confirm this statement, Figure 1 shows the average value of agricultural lands in some European countries and in Ukraine before the lifting of the moratorium on agricultural lands, including land plots of the owners of land shares (units), which actually reflects the market value of land ownership as the main asset, but not in our state.

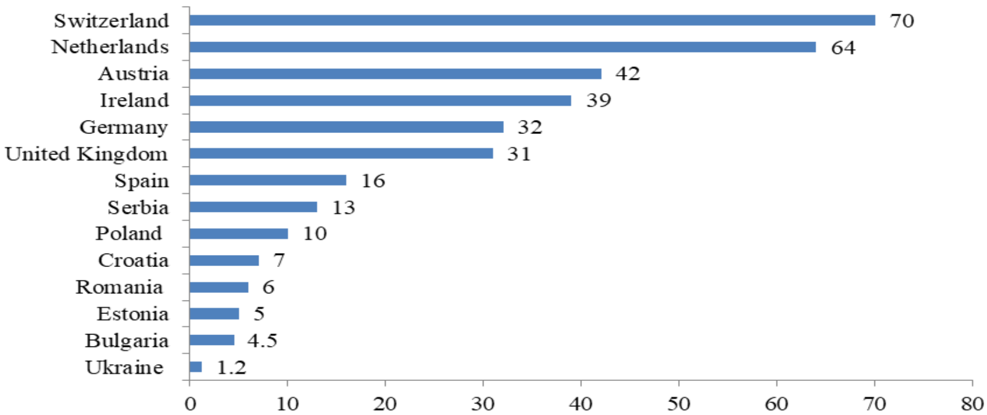

Fig. 1. The average price of agricultural land before the lifting of the moratorium on the purchase and sale of land plots of land share owners, thous. USD
Source: [20].

It should be noted that before the expansion of the market (turnover) of agricultural lands in Ukraine due to the moratorium on the turnover of land plots of the owners of land shares (units) lease relations of these lands were actively developed, the value of which was calculated using normative monetary valuation (hereinafter referred to as the NMV). Therefore, when comparing prices with European countries, the Strategy for Improving the Management Mechanism in the Field of Use and Protection of State-Owned Agricultural Lands and Their Disposal of June 7, 2017, No. 413, set forth the average value of normative monetary valuation of land in Ukraine, which at that time amounted to 1.2

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

thousand dollars per 1 ha [20].

As noted by the analytical center Easy Business, it is indicative that in countries with an open market model, the average price for 1 hectare of agricultural land is one and half times higher than in countries where market operates with restrictions [1]. As for our country, it appears that the land value, even according to the NMV, is underestimated.

In accordance with Article 1 of the Law of Ukraine «On Land Valuation» of December 11, 2003 No. 1378-IV, normative monetary valuation of land plots is a capitalized rent income from the land plot determined according to established and approved standards. Where normative monetary valuation of agricultural land is carried out at least once every 5-7 years (Article 18 of this Law) [19].

It should be noted that the central executive body, namely the State GeoCadastre of Ukraine, every year since 1995, publishes indicators of NMV of 1 hectare of agricultural land (arable land and fallow lands, perennial plantations, natural hayfields, pastures) on average in Ukraine and in the context of regions of Ukraine. Until November 2016, the assessment was carried out in accordance with the Methodology of NMV of agricultural land in settlements, approved by the Resolution of the Cabinet of Ministers of Ukraine of March 23, 1995 No. 213 [4], then the new methodology of NMV of agricultural land of November 16, 2016 No. 831 [6] have been approved.

Table 1. Characteristics of normative monetary valuation of agricultural land in Ukraine as of 01/01/2021*

No	Administrative region	Arable land and fallows		Perennial plantations		Hayfields		Pastures	
		thous. UAH/ha	D_C**	thous. UAH/ha	D_C**	thous. UAH/ha	D_C**	thous. UAH/ha	D_C**
1	Vinnytsia	27.2	-1.1	47.1	-6.9	3.1	-53.2	1.6	-68.7
2	Volyn	21.8	-20.7	41.3	-18.2	6.0	-9.9	4.5	-10.2
3	Dnipropetrovsk	30.3	10.0	55.6	10.0	8.0	18.9	6.2	25.0
4	Donetsk	31.1	13.1	58.5	15.7	7.2	8.1	6.0	21.1
5	Zhytomyr	21.4	-22.1	35.6	-29.5	5.1	-24.4	4.1	-18.0
6	Zakarpattia	27.3	-0.8	37.1	-26.6	6.5	-2.7	5.3	5.5
7	Zaporizhzhia	25.0	-9.1	41.3	-18.2	6.0	-9.9	4.9	-2.3
8	Ivano-Frankivsk	26.1	-5.1	37.1	-26.6	4.8	-28.0	4.5	-10.2
9	Kyiv	26.5	-3.5	42.8	-15.3	6.3	-6.3	4.5	-10.2
10	Kirovohrad	31.9	16.0	67.0	32.6	8.7	29.7	6.0	21.1
11	Luhansk	27.1	-1.4	47.1	-6.9	8.2	22.5	5.8	17.2
12	Lviv	21.5	-21.8	27.1	-46.4	5.8	-13.5	4.1	-18.0
13	Mykolaiv	27.0	-1.7	47.1	-6.9	8.2	22.5	5.8	17.2
14	Odesa	31.0	12.8	62.7	24.2	8.9	33.3	7.0	40.6
15	Poltava	30.4	10.5	64.2	27.0	5.6	-17.1	4.3	-14.1
16	Rivne	21.9	-20.2	37.1	-26.6	5.1	-24.4	3.7	-25.8
17	Sumy	26.8	-2.6	49.9	-1.2	6.5	-2.7	4.7	-6.3
18	Ternopil	29.0	5.6	57.0	12.9	6.3	-6.3	5.6	13.3
19	Kharkiv	32.2	17.2	67.0	32.6	6.3	-6.3	6.4	28.9
20	Kherson	24.5	-11.1	37.1	-26.6	5.3	-20.7	4.3	-14.1
21	Khmelnytsk	30,5	10.8	52,8	4.4	6,8	0.9	5,3	5.5
22	Cherkasy	33,6	22.4	74,1	46.7	8,5	26.1	5,6	13.3
23	Chernivtsi	33,3	21.0	62,7	24.2	5,6	-17.1	5,1	1.6
24	Chernihiv	24,1	-12.5	55,6	10.0	8,7	29.7	5,1	1.6
	Ukraine	**27,5**	**0.0**	**50,5**	**0.0**	**6,7**	**0.0**	**5,0**	**0.0**

Note: * the value of normative monetary valuation of agricultural land in accordance with the nationwide (all-Ukrainian) normative monetary valuation of agricultural land; ** deviation coefficient (D_C, %) is the ratio of indicators in a separate region and the average in Ukraine.

Source: compiled by the authors using the operational data of the State GeoCadastre of Ukraine [0].

The Resolution of the Cabinet of Ministers of Ukraine «On conducting a nationwide (all-

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Ukrainian) NMV of agricultural land and amending certain resolutions of the Cabinet of Ministers of Ukraine» of February 7, 2018 No. 105 [7], defines the procedure for conducting a nationwide (all-Ukrainian) NMV of agricultural land, which simultaneously covered the entire territory of Ukraine. The assessment was carried out in accordance with the new Methodology of NMV of agricultural land, approved by the Resolution of the Cabinet of Ministers of Ukraine of November 16, 2016 No. 831.

According to the operative data of the State GeoCadastre of Ukraine [12], Table 1 shows the data of the normative monetary valuation of agricultural lands in Ukraine, as of 01/01/2021.

The analysis of the Table shows that for the specified period the normative monetary value of arable land and fallows in Ukraine ranged from 21,411.0 UAH/ha – in Zhytomyr region up to 33,646.0 UAH/ha – in Cherkasy region; perennial plantations from 27,091.2 UAH/ha – in Lviv region up to 74,144.4 UAH/ha – in Cherkasy region; hayfields from 3,140.4 UAH/ha – in Vinnytsia region up to 8,938.0 UAH/ha – in Odesa region; pastures from 1,558.1 UAH/ha – in Vinnitsa region up to 7,011.4 UAH/ha – in Odesa region. It should be noted that the average value according to the normative monetary valuation of arable lands in Ukraine in the analyzed period was 1.0 thousand dollars per 1 ha. In general, the data indicates significant regional deviations, as well as imperfection of the Methodology of Normative Monetary Valuation of Agricultural Lands, and, accordingly, non-feasibility of using it as a main basis for determining the starting market value of agricultural lands. In general, the evolution of improving the normative monetary valuation of agricultural lands is also emphasized by the academic community, in particular by O. Kovalova, I. Yarova, G. Mishenina, T. Pizniak, O. Dutchenko [9] etc.

B Table 2 shows a comparative description of the state of land use in European countries, EU countries and Ukraine, which indicates a significant unused potential of Ukrainian agricultural land use (with 46.4 % of black soil) compared to European countries (8.3 %). Although the share of arable land is less than in Ukraine, the share of organic and irrigated land is higher, which indicates a higher intensification and capitalization of land use.

Table 2. Comparative characteristics of land use in European countries, EU and Ukraine

Name of the indicator	Ukraine	European countries	EU
Price per hectare of agricultural land, thousand USD per 1 ha	1.0	3.7	7.2
Average size of land wnership, ha	474	-	85
Land capacity, ha per 1,000 EUR of gross production	3.72	-	0.46
Investment price, thousand USD per 1 ha	1	4	5,5
Grain Export, mln tons	34.8	130	38.5
Total area vs European countries, %	5.9	100	43.1
Share of lands vs the total area by country, %			
Agricultural lands per capita	1.2	0.1	0.1
Agricultural lands, including:	70.7	46.8	40.6
- leased agricultural lands	65	62	53
- arable lands	53.8	27.4	26.5
- chernozems	46.4	8.3	4.1
- irrigated lands	0.8	2.0	2.5
- lands certified as organic ones	0.5	1.1	1.2

Source: generated by authors using source [14; 20].

In addition, when analyzing the Table, the average size of land ownership and land use is important in comparison, while in the EU the average size was 85 hectares, and in Ukraine it was 474 hectares. Moreover, land consumption, which in the EU was 0.46 ha/1,000 EUR of gross output, and in Ukraine was 3.72 ha/1,000 EUR of gross output. According to scientific research [2; 22], this characterizes the intensity of agricultural land use due to the efficiency of their use and depends on the ratio of land area and cost of production produced from this area, where the cost of production is affected not only by the yield but also by the structure of crops cultivated, their complexity. That is, the less land is ultimately needed to produce a unit of output in monetary terms, the greater the value (profitability) of the land itself.

According to some studies [11], in European countries family farms (individual ownership) make up 85% of all agricultural enterprises. In Western Europe, they cultivate 68% of agricultural land and 25% in Eastern Europe. They produce 71% of agricultural products in old EU member states (EU-15). Of course, there are significant differences between European countries (Table 3), in particular [11]: Italy and Austria focus on small and medium-sized family farming; Spain and France (to a lesser extent) for large-scale agricultural production by agricultural enterprises and large family farms; Germany on large in area (100-250 hectares) family farms. However, even large farms in Germany are much smaller than agricultural enterprises in Eastern Europe, which is also aimed at family farms.

Table 3. Distribution of land ownership and land use by size in some European countries and in Ukraine

Country	Small farms (up to 20 hectares)		Medium farms (20-100 hectares)		Large farms (more than 100 hectares)	
	% of farms	% of land	% of farms	% of land	% of farms	% of land
Italy	91	38	8	37	1	26
Austria	70	27	27	55	2	18
Germany	46	8	32	33	11	55
France	46	5	36	36	18	59
Spain	76	15	16	30	5	55
Greece	95	61	5	32	0	7
Poland	92	52	7	27	1	22
Romania	99	43	0	8	0	49
Estonia	73	10	20	17	9	73
Bulgaria	95	9	4	10	1	82
Ukraine*	21	0	40	4	39	96

Note:* Data taken as of November 1, 2019.
Source: generated by the authors using sources [11; 15].

So, despite some Ukrainian stereotype about the effectiveness of large-scale agriculture, the countries of Europe, for the most part, prefer family farms – in terms of ownership and try to maintain a small / medium-sized farms, rather than increase the influence of monopoly companies.

The land consumption rate for some European countries and Ukraine is shown in Figure 2, the analysis of which suggests that less land is ultimately needed in European countries to produce a unit of output that is much different from Ukraine. At the same time, Germany and France have the best indicators of efficiency of agricultural land use among the represented Eastern European countries, and the more so compared to Ukraine.

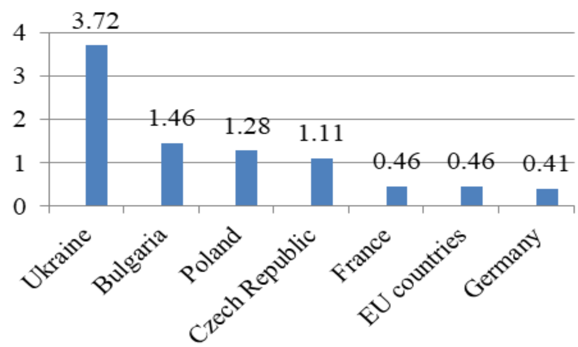

Fig. 2. Land consumption of agricultural lands use in some European countries and in Ukraine
Source: generated by the authors using the source [2].

Obviously, from the point of view of the law of economy on supply and demand, the value of land plots of the owners of lend shares (units) is primarily influenced not only by the regulation of land plots turnover, but also by the demand for them.

The higher is the demand, the greater is the value of land plots of land share owners, the lower is the demand, the lower is their value. Since, as already noted, small and medium-sized land users prevail in Europe and the number of farms is several times more than in Ukraine, the demand for land is greater. Small and medium-sized farms are interested in purchasing even small plots of land (up to 1 hectare), since with an average farm size of 2 hectares, 10 hectares, 30 hectares – even such a small increase in area gives a powerful increase in productivity. And a large number of these farms provides high competition among themselves, which leads to an increase in the cost of land [11]. As an example, the cost of land in Bulgaria (5,546 USD) (Figure 3), the most successful country with corporate cultivation, is half that of Poland (11,639 USD), where farm land use predominates (average farm size – 10 ha) and 3 times less than in Greece (15,152 USD), where farming land use also predominates (average farm size – 1.5 ha). Romania and Estonia (2,502 USD and 3,468 USD respectively), which can be considered typical countries with a corporate structure of agriculture, are even more behind in this indicator.

In addition, as figures from Figure 3 and Table 3 show, land in Italy, who focuses on small and average land use of family farmers, costs an average of 40,246 USD, that is 2.6 times more expensive than in Spain, where land costs 15,392 USD and where they focus on medium and large farms. Thus, in countries where agriculture is dominated by small and medium-sized family farm land use, land values are higher than countries where agricultural enterprises dominate.

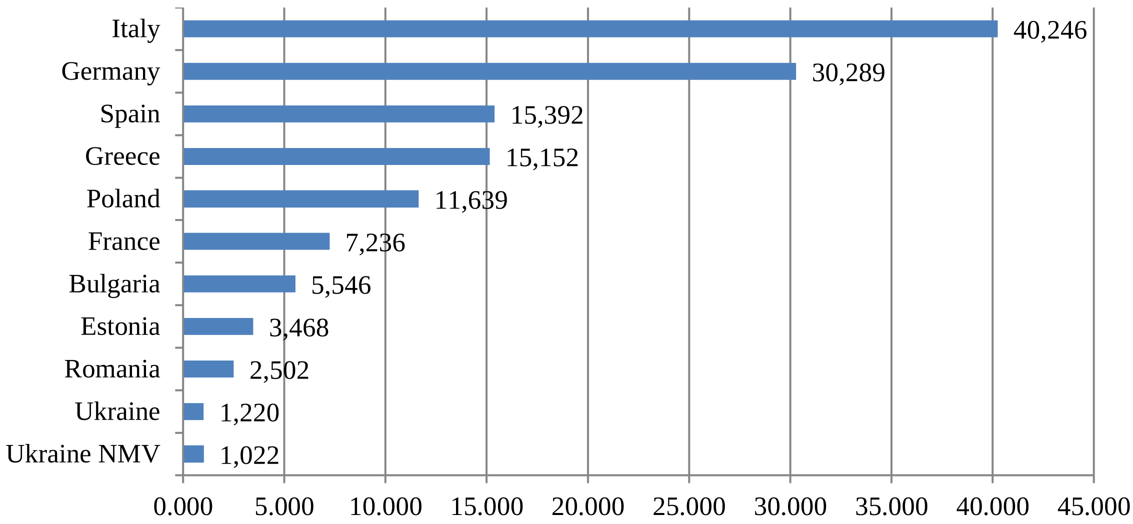

Fig. 3. The average value of a hectare of agricultural land in some European countries and in Ukraine, USD
Note: where Ukraine is the average value of land plots of the owners of land shares (units) after the lifting of the moratorium (in 2021), Ukraine NMV is normative monetary valuation (NMV, see Table 1) (as of 01/01/2021). Data for other countries is taken for 11/12/2019.
Source: formed by the authors using the data of Eurostat and the State GeoCadastre of Ukraine [12].

Thus, in European countries where small and medium land use of family farms predominates in agriculture, the value of land is higher than in countries where agricultural enterprises predominate.

In addition, land consumption in these countries is 8 times better than in Ukraine (Table 2 and Fig. 2). And this, in turn, indicates the intensity of agricultural land use by these countries by means of effective application.

This is due to the better structure of crops, in particular the higher share of labor-intensive crops and their yields (Table 4) as well as prices for such agricultural products.

Table 4. Crop yields in some European countries, hundredweight per hectare

Crops	Ukraine	Romania	Bulgaria	Poland	Greece
Vegetable crops					
Cabbages (all kinds)	212	208	302	434	277
Carrots	161	135	212	390	363
Onions	153	109	115	244	273
Potatoes	132	133	182	179	252
Tomatoes	218	154	392	510	581
Cucumbers	161	136	-	295	-
Pumpkins	208	155	149	347	207
Vegetables (another)	68	109	33	254	258
Fruits and berries					
Apples	85	98	83	110	233
Apricots	84	91	16	20	102
Cherries	58	101	17	33	39
Peaches	37	57	44	28	169
Plums	79	90	19	47	108
Strawberries	70	80	-	41	354
Fruits (other)	17	82	19	82	37

Source: [11].

Thus, the undoubted leaders in the yields of vegetable crops are Poland and Greece, where the difference in yield compared to Ukraine sometimes can differ several times. As for the yield of fruit crops and berries, the undisputed leaders are the small farms of Greece, which in comparison with our country significantly exceed us in growing such traditional crops as apples – 2.7 times, plums – 1.4 times, strawberries – as much as 5 times. In order to confirm the hypothesis that there is a relation between the value of agricultural lands and the size of land use and land consumption, Table 5 shows the calculated correlation coefficient for the studied factors using Excel. It should be noted that in the scientific community, indicators of over 0.50 indicate a significant correlation relation. However, it has to be noted that the land consumption indicator is inverse to the growth of land value, that is why the correlation coefficient is negative and by its nature characterizes the close relation with land consumption. There is also a close relation between the average value of lands and the size of land use, namely for farming households sized between 20 and 100 ha.

Table 5. Calculation of the correlation coefficient between the average value of agricultural lands and the size of farm land use and land consumption

Countries	X	Y			
	The average value of agricultural land, USD/ha	Land consumption, ha/1000 euros of gross output	The size of land use of farming households, %		
			up to 20	20–100	over 100
Ukraine	1,220	3.72	0	4	96
Romania	2,502	N/a*	43	8	49
Estonia	3,468	N/a	10	17	73
Bulgaria	5,546	1.46	9	10	82
France	7,236	0.46	5	36	59
Czech Republic	7,754	1.11	N/a	N/a	N/a
Poland	11,639	1.28	52	27	22
Greece	15,152	N/a	61	32	7
Spain	15,392	N/a	15	30	55
Germany	30,289	0.41	8	37	55
Italy	40,246	N/a	37	37	26
Correlation coefficient		-0.60883**	0.210314	0.748389	-0.51645

Note: * N/a is not available; ** the negative correlation coefficient is due to the fact that the land consumption indicator is inverse to the growth of the value of land plots.
Source: Own results.

Table 6. SWOT analysis of modern institutional support of the land market of land plots of land share owners

Strengths	***Weaknesses***
Economic factors:	
• formation of market-oriented land structure of the country, regions and territorial communities; • implementation of basic directions of state policy in the field of land resources; • implementation of territorial and spatial planning of land use, in particular, zoning of land by types (subtypes) of land use; • favorable institutional conditions for positive examples of the use of levers of financial, economic, land management and legal regulation; • modification on a rent basis of normative and expert (market) monetary valuation of land; • formation of favorable environment for the functioning of individual entities (family farms and private farms) due to institutional support; • expansion of non-conventional (organic) land use.	• imperfect mechanism for regulating economic and environmental relations of property rights and land use; • the problem of determining the rational scale of state intervention in the process of distribution (redistribution), use and restoration of land resources; • self-disqualification of the state from the implementation of land management of the formation of agricultural land tenure and land management, zoning of land and organization of crop rotation and arrangement of land; • inconsistency in the assessment of agricultural land, their value; • lack of order for creating new and streamlining existing land tenures and land management in communities; • lack of a land and land ownership accounting system and its inconsistency with international standards and current legislation; • leveling the function of territorial and spatial planning of land use in the territory management system.
Environmental factors:	
• implementation of the institute of territorial and individual restrictions (encumbrances) in the use of land and other natural resources; • implementation of the norms of the laws of Ukraine «On Land Protection», «On the Ecological Network of Ukraine»; • implementation of environmental measures (construction and reconstruction of anti-erosion hydraulic structures, conservation of land, creation of field-protective forest strips, etc.).	• lack of the necessary list of state standards, norms and rules in the field of land protection, land management, sustainable land use; • the need to develop a system of zoning of land by types (subtypes) of land use outside settlements; • no established environmental restrictions on the use of land.
Social factors:	
• social rationing, regulation of the size of private land ownership; • expansion of non-conventional (organic) land use; • increase in the number of family farms.	• high level of corruption and legal nihilism of the population; • the need for legislative distinction between land use of family farms and personal farms and their stimulation; • lack of information on land rights and other natural resources in territorial communities.
Possibilities	***Threats***
Economic factors:	
• implementation of measures for land management with the aim of zoning land by types (subtypes) of land use outside settlements to form its investment attractiveness and increase capitalization; • institutional prerequisites for the formation and functioning of the land-mortgage bank; • implementation of land management to create new and streamline existing land properties in communities.	• lack of land registration and redistribution of agricultural land between various business entities in a non-market way; • lack of authority for territorial communities to manage land use outside settlements; • significant risks of unsatisfactory level of information about land and other natural resources in territorial communities; • lack of concept of market-oriented and environmentally safe land structure in the countryside and their regional and local models.
Environmental factors:	
• implementation of a set of measures to reduce plowing in the steppe zone, improve the structure of land, increase the area of environmentally stabilizing land; • implementation of territorial and spatial planning of land use, in particular, zoning of land by types (subtypes) of land use; • introduction of environmental insurance system.	• incomplete formation of the ecological network at the local level (only 12.5%); • uncertainty of restrictions (encumbrances) on the use of land and other natural resources; • threat of continued degradation of land and other natural resources, climate change and desertification; • violation of environmental equilibrium in the ratio of the main types of land.
Social factors:	
• monitoring and construction of models of market-oriented land structure to identify trends and prospects of social development; • prerequisites for the creation of the necessary and effective infrastructure of the land and agricultural products market; • institutional stimulation of the development of non-conventional (including organic) land use of peasant farms and individual farms.	• legal and bureaucratic traps in access to land resources, which will lead to the formation of protest sentiment among the population; • low incentives for active involvement of the population in the process of development of the civilized agricultural land market; • lack of social consensus on regulating the development of family farm land use and regulating the land use of agricultural holdings between entrepreneurs and the local community; • lack of necessary and efficient infrastructure of land and agricultural products market.

Source: developed by authors.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 7. Information on the sale of land plots by owners of land shares in the context of regions of Ukraine

No.	Administrative region	For the period of 07/01/2021 to 08/19/2021			Average price			Rating by price per 1 ha
		Quantity	Area, ha	Price, UAH	UAH/ha	USD/ha*	D_C**, %	
1	***Kyiv***	***1,009***	***1,174.3***	***173,640,462***	***147,865.2***	***5,497***	***350.6***	***1***
2	***Lviv***	***167***	***119.4***	***14,327,938***	***120,006.8***	***4,461***	***265.7***	***2***
3	***Odesa***	***100***	***235.4***	***20,992,405***	***89,160.2***	***3,315***	***171.7***	***3***
4	***Ivano-Frankivsk***	***157***	***56.1***	***3,791,615.2***	***67,560.2***	***2,512***	***105.9***	***4***
5	Rivne	125	164.3	6,367,346.3	38,756.7	1,441	18.1	5
6	Chernivtsi	102	67.5	2,342,309.6	34,724	1,291	5.8	6
7	Zhytomyr	261	379.7	12,885,548	33,938.1	1,262	3.4	7
8	Khmelnytsk	482	821.2	26,555,106	32,336.5	1,202	-1.5	8
9	Cherkasy	282	497.4	13,609,270	27,360	1,017	-16.6	9
10	Ternopil	130	156.2	4,142,368.4	26,515.7	986	-19.2	10
11	Donetsk	109	498.5	11,536,508	23,142.5	860	-29.5	11
12	Poltava	831	2,020.1	42,012,473	20,797.3	773	-36.6	12
13	Volyn	416	620.2	12,231,020	19,721.7	733	-39.9	13
14	Kharkiv	480	1,866.7	35,944,422	19,256	716	-41.3	14
15	Sumy	712	1,112.2	20,332,980	18,281.8	680	-44.3	15
16	Zakarpattia	118	110.7	1,994,528.6	18,019	670	-45.1	16
17	Zaporizhzhia	157	486.5	8,180,837.2	16,816.9	625	-48.7	17
18	Mykolaiv	146	521.9	8,549,960.1	16,383.8	609	-50.1	18
19	Kherson	284	1,253.5	17,990,745	14,351.9	534	-56.3	19
20	Chernihiv	409	922.7	12,271,099	13,299.7	494	-59.5	20
21	Kirovohrad	377	1,350.3	16,210,275	12,005.2	446	-63.4	21
22	Vinnytsia	516	795.2	9,516,286.1	11,967.8	445	-63.5	22
23	Dnipropetrovsk	410	1,364.6	14,505,957	10,630.3	395	-67.6	23
24	Luhansk	31	41.5	352,620.39	8,502.1	316	-74.1	24
	Ukraine	**7,901**	**16,641.5**	**546,058,607**	**32,813.1**	**1,219.8**		

Note: * at the dollar rate of 1 USD=26.9 UAH; ** deviation coefficient (D_C, %) is the ratio of indicators in a separate region and the average in Ukraine.
Source: compiled by the authors using the operational data of the State GeoCadastre of Ukraine [12].

An informative reflection for the study of the institutionalization of the land market is the SWOT analysis, which determines strengths and weaknesses, opportunities and threats (Table 6).

On July 1, 2021, the Law of Ukraine «On Amendments to Certain Legislative Acts of Ukraine on the Conditions of Circulation of Agricultural Land», which lifted the moratorium on the turnover of land plots of the owners of land shares (units) in agriculture. According to the operative data of the State GeoCadastre of Ukraine, Table 7 shows the first sales of land plots by the owners of land shares (units), which indicate the ambiguity of the institutional environment of market turnover of these land plots, namely as regards the institution of pricing, form developments planning and greening of agricultural land use, information support, etc.

The rating analysis of the average value of sold land plots of the owners of land shares (units) shows a very large regional difference in value. In particular, the deviation coefficient ranges from -74.1% to 350.6%. Thus, the sale price of land plots in the context of Ukraine ranged from 8,502.1 UAH/ha in Luhansk region. To 147,865.2 UAH/ha in Kyiv region, which is 17 times more (the difference is 139.4 thousand UAH/ha). This is despite the fact that at the same time the value of the normative monetary valuation of arable lands in Ukraine ranges from 21,411.0 UAH/ha in Zhytomyr region to 33,646.0 UAH/ha in Cherkasy region (see Table 1), which is only 1.6 times higher.

It should also be noted that the value of land plots of the owners of land shares (units) in Kyiv, Lviv, Odesa and Ivano-Frankivsk regions has already reached the level of European countries such as Romania, Estonia and Bulgaria at the initial stage of turnover.

Figure 4 is a comparison of indicators for identifying the presence or absence of a certain mutual coordination of indicators of normative monetary valuation of arable lands and the average value price of sold land plots of the owners of land shares (units) after the lifting of the moratorium. In addition, the authors have used the study by V. V. Makarova [10] who conducted a study using the largest ad service by regions of Ukraine (OLX – https//www.olx.ua) were used for real private offers in public announcements on the sale of agricultural land for the period of 2020 and Landlord data «How much is a hectare? Regions of Ukraine for real sales of agricultural land» for the period 2019–2020. Wherein, the researcher, for each region (area) selected 15 to 25 private proposals in public announcements regarding the sale of agricultural lands and made the correlation of the average value. The analysis conducted by the researcher gives an understanding that even before the lifting of the moratorium on the turnover of land plots of the owners of land shares (units), the owners were little aware of the real price of their land plots. In addition, Figure 5 shows that twelve regions of Ukraine have a lower market value of land plots of the owners of land shares (units) compared to the lowest limit of the normative monetary valuation of arable lands, including the regions such as Vinnytsia, Poltava regions where highly fertile soils predominate.

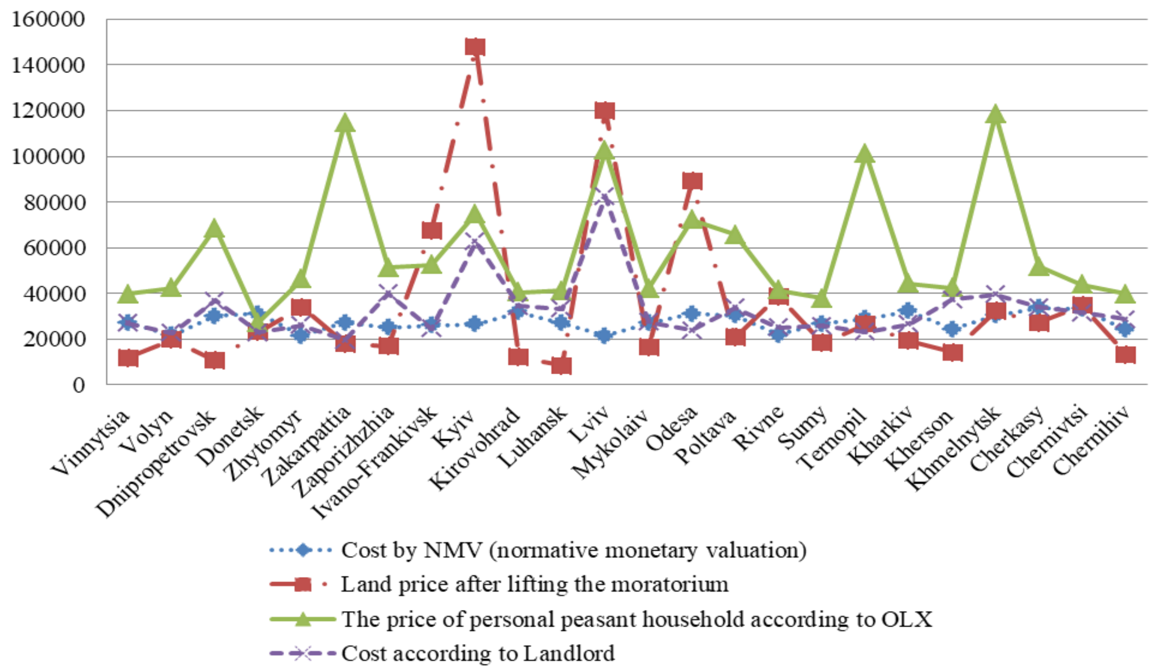

Fig. 4. Comparison of indicators of average value of agricultural lands by regions of Ukraine, UAH/ha
Source: compiled by authors using sources [0; 19; 21].

The data indicate the need for further research into the institutional pricing environment in the agricultural land market and a deeper analysis of this environment. In particular, in most regions of Ukraine (except Kyiv, Lviv, Odessa and Ivano-Frankivsk, where prices range from 2.5 to more than 5 thousand USD per 1 hectare, and this is already European indicators), the indicators of land sales prices in general correlate with the indicators of NMV based on understated indicators.

It should be noted that the estimated value of the normative monetary valuation is not currently dependent on the specific date of assessment, the existing market characteristics, the official exchange rate, the average monthly wage in the regions, etc. Consequently, the normative assessment does not determine neither the probable potential value nor the market value of farmland [10]. At the same time, the value of the normative monetary valuation of a land plot remains the basis for determining the rent for land, determining the amount of land tax, state duty, etc., pursuant to the law [10], i.e., it is used in regulating land relations. Expert (market) monetary valuation of agricultural land plots or rights to them is carried out in order to determine the probable value of the object at the date of evaluation for the implementation of civil law agreements [4; 5].Therefore, the authors believe, based on this study, that when determining the market value of agricultural land plots in the Methodology of Expert Monetary Valuation of Land Plots, the following factors should be taken into account: the size of land use and land consumption. In addition, the study can serve as an informative basis for specific recommendations for improving the normative monetary valuation.

Therefore, it is necessary to state the need to improve the institutional environment. In particular, regarding pricing, environmental rationalization, capitalization (by reducing land intensity, expanding non-conventional land use, etc.) and socialization (family farming and intensification of the development of personal farms) agricultural land use, which will be the subject of our further research.

CONCLUSIONS

The work carried out in the article was aimed at studying the state and institutional problems of the market (turnover) of land plots of the owners of land shares (units) and identifying factors influencing the value of agricultural lands in Ukraine. In the course of this, the authors have drawn the following conclusion:

(1) in Europe, small and medium-sized land ownership and land uses predominate, and the number of farming households is many times higher than in Ukraine, and the demand for land is higher. The relation between the value of agricultural lands and the size of land uses is confirmed by the calculation of the correlation coefficient. In particular, this showed a close relationship between farming households ranging in size from 20 to 100 ha, which amounted to 0.748389. At the same time, the farming households with more than 100 ha received a negative correlation. For example, land in Italy, which focuses on small and medium land use of family farmers, costs in average 40,246 USD, which is 2.6 times more expensive than in Spain, where land costs 15,392 USD and which focuses on large farming households. Thus, in countries where in agriculture both small and medium land uses of family farms predominate, the value of land is higher than in the countries where agricultural enterprises predominate.

(2) in European countries, the land consumption is 8 times better than in Ukraine. It is noted that the land consumption indicator is inverse to the growth of the value of agricultural lands and the calculated correlation coefficient has a negative value that by its nature characterizes the close relation (-0.60883). The low land consumption is characterized by efficient use of agricultural lands. For example, by the higher share of labor-intensive crops, their yields and prices for agricultural products. In particular, fruit and berry crops, where small and medium-sized farming households in Greece are an undisputed leader of this example, which country, in comparison with our country, has much higher indicators than those of Ukraine in the crops traditional for us such as growing of apples – 2.7 times, plums – 1.4 times, strawberries – as much as 5 times.

(3) analysis of the average value of sold land plots of the owners of land shares (units) shows a very large regional difference in value. Thus, the sale price of land plots in the context of Ukraine ranged from 8,502.1 UAH/ha in Luhansk region to 147,865.2 UAH/ha in Kyiv region and the coefficient of deviation of regions to the average value throughout Ukraine is -74.1% to 350.6%. In addition, the study demonstrated that twelve regions of Ukraine had a lower market value of land plots compared to the lowest limit of the normative monetary valuation of arable lands, which amounts to 21,411.0 UAH/ha (Zhytomyr region).

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

COMPARATIVE STUDY ON THE LEVEL OF PRODUCTION COSTS IN ORGANIC AND CONVENTIONAL AGRICULTURE IN ROMANIA

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Abstract

The concept of sustainable development appeared in the attempt to reconcile agri-food production with measures to conserve non-renewable resources, but also the attempt to protect the environment, and in this process the farmer has an important role given the effects that specific activities have so much on the environment. Because of this, more and more actors involved in this process, from farmers to consumers, but also politicians have begun to pay more attention to organic farming, as an advantageous means of reconciliation between man and nature. In this paper we aim to analyze the production costs recorded in six crops, both in the case of applying the conventional production system and in the case of applying the ecological system in Romania, in order to determine the profitability of those crops. The research methodology involved the use of existing data in domestic and international databases, but also data collected through the project ADER 23.1.1. Technical and economic substantiation of the production costs and estimates regarding the capitalization prices of the main vegetal and animal products, obtained in conventional system and in ecological agriculture, data that were processed, analyzed and which formed the basis for formulating conclusions. The conclusion was that sugar beet and sunflower are profitable crops both in the conventional and organic system, while rape, soybean, rice and hemp registered losses which have to be covered by subsidies. Income depends on production performance and selling price, in the both systems, and case of organic products is inversely proportional.

Key words: *organic agriculture, conventional agriculture, cost, profitability*

INTRODUCTION

As the world becomes more and more concerned with protecting the environment, its own health, animal welfare, organic farming has become an increasingly current concept, even if it is not new. Given that it is an agricultural production management system, it protects the environment due to the fact that it allows the renewal of resources, recycling, and the resulting products are much healthier, due to the fact that they reduce or eliminate the use of pesticides, synthetic fertilizers, other substances chemical, but also genetic manipulation practices, arising from the need to get more and cheaper food [3].
The same principles are applied for obtaining animal products, avoiding the use of antibiotics, growth hormones, but also pursuing animal welfare. Thus, this type of agriculture responds to the demand of consumers who are concerned with the use of sustainable practices, environmental protection, animal welfare and who want to consume products obtained respecting these principles [4].
At the same time, Community agricultural policies are geared towards natural agriculture, in which organic farming is well defined, and measures to promote organic production techniques are supported at European level, with financial support [10].
In the Codex Alimentarius Commission, organic farming is defined as "a holistic approach to the production management system, which promotes and maintains the healthy development of agro-ecosystems, including biodiversity, biological cycles and

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

soil biological activity. The emphasis is on the use of managerial practices in accordance with the use of external inputs from the farm, considering the regional conditions to which the systems must adapt. This is achieved by using, where conditions allow, agricultural, biological and mechanical methods, as opposed to the use of synthetic substances, to perform any specific function in the system with use" [6].

Another definition was proposed in 2008 at the International Federation of Organic Agriculture Movements (IFOAM) General Assembly in Italy: "organic farming combines tradition, innovation and science for the benefit of the environment and promotes fair relations and a good quality of life for all involved" [7].

Given all these advantages, organic farming has begun to have more and more supporters, being considered a viable alternative to conventional agriculture [9], developing both globally and nationally [2].

In this context, the purpose of the paper was to analyze production costs recorded by six crops (sugar beet, sunflower, rape, soybean, rice and hemp), both in the case of applying the conventional and organic production system, in order to compare the profitability.

MATERIALS AND METHODS

The researches were carried out starting from the statistical data provided by the Ministry of Agriculture and Rural Development, as well as from the data published by the National Institute of Statistics and Eurostat regarding the ecological agriculture and the way of practicing it. The analysis also involved the processing of data collected within the project " Agriculture and Rural Development - ADER 23.1.1. The analyzed time period is between 2015-2019. The Technical and economic substantiation of the production costs and estimates regarding the capitalization prices of the main vegetal and animal products, obtained in conventional system and in ecological agriculture for 2020.

To make comparisons between the results of conventional agriculture and organic farming, we used statistical methods: Fixed-base index method and Chain-based index method, which reflected the dynamics of the phenomenon analyzed. These indices were determined as the ratio between the level of the compared indicator and the level of the indicator used as a basis for comparison. The calculation relationship used were:

$$I_{t/1}=y_t/y_1; \quad I_{t/t-1}=y_t/(y_{t-1}); \quad [1]$$

where:

y_1 - the level of the indicator in the reference period;

y_t - the level of the indicator in period t;

y_{t-1} - the level of the indicator in the period t-1.

RESULTS AND DISCUSSIONS

According to the Research Institute of Organic Agriculture (FiBL statistics), Europe ranks 2nd in terms of agricultural area used for organic farming, with Oceania ranking 1st. At the U.E. level. in 2019 there were 13.79 million ha converted or are being converted in terms of organic agriculture, increasing by 9% compared to 2017 (12.6 million ha) and by 46% compared to 2012 (Fig. 1).

Romania recorded an increase of 37% during this period, from 288 thousand ha in 2012 to 395 thousand ha in 2019, placing it among the countries with an increased conversion. However, the area destined for organic crops is the smallest in the European Union, of about 2%, given that the growth potential exists. Eurostat data show that in Romania there are about 33% of all agricultural farms in the EU, but about 70% of them have an area of less than 2 ha. The data also show that the number of organic farms in Romania is about 0.1%.

In these conditions, there is a need to promote organic crops, to apply agricultural policies that encourage the transition to this system of culture.

As we mentioned before, in Romania the area occupied by organic crops increased in the period 2015-2019 by 62%, this growth rate being above the European Union average.

The evolution of the arable area occupied by organic crops decreased in 2017 in the EU, the decrease being almost 50% compared to 2015. Subsequently, this area registered increases of 28% in 2018 compared to 2015 and 40% in 2019 compared to the same year (Fig. 1).

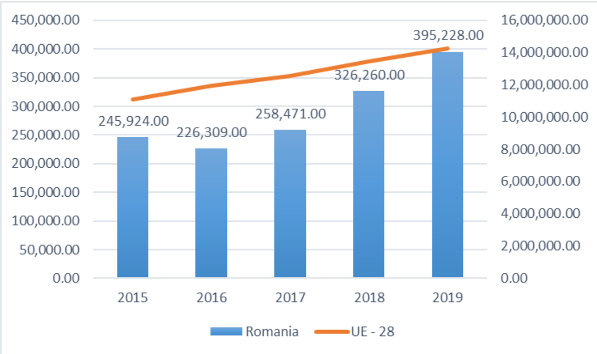

Fig. 1. Evolution of areas occupied by organic crops, Romania and U.E. (hectares)
Source: [5].

In Romania, the arable land areas destined for organic crops have increased since 2015. After a decrease of 1.5% in 2016, the increases were 22% in 2017 compared to 2015 and 51% in 2018, respectively 62% in 2019.

In the following we will analyze starting from the situation of the areas cultivated with sunflower, soybean, rapeseed, sugar beet, rice and hemp in the period 2015-2019, the production costs registered for these crops in 2020, both for the conventional system and for the ecological one (Fig. 2).

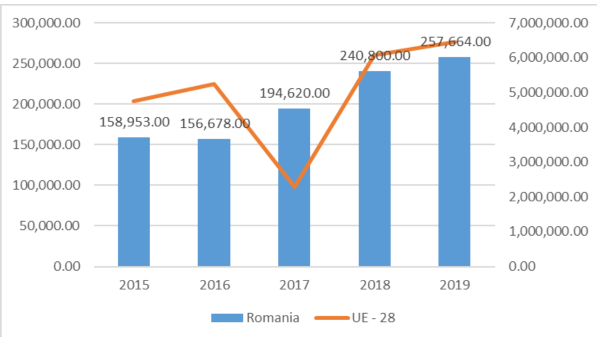

Fig. 2. Evolution of arable land for organic crops (ha)
Source: [5].

The data registered in the statistics of the National Institute of Statistics show that in the period 2015-2019 the area occupied by sunflower crops varied between 998.4 thousand ha in 2017 and 1,282.6 thousand ha in 2019 (Fig. 3).

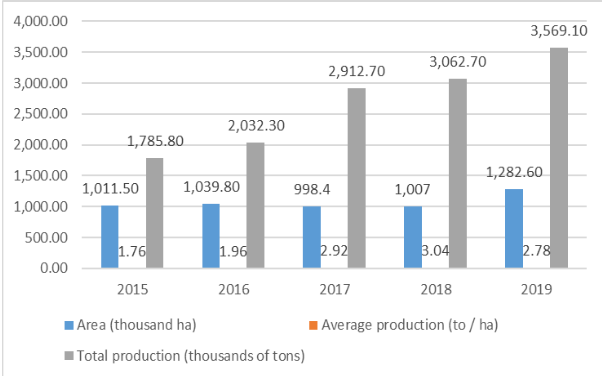

Fig. 3. Evolution of areas, average production and total sunflower production
Source: [8].

Compared to 2018, the total production increased by 14% in 2016, by 63% in 2017, by 72% in 2018 and doubled in 2019. It is found that these increases were due not only to the increase of areas, but also to average yields per hectare which increased from 1.76 to/ha in 2015 at 2.78 to/ha in 2019.

Regarding the area cultivated with soybeans, the increases were between 23% in 2019 compared to 2015 and 32% in 2018 compared to 2015 (Fig. 4).

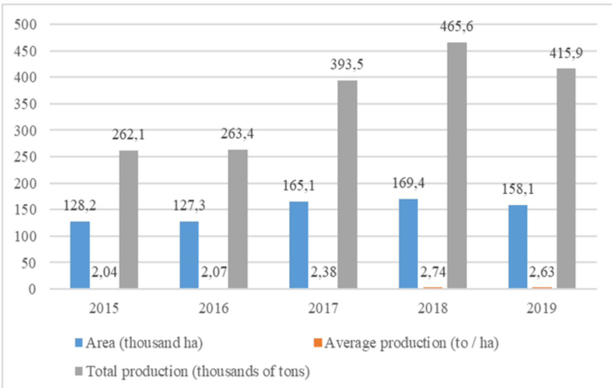

Fig. 4. Evolution of areas, average production and total soybean production
Source: [8].

However, we find that in the conditions of continuous growth of average production, by almost 30% in 2019 compared to 2015, the total production decreased in 2019 by 11%

compared to 2018, against the background of the decrease of cultivated areas by 7%. The year in which the largest production of 456.6 thousand tons was registered was 2018, the year in which the surface of this crop was almost 170 thousand ha (Fig. 4).

The rape, due to the favorable weather conditions in 2017, recorded the highest production in the analyzed period, this being 1,673.3 thousands of tons. This year the average production increased by 16% compared to 2015. In 2019, the average production was the lowest in the analyzed period, and given that the cultivated area was 352.6 thousand ha, the total production approached 800 thousand tons (Fig. 5).

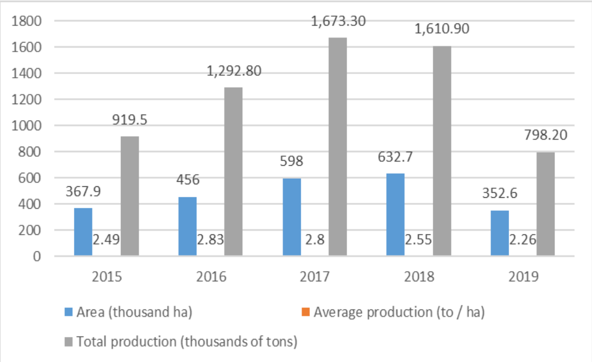

Fig. 5. Evolution of surfaces, average productions and total rape production
Source: [8].

In sugar beet, the year in which both the average production and the cultivated area were the highest was 2017.

This determined an increase in total production of 13% compared to 2015 due to the 6% increase in both average production and the cultivated area. In 2019, although the average production increased reaching approximately 41 tons/ha, due to the reduction of the cultivated area, the total production was 945 thousand tons.

Areas cultivated with flax and hemp increased compared to 2015. The highest increase, more than 4 times was recorded in 2017. Also, in 2018 and 2019 the increase was 350%, but the highest total production was recorded in the year 2016, this being over 370,000 tons.

Compared to 2015, in 2019 the total production increased by approximately 60%.

All these statistical data highlight the development potential of some cultures that are not part of the category of those traditionally cultivated on large areas, but also the possibility of expanding the areas grown organically (Fig. 6).

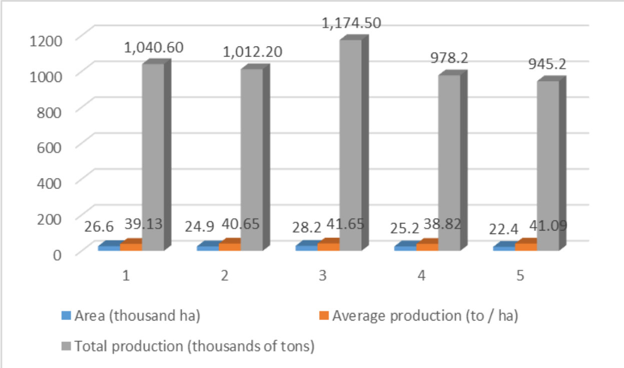

Fig. 6. Evolution of surfaces, average productions and total production at sugar beet
Source: [8].

In the following paragraph we will analyze the comparative economic indicators that reflect the economic efficiency of these cultures, both for the conventional system and for the ecological system.

Data on production costs show us that the lowest costs are recorded for hemp and sugar beet. Thus, if for the conventional culture system, the sugar beet has a cost of 34.36 euro/ton, in the ecological system it is 45.68 euro/ton, higher by 33%.

For hemp, the cost per ton in the conventional system is 34.77 euro, and in the ecological system it is 28% higher.

The highest production cost is recorded for soybeans, where the cost per ton was 486.94 euro in the organic system, being 53% higher than the conventional system. Also, for rice the cost in the organic system was 34% higher than by the conventional system.

The smallest differences were recorded for sunflower, where the cost difference was 6% and for rapeseed where the difference between the two cropping systems was 19%.

Regarding the average productions, there are also significant differences here. Thus, if for sunflower and hemp the average productions for the conventional system are higher by 25%, respectively 29%, for soybeans the average production is double the conventional insistence compared to the ecological one, and for rapeseed the average production is 50% higher (Fig. 7).

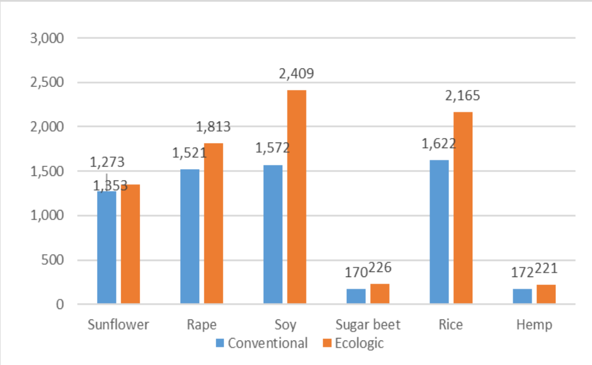

Fig. 7. Situation of production costs, for the analyzed crops (euro)
Source: [8].

Comparing the costs with the profit obtained, we find that five of the six crops analyzed record a profit rate for the conventional system (sunflower 3.4%, rapeseed 3.1%, sugar beet 18.2% and hemp 3.1%). Rice is the only crop with losses for both cropping systems. The most profitable crop is sugar beet, which has a 0.4% higher profit rate in the case of organic farming compared to the conventional system (Fig. 8).

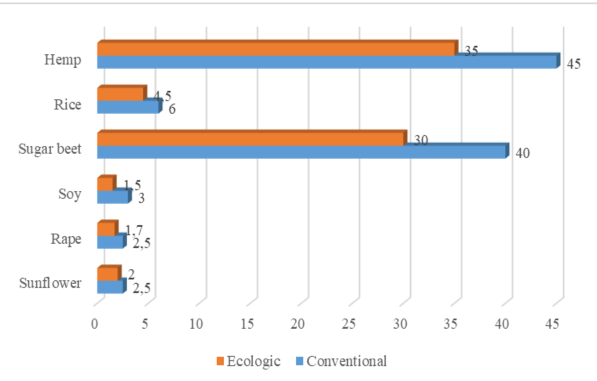

Fig. 8. The situation of the average productions, at the analyzed crops
Source: [8].

We can notice the rates of losses registered in the ecological system for rapeseed, soybean, rice and hemp. The highest rate of losses is recorded in soybeans (approximately 17% 0), and the lowest rate of losses is recorded in hemp (approximately 3%).

The calculations were made without considering the financial support granted in the form of subsidies (Fig. 9).

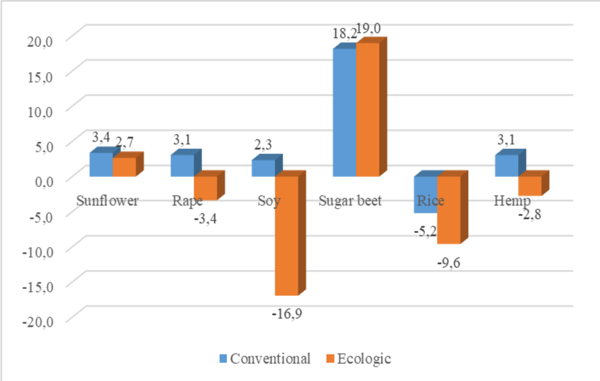

Fig. 9. Profit rate situation for the analyzed crops (%)
Source: [8].

CONCLUSIONS

Based on the analyzed data, it is found that, without considering the subsidies granted, some of the crops in the case study proved to be profitable, both in the conventional system and in the ecological system (sugar beet and sunflower). For the other four crops analyzed (rape, soybeans, rice and hemp) there were losses, but these can be covered by subsidies, the level of income depends on both the level of production obtained, but also the selling prices, which in the case of products ecological is inversely proportional.
The aspect that must be considered, however, is the one related to the level of production obtained, a level that can influence the choices that farmers make regarding the chosen crop system.

ACKNOWLEDGEMENTS

We thank the referees for all the data provided for this paper. The publication of this article was possible thanks to the sectoral project ADER 23.1.1: “Technical-economic basis of production costs and estimates regarding the prices of capitalization of the main plant and animal products, obtained in conventional system and in organic farming” Subcontract no: 23.1.1./2-03.10.2019 contracted with the Ministry of Agriculture and Rural Development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVOLUTION OF THE AGRICULTURAL LAND FUND OF THE REPUBLIC OF MOLDOVA IN THE CONTEXT OF THE TRANSITION FROM THE HYPER-CENTRALIZED ECONOMIC SYSTEM TO THE MARKET ECONOMY

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Abstract

Efficient management of the agricultural land fund is one of the basic priorities of each state. The given resource represents the totality of the agricultural lands within a territorial-administrative unit. The Republic of Moldova, having a specific geopolitical position, during the twentieth century was subjected to various areas of influence, which imposed their own views on how to manage the land. As a result, all the political and administrative changes involved the fundamental reform of the agricultural sector and, directly, of the agricultural land fund. The paper is a reflection of the evolution of the country's land fund in the context of social and political change during the XX-XI century. The analysis of that period showed that the only viable and efficient method of managing the land fund agricultural is private property based on the implementation of modern production technologies. The general research methods (empirical and theoretical methods) were used in the process of elaborating this report, the analysis of statistical data reflecting the evolution of the national land fund as well as of the agricultural land areas were widely applied.

Key words**:** *agriculture, land fund, reform, agricultural enterprise, consolidation, efficiency*

INTRODUCTION

The land is the main factor that underlies the existence of a state, a fact based on a series of principles, such as: geographical - by drawing the perimeter on a certain area of land are delimited the borders of the state; political-administrative - by approving and executing a set of principles of conduct, both within the state and in international relations; socially - the land is the place where the vital processes of the human population or the citizens of the respective country take place, economically - it is the main source of food and raw material necessary for the daily activity of the society [11].

Being an extremely valuable resource, but at the same time impossible to expand territorial, the efficient administration of the available land fund has been an essential objective at both: state and community level. The success of this action, to a large extent, is conditioned by the quality of the political, social and economic systems in which the management of the land fund takes place. Therefore, the history of the XX century proved that the market economic system, where agricultural land has the status of a commodity, is clearly superior to the economic system planned and widely propagated by the socialist-communist doctrine.

The Republic of Moldova, as the rest of the countries in the former socialist camp, has revised its economic development model, focusing on implementing a free market economy. Respectively, this fact imposed the execution of an extensive land reform which involved the redistribution of the country's population with agricultural lands, previously in the exclusive possession of the state. As a result, the administrative restructuring of the national land fund, but also of the former agricultural holdings has become a difficult and time-consuming process.

Stage of knowledge of the problem

The reforms and the successful management of the land fund of the Republic of Moldova is an extensive transition process, consisting of a series of successive actions, aimed at achieving two objectives: creating and ensuring the functioning of a genuine land market; promoting the concept of sustainable agricultural land management [6].

In general, twenty years after the start of the restructuring, the goals have been achieved. The domestic land market operates according to the principles of the market economy. The management of agricultural land is being improved constantly, but there are also a number of issues that need to be addressed. These topics are: excessive plots of land, the delayed process of consolidating small and scattered lands, inefficient management of protection and conservation of the quality of the fertile soil [10, 7].

Also, land market does not operate correctly as land price is very small due to the low land efficiency [6].

In this context, the purpose of the paper is the analysis of the agricultural land fund across the time in the Republic of Moldova pointing out the land reforms and their consequences in terms of economic and social impact till nowadays. Also, it aimed to assess in what manner the agricultural land restructuration has led to land consolidation and maintaining of the property rights and allowed the development of agriculture in agricultural holdings based on the principles of the market economy.

MATERIALS AND METHODS

The general research methods (empirical and theoretical methods) were used in the process of elaborating this report, the analysis of statistical data reflecting the evolution of the national land fund as well as of the agricultural land areas were widely applied. Case studies aimed at land reform of the Republic of Moldova have been documented.

Primary documents represented by specialized literature (books, monographs, scientific reports and teaching materials, etc.) as well as secondary documents in the form of institutional sources (statistics on the field) were used as sources for this research. The information provided by the National Bureau of Statistics was widely used, as well as the data provided by the Agency for Land Relations and Cadaster of the Republic of Moldova.

RESULTS AND DISCUSSIONS

All the agrarian reforms carried out on the current territory of the Republic of Moldova during the last centuries were based on the evaluation of the form of ownership and the administration of agricultural lands. The main factors that have contributed decisively to the realization of these changes are political, social and economic one. This fact is amply proved by the agrarian reforms carried out during the 20th century - the beginning of the 21st century, the period when these changes represent a multitude of hopes, disappointments and thousands destroyed destinies.

The first land reform, illustrated by relevant statistics, was carried out in the interwar period of Bessarabia (the official name interpreted by the Russian Empire of the territory of Moldova located on the left bank of the Prut River. Currently part of that territory forms the Republic of Moldova). 1919-1924. This reform was based on the following factors: social and economic inequality; the way in which the rural property was distributed, the increase of the number in rural population, the political situation of that period.

Thus, out of the total area of 4,129,589 ha of agricultural land subject to records in 1918 (including the land fund of Herta Lithuania, territory annexed to Ukraine in 1940), 1,327,491 ha or 32.15% belonged to people with more agricultural possessions, large of 109 ha.

The respective category of properties, including legal entities (monasteries, cities and state institutions), accounted for 2,171 units and owned 40.7% of the total area, while households with agricultural areas of less than 109 ha constituted 22,600 (59.3%) of units [1]. The given situation increased the discrepancy of incomes in the rural environment, making the given reform inevitable, fact that resulted in the redistribution of the existing land fund at that

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

time. Thus, the surplus of the agricultural area that exceeded more than 100 ha was subject to nationalization in favor of the state with a subsequent ownership of the peasants. As a result, the total area of agricultural land subject to redistribution was 1,491,920 ha, with 357,016 peasants being owned. Initially, it was thought that the minimum area of agricultural land to be owned by a peasant should be 6 ha, but in reality, it varied around 3 ha, in some cases even less than 1 ha.

This reform had both positive and negative aspects. Initially, it was possible to solve the current political and social problems, in a way it boosted the development of the industry thanks to the multiplication of trade relations between the new landowners and the producers of industrial goods. The negative effects of this reform have manifested themselves over time, being exposed by slowing down the mechanization of agricultural operations, excessive parceling of land plots. This has considerably stagnated the development of the agricultural sector in interwar Bessarabia.

The next land reform carried out on the territory of our country took place during the years 1940-1950, an action with a dramatic social, political and economic effect for the local population. Based on abuse, terror and violence, this reform presented a mixt between Marxist-Leninist ideology and a kind of economy based on socialism. According to this doctrine, the state had the exclusive right over all production resources, including the land fund, and the administration of this good being carried out through collective households (kolkhozes and sovhozes). This method of management had already been applied in the Soviet Union since 1924 and was to be imposed on the new annexed territories.

The actual reform began immediately after the annexation of Bessarabia to the Soviet Union (June 28, 1940). Initially, all agricultural land was nationalized, becoming subordinate to the state. However, as this process was carried out in the middle of the summer of that year and the common farms were not yet organized, the new authorities found themselves in a situation where they did not have the capacity to carry out the harvesting process. In order to solve this situation, the Soviet officials resorted to an original trick, namely, the agricultural land left to be destroyed by the former owners was redistributed among the local peasants.

Subsequently, after the end of the harvest, the peasants were forced to return to the state almost entirely the agricultural production already harvested. With the end of World War II, the process of agricultural reform of Bessarabia (renamed the Moldavian Soviet Socialist Republic or MSSR) resumed. However, due to the disastrous economic situation, but also to the severe drought of 1946-1947, the reform process stagnated, being resumed in full force only in 1949. Thus, at the end of 1950, the agricultural land fund of the MSSR represented 2,808 thousand ha, of which 2,724 thousand ha (97%) were subject to collectivization, being nationalized, at the same time, 433,923 individual properties [8].

In the next ten years of Soviet administration, according to statistics for 1960, the agricultural land fund amounted to 2,717 ha, of which 2,366 ha were in the possession of 206 collective households, and the auxiliary households accounted for only 351 thousand ha [9]. Over the next 30 years, the structure of this fund has undergone some changes. Thus, according to statistics for 1990, the total area of agricultural land decreased by 8.6% compared to 1950, amounted to 2,566 thousand ha, of which: collective farms owned 2,222 ha, auxiliary households - 324 thousand ha, state land reserve - 7 thousand ha, other land beneficiaries - 13 thousand ha [5].

This agricultural reform, like the previous reform implemented during the years 1918-1924, was based on the redistribution of the agricultural land fund but with the implementation of the collective management model, this fact having both positive and negative aspects.

The good part of this restructuring was the consolidation of agricultural land that was excessively parceled out. By creating collective farms that owned several thousand hectares of agricultural land, it was possible to implement more efficient agricultural production technologies. Thus, it was possible to introduce the crop rotation of agricultural fields, the widespread use of agricultural machinery and, respectively, the intensive mechanization and automation of agricultural processes, were created households specialized in producing a limited group of crops (vineyards, orchards, vegetables). . With the increase of the economic efficiency of the respective households, the living standard of the rural population involved in agricultural activities gradually increased, and this category until 1990 varied around 20% of the total available labor resources.

However, the socialist economic system was far surpassed by the market economic system implemented by Western countries. This was evident in all sectors of the MSSR economy, but especially in agriculture. Regardless of the massive financial investments directed towards this sector, the tendencies to implement the super intensive system of agriculture, the yield and the macroeconomic indicators yielded a lot to those in the developed countries. Low productivity of agricultural land, irrational land use - which accelerated the process of erosion, very low labor productivity led to the economic collapse of this sector, the national economy as a whole, but also the Soviet Union as a state.

Due to these circumstances, the Republic of Moldova has established itself as a state, orienting its economic mode of development towards an economy based on market economic relations. This created new premises for the start of the next agricultural reform, and again based on the distribution of the national agricultural land fund, a reform that lasted over ten years.

At that time, the low economic efficiency of Soviet-style farms, the growing danger of supplying these households with production resources because of the disintegration of economic relations between the former Soviet republics required radical actions to reorganize the entire agricultural system.

The actual reform started in 1992, with the independence of the Republic of Moldova. Initially, this restructuring aimed at reorganizing the former farms (kolkhozes and sovhozes) into agricultural cooperatives of production with full rights of self-management - an action that was to increase the economic efficiency of these economic entities. The next action of this reform was the redistribution of real estate, including agricultural land, among the members of these households. However, as a result of the continuing deterioration of the national economy, the lack of experience of decision-makers, the reform did not yield any tangible results. Thus, the new households formed within five years have accumulated debts to the state and suppliers in the amount of millions of lei, and the process of transferring agricultural land owned by citizens was limited only to the privatization of plots of land near households, amounting to only 350 thousand ha or 10.3% of the agricultural land fund.

The process of liquidation of inefficient farms but also the massive redistribution of agricultural land accelerated in 1998 with the implementation of the project "National Land Program". As a result, 98.7% of the agricultural land was privatized over the next two years, 1,034 collective farms were completed, 864 collective farms were liquidated [8].

Land reform, as well as the reform of the entire agro-industrial complex, took place in the following years. According to the 2011 General Agricultural Census [8], both the structure of the national land fund and the forms of its administration had the configuration presented in Table 1.

In Moldova, of 2,243,540 ha agricultural land, 56.72% belongs to Agricultural holdings with legal personality and 43.28% to the ones without legal personality.

In the total number of agricultural holdings, accounting for 902,214, 99.61% are without legal personality. Among the agricultural holding without legal personality, there are 164,831 small family farms, with a share of 18.33%.

As a result the average farm size in Moldova is very small, only 2.49 ha/farm, but 0.38% of agricultural holdings representing the ones with legal personality have an average size of 369.32 ha.

The smallest size is in the smallest family farms who owns only 0.06 ha/household (Table 1). Similar aspects were pointed out in their research works by [10], [7] and [3] who affirmed the existence of land fragmentation and small size of the farms in Moldova, and that because of this modern technologies cannot be applied compared to EU countries.

Table 1. Agricultural land and farm structure in the Republic of Moldova

Farm type	No. units	% of total	Agricultural land, ha	% of total	Average land per farm ha
Total (a)+(b)	902,214	100.00	2,243,540	100.00	2.49
(a)Agricultural holdings with legal personality	3,446	0.38	1,272,666	56.72	369.32
(b)Agricultural holdings without legal personality	898,768	99.62	970,874	43.28	1.08
-Small agricultural farms	164,831	18.26	9,830	0.44	0.06

Source: General Agricultural Census, 2011 [8].

Reforming the process of redistribution of agricultural land has been completed, but a negative issue has emerged - excessive parceling of plots. Due to the large number of potential owners, the problem was obvious from the beginning of the first stage of the process. Thus, according to the Land Code (no. 828/199) of December 25, 1991 [4] based on the principle of social equity, approximately 1.5 million ha of agricultural land was divided into 1.2 million citizens.

The process of redistributing the agricultural land fund has resulted in an excessive subdivision of agricultural land. The average surface of the plot was around one hectare of agricultural land, but it was also delimited in arable land and land occupied by perennial crops, which further dispersed the agricultural area. Initially, in the distribution process, it was counted on the principle of neighborhood where the agricultural land was to be distributed among persons of different degrees of kinship in the perspective of the subsequent consolidation of the plots. In reality, the given option did not materialize, still maintaining the dispersed management character of these plots of land. Consequently, 704 067 households owned and processed 749.9 thousand ha of agricultural land, on average 1.06 ha for each household [2].

The excessive number of small farms has completely distorted the agricultural production process. Being limited in the application of modern production technologies, lacking financial and production sources, these entities reoriented themselves to an extensive agriculture without an added economic value, and the production obtained was destined for self-consumption. Therefore, the contribution of these households to the development of the national economy was minimal.

In order to remedy this situation, the central administrative authorities have started an extensive process of consolidating agricultural land, taking into account, at the same time, the principle of the right to property. A set of mechanisms was developed and adopted with the aim of developing the land market, creating the optimal conditions for establishment and activity for new forms of agricultural enterprises. As a result, in the landscape of national economic activities are currently active such legal forms as: Limited Liability Companies (LLC), Individual Enterprises (IT), Peasant Households (GO), Joint Stock Companies (SA).

This has favored a broad restructuring of the forms of land administration resulting in obvious progress in the economic recovery of the agricultural sector. According to the data provided by the Agency for Land Relations and Cadaster of the Republic of Moldova on 1.01.2021, the national agricultural land fund

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

has not undergone essential changes and constitutes 1,376,1 thousand ha in the possession of 1,283,239 landowners. However, due to efforts to consolidate and optimize management methods, the number of agricultural holdings that own or lease large areas of agricultural land has increased substantially. After reporting the afore mentioned source, on January 1, 2021 the situation of agricultural land and farm structure in the Republic of Moldova was as presented in Table 2.

Table 2. Agricultural land and farm structure in the Republic of Moldova on January 1, 2021

Farm type	No. units	% of total	Agricultural land, thousand ha	% of total	Average land per farm ha
Total (a)+(b)	307,783	100.00	1,376.1	100.00	1.66
(a) peasant households	271,160	88.1	466.6	33.9	1.72
(b) limited liability companies	34,187	11.1	812.3	59.0	23.76
(c) agricultural cooperatives	1,408	0.46	69.9	5.1	49.64
(d) joint stock companies	1,028	0.34	27.3	2.0	26.55

Source: [4]. Cadastre of the Republic of Moldova 2021.

The data in Table 2 show that currently the most viable forms of agricultural land management (from an economic point of view) are the limited liability companies (59% of the agricultural land fund) and the peasant households (33.9%). In the future, there is a clear downward trend in the number of households and the areas worked by these economic entities. This is influenced by economic opportunities, the much wider scope of maneuver offered by the legislation of the Republic of Moldova to limited liability companies.

At the same time, the simplification of the lease relations and the increase of the minimum period of leasing of the agricultural land allows these economic entities to successfully implement advanced production technologies.

Due to the market relations, the principle of economic efficiency, the given structure is in a permanent change. This is conditioned both by the principles of economic activity and by the policies promoted by central and local authorities.

A significant contribution to the efficiency of the economic activity of agricultural enterprises is provided by scientific research institutions in the Republic of Moldova. Through research projects and programs, for example the State Program "*Development of new economic instruments for assessing and stimulating the competitiveness of agriculture in the Republic of Moldova for the years 2020-2023" (figure - 20.80009.0807.16),* executed within the National Institute of Economic Research in Chisinau, both the optimal land management models and the ways to attract investments for the development of a sustainable agriculture are identified.

CONCLUSIONS

On the basis of all agrarian reforms carried out on the territory of the Republic of Moldova was based on the administrative restructuring of the agricultural land fund.

These actions were triggered under pressure from social, economic and political factors.

The first attested reform in statistical materials took place between 1918 and 1924 and aimed at redistributing agricultural land in order to alleviate economic inequity between different social classes. The result of this restructuring has resulted in the re-ownership of a significant number of peasants, but in the long run this action has led to a delay in the development of the agricultural sector caused by the excessive subdivision of agricultural plots.

The reform from 1940 to 1950 was carried out on the principles of communist ideology, the total nationalization of the agricultural land fund was carried out, large collective households were set up. Due to the total consolidation of agricultural land, it has been possible to mechanize large-scale agricultural processes, the introduction of new production technologies, but the hyper-centralized socialist economic system has substantially diminished the economic efficiency of these households.

As a result of the political events of the early 1990s and the independence of the Republic of Moldova, the central authorities decided to implement the market economy principle as a model for development. Since 1992, the agricultural land fund has undergone extensive administrative restructuring. As a result, this fund was redistributed to 1.2 million citizens, which led to an excessive subdivision of agricultural land.

The efforts of the authorities within 30 years of the start of this process have succeeded in: building a viable land; restructuring the agricultural sector by creating the premises for land consolidation; maintaining the right to property; the emergence of new types of agricultural enterprises operating on the principles of the market economy.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SAFFRON (*CROCUS SATIVUS*) AS AN ALTERNATIVE CROP IN SUSTAINABLE AGRICULTURAL SYSTEMS. A REVIEW

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Abstract

Saffron (Crocus sativus) is a bulbous perennial of the iris family Iridaceae. The plant of C. sativus is generally planted for the production of the most valuable part in its flower the stigmas, the commercial name of the dried stigmas being saffron. Crocus plant was considered as 'red gold' and the most expensive spice in the world. This paper aims to pay attention to the world distribution of saffron, its application in various fields and the possibility for its cultivation as an alternative crop in sustainable agricultural systems. The materials used in the research paper cover a wide range of information that credibly cites the authors who reported or referenced the important information about saffron. Available scientific literature enriching information on saffron was used. The collected scientific material is analyzed theoretically, as the article is a review. From antiquity, saffron was widely used as a spice for culinary purposes and food colorant, as well as a dye, preparation of perfumes, preparing tea. In particular, saffron is gaining increasing attention as an alternative crop in sustainable agricultural systems due to its unique biological, physiological, and agronomic traits, such as the capability to exploit marginal land. From an agronomic point of view, saffron is well adapted to different environmental conditions and in recent years a growing interest has been reported in growing saffron in low-cost systems, for example in mountainous regions.

Key words**:** *Crocus sativus, Saffron, sustainable agriculture*

INTRODUCTION

Crocus sativus is a bulbous perennial of the Iris family (Iridaceae) [41, 16, 56]. The plant of *C. sativus* is generally planted for the production of the most valuable part in its flower - the stigmas [88, 56], the commercial name of the dried stigmas being saffron [47, 97, 102]. The name 'saffron' is derived from the Arabic word zá-faran/'Zafaran' [105], which comes from the Persian word 'Zarparan', meaning 'flowers of golden petals' [34]. Crocus is considered the 'red gold' [63, 73, 59, 56, 52] and the most expensive spice in the world [70, 101, 8, 38, 55, 105, 97]. This 'golden' spice is known as 'Kum Kum' and 'Kesar' in Sanskrit, and 'Koung' in Kashmiri language [43, 44, 34]. Its very high price is directly linked to the intensive hand labour required for the daily flower picking, separation of stigmas and drying [36, 37, 96, 95].

This paper aims to pay attention to the world distribution of saffron, its application in various fields and the possibility for its cultivation as an alternative crop in sustainable agricultural systems.

MATERIALS AND METHODS

The review article draws attention to *Crocus sativus*, as a bulbous perennial that is commonly planted to produce the most valuable part in its flower - the stigmas. Its prevalence and wide use in traditional medicine, culinary, etc. are indicated, as well as the main parameters used to determine the quality of saffron, namely colour, flavor and aroma. The materials used in the research paper cover a wide range of information that credibly cites the authors who reported or referenced the important information about saffron. Available scientific literature enriching information on saffron was used.
The collected scientific material is analyzed theoretically, as the article is a review.

RESULTS AND DISCUSSIONS

[53] cites [21] who state that over 418 tons/annum of saffron are produced worldwide in areas as follows: in Iran - 108,000 ha, in Afghanistan - 7,557 ha, in India - 3,674 ha, in Greece - 1,000 ha, in Morocco - 850 ha, in Spain - 150 ha, in Italy- 70 ha, and in France - 37 ha. Saffron (*Crocus sativus* L.), is a plant cultivated in various parts of the world, including Iran, China, Spain, Italy, Greece [55, 94, 72, 20, 53], Algeria, Tunisia [15, 81], Azerbaijan, France, Egypt, India, Israel, Mexico, Morocco, Turkey [82, 85, 103, 56], Tibet [16], and Portugal [98]. Saffron is native to Iran and Greece [16]. Iran is the most important saffron producer in the world with a share of 90% of the total production [2, 77, 102, 75, 104, 99] and has the widest cultivation area of saffron covering 47,000 ha, most of which is grown in the Khorasan province [64, 38]. Other locations in Iran, where saffron is grown, are Birjand, Ferdows, Ghaem, Neishbor, and Sahr-Kord. In India it is mainly cultivated in Kashmir and Uttranchal [16] as in the Pampore Karewa of Kashmir saffron cultivation dates back to very ancient times [34]. Saffron cultivation areas are significantly less in Greece (Kozani, Western Macedonia), Azerbaijan (Aspheron peninsula) and Morocco (Taliouine area) [38], Spain (La Mancha), and Italy (Navelli). In Italy there are also small areas of saffron cultivation concentrated mainly in Sardinia (S. Gavino, Cagliari province) and Abruzzo (Altopiano di Navelli, L'Aquila). The authors [30, 31, 38] point out that saffron is also grown on larger areas in France, Turkey, Switzerland, Israel, Pakistan, China, Egypt, United Arab Emirates, and Japan. The Taliouine region in Morocco provides bulbs and saffron, but in recent years there has been a spread to new parts of the country, such as Elhaouz, Oulmes, Boulmen, Chefchaouen, and Midelt [3, 67]. According to Hasan Tahirov- the Chairman of the Bulgarian National Association of Producers of Saffron and Organic Saffron Products, there are 4,750 saffron producers - members of the organization covering an area of about 7,500 dka, which is constantly growing due to the great interest in saffron. Tahirov points out that the soil and climatic conditions in Bulgaria are favourable for saffron cultivation. In Bulgaria, saffron is grown at an amateur level, and the enthusiasm and aspiration of Bulgarian farmers to grow saffron may be seen in Kardzhali region (village of Oreshnitsa, village of Gluhar); in Haskovo region (village of Golyamo Asenovo, village of Slavyanovo, town of Harmanli); in Yambol region (village of Drazhevo); in Shumen region (village of Dobri Voynikov, village of Pristoe); in Silistra region (village of Bradvari, town of Dulovo); in Vratsa region (village of Krushovitsa); and in Sofia region (village of Trudovets).

Saffron is classified into Domain Eukarya, Kingdom Plantae, Phylum Magnoliophyta (Angiosperm), Class Liliopsida (Monocot), Order Asparagales, Family Iridaceae, Genus Crocus and Species *C. Sativus* [34, 38] point out the biological cycle of saffron described by [7], namely that saffron is an autumn-flowering geophyte that is characterized by a long summer rest, during which the plant survives periods of drought by means of corms. Due to the sterile nature of saffron, the only technique of propagation is classically by daughter corms forming below or on the sides of mother corms; the mother corm thrives only for one growing season and produces 4-5 cormlets; therefore, the rate of propagation is relatively low [99]. [97] cites [27] who state that the annual cycle of saffron involves five major stages: sprouting, flowering, leaf development, development of daughter corms, and dormancy. Saffron is cultivated under various environmental conditions [107]. Saffron cultivation requires explicit climatic conditions with temperatures ranging from not more than 35ºC or 40ºC in the summer to about -15ºC or -20ºC in the winter, and can be grown in dry, moderate and continental climate types. It thrives on loamy, sandy, and calcareous soils. Gravelly soil is also excellent for saffron farming, while heavy clay soil is not. Saffron grows best on acidic soil. It thrives well when the soil pH is 5.5 to 8.5 [53].

Rainy autumn, mild winter and warm summer represent the optimal climatic conditions for this species [28] The monthly minimum and maximum temperatures are the most important variables influencing saffron yield in most of the studied locations [39, 107]. Saffron loves dry hot summers and grows well in climate with annual rainfall ranging from 250 mm to 600 mm. However, in very dry summers it may be necessary for you to water your saffron once - through sprinkling, for stimulation of growth, as rainfalls just before flowering increase the yield. The terrain should be slightly inclined for the water to drain away, as it is preferable to have a sunny terrain facing south. The areas, subject to selection, should be crop-free for the last 3 years as regards crops such as potatoes, carrots, onion, garlic, lucerne, flowers (narcissi, irises, fressias, gladioli), which suffer from the same diseases as saffron, with the best option being for the saffron to be returned to its crop rotation after 10 years. It is recommended to make deep ploughing in the autumn, and to perform preliminary preparation of the soil in April/May. And before planting the bulbs it is preferable to enrich the soil, as proper fertilization significantly increases the yield of saffron [45]. Saffron is a perennial crop (at least 4 to 5 years) that requires sufficient nutrients [64, 53, 39, 8] and due to its low water requirement it occupies a particular position among field crops [64], but realizes very low harvested yield (stigmas/biomass), and in countries with mild and dry climate it is important to improve cultivation in order to increase yields. [53] report that the critical environmental parameters that affect saffron production are altitude, temperature, photoperiod, topographic location [74, 22]; loose, low density, well-irrigated and well-drained clay calcareous soils with an optimum pH range between 6.8- 7.8 [109, 8] cites [14] and [51] indicating that 20-80% of saffron yield is attributed to soil fertility (C/N ratio, available phosphorus, mineral nitrogen and exchangeable potassium). [53] cites [37] indicating the highest flower number and dry stigma yield when planting corms with high density in sandy soil, while obtaining the highest stigma weight on sowing corms in clay soil with high density. Saffron has a growth length of 220 days, as it needs a mild winter but with enough snow and a dry and hot summer [64]. When plants begin to bloom, harvesting commences quickly, for the flowering period may last only 15 days. The triple stigmas are picked by hand daily just as the flower opens. On drying, either in the sun or by artificial heat, the stigmas lose 80% of their weight. After harvest and when fully dried, saffron must be stored immediately, preferably in tightly covered or sealed tin containers, and protected from light to avoid bleaching. The final product is a compressed, highly aromatic, matted mass of narrow, threadlike dark orange to reddish brown strands about 1 inch long [98].

Saffron is a sterile triploid (2n = 3x = 24) plant with a large genome size and a unique source of specific apocarotenoids [31, 99]. The three foremost parameters used to define saffron quality are colour, taste and aroma [100, 23]. [101] cite [13] according to whom saffron is widely used as a food additive for its colour and aroma (taste and smell). The main aroma factor in saffron is safranal, which comprises of about 60% of the volatile components of saffron [92, 42]. Safranal may be partly responsible for the therapeutic effects of saffron, which used to be considered as important factor in traditional treatment of various disorders [78]; [6]; [1]; [31]; [17]. Carotenoids are responsible for the intense colour that saffron provides to aqueous solutions. The main carotenoid of saffron was first isolated by Aschoff in 1818 and was called crocin from the word 'crocos' meaning saffron in German [12].

[94] cites [106], according to whom phytochemical studies of saffron have shown that the main chemicals responsible for its color are crocins, which are a series of mono and diglucosyl esters of crocetin, a polyene dicarboxylic acid (8,8-diapocarotene-8,8-dioic acid). Further secondary metabolites include flavonoids (mainly glycosidic derivatives of kaempferol), mangicrocin, an unusual xanthone-carotenoid glycosidic derivative, and picrocrocin, namely 4-(b-D-glucopyranosyl)-2,6,6-trimethyl-1-cyclohexene- 1-carboxaldehyde, this last responsible for the bitter taste of the spice

[96]. [102] reports that in order for the stigmas of *C. sativus* L. to turn into a spice, a dehydration process is necessary and according to [24] drying causes changes in the physical, biochemical and chemical properties of saffron. [61] reports that the quality of saffron is determined in accordance with ISO 3632 (2003), and depending on the physical and chemical characteristics saffron is classified into three categories. One stigma of saffron weighs about 2 mg and each flower has three stigmata; 150,000 to 200,000 flowers must be carefully picked one by one to obtain 1 kg of spice [72] and about 400 hours of work [67]. Saffron-growing in Spain has been world-wide referenced both in yield and quality; the spice produced in the region of Castilla-La Mancha, Spain is globally recognized as being of the best quality [23, 59]. Among the varieties, the most hard to find on the market is the saffron coming from the Indo-Pakistani area of Kashmir, which produces the darkest variety in the world that tends towards a purple-brown colour, called Mongra or Lacha. The small Italian village of Zafferana Etnea, Sicily produces a very rare variety of saffron, and the most precious saffron in the country comes from the valleys close to the city of L'Aquila in Abruzzo [33].

For a long time, saffron has been neglected by researchers and farmers since it was considered a minor crop used only for agricultural diversification [38]. Nowadays, the interest in it is increasing due to its applications in industry viz., the textile, dye, drug and culinary adjunct, coloring, and flavoring industries; furthermore, it has also gained interest for its pharmacological properties [65, 66, 53]. Its other advantages are the higher cost and lower water needs [99]. In recent years, saffron cultivation has assumed a more important role in low-energy agricultural systems, such as the organic farming system [68]. In particular, saffron is gaining increasing attention as an alternative crop in sustainable agricultural systems due to its unique biological, physiological and agronomic traits, such as the capability to exploit marginal land [50]**.** Saffron is cultivated in a wide range of environments [38] and from an agronomic point of view it is well adapted to a variety of environmental conditions from dry subtropical to continental climates [11, 60, 64, 50, 96, 57]. There is a growing interest in applying low-input cropping systems (e.g. saffron cultivation) in mountain regions. Saffron may be also cultivated under semi-mountain and mountain conditions [48]. Climate change has become the biggest threat to Nature and humanity with data showing that the 15 hottest years on Earth on record occurred in the last 20 years. In Bulgaria we witness increasingly longer periods of drying up [25]. It is expected that by the end of the XXI century there will be a decrease in Bulgaria of the average annual precipitation of 5- 10 to 15- 20%, reaching its highest point in the summer and in South East Bulgaria [5]. The growing impact of the Azores (tropical) anticyclone on the temper of weather already affects even the winter weather in Bulgaria with a tendency towards more snowless and warm winters [62]. The expected significant increase of the frequency of dry periods in Bulgaria requires purposeful and reasonable measures as regards the rational use of water resources, as well as the adaptation of the agricultural profile towards more dry-resistant and drought-loving crops [26]. Climate change, which is the result of the global trend of temperature increase, may create an opportunity to cultivate the crop saffron in regions, which already have the necessary climatic specifics, namely soft and low temperatures, respectively during the day and at night. The climate to the south of the Balkan Mountains become increasingly Mediterranean [25].

There is also an assumption that climatic changes in Italy and Spain will affect the reduction of their production, and that in the next 40 years the Balkans will prove to be the most favorable place for the cultivation of this crop [46].

Saffron is becoming a "modern" crop on alternative farms in Bulgaria, following attempts to redirect tobacco production [71]. There are scientific publications on saffron in literature covering its biology [19, 37], history [55], origin [18, 57], chemical composition [78, 54, 105, 19], distribution and production [29], cultivation [89], harvesting, processing, yield [90], and uses [68]. In Antiquity saffron was widely used as a spice for culinary purposes and a food colorant, as well as a dye [40, 41, 42], for preparing tea, perfumes [16], cosmetics preparation [13, 38], incense sticks. Its health management properties was discussed in traditional prescriptions, including Chinese, Ayurveda and Unani medicines [76]. Especially recently, saffron has been used as a natural colorant instead of synthetic colorants [9]. In recent years, the use of saffron in food applications has been steadily increasing, despite its high price, because of changes in consumer preference toward natural products. The stigmas of *C.sativus* Linn. are used as coloring and flavoring agents in the preparation of food in different parts of the world. Saffron stigmas have a pleasant bitter and somewhat warming taste [16]. True saffron has a pleasantly spicy, pungent, bitter taste and a tenacious odor. Besides being steeped in tea, it is used for seasoning many foods, such as fancy rolls and biscuits, rice. It is a highly prized spice used for both sweet and savory dishes, most notably Italian risotto, Spanish paella, and many Iranian and Asian recipes [97]. Saffron is used as a spice on fish products, meat, pastry, cooked rice, soups, cheeses, lemonades, food sauces [10]. In Sicily, the interest in this crop is even greater and particular, as it is involved in the production of the traditional 'Piacentinu Ennese' cheese, the taste, colour and aroma of which are strongly influenced by this spice [96]. It is possible to buy wines aromatized with saffron, as well as many liqueurs, comprising vodka and gin, which are renowned for their digestive properties [33].

Herbal/natural products represent one of the most common forms of complementary and alternative medicines [94, 69, 108]. The stigmas of the plant are mainly used for therapeutic purposes [79, 16]. In Persian traditional medicine, it is used for treatment of depression [76, 58] quotes the authors [32] who point out that the dried stigmata of *Crocus sativus* L. have been used in traditional medicine against spasms, bronchospasm, menstruation disorders, liver disease, pain, insomnia, digestive ailments and as a stimulant, aphrodisiac, antidepressant and for supportive treatment of cancer [91]. [82] point out that according to the authors [86, 83, 84] saffron and its ingredients have hypolipidemic, anti-inflammatory, antioxidant and anticancer effects [110], moreover, this is applicable for the treatment of asthma.

[72] and [78] adds that the stigmata of saffron are also used in folk medicine as an anticatarrhal, eupeptic, antispasmodic, expectorant, emmenagogue and nerve sedative. [8] reports authors [87, 105] indicating that the stigmata of saffron have been used as a sedative and analgesic in traditional medicinal preparations. [76] cite authors [35], according to whom *Crocus sativus* has a role as an expectorant, anti-asthma agent. [93] and [80] adds that saffron is used to treat coughs, whooping cough, atherosclerosis, intestinal gas, Alzheimer's disease and dry skin. [50] reports that according to authors [40, 49, 4] this herb has many pharmacological properties, such as anti-inflammatory, antioxidant, anti-tumor and anti-depressant effects.

CONCLUSIONS

Saffron (*Crocus sativus* L.) is a plant that is cultivated in different parts of the world and that is gaining increasing attention as an alternative crop in sustainable agricultural systems due to its unique biological, physiological and agronomic characteristics. From an agronomic point of view, saffron is well adapted to different environmental conditions and in recent years a growing interest has been reported in growing saffron in low-cost systems, for example in mountainous regions.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE RELATIONSHIP BETWEEN THE VOLUME OF OUTPUT AND THE LEVEL OF UNEMPLOYMENT IN THE RURAL AREAS OF THE REGION

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Abstract

The problem of unemployment for rural residents of municipalities in the region has become very relevant in recent years, as well as for all residents of Russia. In the current conditions, there was a massive reduction in jobs and depreciation of the labor force. Extremely low wages at vacant jobs, does not even ensure the simple reproduction of an employee The empirical method of grouping Sturges is used to determine 6 groups of districts depending on the level of unemployment. A methodical approach to planning the unemployment rate based on the interpretation of Okun's law is proposed. The paper estimated the empirical sensitivity coefficient and adjustment of the potential size of agricultural production per capita of the working population for all categories of farms (agricultural enterprises, peasant farms, personal subsidiary plots). Also, it aims to identify the dependence of changes in economic indicators based on the increase of employment level. It shows the possibility of reducing the unemployment rate o from 0.77 to 4.30 points with an increase in production by 7%; (taking into account the estimated sensitivity factor of 1.12).

Key words**:** *agricultural products, employment, potential, unemployment, working-age population*

INTRODUCTION

The reasons for the unemployment of a rural settlement are, first of all, the reduction of enterprises associated with the production and processing of agricultural products. Partial or complete cessation of the work of many agricultural industries, slowdown in the creation of new ones, modernization and reconstruction of existing ones.

Increasing the level of employment of the population must be included in the list of priority tasks for solving social problems in rural areas. The costs of unemployment are insufficient output. As a result of the underutilization of the total labor force, the revenue side of municipal budgets is reduced, tax revenues are reduced, and revenue from the implementation of various types of activities is reduced; which leads to a decrease in the standard of living, loss of personal income of persons who have become unemployed. Researchers like [10] noted the importance of increasing the productivity of agricultural production. Its reduction has a profound impact on the cost of production, gross value added and labor costs. Which in the future can lead to a reduction in employment. Also, [3] justified the need to form consulting services and specialized recruitment agencies in order to develop the rural labor market and reduce unemployment.

The prerequisite for considering this issue was that it is the opacity of the labor market, the lack of information about the hidden processes taking place on it, that leads to its disorganization – an oversaturation or unclaimed specialists and a shortage of required workers. These factors, in turn, further contribute to the growth of informal phenomena in the labor market – informal employment and informal unemployment. There is a social vulnerability of the able-bodied population, an increase in the number of unemployed, going into the "shadow" of enterprises, which is a barrier to development and reduction of the tax base. The solution to the current problem of unregistered officially unemployed is within the competence of regulatory institutions and labor market participants [5]. Also, a special place in the regulation of the labor market and the identification of labor potential is occupied by the labor exchange, as an intermediary between employees and employers in transactions for the sale of labor and, thereby, being a regulator of unemployment [1, 4].

MATERIALS AND METHODS

To analyze the current level of unemployment, the grouping feature determined the “number of unemployed people” divided by the Sturges rule of thumb into 6 conditional groups on average over a period of 7 years, and the calculated interval step is 176 [12]. The application of this method gives good results if the population consists of a large number of units, in our case it is 38 districts of the region. Second method: Okun's law represented by an empirically established ratio, according to which, for every two to three percent increase (or decrease) in real output compared with the natural level, there is a decrease (or increase) in the unemployment rate by one percentage point relative to the natural value [9].

RESULTS AND DISCUSSIONS

The analysis of unemployment in rural areas of the Saratov region in the context of sustainable development of rural areas contains statistical materials grouped by municipalities of the region, and includes the dynamics of indicators in the field of employment and general unemployment; registered unemployment; in the registered labor market.

Table 1. Estimated unemployment rate in rural areas of the Saratov region on average for 2013–2020, people

Categories	Unemployed	Unemployed, voluntarily laid off	Unemployed laid off due to liquidation of enterprises	Unemployed, long-term idle
1 group				
Average for the period	12.3	54	16	23
Ratio of 2020 to 2013, %	73.7	98/2	33.8	115.0
Ratio of 2020 to 2018, %	89.9	107.7	63.3	105.7
2 group				
Average for the period	303	110	37	53
Ratio of 2020 to 2013, %	65.2	87.4	22.9	66.6
Ratio of 2020 to 2018, %	83.1	106.7	37.5	101.2
3 group				
Average for the period	513	208	57	137
Ratio of 2020 to 2013, %	77.5	90.6	7.4	176.7
Ratio of 2020 to 2018, %	75.7	79.9	21.3	69.0
4 group				
Average for the period	677	324	96	129
Ratio of 2020 to 2013, %	65.2	71.9	44.9	33.7
Ratio of 2020 to 2018, %	92.2	102.3	66.6	101.1
5 group				
Average for the period	813	376	177	88
Ratio of 2020 to 2013, %	68.5	95.2	27.4	55.6
Ratio of 2020 to 2018, %	75.3	81.1	66.2	81.6
6 group				
Average for the period	1116	627	161	99
Ratio of 2020 to 2013, %	70.1	76.3	98.2	60.9
Ratio of 2020 to 2018, %	71.3	72.0	101.4	69.2

Source: Calculated by the authors according to the data of the Ministry of Labor and Social Protection. social.saratov.gov.ru, Accessed on 24.07.2021 [7].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The calculation based on the Sturges rule pointed out that the most numerous is the first group including of 27 districts with an average unemployment rate of 123 people (Table 1).

The level of official unemployment by groups of districts of the Saratov region for 2013–2020 averaged in the range of 0.64–2.19%. Such low values do not reflect the real picture of employment in rural areas. Most of the unemployed in rural areas are not officially registered due to the remoteness of settlements from regional centers and the inability to regularly report to the employment service.

To combat unemployment, it is necessary to develop and adopt state programs to ensure employment, the implementation of which requires significant budgetary funds. Therefore, as an important element, the social paradigm of sustainable development of rural areas of the region, the task was set to explore the internal potential of agricultural producers to eliminate unemployment [2, 6, 11]. Let's reveal the influence of internal production reserves on the change in the unemployment rate, based on Okun's law (Table 2).

Let us determine the potential size of agricultural production at the natural rate of unemployment. If the level of natural unemployment in the Saratov region, according to the Ministry of Economic Development of Russia, in 2013 is 5.2%; in 2014 – 4.6%; in 2015 – 4.7%; in 2016 – 5.1%, in 2017–2018 – 4.8–5.0%, for 2019–2020 – 4.3% [8].

Table 2. Rural unemployment forecast for the region (based on the Okun's model)

<table>
<tr><td colspan="2"><u>Purpose: to identify the actual unemployment rate (in the context of the regions of the subject of the Russian Federation) and calculate the forecast level in the long term</u></td></tr>
<tr><td colspan="2"><u>Input data: the volume of the potential size of agricultural products in selling prices</u></td></tr>
<tr><td colspan="2"><u>Calculation formula for the size of the calculated (potential) products):</u> $Y^{\circ} = \frac{Y}{1 - \beta np * (U - U^{\circ})}$
where: Y– actual size of agricultural production, thousand roubles; Y^0 – estimated (potential) size of agricultural products, thousand roubles; U – actual unemployment rate, %; U^0 – natural rate of unemployment,%; β – Okun's ratio.</td></tr>
<tr><td><u>Basic pattern:</u>
Annual growth rate products by 2–3% leads to a decrease in unemployment by 0.4%.</td><td><u>Calculation formula (according to the unemployment rate):</u>
$U = -0{,}4 \times \left(\frac{Pri1}{Pri0} \times 100\right) - 2{,}5\%$
where:
U – unemployment rate, %;
Pri1 – products of the current period, rubles.</td></tr>
<tr><td><u>Achieving output growth</u>: investment through growth in the size of agricultural products as a result of the reduction in unemployment,
Po.p. = Nt/r – 2*(Ui – ((Ui – 1)) where, Po.p. – volume growth agricultural products, taking into account the unemployment rate according to Okun,
Tr.b. = (β) r*(Tr.p. – Nt/r), where Tr.b. – Okun's unemployment rate Tr.p. – actual growth rate of agricultural production, Nt/r – standard growth rate of agricultural production, %.</td><td><u>Calculation result:</u> increase in agricultural output 2.5 % reduces unemployment by 0.4%.

Estimated Okun's ratio – 1.12 - formed with a planned increase in production by 7%.</td></tr>
<tr><td colspan="2"><u>Output</u>: rate of unemployment reduction (by 2030) at the planned rate of production growth in the 1st, 2nd, 4th and 5th groups of the studied districts of the region will be 0.77%, 0.59%, 0.18%, 4.3%, respectively.
Under these conditions, the growth in production for the same groups amounted to: 6.99%, 6.97%, 6.98%, 6.94% for the future.</td></tr>
</table>

Source: compiled by author.

According to the estimates of regional statistical bodies, the values in Table 3.

The volume of the potential size of agricultural products can be calculated by the formula:

$$Y^\circ = \frac{Y}{1-\beta np*(U-U^\circ)}$$

..............................(1)where:

Y – actual size of agricultural production, thousand roubles;

Y^0 – potential size of agricultural production, thousand roubles;

U – actual unemployment rate, %;

U^0 – natural rate of unemployment, %;

β – Okun's coefficient.

Hence, the calculated potential size of agricultural production (Y°) is equal to:

1 group:

$$Y^\circ_{2013} = \frac{59,358,224}{1-2.5*(1.24-5.2)} = 5,445,708.62$$

$$Y^\circ_{2014} = \frac{62,988,654}{1-2.5*(1.08-4.6)} = 6,427,413.57$$

$$Y^\circ_{2015} = \frac{87,970,127}{1-2.5*(1.02-4.3)} = 9,561,970.33$$

$$Y^\circ_{2016} = \frac{95,258,550}{1-2.5*(1.13-5.1)} = 8,719,318.08$$

$$Y^\circ_{2017} = \frac{82,539,591}{1-2.5*(1.16-4.8)} = 8,172,236.73$$

$$Y^\circ_{2018} = \frac{77,735,640}{1-2.5*(1.10-5.0)} = 7,231,222.33$$

$$Y^\circ_{2019} = \frac{87,970,127}{1-2.5*(1.02-4.3)} = 9,561,970.33$$

Table 3. Dynamics of the actual level of unemployment of the population by groups of districts of the Saratov region, % for 2013–2020

District groups	2013	2014	2015	2016	2017	2018	2019 – 2020	Mean
1	1.24	1.08	1.06	1.13	1.16	1.10	1.02	1.11
2	1.33	1.02	1.05	1.25	1.18	1.13	0.98	1.14
3	2.00	1.80	2.30	2.50	2.40	2.40	1.90	2.19
4	1.40	1.20	1.3	1.40	1.15	11.00	1,05	1.23
5	0.60	0.60	0.50	1.00	0.70	0.60	0.50	0.64
6	0.70	0.60	0.60	0.80	0.70	0.60	0.50	0.64

Source: Calculated by the authors according to the data of the Territorial Office of the Federal State Statistics Service for the Saratov Region. https://srtv.gks.ru, Accessed on 06/27/2021 [13].

The potential size of agricultural production in all categories of farms of 2–6 groups of districts was determined in a similar way (Table 4). The potential size of agricultural output is determined with the full use of labor resources and production assets, taking into account the restrictions imposed by the characteristics of the regional market.

Table 4. The volume of estimated (potential) agricultural production (in actual prices) in farms of all categories, thousand rubles. for 2013–2020

	2013	2014	2015	2016	2017	2018	2019	2020	Mean
1	5,445,708.62	6,427,413.57	7,484,887.03	8,719,318.08	8,172,236.73	7,231,222.33	9,561,970.33	12,469,880.65	7,564,766.26
2	1,710,676.44	2,076,403.52	2,560,882.57	2,602,539.76	2,493,417.41	2,246,982.86	2,928,690.65	4,159,169.14	2,375,578.03
3	255,376.22	336,897.75	496,913.57	482,238.40	358,107.57	390,653.87	429,376.57	701,118.29	389,768.24
4	646,319.33	873,288.32	1,050,473.89	1,103,191.41	1,005,236.15	924,460.09	1,083,013.48	709,089.86	955,282.72
5	646,319.34	354,564.82	370,822.26	519,136.44	445,429.51	364,118.75	550,548.57	611,274.48	408,577.98
6	700,277.55	905,935.91	992,177.51	925,451.15	731,536.18	744,590.17	93,008.67	1,014,720.00	735,854.65

Source: Calculated by the author.

It can be lower than the maximum possible due to the presence of a natural level of unemployment, incomplete use of production resources. In our case, the hidden level of unemployment resulted in a significant excess of the actual value of agricultural production over its potential size. If, according to the Federal State Statistics Service, the unemployment rate of the population aged 15 years and older was 4.8% on average for the period from 2013 to 2020, then according to the reporting data of the Ministry of Labor and Social Protection of the Saratov Region, it was 1.11, 1.14, 2.19, 1.23, 0.64, 0.64%

(average 1.16%) for 6 groups of study areas over the same period, respectively. This study determines the significance of Okun's law in identifying the dependence of changes in effective economic indicators on the unemployment rate for a particular region. Reserves for reduction due to demand stimulation are also calculated. The rate of production growth according to Okun is taken in the range from 2 to 3%. If it stays the same, then the unemployment rate also stays the same. If the output growth rate is higher than 2-3%, then the unemployment rate will decrease, an increase in the output growth rate by each percentage above 2-3% will lead to a decrease in unemployment by 0.4 percentage points and vice versa (Table 5).

This pattern is reflected by the formula:

$$U = -0{,}4 \times \left(\frac{Pri1}{Pri0} \times 100\right) - 2{,}5 \qquad \text{...........(2)}$$

where:

U – unemployment rate, %;

Pri1 – production of the current period, rubles;

Pri0 – production of the previous period, rubles.

We have obtained the calculated value of the sensitivity coefficient:

X = (7*(-0.4))/2.5 = -1.12

where:

2.5 – the increase in production according to Okun, %;

7 – planned production growth rate, %;

-0.4 – basic response factor sensitivity Okun, %;

X – calculated response factor according to Okun.

Table 5. The size of the planned unemployment rate. by groups of districts of the Saratov region for the period of 2030

№ groups	Salary, rub.	Actual growth rate of agricultural products, %	Growth in the volume of agricultural products, taking into account the unemployment rate according to Okun, %.	Okun's unemployment rate (scheduled at (β)r), %	Normative growth rate of agricultural products. %	(β) r calculated, % (decrease in unemployment according to Okun)
1	21,133.6	7.69	6.99	-0.77	7	-1.12
2	20,351.68	7.53	6.97	-0.59	7	-1.12
3	20,547.41	6.51	6.90	0.55	7	-1.12
4	23,012.10	70.16	6.98	-0.18	7	-1.12
5	25,453.78	10.84	6.94	-4.30	7	-1.12
6	19,835.95	-13.20	6.99	22.63	7	-1.12

Source: Calculated by the author.

Based on Okun's law define empirical coefficient sensitivity (β)r:

(β)r= (Nt/r*(β)o)/Ppo.............................. (3)

where:

(β)r – empirical coefficient sensitivity production to the dynamics of cyclical unemployment;

Nt/r – standard growth rate of agricultural production %;

(β)o – β according to Okun, %;

Ppo – production growth rate according to Okun %.

The normative growth rate of agricultural products is established in accordance with the Strategy for the socio-economic development of the Saratov regionby economic growth of gross national productby 7% per capita is determined by the formula:

Po.p. = Nt/r – 2*(Ui – ((Ui – 1))............... (4)

whereat: Po.p. – growth in the volume of agricultural products, taking into account the unemployment rate according to Okun, %;

Ui – unemployment rate of the current period, %; (Ui – 1) – previous period's unemployment rate, %. In turn, the rate of growth or decline in unemployment with the estimated Okun coefficient (-1.12%) is calculated by the formula:

Tr.b. = (β) r*(Tr.p. – Nt/r)........................ (5)

where:
Tr.b. – rate of growth of unemployment according to Okun, %;
Tr.p. – growth rate of agricultural products, %.
Okun's coefficient calculated by us (1.12) will allow us to determine the level of unemployment that will develop with the planned increase in production (7%). The 1, 2, 4, 5 studied groups revealed the possibility of reducing the unemployment rate by 0.77%, 0.59%, 0.18%, 4.3% and increase production by 1.93%, 1.48%, 0.45%, 10.75% respectively (at β -0.4) or 0.69%, 0.53%, 0.16%, 3.84% (with (β)r -1.12) annually (6.99%, 6.97%, 6.98%, 6.94% for the future), respectively, by groups [14, 15, 16].

CONCLUSIONS

A combined method of unemployment planning is proposed based on revealing its hidden forms and determining the potential size of agricultural products per capita, taking into account the characteristics of the regional market and the calculated Okun coefficient (equal to 1.12 units) aimed at increasing production by 6.99%, 6.97%, 6.9%, 6.98%, 6.94%, 6.99% for the future, respectively, for 6 selected groups of districts. An increase in the level of employment due to tax incentives for the costs of advanced training will lead to an increase in the level of profitability of enterprises by 0.77% on average in the region.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AGRICULTURE IN MOUNTAIN AREAS OF PODKARPACKIE VOIVODSHIP, POLAND: DEFINITION, CHARACTERISTICS, LIMITATIONS IN AGRICULTURAL PRODUCTION, DEFICITS AND DEVELOPMENT OPPORTUNITIES

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Abstract

Exogenous and endogenous factors influencing the condition of agriculture in mountain areas of Podkarpackie voivodeship were presented. The scope of the research includes the determination of characteristic features, limitations in agricultural production, deficits and development opportunities as well as ways of using/reinforcing existing trends in the agri-food sector in the aspect of mountain farming development in the areas of Podkarpackie voivodeship. Preservation of agricultural production in this valuable natural area is very important due to the numerous social, economic, environmental, but also cultural functions performed by agriculture and farms here. Departure of inhabitants from agriculture may cause irreversible negative phenomena resulting in reduction of landscape attractiveness and consequently tourist attractiveness. Mountain areas have development opportunities which should be utilised by coordinating actions at the regional and macro-regional level.

Key words: *mountain areas, foothill areas, less favoured areas (LFA), agriculture, farmstead, agricultural production, Podkarpakie region, Poland*

INTRODUCTION

Agriculture is one of the oldest and basic economic activities of man. Its primary function is to provide the food necessary for life and the development of human civilisation. However, over the last centuries, the economic importance of agriculture has significantly decreased. Although it still retains its key function it is now only one of many links in the economy [5].

However, it should be remembered that despite significant technical and technological progress and gradual elimination of economic differences between countries and regions, agricultural production is subject to many specific local conditions. The basic ones include natural conditions including: soil quality, agroclimate, topographic profile and water availability [3].

A characteristic feature of agricultural production is that natural conditions, factors independent of the agricultural producer, largely determine the economic efficiency of production and the income earned by agricultural producers [4].

Agricultural production takes place under different natural environmental conditions more or less favourable to production. It is generally recognised that agricultural activity in mountainous areas is subject to various constraints.

Due to the specific climatic conditions of mountainous areas, i.e. the altitude floors, there are significant restrictions in the selection of crop species (and varieties) and their yields. The slope of the terrain also causes many limitations in the application of machine production technologies, especially plant production. The relief of the terrain makes soils susceptible to erosion, which may be reduced by an adequate structure of land use, especially including grasslands and forests. These and other conditions cause the

need for far-reaching adjustment processes, the frequent need to shape the proportions of production factors differently, and also contribute to increasing mechanisation costs, increasing labour intensity and increasing the total cost of agricultural production [6].
Mountainous and foot-hill areas, are territorially interesting subjects of agro-economic analyses, as due to topographical and climatic conditions there are numerous and specific limitations in agricultural production and farm organisation [5].
The deteriorating profitability of production in mountain areas over the last few years makes it necessary to identify the causes of this situation and to develop new regional and national tools to improve the current situation and create better and more effective development opportunities in the future.
The current forms of agricultural production support aimed only at these areas (LFA support, agricultural tax reliefs) seem to be insufficient and do not build competitive advantage, which makes the production potential of these areas unused.
In this context, the aim of the research was to analyse exogenous and endogenous factors influencing the condition of agriculture in mountain areas of the Podkarpackie voivodeship and to identify opportunities for its development. The scope of the research included the determination of characteristics, limitations in agricultural production, deficits and development opportunities, as well as ways of using/reinforcing existing trends in the agri-food sector in the aspect of mountain farming development in the areas of Podkarpackie voivodeship.

MATERIALS AND METHODS

The work is primarily of a theoretical and empirical nature and concerns a review of the literature on the functioning of farms in mountainous areas.
The literature review will allow to determine directions of agriculture development in mountain areas of the Podkarpackie voivodship. The choice of Podkarpackie voivodship resulted from the fact of a significant share (as compared to Poland) of mountain areas in the voivodship area and the specificity of agriculture in Podkarpackie voivodship as compared to Poland (significant agrarian fragmentation).
Expert method was applied to determine the barriers and opportunities for the development of mountain agriculture in the Podkarpackie voivodeship, It is a method which allows to forecast and solve complex tasks scientifically. The essence of this method consists in using data obtained as a result of a scientifically justified procedure of collecting, systematising and analysing information from specialists in a given field (experts) [12, 15].
A team of purposively selected experts was created: representatives of science in the field of agricultural economics, rural development, agricultural production technology, representatives of public administration and local government, and farmers from mountain areas.
The approach proposed by the Delphi method was used. The procedure of this method was as follows:
(1)The conceptual phase, in which the methodological basis of the research is defined (setting up the research questions, designing the questionnaire).
(2)Preparation for the Delphi research, which involved the selection of potential experts, compilation of the final list of experts,
(3)Selection of session administrator.
(4)Distribution of the first survey.
(5)Forming initial proposals for solving the problem by presenting the experts' opinions in a questionnaire with reasons and returning the questionnaire.
(6)Analysis of submitted responses.
(7)The next round of the survey, in which the collated results are sent to participants along with an anonymous list of comments and justifications.
(8)Modification of the solution proposal. After reviewing the submitted results, the experts presented their point of view.
(9)Approximation of positions.
(10)Final analysis of results.
The paper presents the final results agreed upon by the experts. The analysis was helpful in elaborating assumptions for the strategy of

agricultural and rural development in mountainous areas.

RESULTS AND DISCUSSIONS

Definition and criteria for delimitation of mountain areas in the context of agricultural production

Individual EU countries have their own definitions of mountain areas. For the purposes of delimiting LFAs, it has been assumed, in accordance with Regulation (EU) No 1305/2013 of the European Parliament and of the Council [8], that mountain areas are areas where communes and cadastral sections account for more than half of the agricultural land located above 500 m above sea level. Irrespective of the criteria used, mountain areas in the context of agricultural production are areas where agricultural production is hampered due to unfavourable topographical and climatic conditions.

Mountainous areas, i.e. mountainous and foothill areas, in Poland constitute a relatively small and differently delimited area of the country, which consists of two mountain ranges, i.e. the Carpathians and the Sudetes. Moreover, the geologically oldest mountains, the Świętokrzyskie Mountains, are often included in the mountains. Due to the relatively high denivelations, the problem areas, delimited according to topographic criteria, i.e. on the basis of criteria adequate for mountains, may also include the Krakow-Częstochowa Upland, which, however, is not a mountain range, and several geodesic districts of Roztocze [5].

The definition of mountainous areas and the criteria for their designation have changed over recent years. Article 13b of the Act on Agricultural Tax of 15 November 1984 defines that localities situated in mountainous and foothill areas are those where at least 50% of the agricultural land is situated above 350 metres above sea level. A list of such localities in a given voivodship is determined by the voivodship assembly. A measurable benefit for the farmer is a lower agricultural tax. Agricultural tax on land located in foothill and mountain areas is reduced by 30% for land in bonitation classes I, II, IIIa, III and IIIb and by 60% for land in classes IVa, IV and IVb [1].

According to the Agricultural Tax Act of 15 November 1984, a farmer is entitled to relief on account of the location of land in foothill and mountain areas. According to the Ordinance of the Council of Ministers of 12 September 2012 on soil classification, land classes are determined on the basis of the soil classification determining the quality of soil in terms of its use value.

Due to the structural changes in Polish agriculture in the last decade or so, the current LFA mountain type and LFA specific type (foothill) ranges have been updated in 2019. The revision of the LFA delimitation in the 2014-2020 Rural Development Programme programming period is based on the application of uniform EU-wide biophysical criteria for climate (length of the growing season, temperature during the growing season, lack of water), soil (poor soil permeability, soil grain size and stoniness, root zone depth, poor chemical properties), soil and climate (excessive soil moisture) and terrain profile. The list and description of the biophysical criteria for the designation of LFAs with natural constraints are included in Annex III of EU Regulation 1305/2013 [8].

The Institute of Soil Science and Plant Cultivation – State research institute (IUNG-PIB) and the Ministry of Agriculture and Rural Development (MRiRW) in cooperation with marshal offices (of southern provinces) assessed the consistency of the lists of villages situated in mountainous and foothill areas, the results of spatial analyses (DEM) and the provisions of the MRiRW Regulation on LFA. In the course of these analyses it was assumed that the LFA specific type includes communes and cadastral precincts of the foothill areas:

-where at least 50% of the agricultural area is above 350 m above sea level, i.e. areas which have been designated for the purposes of the Agricultural Tax Act of 15 November 1984, or

-which, according to the numerical terrain model (DEM), meet the condition "at least 50% of the agricultural area is above 350 m above sea level".

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In Poland, mountain areas covered by LFA support include communes and cadastral districts in which more than half of the agricultural land is located at an altitude above 500 m above sea level.

Under the new LFA delimitation in force from 2019, the area of mountain areas in Poland eligible for payments amounts to 308.9 thousand hectares of UAA.

Irrespective of the criteria used, mountain areas in the context of agricultural production are areas where agricultural production is hampered by unfavourable topographical conditions (high altitude and steep slopes) and climatic conditions (changeable weather, decreasing temperature with increasing altitude, higher precipitation), as well as a shorter vegetation period (170 - 200 days).

Map 1. LFA areas with specific constraints.
Source: IUNG-PIB [2].

Characteristics of mountain farming in Podkarpackie Voivodship

Apart from the tourist and recreational functions and forest management, agriculture plays an important role In the mountain areas of Podkarpackie voivodeship. It provides agricultural products, creates jobs and gives a living to the people who live here. To a large extent agricultural production here is carried out in a traditional way, and due to the terrain and harsh climate it is difficult and requires increased expenditure. Apart from social farms (oriented mainly on subsistence farming, often their owners are bi-professionals and the agricultural equipment on the farms is so-called "self-made") there

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

are also market farms equipped with modern agricultural equipment.

In addition to the production of agricultural products, the role of agriculture here is to preserve unique cultural, natural and landscape values. Agriculture in the region is also important for the preservation of biodiversity.

Hidden unemployment, low level of modernity of the applied production technologies, monofunctionality, high share of marginal land in the total area of agricultural land, underdevelopment of infrastructure are recorded in the mountain agriculture of the region. The phenomenon of depopulation is recorded in towns that are not very attractive to tourists. Due to the terrain, there is a phenomenon of erosion in the mountain region. Therefore, in the mountains, anti-erosion tillage and special agricultural machines are used on arable fields [14]. Climatic conditions prevent or limit the cultivation of many crop species. The yields of cultivated plants are low. Farms are small and divided into remote plots. Hence, farmers are looking for alternative or additional sources of income, such as: agrotourism, organic products, beekeeping, trout farming, wickerwork, handicrafts, etc. Significant area of the mountain regions is occupied by permanent grassland and animal production such as rearing of cattle, sheep or goats is connected with it. Damage caused by game and legally protected animals is frequent, hence the need to pay numerous compensations [13]. The above has the effect of discouraging farmers from cultivating crops. A significant part of the mountain region is subject to various forms of nature protection, which in turn limits the possibility of developing intensive agricultural production technologies. Another factor specific to mountain areas is usually the considerable remoteness from markets and supply of means of production.

The state of agriculture in mountain areas is influenced by the general situation of agriculture in Podkarpackie. It should be noted that the volume of agricultural production from 1 ha of agricultural land in Podkarpackie is the lowest among all voivodeships. The dynamics of agricultural production growth is also important. Analysing its value in the period 2012-2019 it can be noticed that it was one of the lowest. The main driver of this state is the large number of small farms. The small area of farms limits the possibility of achieving economies of scale and largely restricts the development of agriculture to intensive animal husbandry.

One of the reasons for the declining productive role of mountain farming is its low competitiveness, due to the difficult natural conditions. As altitude increases, snow cover lasts longer, the growing season shortens, precipitation is higher and wind speeds are greater. In the mountains there are higher relative humidity indices and greater intensity of solar radiation. The soil cover also shows great variability. As the slope increases, erosion processes (especially water erosion) intensify. The cultivation of many plant species is impossible or risky.

It is more difficult for farmers to adapt to changing market conditions or to modernise their farms. The increased costs of agricultural production in mountain areas at free market prices result in the low profitability of many crops. The remoteness of some areas makes access to markets difficult. Some farmers have abandoned agricultural production and, in addition, a significant proportion of farms have no successors.

Due to soil and climatic constraints in mountain areas, the farms in operation mostly produce cattle, sheep or keep horses. The unit profitability of these lines of production is steadily decreasing. This forces increasing the scale of production or abandoning it. A very important limitation reported by farmers who want to enlarge their farms is actually the lack of possibility to acquire (purchase or long-term lease) agricultural land, despite the fact that the vast majority of landowners do not conduct any agricultural activity. The main reasons for this state of affairs are the social insurance system for farmers and the system of area payments.

Paradoxically, abandoning agricultural production, especially livestock production, and switching to maintaining permanent grassland for the purpose of obtaining area subsidies, generates more income for the farm than any livestock production. This causes a drastic decrease in the number of animals and consolidation of the unfavourable agrarian structure.

In livestock production, especially sheep production, wolf damage is a major constraint. In fact, the inability to effectively protect flocks from these predators discourages farmers from continuing to keep sheep.

In the Podkarpacie region, there are breeding centres, operating within the Polish system of research and development units, which keep mountain breeds of animals. Thanks to many years of activity and cooperation with farmers, these centres have become authentic, in fact the only, leaders in breeding in Podkarpacie. Unfortunately, deprived of any investment support, including support under RDP, with limited area payments (degressivity), they lose the ability to remain leaders to the detriment of the whole mountain agriculture. This is all the more unfavourable in a situation where universities, agricultural schools, agricultural environment institutions do not have their own farms and cooperate with breeders to a very limited extent.

The lack of systemic support for mountain farming by science and agricultural consultancy should be noted. Scientific research in this area is practically non-existent, and the participation of science in shaping the agricultural policy of mountain areas, which are so different from lowland areas, is marginal.

A new phenomenon is the negative perception of any agricultural activity, especially related to animal husbandry, by people living in the countryside, who more and more often have nothing to do with agriculture. This is connected with migrations and the attractiveness of rural areas as places to settle down for city dwellers.

Agreeing on the characteristics of mountain farming, the following development deficits affecting the development of mountain farming can be distinguished in Podkarpackie voivodeship:

-limited possibilities to change the production profile on the basis of market information, as natural conditions dictate the use of agricultural land, which in turn affects the direction of animal husbandry or the choice of crops,

-ageing of the population with simultaneous migration of young people, lack of successors to farm. The depopulated parts of the mountains are becoming less attractive for tourists. Homesteads are becoming empty, and the meadows and pastures that were tended until recently are rapidly becoming overgrown with bushes, and later forests. The depopulation of mountain areas and the disappearance of agricultural production make it impossible to fulfil the basic functions of mountain areas associated with water management, forestry, tourism and agricultural production,

-a permanent income disparity of mountain farming in comparison with lowland farming, which results in a difficult accumulation of capital in mountain farms and is the cause of increasing developmental disproportions between mountain farming and other areas,

-lack of developed marketing strategies for food products and agricultural raw materials from mountain areas,

-a small number of local processing plants buying up raw materials and agricultural produce produced by agricultural producers,

-lack of efficient food distribution chains that bring together farmers, agri-food processing, trade and catering, allowing quality products to reach discerning consumers,

-underdevelopment of the infrastructure surrounding agriculture (technical infrastructure, agricultural advisory services, economic infrastructure, service infrastructure, etc.) limiting the possibilities for farmers to cooperate and develop their farms,

-a defective area structure of agricultural holdings and an improperly shaped distribution of holdings hindering improvement of farming efficiency,

-unregulated property relations limiting the flow of land from decommissioned farms to potentially developing farms,

-water shortages, lack of water supply, exploited water drainage system.

Development opportunities in the context of mountain agriculture in the Podkarpackie Region

Among the development opportunities for mountain agriculture in the Podkarpackie region were listed:

-growing demand, both at home and abroad, for food products characterised by specific and unique taste and geo-cultural values,

-growing public awareness of the functions of mountain areas and the role of agriculture in fulfilling them. The following closely related and interacting functions of mountain areas can be distinguished:

-the possibility of providing agri-environmental services linked to agricultural production (e.g. protection of the value of the mountain landscape, protection of the natural environment through agri-environmental programmes, water protection),

-the possibility of activating the non-agricultural functions of mountain areas by correctly defining the place and role of agriculture in the possibility of developing other branches of economic activity in mountain areas (water management, forestry, tourism),

-providing support for mountain farming e.g. through a special instrument - a measure within the Common Agricultural Policy aimed directly at comprehensive development of mountain farming. This type of measure should be implemented regionally with the possibility of modification on the voivodship level and selection of the most desirable support areas in the given region. The measure should be implemented by voivodship self-governments in the scheme developed so far under successive RDP perspectives. The voivodship local governments implementing the voivodship development strategies would act as implementing entities which could decide on the implementation of the schemes (under this measure) which are most needed due to the regional conditions. This type of measure would be a centrally managed instrument, implemented regionally,

-productive use of grassland through the rearing of grazing livestock. Financial gratification for 1 ha of grazed grassland or for 1 livestock unit (LU) of grazed animals should be an impulse to undertake such production. An example of such a solution, tested in practice, is the Podkarpacki Naturalny Wypas programme implemented by the Podkarpackie Voivodeship Local Government [10, 11]. This programme - the only one in the country and of great interest - could become a national programme. Its main objective is the conservation, protection and restoration of the biodiversity of the characteristic landscape, as well as the protection of the natural environment based on grazing in a landscape and tourist attractive area. Financial support is aimed, inter alia, at maintaining and initiating the rearing of grassland animals (including Simmental cattle) with a view to producing a high-quality natural regional product, including an organic one,

-creating branded products specific to the Podkarpackie voivodship, such as 'Podkarpacka Wołowina'/ Beef of Podkarpacie Region. The geographical and natural conditions of Podkarpackie are favourable to the use of Simmental cattle for dairy and meat production. High-quality beef may be obtained from natural fattening of Simmental cattle on meadows and pastures rich in health-promoting plants in the Beskid Niski and Bieszczady mountains. Beef production can be based on natural resources, which is important for customers who pay attention to ethical, health and animal welfare aspects. A product obtained in this way is meat with great potential, giving consumers great culinary and taste satisfaction. The needs and directions of development of production of high quality regional beef under the brand "Podkarpacka Wołowina" will be determined by consumers [9].

-rich biodiversity of Carpathian meadows and pastures, which is a source of rich fodder resources and creates a unique mountain landscape attractive for tourists. Numerous plant species, including herbs, can be a raw material base for plants processing and packaging herbs,

-organic farming as a farming system with balanced crop and livestock production, organic production should combine environmentally friendly farming practices, support a high level of biodiversity, exploit natural processes and ensure adequate animal welfare,
-periodic events, agricultural events promoting the region and its mountain agriculture, e.g. Regional Breeding Animals Exhibition organised by Podkarpacki Agriculture Advisory Centre in Boguchwała, Agrobieszczady in Lesko, Horse Fair in Lutowiska, Farewell to Summer Holidays in Rudawka Rymanowska including the National Simmental Cattle Exhibition, Regional Hucul Horse Championship and Native Breeds Exhibition, which are visited by tens of thousands of people every year.

Ways to use/reinforce existing trends in the agri-food sector in terms of developing mountain agriculture

The proposed solutions are:
-changes in the agrarian structure so that the fragmentation and spatial dispersion of land does not lead to its abandonment for agricultural use,
-promotion through coordinated marketing actions of the assets of mountain areas,
-raising awareness of food production and good nutrition through education of children, young people and consumers,
-improving the 'Podkarpackie Natural Grazing' programme implemented by the Podkarpackie Voivodship Self-government, which could become a government programme,
-the creation of a national programme to eradicate Sosnowsky's hogweed in municipal areas,
-development of niche directions in agricultural production and small-scale agri-food processing (fish farming, beekeeping, cheese-making, local food directly from farms, herbalism, rabbits and others) combined with agro-tourism,
-raising consumer awareness of food choices (local, regional, traditional, organic food, often purchased directly from the farmer, not only offers particular health benefits, but also maintains agricultural production),
-the equal distribution of added value along the food chain to prevent the capture of added value by non-agricultural agribusiness links,
-supporting various forms of organisation of agricultural producers, allowing for benefits in both production and trade. This concerns in particular the creation of a professional wholesale market and the promotion of cooperatives and producer groups as well as all activities aimed at the activation and cooperation of agricultural producers,
-supporting farmers' entrepreneurship in the field of processing, trade and catering and the use of the Internet as a tool for distributing agricultural raw materials and food products,
-supporting the marketing and promotion of quality food and the participation of producers in the system of producing high quality, guaranteed food such as: regional, traditional and local products as well as products of organic farming and integrated production,
-development of rural infrastructure that boosts the development of rural areas,
supporting the process of modernisation of agricultural holdings using innovative technical, technological, biological and organisational solutions while respecting the principles of sustainable development of agriculture,
-promoting and developing organic farming,
-development of small and medium-sized entities in the field of agri-food processing aimed at producing high-quality food products with a specific taste.

CONCLUSIONS

Taking into account the specific character of the Podkarpackie voivodship there is a need to include in both national and local development strategies objectives, measures and development programmes for mountain areas, creating conditions for faster development of those regions on the basis of possessed resources (natural, cultural, social, economic), simultaneously ensuring cohesion in the social, economic and spatial dimension.
Alongside the tourism, recreation and forestry functions, mountain areas play an important role in agriculture, providing jobs and livelihoods for the people living here.

Agricultural production here is largely carried out in the traditional way, and due to the terrain and the harsh climate, it is difficult and requires increased expenditure. The role of agriculture, apart from the production of crops, is to preserve the unique cultural, natural and landscape values. Agriculture in the region is also important for the preservation of biodiversity.

The abandonment of agriculture by the inhabitants may cause irreversible negative phenomena (impoverishment of biodiversity, reduction of soil organic matter content) resulting in a decrease in the attractiveness of the landscape (overgrown meadows and pastures, lack of animals, nuisance and invasive plants – Sosnowsky's hogweed etc.) and consequently tourist attractiveness.

Mountain areas have development opportunities that should be used by coordinated action at the macro-regional level. There is currently a lack of action aimed at developing such areas. The need for the development of these areas is evidenced by the growing demand, both in Poland and abroad, for food products characterised by specific, unique taste and geo-cultural values.

Efforts should be made to maintain mountain preferences in agricultural policy, and to regionalise the common agricultural policy in order to better adapt support instruments to regional and even local needs.

The development of a special new support system to sustain agricultural land use, adequate to the environmental conditions in areas covered by various forms of nature conservation, including mountainous areas, requires consideration [7].

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPROVING THE ORGANIZATIONAL MECHANISM OF LAND MANAGEMENT IN AGRICULTURE

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Abstract

The developed organizational mechanism of management of land resources is intended for improvement of the land legislation on the basis of activization of initiatives from legislative and executive authorities by means of attraction of law-enforcement practice, the Russian Academy of Sciences, scientific institutions and universities of the country. Acceleration of process of formation and development of the mechanism of public-private partnership in the field of the land relations on mutually advantageous conditions is provided in it, at respect for the balance of interests allowing to unload a part public sector of economy, to delegate in a contractual order separate powers in the private sector. It is recommended to form in regional divisions of the Management of the land relations in agriculture the departments of digital development and management of land resources designed to integrate, generalize in the interactive mode information obtained from different databases on possession, use, the order of the agricultural land for the purpose of the effective leadership in this process.

Key words: *organizational mechanism, management of land resources, agriculture, scientific potential, qualitative management decisions*

INTRODUCTION

For the last decades in scientific literature a definition "mechanism" and its specifications are widely used: housewifely, economic, organizational, organizational and economic, etc.
The word is borrowed from Greek (μηχανισμός - the mechanism) for conceptual identification of objects and phenomena in values "the internal device of the machine, the device, the device putting them in action", "system, device defining an order of some type of activity", "set of processes or states which define any phenomenon" [14, 20]. Distribution of the concept "mechanism" applied initially in the technical sphere on the systems of the no mechanical nature in philosophy is connected with the name of Hegel [7]: "… all of us have to demand definitely for the mechanism of the right and value of general logical category, and its application, agrees with it, should not be limited at all to borders of that area of the nature from which this category received the name".
In works on economy this term appeared in the second half of the XX century, in further development in the 1970th years it was accepted as "housewifely mechanism". The fundamental contribution to his explanation belongs to [1]: "… a way of the organization of social production with forms and methods, economic incentives and precepts of law peculiar to it".
Certain authors in the researches consider the concept "organizational mechanism".
[9] includes in him structure of appropriate authorities of management; the nature of distribution between them the main functions, a way and the procedure of their realization, [11] – the system of the communications of this organization arising in dynamics, [19] – structure of the bodies which are carrying out management process, united in the system of communications and the relations between components of an object of management, and set of the levers on an object relating to the organization of the processes in a system

leading to development of rational organizational structures, [13] – set of elements of production (human resources, means of labor, objects of the labor, information); ways of the organization of communications between elements, the organizational forms, methods, precepts of law and standards providing rational functioning of all production system, [8] – a way of group of works and carrying out the lines of submission uniting works.

[12] presents the organizational and economic mechanism as the tools of management including normative legal acts, organizational structures, incentive motives, incentives, methods, measures, forces and means by means of which the subject of management influences an object for the benefit of achievement of goals of innovative development, [3] – a way of management housewifely and economical mechanisms which defining criterion is its role as the integrator of all spheres and links, uniting them in a whole at the different levels of management: the countries, the territorial subject of the federation, the region, the area, production division, [16] – the mechanism of interrelation and interaction of organizational structure of management and organization of decision-making processes with methods, receptions and rules of managing directed to its most effective functioning and development in general.

In interpretations by most of authors of this term it is possible to allocate two approaches.

Supporters of the first define essence of the organizational and economic mechanism through category "set". According to [2] representation, the organizational and economic mechanism – set of the organizational and economic forms and methods coordinated on micro and macro levels in a uniform order of any type of activity, to [15] – set economical and financial and legal forms, methods, tools and a leverage over economic activity for the purpose of providing a desirable vector of development which functions in borders of the fundamental communications displaying the nature of its structure, to [23] – set of economic levers, ways and methods of impact on object of management, as a result of which object of management passes from actual state into the desirable.

Adherents of the second approach consider the organizational and economic mechanism as a system. In particular, [10] the organizational and economic mechanism calls the system of formation of the purposes and incentives which allows to transform in the course of work the movement of material and spiritual needs of members of society to the movement of means of production and its end result directed to satisfaction of solvent demand of consumers, [6] – the system of elements of organizational and economic impact on administrative process in which there is a purposeful transformation of impact of control elements on object of management and which has entrance parcels and the resulting reaction, [17] – the system of the legal and organizational and economic actions allowing to provide development of advantages of integration processes in the course of managing.

According to [18], in the concept "economic mechanism" there is already an organizational component, and the term "organizational and economic mechanism" is not up to the end thought over scientific phrase.

Thus, it is logical to consider the mechanism as unity of structural and process components, a form of the system interaction of various subjects and objects having entrance parcels (impulses) and the resulting reaction. Depending on overweight of accents this or that mechanism will have the name.

In our opinion, the organizational mechanism of management of land resources in agriculture is a combination of organizational and institutional structures, forms, methods, instruments of their administrative, economic, coordinating influence at the regional, municipal, economic levels for achievement of full and effective use of land resources taking into account reproduction of soil fertility, creation of legal, information operating conditions of a system, analytical maintenance.

In this context, the purpose of the paper – to offer the organizational mechanism of management of land resources in agriculture.

MATERIALS AND METHODS

The organizational mechanism of management of land resources in agriculture is developed on the basis of system, functional approaches. In a research special methods of a research are productively used: ontologic – for formulation of the concept "organizational mechanism" in the field of management of land resources of agriculture, definitions of elements of the mechanism, identification of communications between them; imitating modeling – for creation of a form of display of the mechanism and interaction of its organizational elements.

RESULTS AND DISCUSSIONS

The developed organizational mechanism provides need of coordination for questions of management of land resources for agriculture between legislative (the Federation Council of the Federal Assembly of the Russian Federation and the State Duma of the Federal Assembly of the Russian Federation) and executive bodies of the government (the Ministry of Agriculture of the Russian Federation, the Ministry of Economic Development of the Russian Federation) in interaction with science and economic entities (Figure 1).

Executive authorities along with implementation of administrative decisions fulfill the requirements of the acts adopted by the State Duma, participate in development and discussion of bills in the field of the land relations and use of land resources.

Carrying out parliamentary hearings on problems of the land relations and managements of land resources in the relevant State Duma Committees allows to consider various political positions and to develop the general point of view. As their initiators the Ministry of Agriculture of the Russian Federation and the Ministry of Economic Development of the Russian Federation can also act. The question which is submitted for discussion listens with delight previously in their public councils that is an important management decision confirming interaction of the state and society. The ministries have to be coordinated with each other, resolve problematic issues in common or separately.

In it administrative process of increase in interest of political figures, parliamentarians, scientists, businessmen in the solution of problems of the land relations and management of land resources in agriculture consists. The confirmations of need of situational management presented by them can form the basis for consideration in appropriate committees.

The interaction of special-purpose committees of the State Duma which is carried out when carrying out parliamentary hearings on the corresponding subject with research institutes and other institutions is not systematized, has no certain rules and procedures. For adoption of qualitative management decisions it is necessary to provide obligatory scientific maintenance. Its streamlining by means of work with the Russian Academy of Sciences (RAS) and its industry scientific institutes concerning development of agro-industrial complex and rural territories, regulation of the land relations and management of land resources is offered. The management of RAS gives the received task to Office of agricultural sciences (Section of economy, the land relations and social development of the village) which have to attract the federal scientific, research centers, institutes. The most significant problems are considered at meetings of Section, Bureau of Office, Presidium of RAS. The made offers and recommendations are submitted on behalf of academy in committees of the Federation Council and the State Duma.

This organizational approach allows to involve effectively scientific potential, to increase insistence to quality of scientific developments and their effectiveness for realization important for the country and regions of decisions, to make pointed changes to the land legislation for the purpose of its improvement and maintenance of mechanisms of their execution.

At the level of the Ministry of Agriculture of the Russian Federation of function of management of land resources are concentrated in the Department of melioration, land policy and state property (department of the state land supervision and land management). In the previous researches attention is paid to creation of the Management of the land relations and its regional divisions which have to submit directly to the government and interact with the agricultural organizations [20, 21]. In the new organizational mechanism of division of the Management will be able to address higher body – the Ministry of Agriculture of the Russian Federation – with the reasoned legislative initiative in the sphere of management of land resources to submit the made recommendations in the relevant committees and to discuss them on round tables, parliamentary hearings.

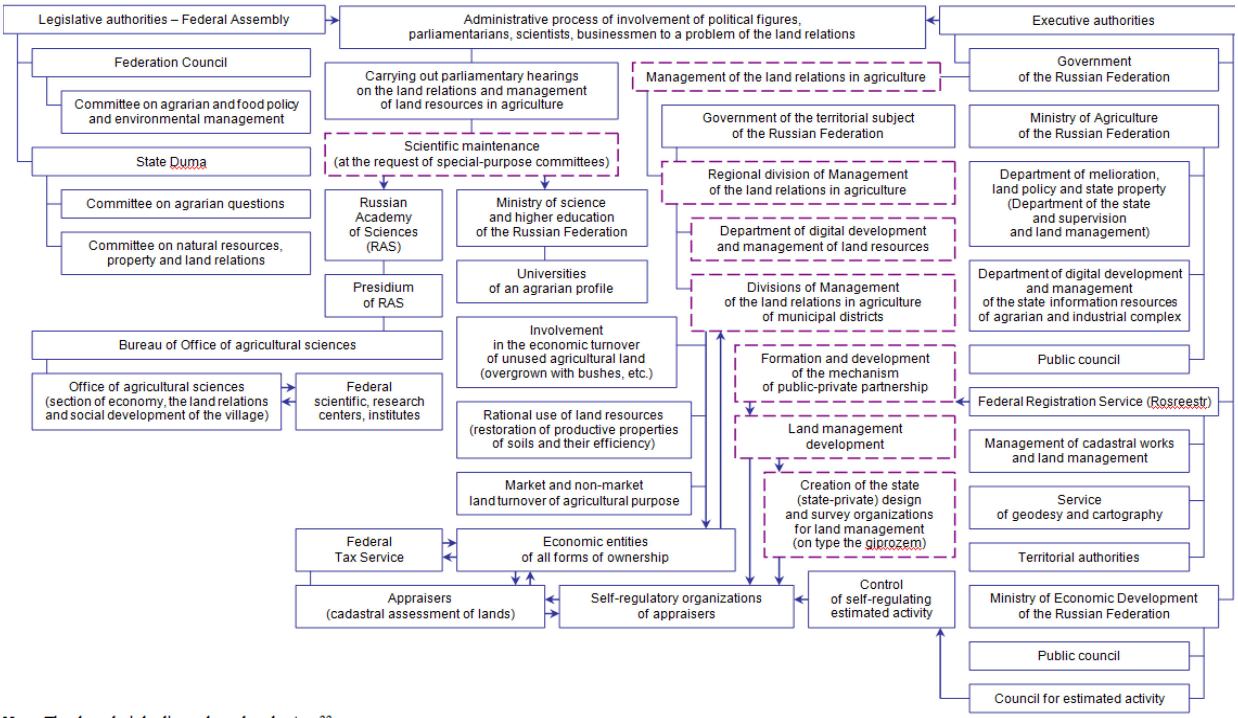

Fig. 1. The offered organizational mechanism of management of land resources in agriculture
Note: The dotted violet line selected authors' offers.
Source: Author's own elaboration.

For increase in efficiency of activity of the Management of the land relations in agriculture it is expedient to create in its regional divisions the Departments of digital development and management of land resources coordinating the actions with territorial authorities of the Federal Registration Service (Rosreestr), the Department of digital development and management of the state information resources of agrarian and industrial complex. Tasks of department will include digitalization of accounting of the agricultural land, their market and non-market turnover, drawing up the electronic atlas with the instruction on cards of existence of agricultural grounds by types, indicators of fertility of soils, effectiveness of production and economic use of lands, etc. The obtained information will be constantly updated and form the basis at acceptance by executive authorities of the correct management decisions directed to increase in completeness and efficiency of use of land resources. It will give the chance to apply electronic technologies at provision of services to the organizations and citizens, to modernize infrastructure at the expense of the means received from them.

The offered organizational structure is obliged to solve interdepartmental problems in interaction with the Ministry of Agriculture of the Russian Federation, the Federal State Statistics Service (Rosstat), the Federal Service for Veterinary and Phytosanitary Surveillance (Rosselkhoznadzor) and other executive authorities having direct or indirect relation to possession, use, the order of land resources that will allow to create prerequisites for increase in access to transactions with the agricultural land.

The Ministry of Economic Development of the Russian Federation is coordinated with the Federal Agency for State Property Management (Rosimushchestvo) and the Federal Registration Service into which enter the Management of cadastral works and land management, the Service of geodesy and cartography, territorial authorities.

The efficiency of interaction of the state and society is reflected in approval by public councils of the made decisions on the questions of management of land resources which are subject to obligatory consideration in agriculture.

Due to the high cost intensity of actions land management needs the state support (subsidies or other forms). Formation and development of public-private partnership which advantages, judging by international experience [5], consist in modernization of technical infrastructure, acceleration of performance of land management works and registration of the land plots, improvement of personnel potential, increase in urgency of execution, quality, availability of services to the agricultural organizations and citizens is necessary.

The Federal Law "About Public-private Partnership, Municipal-private Partnership in the Russian Federation and Introduction of Amendments to Separate Acts of the Russian Federation" [4] extends to actions in the system of land management by preparation and signing of the contracts on public-private partnership. In certain cases by transfer of land management works by public authorities to private structures there can be contradictions between the general and land legislations that will demand introduction of corresponding changes.

High-quality development of land management depends on creation of the state (state-private) organizations (institutes) which tasks have to enter performance of a complex of design and survey, land and cadastral, land management works, including carrying out cartographic, soil, agrochemical, geobotanical inspections. After destruction of a system of the state design institutes on land management (giprozem) there was a serious problem of reconstruction of similar structure because of loss of personnel potential (soil scientists, agrochemists, biologists, etc.), bias of cadastral assessment of agricultural grounds. Appraisers, surveyors and other external performers under contracts (contracts) or with performance of single works can be involved in such structure from the private sector (IT-specialists, lawyers, notaries, etc.). The state has to improve a regulatory framework of public-private partnership in the field of management of land resources, carry out various forms of support, including on a competitive basis. One of the main tasks when developing the mechanism of public-private partnership – providing the competitive environment allowing qualitatively in short terms to perform works on land management, to reduce economic return.

CONCLUSIONS

The developed modern organizational mechanism of management of land resources in agriculture stirs up activity legislative and executive authorities, regional governing bodies of agriculture, the Russian Academy of Sciences, profile research establishments and higher education institutions on providing the improved institutional conditions for creation of the Management of the land relations in agriculture, the mechanism of public-private partnership, land management development.

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Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 2, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE EFFICIENCY OF SUNFLOWER CULTIVATION ON DIFFERENT LEVELS OF BIOLOGIZATION

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Abstract

The article presents experimental materials on the assessment of economic, bio-energy and ecological efficiency of the elements of the levels of technology biologization for sunflower cultivation. The study was dedicated to evaluation of the following cultivation technology elements: sunflower hybrid (factor A); the level of biologization of cultivation technology (factor B). All the elements of biologization of the cultivation technology for sunflower hybrids resulted in significant improvement of basic indexes of economic efficiency. The analysis of the indexes makes it possible to state that, by Factor A, the highest economic attractiveness is characteristic of the variants of an extensive (minimum) cultivation technology, in which the level of profitability during the years of the research was 160.1% on average, and organic technology -159.9%, respectively. If the manufacturer is certified and a batch of commercial sunflower has organic status, it is possible to increase this index to 211.9%, taking into account 20% organic bonus. The highest energy efficiency in the experiment was characteristic of the variants without the use of the most energy-intensive components - mineral fertilizers. The variants of biologized I and organic technologies ensured the value of this index at the level of 4.76 and 5.73, respectively. Analysis of the environmental suitability of the crop hybrids that formed the gradation of factor A of the experiment allows drawing a conclusion that the advantage of the hybrid PR64F66 F_1 in the main indexes reflects its ecological tolerance, and primarily in the plasticity bi (1.06 compared to 0.96 for the variant of the hybrid Tunca F_1) and stability Sd_i^2 (0.00091 vs. 0.00077, respectively).

Key words*: *sunflower, economic efficiency, energy efficiency, ecological efficiency, organic technology

INTRODUCTION

Modern trends in the agrarian market set more requirements for the available cultivation technologies than ever before. Nowadays the existing technology of crop cultivation should not only ensure the maximum productivity level of crop yields, but at least result in economic efficiency of yields, i.e. compensate production costs per unit of area or unit of production [2, 4, 19, 11, 9, 10, 15, 14].

However, according to the opinions of a wide range of experts, it is not enough for a modern crop cultivation technology just to have economic efficiency, because under the current conditions any individual technological element and operational technology as a whole should also be evaluated in terms of energy efficiency and environmental suitability for agrocenosis [6, 12, 18, 13], that made us perform thorough analysis of the experimental variants according to these criteria.

MATERIALS AND METHODS

Field trials on the sunflower cultivation technology were conducted during 2016-2021 in the non-irrigated lands of the Farm “Vera” in Hola Prystan district of Kherson region. The experimental plots were located at the latitude 46°20'16.11"N, longitude 32°17'31.38"E, and were elevated to 9 m above the sea level.

The soil of the experimental plots was represented by the dark-chestnut middle-loamy middle-saline soil with the humus content of 2.34-2.60%. The content of mobile forms of the elements of mineral nutrition: nitrogen - 1.7-2.0; phosphorus - 4.9-6.5; potassium - 28-36 mg-eq in 100 g of soil, pH - 6.9-7.2. The soil has moderate natural fertility, which mainly depends on nitrogen content.

The field experiments were conducted in four replications by using the split plot design method. The study was dedicated to evaluation of the following cultivation technology elements: - A - sunflower hybrid: A1 - sunflower hybrid PR64F66 F_1 (bred by Pioneer); A2 – sunflower hybrid Tunca F_1 (bred by Limagrain); - B - the level of biologization of a cultivation technology: B1 (Traditional) - a traditional intensive zonal cultivation technology is recommended by the originator for the conditions of the Southern Steppe of Ukraine with using mineral fertilizers and chemical plant protection products (PPP), aimed at maximum realization of the genetic potential of the hybrid; B2 (Biologized I) - an intensive technology, in which the system of plant care replaces mineral fertilizers by biological fertilizers allowed to be used in the practice of organic farming. The multifunctional preparation TM “Eco-Growth” was used as an organic fertilizer; B3 (Biologized II) - an intensive technology in which the system of plant care replaces mineral fertilizers by biological preparations allowed to be used in organic farming, and herbicides are replaced by mechanical weed control operations. The preparations “ENZIM-Agro” Gaubsin-FORTE and Viridin (Trichodermin) were used as a biological fungicide preparation. The insecticide-acaricides TM "ENZIM-Agro" Entocid (Metarizin) and Aktarofit were used as a biological insecticide; B4 (Organic) - organic - a technology in which the crop care system is based solely on the use of biological preparations (both fertilizers and pesticides); B5 (Extensive) - extensive (minimal) - a technology of crop cultivation, in which the system of crop care is represented only by mechanical operations to control weeds without using chemical and biological fertilizers and PPP.

The method of plot placement in the experiment - split blocks, the total area of the experimental plot was 1.2 ha, the total area of the quartic plot - 672 m^2, the registered plot – 560 m^2. The replication of the experiment was fourfold. In general, the scheme of the field two-factor experiment and the plan of placement of the research plots had the following pattern.

The characteristics of the experimental hybrid: PR64F66 F_1: the originator company - Pioneer® (USA) , simple two-lined highly oleic, the maturity group - medium-early (111-115 days), the actual production yield - 30.8 c/ha, the plant height - below the average (146 cm), convex seeds, the color - black-gray, the inflorescence - flat capitulum, the diameter - 15.4 cm, oil content - 51.1-52.3%, protein content - 16.0-17.2%, the weight of 1,000 seeds – 67 g. Disease and stress resistance: very high resistance to drought, excellent cold resistance, high resistance to lodging, resistance to 7 races of Orobanche cumana (A-G), resistance to various types of cinerea (white, ashy, dry, root), tolerance to phomosis and phomopsis; Tunca F_1: the originator company - Limagrain® (France), simple two-lined, the maturity group - medium-early (110 days), the actual production yield - 29.5 c/ha, the plant height - medium (150 cm), elongated seeds, the color - black-gray, the inflorescence - flat capitulum, the diameter - 15.9 cm, oil content - 50.6-51.7%, protein content - 16.2-17.0%, the weight of 1,000 seeds – 73 g. Disease and stress resistance: high resistance to drought, excellent cold resistance, resistance to lodging, resistance to 7 races of Orobanche cumana (A-G), resistance to various types of cinerea (white, ashy, dry, root), tolerance to phomosis and phomopsis.

During the research we were guided by the generally accepted methods of conducting field experiments and performing laboratory experiments. The experiments were accompanied by appropriate observations, measurements and analysis of soil and plant samples. All the records and observations were performed in two non-contiguous replications.

The economic efficiency of epy crop cultivation was determined with the generally accepted method using zonal production standards [5, 16, 7]. Calculations of bio-energetic efficiency were performed according to the guidelines of bioenergy assessment of crop production technologies [6, 12, 13, 3, 20]. The ecological plasticity of the experimental variants was determined using the Ebergard-Russell method modified by Khotylova and Letun [20, 1, 21, 8, 17].

The agricultural techniques in the experiments, provided that the specified technological operation or its gradation was not a factor studied according to the scheme of the experiment, had the following pattern: winter wheat was a pre-crop, after harvesting it there was disking to a depth of 10-12 cm with BDT-7. In 14 days after the last disking, the stubble was plowed to the depth of 22-24 cm, leveling with KPE-3.8 (8-10 cm), double pre-sowing tillage with the Lemken Compactor S unit. According to a preliminary agreement with the regional representatives of the companies-originators of sunflower hybrids, the crop seeds without pre-sowing incrustation with fungicidal-insecticidal composition were purchased for the experiment. Pre-sowing treatment was carried out independently: in the variant of intensive and biologized I technologies - with a mixture of Cruiser 6 l/t (thiamethoxam 350 g/l) and Maxim 1 l/t (fludioxanil 25 g/l), in the variant of biologized II and organic technologies - with a mixture of biological preparations (Table 1) at the recommended rates with the expense of the working liquid of 10 l/t. Mineral fertilizers (ammonium nitrate and granular superphosphate) were used in the variants of intensive and biologized II technologies at the calculated rate $N_{54}P_{46}$, average for the years of the research (40% nitrogen and 100% phosphorus - for basic tillage, 60% nitrogen - for pre-sowing tillage) And in the variant of an organic technology - with biological fertilizers at the recommended rates (Table 2). Sunflower seeds were sown in the middle of spring at a soil temperature of 6-7°C at a depth of 5 cm using a wide row method with a row spacing of 0.7 m and a seeding rate of 55 thousand units/ha with SUPN-8 seeder with post-sowing soil rolling with KKSH-3 rollers.

Table 1. The characteristics of biological preparations used in the variants of the experiment

Preparation	Content	Methods and rates of application
Organic fertilizer **"Eco-Growth"**	Strains of the culture Bacillus thermophiles, Bacillus subtilis, phosphorus-mobilizing, nitrifying bacteria and chelate micro-fertilizer (51 g/l N, 12.0 g/l K_2O, 58 g/l MgO, 50 g/l SO_3, 6.5 g/l B, 12.5 g/l Cu, 12.4 g/l Fe, 12.0 g/l Mn, 0.2 g/l Mo, 6.4 g/l Zn, 0.1 g/l Co, 66.4 g/l amino acids, 67.8 g/l organic acids (succinic, malic, tartaric and citric), 3.3 g/l humic acids, 0.58 g/l fulvic acids, 0.0055 g/l phytohormones, 0.049 g/l of polysaccharides, vitamins, cytokinins, gibberellins compounds) pre-sowing seed treatment -2 l/t; vegetative foliar feeding – 2 l/ha	pre-sowing seed treatment – 2 l/t; vegetative foliar feeding – 2 l/ha
Bio-fungicide **Gaubsin-FORTE**	Two strains of Pseudomonas aureofaciens with a cell titer of at least 4×10^9 KUO/ml	plant vegetative spraying – 2 l/ha
Biofungicide **Viridin** (Trichodermin)	Spores and mycelium of fungi of the genus *Trichoderma spp*. with a titer of not less than 1×10^8 KUO/ml and metabolic products - biologically active substances pre-sowing seed treatment – 5 l/t; vegetative spraying of plants – 2 l/ha	pre-sowing seed treatment – 5 l/t; plant vegetative spraying – 2 l/ha
Biofungicide **Entocid** (Metaryzyn)	Spores of entomopathogenic fungi - not less than 2×10^8 KUO /ml	soil spraying for pre-sowing treatment – 5 l/ha
Biofungicide **Actarofit**	complex of natural avermectins produced by the beneficial soil fungus Streptomyces avermitilis (abamectin - 50%, emamectin - 50%). The total content of toxins is not less than 1.8%	plant spraying - 0,2 l/ha

Source: Own description based on materials provided by firm manufacturers.

The care of sunflower plants was represented by the measures protecting the crop against a complex of pests in case of exceeding the rate of the economic threshold. Protection against weeds in the variant of intensive and biologized I technologies was realized by application of the soil herbicide Triflurex at the rate of 3 l/t (triflurex 480 g/l) and the post-emergent herbicide Select 2 l/ha (kletodim 120 g/l), in the variants of biologized II, organic and extensive - by means of mechanical methods of weed control (pre- and post-emergent harrowing with weeders and rotary hoes, inter-row tillage). Protection against diseases in the variants of intensive and biologized I technologies was presented by two vegetative treatments with the fungicide Amistar Extra 1 l/ha (azoxystrobin 200 g/l + cyproconazole 80 g/l), biologized II and organic - treatments with biofungicides (Table 1). Pest protection in the variants of intensive and biologized I technologies was presented by two vegetative treatments with Ampligo 150 ZC insecticide 0.3 l/ha, containing chlorantraniliprol 100 g/l and lambda-cyhalothrin 50 g/l, in the variants of biologized II and organic technologies - treatments with bio-insecticides. Vegetative plant treatment was carried out twice at the phase of sunflower development “3 pairs of true leaves” and “capitulum formation”, the rate of working fluid consumption in all the cases was 250 l/ha, with the simultaneous use of preparations and tank mixture 30 minutes before treatment. The crop was harvested by direct combining at the stage of full maturity of seeds with the self-propelled grain harvester John Deere 9660 STS. The data obtained resulted in basic moisture (7%) and 100% purity.

RESULTS AND DISCUSSIONS

We performed analysis of the economic efficiency of different technologies of growing sunflower hybrids taking into account the current market prices for commodities and inputs. It allows stating that, on the average by Factor A, a traditional intensive technology for the crop cultivation chosen as a control variant in the experiment, ensured the product cost price at the level of 10,947 UAH/t, the total production costs – 20,250 UAH/ha, the cost of commodities – 38,480 UAH/ha, the operating net profit – 18,230 UAH/ha, that led to the final profitability of production at the level of 90.1% (Table 2).

Table 2. Indexes of economic efficiency of growing sunflower hybrids under different levels of technology biologization

Hybrid (Factor A)	Cultivation technology (Factor B)	Crop productivity, t/ha	Cost price of 1 t, UAH	Total production costs, UAH/ha	The cost of commodities, UAH/ha	Operating net profit, UAH/ha	Profitability, %
PR64F66 F_1	Traditional	1.87	10,830	20,251	38,896	18,645	92.1
	Biologized I	1.94	10,444	20,261	40,352	20,091	99.2
	Biologized II	2.02	8,014	16,187	42,016	25,829	159.6
	Organic	2.27	7,810	17,729	47,216*	29,487	166.3
	Extensive	0.94	7,995	7,516	19,552	12,036	160.1
Tunca F_1	Traditional	1.83	11,065	20,248	38,064	17,816	88.0
	Biologized I	1.96	10,338	20,263	40,768	20,505	101.2
	Biologized II	1.99	8,133	16,185	41,392	25,207	155.7
	Organic	2.16	8,204	17,720	44,928*	27,208	153.5
	Extensive	0.94	7,995	7,516	19,552	12,036	160.1

Note.***** without taking into account the added value of the products with organic status.
Source: original data calculated based on the experimental data obtained.

The refusal to apply mineral fertilizers and the use of organic multifunctional fertilizers (biologized and technology) instead of them in the technology of the crop cultivation ensured significant improvement in all the indexes of economic efficiency, namely: the cost price decreased to 10,391 UAH/t, the total production costs remained unchanged at the level of 20,262 UAH/ha, the cost of commodities increased significantly to 40,560 UAH/ha, the operating net profit amounted to 20,298 UAH/ha, and the profitability of production increased to 100.2%. This is due to a relatively low price of modern organic fertilizers and plant-growth regulators at the market in comparison with the traditional mineral fertilizers, and their significant positive impact on the formation of sunflower seed yields.

The crop cultivation with a biologized AI technology implying the refusal to apply synthetic PPP and the involvement of only organic pesticides, was also characterized by significant improvement in the economic efficiency when compared to the control variant. Despite a little higher market price of insecticides and fungicides of organic origin, relatively higher rates of their use, and the involvement of inter-row mechanical tillage as an alternative to soil and post-emergent herbicides in the cultivation technology, the production costs decreased significantly to 8,073 UAH/t, the total production costs were 16,186 UAH/ha, the value of commodities increased to 41,704 UAH/ha, the operating net profit increased to 25,518 UAH/ha with the profitability of production at the level of 157.7%.

The combination of individual elements of biologization of sunflower cultivation technology in a general organic technology resulted in significant improvement in all the indexes of economic efficiency, namely: the cost price decreased to 8,007 UAH/t, the total production costs dropped to 17,725 UAH/ha, the cost of commodities increased to 46,072 UAH/ha, the operating net profit was 28,347 UAH/ha, and the profitability increased to 159.9%.

Even under these conditions, an organic technology looks completely competitive in comparison with a traditional intensive technology for sunflower cultivation, but we have involved an additional factor to optimize the economic component of crop production, namely, the so-called “organic ratio” - the additional market value of a unit of crop products provided that the operator (a business entity) received a certificate confirming the compliance of the technology of crop cultivation with the requirements of the European Union for such products.

Analysis of the modern market of organic products allows stating that if the technology of sunflower cultivation meets the requirements of EU regulations №834/2007 and EU №889/2008, confirmed by the relevant certificate issued by an accredited certification organization in Ukraine, the actual market value of organic sunflower increases at least by 20% in comparison with the products of conventional origin [17, 19]. Therefore, the main economic indexes of sunflower cultivation using organic technology in the farm, certified as an organic agricultural producer, will look in the following way (Table 3).

Table 3. Estimated economic efficiency of growing sunflower hybrids under conditions of organic product certification

Hybrid	Crop productivity, t/ha	Cost price of 1 t, UAH	Total production costs, UAH/ha	Cost price of commodities, UAH/ha	Operating net profit, UAH/ha	Profitability, %
PR64F66 F_1	2.27	7,810	17,729	56,659	38,930	219.6
Tunca F_1	2.16	8,204	17,720	53,914	36,194	204.3
Average	2.21	12,383	27,411	55,286	27,875	211.9

Source: original data calculated based on the experimental data obtained.

The above data show that certification of organic sunflower production places the economy of its cultivation to a qualitatively new level, allowing it to exceed the traditional intensive technology of cultivation 2.35 times by the final index of economic efficiency - the level of profitability of production. Taking into account 20% surcharge for organic status, the cost prices of commodities and the operating net profit per unit of sown area of organic crops (UAH 55,286 and UAH 27,875, respectively) are the highest among the experimental variants.

Sunflower cultivation using an extensive (minimal) technology, which has recently become very popular in small farms and private farms, looks attractive in terms of economic efficiency, but it is completely hopeless because this level of productivity and, consequently, economic indexes have been formed due to the residual level of soil fertility. For instance, on the average by Factor A, the refusal to apply fertilizers and plant protection products of any origin in the cultivation technology provided the cost price of products at the level of 7,995 UAH/t, the total production costs – 7,516 UAH/ha, the cost of commodities- 19,552 UAH/ha, the operating net profit -12,036 UAH/ha, that led to the final profitability of production at the level of only 160.1% (Table 4).

Table 4. Indexes of energy efficiency of growing sunflower hybrids under different levels of technology biologization

Hybrid (Factor A)	Technology of cultivation (Factor B)	Crop productivity, t/ha	Energy consumption, GJ/t	Energy gain, CJ/ha	Energy expenses, GJ/ha	Energy increment GJ/ha	Energy coefficient
PR64F66 F_1	Traditional	1.87	7.70	36.24	14.41	21.83	2.51
	Biologized I	1.94	4.10	37.60	7.93	29.66	4.74
	Biologized II	2.02	6.90	39.15	14.01	25.14	2.79
	Organic	2.27	3.30	43.99	7.53	36.46	5.84
	Extensive	0.94	5.50	18.22	5.15	13.06	3.53
Tunca F_1	Traditional	1.83	7.90	35.47	14.37	21.10	2.47
	Biologized I	1.96	4.10	37.98	7.95	30.03	4.78
	Biologized II	1.99	7.00	38.57	13.98	24.58	2.76
	Organic	2.16	3.40	41.86	7.45	34.41	5.62
	Extensive	0.94	5.50	18.22	5.15	13.06	3.53

Source: original data calculated based on the experimental data obtained.

In order to perform more thorough analysis of the proposed technologies for growing commercial sunflower seeds not depending on a number of objective and subjective factors, primarily determined by the market conditions, we performed a bio-energetic evaluation of the experimental variants according to the modern requirements (Table 4).

The analysis of the above research results allows drawing a conclusion that the final index of energy efficiency of sunflower cultivation - energy coefficient on average by Factor A - had the highest values under organic technology (using organic fertilizers instead of synthetic mineral fertilizers, and organic insecticides instead of chemical PPP) and made up 5.73, that characterizes the technology as extremely highly efficient in the energy aspect. Under the traditional intensive cultivation technology, this index was 2.49, that also allows characterizing the technology as highly efficient in terms of total energy consumption. Using organic PPP instead of synthetic pesticides (biologized II technology) in the cultivation technology was also characterized by a significant level of energy efficiency - the amount of energy consumed per unit of sown area was 2.77 times less than the amount obtained with the yield harvested in the same area.

The variant of organic I cultivation technology was also characterized by a high level of energy efficiency: on average by Factor A, it was 4.76 (we explain this value to be a result of removing mineral fertilizers from the structure of the production costs, which are the most energy-intensive). Sunflower cultivation with using a minimal extensive technology also led to a significant level of energy efficiency of the process - the average value of the organic coefficient was 3.53, which exceeded all the other variants of the experiment, except of an organic technology for sunflower cultivation.

In our opinion, the evaluation of the variants under study in the light of their compliance with environmental conditions is not less important, especially under the current conditions of significant climatic transformations experienced by all agro-climatic zones of the country. Ecological plasticity is considered to be the average reaction of a variety or hybrid to changes in environmental conditions, and ecological stability is the deviation of empirical data in each environment from the average reaction. According to the data obtained by V.Z. Pakudin and L. M. Lopatina, the regression coefficient (b_i) characterizes the average reaction of a crop under a particular cultivation technology to changes in environmental conditions, shows the plasticity of this sample and allows predicting changes in the trait under study in specific conditions. The variance of trait stability (Si^2) shows how reliably this variant corresponds to this plasticity estimated by the regression coefficient. Comparison of the plasticity of the hybrids under study shows that the samples with the coefficient b>1 belong to highly plastic ones (in relation to the group average), with the coefficient 1>b=0 - to relatively low plastic ones. If the plasticity index does not differ significantly from unity, then the variant t does not differ from the group average by the reaction to changes in environmental conditions [22]. The evaluation of ecological plasticity and stability of crop varieties and hybrids makes it possible to characterize them in various ways in terms of the formation of potential productivity of a particular crop, its technological quality and resistance to a set of stressors [18]. These values are complementary indexes in their essence, and highly stable hybrids respond to a change in external conditions with a more predictable reaction [22]. It allows stating that adaptability refers to the reaction to the predicted effects of the environment, and stability - vice versa. The most widely used method for studying the interaction of genotype×environment (G×E) in different crops is a comparative method. The aim of our research was to determine the indexes of ecological plasticity and stability of sunflower hybrids of the medium-maturing ecological group by quantitative characteristics of productivity and to establish high- and medium-plastic samples with its stable manifestation by the analyzed characteristics (Table 5).

Table 5. Indexes of ecological tolerance of sunflower hybrids depending on a cultivation technology

Hybrid	Crop productivity, t/ha	DSI - drought susceptibility index	DTL - Drought tolerance index	YSI - yield stability index	YI - yield index	STI - stress tolerance index	b_i - plasticity index	Sd_i^2 - stability index
PR64F66 F_1	1. 81	0.91	0.87	0.59	109	0.51	1.06	0.00091
Tunca F_1	1.78	0.93	0.82	0.53	104	0.47	0.96	0.00077
Average	1.79	0.92	0.85	0.56	107	0.49	1.01	0.00084

Source: original data calculated based on the experimental data obtained.

In the experiment, we detected the advantage of the hybrid PP64F66 F_1 by the main indexes reflecting environmental tolerance, and mainly by the plasticity index b_i (1.06 in comparison with 0.96 for the hybrid Tunca F_1) and the stability of Sd_i^2 (0.00091 suitability of this hybrid to the environmental conditions of the growing area, primarily, by the indexes of drought resistance.

CONCLUSIONS

All the elements of biologization of the cultivation technology for sunflower hybrids resulted in significant improvement of basic indexes of economic efficiency, firstly, the cost price of a unit of production, total production costs, revenues, operating net profit and the final index - the level of profitability of production. The analysis of the latter index makes it possible to state that, by Factor A, the highest economic attractiveness is characteristic of the variants of an extensive (minimum) cultivation technology, in which the level of profitability during the years of the research was 160.1% on average, and organic technology - 159.9%, respectively. If the manufacturer is certified and a batch of commercial sunflower has organic status, it is possible to increase this index to 211.9%, taking into account 20% organic bonus, that is an essential reserve for improving the economic condition of the farm.

The highest energy efficiency in the experiment was characteristic of the variants without the use of the most energy-intensive components - mineral fertilizers. The variants of biologized I and organic technologies ensured the value of this index at the level of 4.76 and 5.73, respectively. The rest of the variants are also characterized by energy efficiency, as they ensure manifold (2.5 times) return of energy consumed per one hectare with the yield.

Analysis of the environmental suitability of the crop hybrids that formed the gradation of factor A of the experiment allows drawing a conclusion that the advantage of the hybrid PR64F66 F_1 in the main indexes reflects its ecological tolerance, and primarily in the plasticity b_i (1.06 compared to 0.96 for the variant of the hybrid Tunca F_1) and stability Sd_i^2 (0.00091 vs. 0.00077, respectively), that indicates significantly higher suitability of this hybrid for the environmental conditions of the growing region, primarily - in terms of drought resistance, which has recently been considered as the most principal one in terms of modern climatic transformations.

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