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EFFECT OF FARM INCOME ON THE LIFESTYLE FACTORS OF FARMERS IN KWARA STATE, NIGERIA

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Abstract

The rising occurrence of chronic and cardiovascular diseases has brought awareness to the role that lifestyle factors play in an individual's disease risk. This study investigated the effect of income from farming on the lifestyle factors of farmers utilizing cross-sectional data gathered from 150 farmers across Kwara State, Nigeria. Three stage random sampling was utilized and the data were analyzed using Descriptive statistics, Simple Lifestyle Indicator Questionnaire and Tobit regression model. The study uncovered that 63.33% of the farmers in the investigated region practiced unhealthy lifestyles while the Tobit regression model result revealed five out of nine independent variables (namely gender, age, educational level, farm size and farm income (the variable of concern)) included in the model were discovered to be significant factors affecting lifestyle factors in the investigated region. The research therefore concluded that farm income has effect on the lifestyle factors of farmers in the study area. Howbeit, the study recommends that farmers should be sensitized on health education so as to understand the pros and cons to various lifestyle factors practiced in order for them to be more cautious regarding their health.

Key words: *income, lifestyle, health, rural, Tobit*

INTRODUCTION

Health is vital and several factors contribute to an individual's health and their risk of illness such as environment, economic and social circumstances, and a person's characteristics and behaviours [6].

Behaviours and habits such as diets, physical activity, smoking, stress and alcohol consumption contribute to a construct known as lifestyle, which can considerably affect health. The rising occurrence of chronic and cardiovascular diseases has brought awareness to the role that lifestyle factors play in an individual's disease risk. Several lifestyle habits including tobacco use, alcohol consumption, physical inactivity, an unhealthy diet, and psychological stress can contribute to an individual's risk of developing an illness [9].

The role of lifestyle factors has caused many underdeveloped and developing countries to experience an epidemiological transition from communicable to non-communicable diseases [3] and this has negative effect on their human capital development enforcing a rising economic burden on their communities [13]. Whilst the occurrence of these diseases varies with socioeconomic status the disparities can be worsen by adopted lifestyles of peoples especially among the rural populace.

The assumption is that unhealthy lifestyle practices have negative health effects and if concentrated among the vulnerable, the inequalities in health will widen [7, 19]. In this regard, it is important to consider the relationship between lifestyle factors and income.

Despite the need, the empirical evidence on the various lifestyle factors and income among rural populace is scanty. The available literatures attempted to examine the contribution of lifestyle factors such as smoking, alcohol use and obesity on income

related health inequality [16, 19], lifestyle factors like healthy eating habit and income which focused mainly on adolescents, youth, universities students and people residing in the urban areas, but there are sparse or no study that have considered the relationship between the cumulated lifestyle factors and income especially among farmers.

Hence it is crucial to evaluate the effect of farm income on the lifestyle factors of farmers in Kwara State, Nigeria. The aim of this study was to describe the socio-economic characteristics of the farmers; identify the lifestyle factors practiced by farmers; and examine the effect of farm income on the lifestyle factors of farmers in Kwara State.

MATERIALS AND METHODS

Study Area

This study was conducted in Kwara State. Kwara State with a total of sixteen Local Government Areas has a population of 3,192,893 and a total land size of 3,682,500 hectares [17, 14]. It is located between latitudes $7^0$45'N and $9^0$30'N and longitude $2^0$30'E & $6^0$25'E. The annual rainfall ranges between 1,000mm and 1,500mm while the average temperature ranges between 300C and 350C. It likewise has an estimated figure of 203,833 homestead families with large numbers living in rural areas [15]. The State is divided into four zones by the Kwara State Agricultural Development Project (KWADP) in consonance with environmental attributes, social practices and project's administrative convenience. Kwara State is principally agrarian with incredible breadth of arable land and rich prolific soils and the major crops commonly cultivated in the state include: yam, cassava, rice, maize, sorghum, cowpeas, groundnut, melon, okra, pepper and some verdant vegetables [14].

Data and Sampling Techniques

A three stage random sampling technique was utilized for the research study. Random sampling method was used in the first stage to select two (2) zones from the four agricultural zones in the state; the second stage included the random selection of five (5) villages from each of the two (2) agricultural zones in the state making a total of ten (10) villages; while the third stage was the random sampling of fifteen (15) farmers from every one of the chosen villages. A sum of 150 farmers were sampled for the study. The data for this study were elicited from the respondent with the aid of a structured questionnaire which was used to seek response on the socio-economic characteristics of farmers, other sources of livelihood and their lifestyle factors in Kwara State, Nigeria.

Analytical Techniques

Descriptive Statistics

Descriptive statistics encompassing the use of measures of central tendency and dispersion (mean, mode, median and standard deviation), percentages, frequency and tabulation was used to capture the socio-economic characteristics and lifestyle factors of the farmer.

Lifestyle Factor Score

The lifestyle factor score was captured using the Simple Lifestyle Indicator questionnaire (SLIQ) which has been tested for reliability and validity by previous researchers [11, 4]. The SLIQ questionnaire consists of 12 questions on diets, physical activity, alcohol consumption, smoking and stress. The overall SLIQ score is established by adding the 5 category raw scores (each category score is 0, 1, or 2), thus the SLIQ score ranges from 0 - 10. The overall SLIQ score was then categorized into:

Unhealthy Lifestyle = If the overall SLIQ score is 0 - 4

Intermediate Lifestyle = If the Overall SLIQ score is 5 - 7

Healthy Lifestyle = If the Overall SLIQ score is 8 - 10.

Tobit Regression Model

Tobit Regression model was utilized to analyse effect of income from farming on farmers' lifestyle factors. Tobit Regression model is used when a dependent variable assumes some constant value for some observations and a continuous value for the rest observations [12]. It was developed by Tobin in 1958 [1, 5] to deal with the problem of censored data. Hence, in this study the dependent variable was a censored variable in which it assumed a constant or threshold

value of score of 5* for farmers who practiced healthy lifestyles. Assume, nevertheless, that Yi is observed if the latent variable Yi* < score of 5 and is not observed if Yi* > 5score. Then the observed Yi will be defined as:

$$Yi = \{Yi* = \beta Xi + Ui \qquad \text{if } Yi* < 5$$

$$\text{if } Yi* \geq 5$$

where:
Yi* is the latent (unobserved) variable,
Yi is the observed variable,
Xi is vector of explanatory variables,
Ui is a vector of error terms and
β is a vector of parameters to be estimated.
*Note that score of 5 is the threshold value for healthy lifestyle as stated by [4].
where:
Y = Farmer Lifestyle Factor
X_1 = Gender (male=1; female=0)
X_2 = Age (years)
X_3 = Marital Status (married=1; single=0)
X_4 = Educational Status (0=Non-formal, 1=primary, 2=secondary, 3=Tertiary)
X_5 = Household Size (adult equivalent)
X_6 = Farm size (ha)
*X_7 = Farm income (Naira)
X_8 = Membership of Cooperative (yes=1; no=0)
X_9= Amount of Loan Accessed (amount)

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Farmers

In this study, a primary data collected from a total of 150 sampled farmers was used. From the total samples, results in Table 1 shows that 87.33% of the farmers were male which indicates farming is dominated by males in the study area. The marital status of the farmers shows majority (98%) of them were married; the age distribution of farmers shows majorities (64%) were within the 41–60 years age group and the mean age is 53.89 years. Furthermore, about 70% of the farmers had at least primary education as their highest level of education; also 58.67% of the farmers have a household size ranging between 5-8 persons and the average household size of farmers in the study area was 7.88 persons.

Table 1. Socio-Economic Characteristics of Farmers (n=150)

Characteristics	Frequency	Percentage
Age		
≤30	01	0.67
31-40	15	10.00
41-50	41	27.33
51-60	55	36.67
>60	38	25.33
Mean Age	53.89	
Gender		
Female	19	12.67
Male	131	87.33
Marital Status		
Single	03	02.00
Married	147	98.00
Educational Level		
No formal	37	24.67
Primary	53	35.34
Secondary	52	34.67
Tertiary	08	5.33
Household size		
<5	05	03.33
5-8	88	58.67
8-12	54	36.00
>12	03	02.00
Mean	7.88	
Farming Experience		
≤10	13	08.67
11-20	43	28.67
21-30	41	27.33
>30	53	35.33
Mean	26.97	
Farm Size (hectares)		
≤1	23	15.33
1.1-2	22	14.67
2.1-3	60	40.00
3.1-4	37	24.67
>4	08	05.33
Mean	2.356	
Annual Farm Income (Naira)		
≤300,000	06	04.00
301,000–500,000	14	09.33
501,000-700,000	22	14.67
701,000-900,000	21	14.00
> 900,000	87	58.00
Mean	1,224,162	
Member of Cooperative		
Yes	112	74.67
No	38	25.33
Credit Accessed		
No credit	48	32.00
≤50,000	18	12.00
51,000-100,000	37	24.67
101,000-200,000	28	18.67
>200,000	19	12.67
Mean	108,097.3	

Source: Field survey, 2020.

The finding of the study also figured out that more than 60% of the farmers had a minimum farming experience of 20 years with the mean 26.97 years; about 65% of the farmers cultivated more than 2 hectares of land with the average being 2.3 hectares in the study area.

In addition, the result showed that 74.67% of the sampled farmers belong to a cooperative society, implying the farmers belongs and enjoys the benefits of social groups; regarding the income from farming activities, 58% of the farmers were earning more than 900,000 naira annually with an average of 1,224,162 naira annually. Furthermore, the findings of the investigation showed that 32% of the examined farmers had no access to credit service, while about 46% accessed at least 50,000 naira credit with an average of 108,097.3 naira credit in the study area.

Lifestyle Factor of Farmers in the Study Area (n=150)

The result in Table 2 shows the level of lifestyle factors of farmers which is a summation of various lifestyle factors (diet, alcohol consumption, stress management, smoking etc.) in the investigation region. The result of the study revealed that 63.33% of the farmers practiced unhealthy lifestyles such as consuming unhealthy diet like junks, smoking etc. while only 4% of the farmers in the investigation region practiced healthy lifestyles which may be due to the fact that they are conscious of their health and monitor their lifestyle adequately.

Table 2. Lifestyle Factors Category of Farmers

Lifestyle Category	Frequency	Percentage
Unhealthy Lifestyle	95	63.33
Intermediate Lifestyle	49	32.67
Healthy Lifestyle	06	4.00

Source: Field survey, 2020.

Effect of Farm Income on the Lifestyle Factors of Farmers

Tobit model was utilized to analyze the effect of farm income on the lifestyle factors of farmers. Subsequently, results from the Tobit model utilizing information gotten from 150 sampled farmers (of which 95 were censored/having unhealthy lifestyle as per the model outcome) are presented in Table 3. The overall model is significant at 1% as indicated by the likelihood ratio test (Prob > $\chi 2$ = 0.0001). Also, the model estimate uncovered that out of the 9 explanatory variables, 5 variables were found to have a significant effect.

The coefficient of gender was negative and significant at 1%, this suggests the female farmers are more probable to practice healthy lifestyle than the male farmers. This is because females are more deterrent than men when it concerns their health and they don't leave their wellbeing to chances. This result is similar with the result of the studies carried out by [8] and [10] where they discovered that females have healthier lifestyles than the males.

The coefficient of age was positive and significant at 1%, this suggests that the older the farmers, the healthier their lifestyles when compared with the younger farmers. This may be due to the fact that younger people explore and take unnecessary risks (i.e. involve in vices) that affect their health and wellbeing. This result is in line with studies done by [2] and [8] where they established that unhealthy lifestyles are prevalent among youths and young adults.

The coefficient of educational level was negative and significant at 1%, thus suggesting that the lower the educational level of the farmers, the healthier their lifestyles and vice versa. This result is against a priori expectation, that the level of education should positively affect the lifestyle factors of farmers as education keeps them informed and well exposed. The result might also be true for educated farmers as some of them despite being exposed still involve in some unhealthy lifestyle factors such as eating of junks, excessive alcohol consumption etc.

The coefficient of farm size was negative and significant at the 10%, meaning that farm size exhibits a negative relationship with the lifestyle factors of a farmer. That is, farmers with smaller farm sizes tend to be healthier than those with larger sizes, and vice versa. This may be because farmers who have smaller farm sizes don't really require as much strength to work when compared with

farmers who had larger farm sizes who boost their strength through unhealthy lifestyles such as excessive drinking, smoking and substance use.

Also, *the coefficient of farm income* was positive and significant at 5%, this shows that farmers with higher farm income earnings were more likely to have healthier lifestyles than farmers having low farm income earnings. This is on the grounds that higher farm income encourages the farmer to be able to purchase and eat healthy diet; reduce their stress level as it is discovered that financial inadequacies increases stress among people. The result of this study conforms to the study carried out by [18] that reported income as a major determinant of lifestyle factors.

Table 3. Tobit Regression Result of Effect of Farm Income on the Lifestyle Factors of Farmers

Variables	Coefficient	t-value
Gender	-2.416842***	-4.12
Age	0.100137***	3.43
Marital status	-0.574283	-0.37
Highest educational level	-0.344335***	-2.72
Household size	0.028029	0.22
Farm size	-0.448770*	-1.88
Farm income	5.73e- 07**	2.31
Credit assessed	-5.52e- 07	-0.44
Member of cooperative	0.074025	0.16
Constant	2.605377	1.62
/Sigma	1.845996	

Source: Field survey, (2020).

***Significant at 1%, **significant at 5%, *significant at 10%.

Number of observation = 150; LR chi^2 (9) = 38.90; Prob> chi^2 = 0.0000;

Log likelihood = -197.32426 and Pseudo R^2 = 0.0897

Obs. summary: 55 right-censored observations at SLIQ>4

95 uncensored observations

0 right-censored observations

CONCLUSIONS

The study concluded that farm income affected the lifestyle factors of farmers in the study area. Other explanatory variables that affected lifestyle factors were gender, age, educational level and farm size. Howbeit, the study recommends that if farmers are to live and develop healthy lifestyles awareness and sensitization on health education should be given to them to understand the pros and cons to various lifestyle factors practiced in order to be more cautious regarding their health. Also, programmes and assistance that boost farm income should be initiated by government and non-governmental organizations to help farmers better their livelihood which in turn translate to having a healthy lifestyle.

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EFFECT OF INTER-ORGANISATIONAL RELATIONSHIP ON COMMUNITY-BASED ORGANISATIONS' PERFORMANCE: EVIDENCE FROM OSUN STATE, NIGERIA

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Abstract

The study examined effect of inter-organisational relationship on Community Based Organisations' (CBOs) performance in rural areas. Data were gathered through structured interview schedule from 140 CBOs' members and analysed using appropriate statistics. The results revealed that the mean age of CBOs' members interviewed in the study area was 57.6 ± 15.1 years and had spent an average of 15.3 ± 9.5 years in formal school. Majority (72.1%) of the respondents was male and a lot (82.1%) of them joined CBOs because of their community development. The results also indicated that majority (84.3%) of the CBOs was registered with governmental agency; they had main focus on project execution (82.9%) with main (80.0%) source of fund from members' contribution. There were significant association between improvement in CBOs' performance and respondents' main occupation ($\chi 2= 40.45$; $\rho \leq 0.01$); and reasons for joining CBOs ($\chi 2= 29.04$; $\rho \leq 0.01$), also there were positive and significant relationship between improvement in CBOs' performance and members' age ($r=0.514$; $\rho \leq 0.01$); and years of formal education ($r=0.534$; $\rho \leq 0.01$). As a result of the findings of the study, it was concluded that there was improvement in CBOs' role performance due to inter-relationship among them. In order to maximize potentials inherent in inter-relationship among CBOs, it was recommended that all challenges, such as low level of government assistance, inadequate resources, differing culture and values of partnering CBOs, militating against it should be adequately addressed by the relevant stakeholders.

Key words**:** *community-based, inter-relationship organization, performance*

INTRODUCTION

Community-Based Organisations (CBOs) could be conceptualized in diverse ways, most of which are related to their composition and functions. CBOs as described by Universal Class, (2019) [16] are small informal organisations initiated by local residents based within the communities they serve, operating on voluntary basis and often lacking in formal structure or strategy. They provide various services towards the development of communities (mostly rural) and can be used as channels to route development, information and other resources required in improving living conditions in rural communities; in other times they act as links between the community and outside organisations to enable flow of input into the community. CBOs were borne out of the inadequacy of government to make provision (socio and infrastructural amenities) in respect to the growing population (Yachkaschi, 2005) [18].

Cornwell (2006)[7] and Cornwell & De Beer (2004)[8] listed some advantages of working with CBOs: they are closer to the grassroots and are therefore able to keep up with the needs and views of the "beneficiaries" of the development; CBOs operate at low cost and can adapt more quickly than complex governmental organisations and needs. Therefore they operate more efficiently and cost-effectively; in addition, they are directly accountable to their members, a factor which forces them to be receptive and responsive to the desires and needs of their members. This is in direct contrast to government bodies where staff members are accountable to their departmental heads rather than their clients; furthermore, they are much smaller than governmental organisations. And since they do not have an extensive bureaucratic structure and are not subject to political strife, they tend to be more flexible; and they are characterised by upward flow of information and is therefore easier to experiment within

these organisations, to try new ideas and make regular adjustments, and this makes them ideal instruments of learning process planning. As good and advantageous the CBOs activities, there is need for synergy to boost their overall performance, which called for inter-organizational relationship among them.

Inter-organizational relationships can be defined as the relatively enduring transactions, flows, and linkages that occur among or between an organization and one or more organisations in its environment. It is a reciprocally and well-defined association entered into by two or more organisations with a pledge to a set of common goals, a jointly developed structure and shared obligation, and mutual authority and accountability (Beckman *et al.*, 2004[6]; Mattessich *et al.,* 2001[12]). Inter-organizational relationships, also referred to as collaboration have the advantage that partners have a range of expertise and experience that on combining or integrating, can lead to new insights and productive actions for both, leading to trust and shared vision that potentially enhance the ability of the parties to achieve qualitatively better outcomes.

A number of researchers have highlighted the significance of CBOs and the contribution these organisations make in national social and economic development in general and rural development in particular. Such as participation of community based organisationin rural development projects, (Adisa, 2001)[3], also Abegunde (2009)[1] looked at the role of community based organisations in economic development in Nigeria, Bamiwuye and Adisa (2015)[5] examine the role of CBOs in rural development activities in Osun State, Nigeria; but there is dearth of information in literature as regarding the inter-organizational relationship on CBOs' performance. The acknowledgement of this need is the motivation for the conduct of this study.

Objectives of the Study

The main objective of the study is to examine the effect of inter-organizational relationship on community based organisation in Ife North Local Government Area of Osun State, Nigeria. The specific objectives are to:

(i)describe socio-economic characteristics of CBOs' members in the study area;

(ii)examine CBOs' characteristics in the study area;

(iii)examine attitudinal disposition of respondents towards inter-relationship among CBOs in the study area; and

(iv)identify challenges militating against inter-relationship among CBOs in the study area.

Hypotheses for the Study

(i)There is no significant relationship between selected socio-economic characteristics of CBOs' members and improvement in CBOs' performance due to inter-relationship

(ii)There is no significant relationship between attitudinal disposition of respondents toward inter-relationship and improvement in CBOs' performance due to inter-relationship.

MATERIALS AND METHODS

Study Area and Sample Selection

The study was conducted in rural areas of Osun State, Nigeria. The population consist of all CBOs' members in the study area. Multi-stage sampling procedure was used to select the respondents. At first stage, Ife North Local Government Area was purposively selected because it is rural and has high predominance of CBOs; at second stage, four (4) communities were selected randomly from the Local Government which are *Ipetumodu, Yakooyo*, *Moro*, and *Edunabon*. During the third stage, twenty eight (28) CBOs (7 from each community) were proportionately selected in the already selected communities, that is, 8 from Ipetumodu, 5 from Yakooyo, 6 from Moro and 7 from Edunabon. Finally, a systematic random sampling technique with a random start at an interval of two using members' register as sampling frame was used to select five (5) members from each selected CBO. A total of 140 respondents were interviewed for the study.

Data Collection and Analysis

Validated and pre-tested interview schedule was employed to draw information on socio-economic characteristics of the respondents, CBOs' characteristics, level of inter-

relationship among CBOs, respondents' attitudinal disposition towards inter-relationship among CBOs, and constrains to inter-relationship among CBOS. The data were summarized using descriptive statistics while Chi-Square and Correlation analyses were used to make implications from the hypotheses.

Measurement of Variables

Dependent variable: The dependent variable for the study was conceptualized as improvement in CBOs performance due to inter-relationship. It was measured by listing and scoring the levels of performance of CBOs at each stage of joint rural development activities (problem identification, decision-making, planning, implementation and monitoring/evaluation stages) on a 4-point scale of Much Improved (4), Moderately Improved (3), Less Improved (2), and Never Improved (1).

The respondents' attitude towards inter-relationship of CBOs was determined by asking the respondents to indicate their view using 14 declarative sentences consisting of both positive and negative items on a 4-point scale of; Strongly Agreed (4), Agreed (3), Disagree (2) and Strongly Disagree (1) for positive statements and vice-versa for negative statements. This was further categorized into favourable and unfavourable attitude using attitude mean score as cut off point.

RESULTS AND DISCUSSIONS

Socio-economic Characteristics of CBOs' Members

Results in Table 1 shown that bulk (60.5%) of the respondents were at their old age, while the mean age of the respondents was 57.6±15.1. Likewise, it was revealed that majority (72.1%) of the respondents were male. The table also shown that the mean of years spent in formal schools was 15.3±9.5; Majority (64.3%) of them was farmers by occupation while very few (15.7%) were still in school; in addition, vast majority (80.0%) of the respondents belongs to other social organisations apart from the CBOs such as cooperative and political organisations. The table also shown that vast majority (81.4%) of the respondents was married; this implies that high percentage of married was involved in CBOs' activities. In addition, vast majority (89.3% and 82.1%) of the respondents was aware of CBOs through their community leaders and joined CBOs purposely for development of their community respectively.

Table 1. Distribution of respondents according to their socio-economic characteristics (n= 140)

Variables	Freq	%	Means & St. Dev.
Age (years)			
Below 30	29	20.7	57.6±15.1
30-50	36	25.7	
Above 50	75	53.6	
Sex			
Male	101	72.1	
Female	39	27.9	
Years of formal education			
No formal education	7	5.0	
1- 6	15	10.7	15.3±9.5
7-12	61	43.6	
Above 12	57	40.7	
***Main occupation**			
Farming	90	64.3	
Trading	48	34.3	
Civil service	27	19.3	
Artisanship	42	30.0	
Schooling	22	15.7	
Belonging to other social organization			
Yes	112	80.0	
No	28	20.0	
Marital status			
Married	114	81.4	
Widowed	3	2.1	
Single	23	16.4	
***Sources of awareness about CBOs**			
Extension personnel	50	35.7	
Neighbours	80	57.1	
Community leaders	125	89.3	
Media	23	16.4	
***Reasons for joining CBOs**			
Community development	115	82.1	
Personal profit	57	40.7	
Personal interest	87	62.1	
Leaving legacy for children	68	8.6	

Source: Field survey, 2019 *Multiple choices

Characteristics of CBOs

Result in Table 2 revealed that the average year of existence of the CBOs was 13.6± 9.1; also vast majority (84.3%) of them was registered with government agency.

It was also of note that the main activities of CBOs were monthly meetings (90.7%) and execution of developmental projects (82.9%). Few (13.6%) CBOs had abandoned projects, this could be as a result of limited fund available for use.

Table 2. Distribution of respondents according to their CBO's characteristics (n = 140)

Variables	Freq.	%	Mean & St. Dev.
Years of existence			
Below 10	39	27.9	13.6±9.1
10-20	71	50.7	
Above 20	30	21.4	
Registered with Govt. agency			
Yes	118	84.3	
No	22	15.7	
***CBOs' activities**			
Anniversary	75	53.6	
Monthly meeting	127	90.7	
Annual general meeting	59	42.1	
Execution of projects	116	82.9	
Town's day	55	39.3	
Youth carnival	20	14.3	
***Source of funding**			
Members' contribution	112	80.0	
Members of public	48	34.3	
Government	52	38.1	
Philanthropists	62	44.3	
Stages of projects			
Completed and in use	89	63.3	
On-going	57	40.7	
Abandoned	19	13.6	

Source: Field survey, 2019 *Multiple choices

Attitude of CBOs' Members towards Inter-relationship of CBOs

The result in Figure 1 shows that many (68.6%) of the respondents showed favourable attitude towards inter-relationship among CBOs; the attitude means score was 72.7 with standard deviation of 1.8.

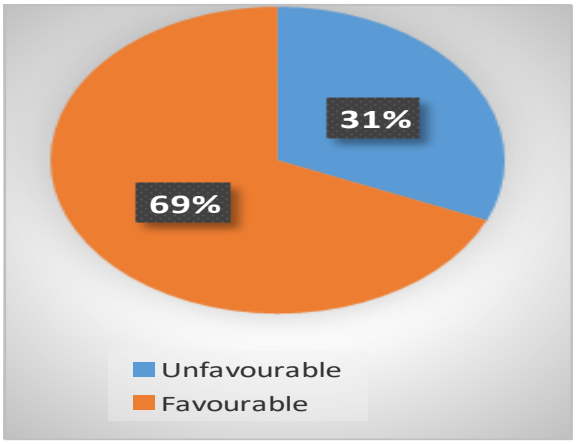

Fig 1. Distribution of the respondents according to attitude towards inter-relationship of CBOs.

Mean = 72.7±1.8

Source: Field survey, 2019.

Challenges Militating against Inter-relationship among CBOs

Result in Table 3 revealed that vast majority (79.3%) of the respondents agreed inadequate resources as a main challenge militating against inter-relationship among CBOs which was ranked highest, followed by low level of government assistance (76.4%) and differing culture and values of partnering CBOs (65.0%) in that order, while tight timeframes (27.1%) ranked least among the challenges.

Table 3. Distribution of respondents according to challenges militating against inter-relationship among CBOs (n = 140)

*Challenges	%	Rank
Inadequate education of CBOs' members	33.6	10th
Low level of government assistance	76.4	2nd
Inadequate resources	79.3	1st
Lack of cooperation among partnering CBOs	37.9	8th
Tight timeframes	27.1	11th
Differing culture and values of partnering CBOs	65.0	3rd
Mismanagement of project fund	45.0	7th
Improper project coordination/supervision	36.4	9th
Conflict among partnering CBOs	62.9	4th
Lack of shared agendas	48.6	6th
Overload of new initiatives	57.9	5th

Source: Field survey, 2019 * Multiple responses

Improvement in CBOs' Performance

The improvements mean score was 66.9±4.1. This finding in Table 4 revealed that majority (82.26%) of the CBOs had commendable improvement in their performance due to inter-relationship.

This result is in agreement with that of De Beer and Swanepoel (1998)[10] that reported that collaboration among organisations led to better functioning and performance.

Socio-economic characteristics

The mean age of the respondents was 57.6±15.1 implies that the respondents comprise few numbers of active people, which might be because of high rate of rural-urban migration of able bodies in search of white-collar jobs. Low percentage of female may be due to the fact that women are still considered in most rural communities as second class citizens, traditional (cultural) beliefs regarding the role and status of women as homemaker in society are still widespread.

Furthermore, high year of formal education (Mean= 15.3±9.5) revealed that majority could read and write which would affect their participation in CBOs' inter-relationship positively, this finding disagreed with the position of Olanrewaju (2014)[14] who posited that many rural dwellers in Osun State were not literate. In addition, that the respondents were engaged in more than one occupations concurred with the findings of Yusuf (2011)[17], who indicated that rural dwellers engaged in a variety of activities as occupation with agriculture usually the prime. The fact that high percentage (81.4%) of the respondents involved in CBOs were married was in tandem with earlier reports of Adisa and Jibowo (2006)[2] that that reported that high percentage of married in the rural communities of Osun State are involved in the community based development projects.

Characteristics of CBOs

The main (80.0%) source of fund for the CBOs was from the members' contribution; this implied that the fund available for CBOs will be limited due to the socio-economic characteristics of the members, this is in agreement with Thake (2004)[15] who reported that many CBOs finance their activities through contribution from their members. In addition, many (63.3%) of the projects embarked on by the CBOs were completed and in use; this could be connected with the fact that the members will not want their contribution to go down the drain.

Table 4. Distribution of the respondents by improvement in CBOs' performance (n = 140)

*Variables	MuI	MoI	LI	NI
	F(%)	F(%)	F(%)	F(%)
Problem identification				
Initiator	2(1.4)	30(21.4)	37(26.4)	71(50.7)
Opinion giver	0(0.0)	33(23.6)	52(37.1)	55(39.3)
Information giver	0(0.0)	4(2.9)	98(70.0)	38(27.1)
Information seeker	0(0.0)	16(11.4)	49(35.0)	75(53.6)
Decision making				
Committee member	0(0.0)	36(25.7)	45(32.1)	59(42.1)
Debate and discussion	0(0.0)	0(0.0)	34(24.3)	106(75.7)
Conducting opinion poll	0(0.0)	0(0.0)	12(8.6)	120(91.4)
Planning				
Arranging meeting	0(0.0)	51(36.4)	76(54.3)	13(9.3)
Brainstorming	0(0.0)	0(0.0)	16(11.4)	124(88.6)
Sourcing for resources	0(0.0)	0(0.0)	26(18.6)	114(81.4)
Implementation				
Contribution of resources	0(0.0)	0(0.0)	13(9.3)	127(90.7)
Personal labour	0(0.0)	0(0.0)	30(21.4)	110(78.6)
Hired labour	0(0.0)	0(0.0)	46(32.9)	94(67.1)
Monitoring / Evaluation				
Beginning	0(0.0)	3(2.1)	95(67.9)	42(30.0)
Middle	0(0.0)	31(22.1)	61(43.6)	48(34.3)
End	0(0.0)	4(2.9)	12(8.6)	124(88.6)
As need arises	0(0.0)	13(9.3)	54(38.6)	73(52.2)

Source: Field survey, 2019 * Multiple responses

Mean = 66.9±4.1

Much Improved= MuI, Moderately Improved = MoI, Less Improved= LI, Not Improved= NI

Attitude of respondents towards inter-relationship among CBOs

Many of the respondents (68.6%) indicated that they have favourable attitude towards inter-relationship among CBOs It could be inferred that the favourable attitude of the respondents toward inter-relationship among CBOs would lead to full involvement in all CBOs' activities to the extent of releasing their resources among others.

This will automatically result into improvement in CBOs' performance. This result is in agreement with that of Abudu and Idehen (2017)[4] that stated that farmers had favourable attitude towards CBOs in Rivers State, Nigeria.

Challenges militating against inter-relationship among CBOs

Vast majority (79.3%) of the respondents agreed to inadequate resources as a main challenge militating against inter-relationship among CBOs; the resources include both human and material resources, in quantity and quality, followed by low level of government assistance (76.4%), in providing counterpart funds and conducive environment; and differing culture and values of partnering CBOs (65.0%).

This finding corroborated that of Das & Teng, (2000)[9]; and Greve *et al.,* (2010)[11] who reported similar challenges militating against inter-relationship among CBOs.

Improvement in CBOs' Performance

There is improvement in CBOs' performance due to inter-relationship among them in problem identification, decision-making and monitoring/evaluation stages of joint development programme activities.

Apart from improvement in CBOs' performance, inter-relationship gives visibility to the joint development programmes and prevent duplicity of developmental effort. This result is in agreement with that of Osuchukwu and Edewor (2016)[14] and De Beer & Swanepoel (1998)[10] that reported that collaboration among organisations led to better functioning and performance.

Hypotheses Testing

The results in Table 5 show that at 0.05 level of significant, there was no significant association between sex (χ^2=6.83) also marital status (χ^2=5.51) with source of awareness about CBO (χ^2=6.09) of the respondents and improvement in CBOs' performance due to inter-relationship.

This implies that performance of CBOs was not a function of sex, marital status and source of awareness about CBO of the members. On the other hand, reason for joining CBOs (χ^2=29.04), membership of social group (χ^2=17.71), and occupation (χ^2=40.45) were significantly associated with improvement in performance of CBOs due to inter-relationship.

Table 5. Results of Chi-Square analysis of the association between socio economic characteristics of respondents and improvement in CBOs performance due to inter-relationship (n = 140)

Variables	χ^2 – value	DF	P-Value
Reason for joining CBOs	29.04	5	0.000*
Source of awareness about CBOs	6.09	6	0.749
Main occupation	40.45	5	0.000*
Marital status	5.51	4	0.647
Sex	6.83	2	0.508
Membership of other social group	17.71	2	0.000*

Source: Field survey, 2019 *Significant at P<0.05 DF= Degree of Freedom

Table 6. Correlation analysis showing relationship between socio-economic characteristics of the respondents and improvement in CBOs' performance (n = 140)

Variables	Correlation coefficient (r)	Coefficient of determination (r^2)
Age	0.514**	0.099
Years of formal education	0.534**	0.111

Source: Field survey 2019.
**Significant at 0.01level

Result in Table 6 revealed that at 0.01 level of significance, respondents' age (r=0.514) and years of formal education (r=0.534) had positive and significant relationship with improvement in CBOs' performance. Thus, increase in respondents' age and years of formal education would increase the improvement of CBOs' performance.

Result in Table 7 show that there was positive and significant relationship (r= 0.618; P≤ 0.01) between improvement in performance of CBOs and their attitude towards inter-relationship among CBOs. The contribution of respondents' attitude towards improvement in CBOs' performance was 34.4 percent (r^2=0.3442). This implies that the more favourable the respondents' attitude towards inter-relationship among CBOs, the higher the improvement in CBOs' performance.

Table 7. Correlation analysis showing the relationship between attitude of respondents towards inter-relationship among CBOs and improvement in their performance (n= 140)

Variables	Correlation coefficient (r)	Coefficient of determination (r^2)
Attitude	0.618**	0.3442

Source: Field survey, 2019.
**Significant at the 0.01 level

CONCLUSIONS

Based on the findings of the study, it was concluded that there was improvement in CBOs' role performance due to inter-relationship among them, especially in problem identification, decision-making and monitoring/evaluation stages of joint development programme activities. In order to maximize potentials inherent in inter-relationship among CBOs, it was recommended that all challenges, such as low level of government assistance, inadequate resources, differing culture and values of partnering CBOs, militating against it should be adequately addressed by relevant stakeholders.

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BIOPREDICTION OF LIVE BODY WEIGHT USING MORPHOMETRIC TRAITS IN AMERICAN STANDARD CHINCHILLA RABBITS

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Abstract

Lack of conventional weighing scales in the rural areas makes the use of body measurements to predict live body weight in rabbits an important study. The objective of this study were to: examine the effects of sex on body weight and other growth traits at eight (8) week, to determine the phenotypic correlations between the body weight and linear body measurements and to predict live body weight of the rabbits using linear body measurements. Measurements were taking on body weight, body length, ear length, tail length, fore arm length, heart girth and abdominal circumference from 61 females and 39 males of American Standard Chinchilla rabbits. The results show that, the values for body weight, body length, ear length, tail length, fore arm length, heart girth and abdominal circumference for female were 1.19 ± 0.02, 31.97 ± 0.25, 10.67 ± 0.13, 9.89 ± 0.19, 15.61 ± 0.14, 21.61 ± 0.17 and 23.75 ± 0.14 respectively, while the corresponding values for male were 0.88 ± 0.04, 28.00 ± 0.37, 10.44 ± 0.25, 8.95 ± 0.14, 14.74 ± 0.17, 19.62± 0.20 and 21.67 ± 0.29. Means were statistically higher ($p<0.05$) in the female compared with male in virtually all the traits considered except in fore arm length. The correlations between body weight and the linear body measurements ranged between -0.011 to 1.000 in the overall population. It is significant in most cases, except in body weight and ear length (-0.156), body weight and face length (- 0.011), heart girth and ear length (-0.046), abdominal circumference and ear length (-0.235). Others are: face length and heart girth (-0.086) and face length and abdominal circumference (-0.216). Coefficient of determination was highest when body length was fitted in the model. When two variables were included in the model highest coefficient of determination was observed in body length and ear length. When all the variables were fitted, the coefficient of determination was the highest. Increased variables in the model showed that, the coefficient of determination also increased. The best predictor of live body weight at eight weeks in American Standard Chinchilla rabbits was body length.

Key words**:** *body weight, body length, abdominal circumference, ear length, fore arm length*

INTRODUCTION

Linear body measurements can give a good description of performance, productivity and carcass quality of animals [9]. Linear body measurements can be used to compare growth in different parts of the body. The various body dimensions develop at different rates and these alterations determine the shape, conformation and body proportion of the animal within a specific period of time. [8], described the inter-relationship between body weight and linear body characters of meat animals as an important application in quantifying body size, shape, growth performance, productivity, and carcass characteristics of animals. Linear body measurements determine the growth of long bones over a period of time. Change in the shape of an animal could readily be an indicator of its live weight and carcass composition. In addition, live weight of an animal predicts its market value [14]. In a similar vein, [3], reported that meat yield increase of an animal is a factor of its genetic improvement of its body weight which depends on the measurement of its growth traits. Therefore, linear measurements have been found very relevant in the prediction of growth in farm animals such as in the case of

poultry [1], goats [10], sheep, cattle and pigs [12]. In an attempt to genetically improve rabbits, [4], conducted a study to assess the relationships among linear body dimensions and body weight in rabbits and crosses. The results indicated that body measurements and weight were generally positive and significant ($p< 0.001$) indicating a very strong inter relationship among different body dimensions. [1] reported very high, positive and highly significant correlation coefficients between the body weight and the measured linear body measurements. Therefore, animals with highly and positively correlated traits in a breeding programme could demonstrate great tendency of achieving increase body weight through body width in the selection index. Selection for growth rate in rabbits depends on its body weight measurement, therefore, selection of genotypes with potential for appreciable body weight is very germane [6]. Growth from different parts of an animal could also be compared with the use of linear body measurements. The performance of an animal is also a factor of body weight and linear body measurements of the animal [17] and [5]. Therefore, improvement of rabbits is important in order to increase their contribution to the much-needed animal protein in Nigeria. Rabbit producers are interested in the relationship that exists between body weight and physical characteristics, since this reflects the performance of the rabbits. According to [11], breeders should be very sure of the relationship that exists between the mentioned parameters before organizing the breeding programmes in order to achieve an optimum combination of body weight and good conformation for maximum economic returns. Relating body weight to linear body measurements is a way of predicting body weight of rabbits. This is relevant especially in rural areas where conventional weighing scales are not available. The objectives of this study were to examine the effects of sex on body weight and other growth traits, to determine the phenotypic correlations between the body weight and linear body measurements and to predict live body weight of the rabbits using linear body measurements

MATERIALS AND METHODS

One-Hundred American Standard Chinchilla rabbits at eight weeks of age comprising of sixty-one (61) females and thirty-nine (39) males were used for this study at Olusegun Agagu University of Science and Technology Teaching and Research Farm, Okitipupa, Ondo State, Nigeria. The animals were housed in individual cages in a well-ventilated Rabbit building. The cages were large enough for free movement. Each cage was fitted with a stainless feeder and drinker. The animals were fed with pelleted food at the rate of 120 g for the adults and between 60 and 100 g for the growers depending on the ages. Clean drinking water was served daily throughout the experimental period. Feeders and drinkers were cleaned daily with soap and water. The cages were cleaned every day from food particles, faeces and other waste. Data on body weight (BW) in kg using a weighing scale and five other linear body measurements in cm [2] were taken according to the procedure of [13] using measuring tape.

Body length (BL): Diagonal distance from the point of the shoulder to the pin bone

Tail length (TL): Measured from the base of the tail to the tip.

Ear length (EL): the distance from the base of attachment of the ear to the head to the tip of the ear.

Fore arm length (FL): is the length from the attachment of the fore arm

Heart girth (HG): measured as body circumference just behind the fore leg.

Abdominal circumference (AC**):** measured as body circumference at the middle of the animal.

The data collected were summarized with descriptive statistics to report the summary statistics and analysis of variance was carried out to examine the effect of sex on the growth traits using [16].

Pearson correlation was used to determine the correlation coefficients among the traits on sex basis. Stepwise multiple regression analysis was used by including the different linear measurements individually and collectively, to identify the best predictor

variables for estimating the body weight. Body weight and regression equation were compared based on coefficient of determination.

The full regression model of the measurements (all the six linear body measurements) was defined as:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$

where:

Y = dependent variable (body weight),

a = intercept,

b's = regression coefficients,

X's = independent variables (BL, TL, EL, FL, HG AND AC).

RESULTS AND DISCUSSIONS

Table 1 shows the summary statistics of body weight and linear body measurements of American Standard Chinchilla rabbit at 8 weeks on the basis of sex.

Higher coefficients of variations were observed in the body weight of male (25.86) and female (16.21).

While the least values were observed in abdominal circumference (4.52) in female and heart girth (6.47) in male.

Table 1. Summary statistics of body weight and linear measurements in American Standard chinchilla rabbits

Sex	Variables	Means	SD	N	Min	Max	CV
Female	BW	1.19± 0.02	0.19	61	0.80	1.50	16.21
	BL	31.97± 0.25	1.98	61	28.00	34.00	6.20
	EL	10.67± 0.13	1.05	61	9.00	13.00	9.82
	TL	9.89± 0.19	1.47	61	8.00	13.00	14.87
	FL	15.61± 0.14	1.07	61	14.00	17.00	6.85
	HG	21.61±0.17	1.35	61	19.00	23.00	6.23
	AC	23.75± 0.14	1.07	61	22.00	25.00	4.52
Male	BW	0.88± 0.04	0.23	39	0.70	1.40	25.86
	BL	28.00± 0.37	2.31	39	25.00	33.00	8.23
	EL	10.44± 0.25	1.57	39	9.00	14.00	15.08
	TL	8.95± 0.14	0.85	39	8.00	10.00	9.49
	FL	14.74± 0.17	1.04	39	13.00	17.00	7.08
	HG	19.62± 0.20	1.27	39	18.00	22.00	6.47
	AC	21.67± 0.29	1.81	39	20.00	25.00	8.36

Bw-body weight; Bl-boy length; El-ear length Tl-tail length; Fl-fore arm length; Hg-heart girth; Ac-abdominal circumference

Source: Data generated in a rabbit experiment conducted at Olusegun Agagu Teaching and Research Farm Okitipupa Ondo State, Nigeria.

Table 2 shows the effect of sex on the body weight and the linear body measurements. The estimates were statistically ($p<0.05$) higher in the female compare with male in virtually all the traits considered except in fore arm length in this rabbit breed. The values for body weight, body length, ear length, tail length, fore arm length, heart girth and abdominal circumference for female were 1.19 ± 0.02, 31.97 ± 0.25, 10.67 ± 0.13, 9.89 ± 0.19, 15.61 ± 0.14, 21.61 ± 0.17 and 23.75 ± 0.14 respectively, while the corresponding values for male are 0.88 ± 0.04, 28.00 ± 0.37, 10.44 ± 0.25, 8.95 ± 0.14, 14.74 ± 0.17, 19.62± 0.20 and 21.67 ± 0.29.

Tables 3 and 4 depict the correlation coefficients between body weights and linear measurements, and regression equations for predicting live weight from linear body measurements respectively. The upper diagonal indicates the correlations for males,

while the lower diagonal indicates that of the females.

The results indicate positive and significant correlations between body weight and the linear body measurements ($p<0.05$ and $p<0.001$) and ranged between 0.301 and 0.951 in male while in female, positive and significant correlations were also found between body weight and body length (0.831), tail length (0.184), heart girth (0.788) and abdominal circumference (0.719).

Table 2. Effect of sex on body weight and linear body measurement at 8weeks in American Standard chinchilla rabbits

Variables	Male	Female	Overall
BW	$0.88^{b} \pm 0.04$	$1.19^{a} \pm 0.02$	1.07 ± 0.03
BL	$28.00^{b} \pm 0.37$	$31.97^{a} \pm 0.25$	30.42 ± 0.29
EL	$10.44^{a} \pm 0.25$	$10.67^{a} \pm 0.13$	10.58 ± 0.13
TL	$8.95^{b} \pm 0.14$	$9.89^{a} \pm 0.19$	9.52 ± 0.13
FL	$14.74^{b} \pm 0.17$	$15.61^{a} \pm 0.14$	15.27 ± 0.11
HG	$19.62^{b} \pm 0.20$	$21.61^{a} \pm 0.17$	20.83 ± 0.16
AC	$21.67^{b} \pm 0.29$	$23.75^{a} \pm 0.14$	22.94 ± 0.17

Bw - body weight; Bl - body length; El-ear length Tl-tail length; Fl-fore arm length; Hg-heart girth and Ac-abdominal circumference.

Source: Data generated in a rabbit experiment conducted at Olusegun Agagu Teaching and Research Farm Okitipupa Ondo State, Nigeria.

The correlations among the body linear measurements in the males ranged between 0.108 and 0.951 while it ranged in females between -0.235 and 0.681.

The correlations between the body weights and the linear body measurements in the overall population was observed to range between -0.011 to 1.000 as shown in Table 3. The results show that the correlations between the body weights and the linear body measurements is significant in most cases, except in body weight and ear length (-0.156), body weight and face length (- 0.011), heart girth and ear length (-0.046), abdominal circumference and ear length (-0.235). Others are: face length and heart girth (-0.086) and face length and abdominal circumference (-0.216).

Table 3. Phenotypic correlation among the body weight and linear body measurements in male and female America standard Chinchilla rabbits

	BW	BL	EL	TL	FL	HG	AC
BW	1.000	0.951***	0.884***	0.301*	0.930***	0.648***	0.851***
BL	0.831***	1.000	0.892***	0.108	0.874***	0.674***	0.851***
EL	-0.156	0.163	1.000	0.411**	0.895***	0.748***	0.856***
TL	0.184	0.530**	0.483**	1.000	0.341*	0.396*	0.288
FL	-0.011	0.505**	0.627***	0.681***	1.000	0.638***	0.816***
HG	0.788***	0.570**	-0.046	0.086	-0.086	1.000	0.870***
AC	0.719***	0.489**	-0.235	0.024	-0.216	0.877***	1.000

Bw-body weight; Bl-boy length; El-ear length Tl-tail length; Fl-fore arm length; Hg-heart girth; Ac-abdominal circumference

Source: Data generated in a rabbit experiment conducted at Olusegun Agagu Teaching and Research Farm Okitipupa Ondo State, Nigeria.

The significant effect ($p<0.05$) observed in virtually all the variables considered in this study was in favour of female which indicates sexual dimorphism. This is in line with the observation of [13] who reported that at eight weeks female New Zealand White, Dutch and

their crosses were statistically higher in body weight and linear body measurements compared to the males. The body weight of 1.19 kg observed for female in this study is higher to what was reported (856.25 g and 544.64 g) for Dutch and New Zealand White female rabbit by [13]. This could be attributed to differences in breed. Similar trend was observed in male body weight and all other variables considered. The overall abdominal circumference (22.94 cm) observed in this study is lower to the report of [7] at age twenty weeks (23.59 cm). The overall estimates for all the parameters considered are lower to the reports of [18] for the same breed.

The phenotypic correlations between body weight and the linear body measurements in males are all significant, positive and moderate to highly correlated which indicate pleiotropy i.e. improvement in any of the variables will lead to improvement in the body weight. This observation is similar to the report of [7] and [15]. Similar trends were also observed in females. As the coefficient of determination increased in each regression model, residual mean square decreased. In regression model with one variable, body length had the highest coefficient of determination (0.858) which means that 85.8% change in body weight could be attributed to change in body length.

Table 4. Regression equations for predicting live weight from linear body measurements in America standard chinchilla rabbit

Predictive equations	A	b1	b2	b3	b4	b5	b6	MSE	R^2
Y= a+b1BL	-1.444	0.8083						0.097	0.858
Y= a+b2EL	0.290		0.073					0.239	0.135
Y= a+b3TL	0.417			0.069				0.240	0.130
Y= a+b4FL	-0.677				0.114			0.221	0.258
Y= a+b5HG	-1.611					0.129		0.146	0.676
Y= a+b6AC	-1.829						0.126	0.132	0.735
Y= a+b1BL+ b2EL	-1.383	0.086	-0.014					0.096	0.862
Y= a+b1BL+ b3TL	-1.383	0.089		-0.026				0.093	0.872
Y= a+b1BL+ b4FL	-1.021	0.100			-0.062			0.083	0.897
Y= a+b1BL+ b5HG	-1.770	0.064				0.043		0.086	0.889
Y= a+b1BL+ b6AC	-1.830	0.060					0.047	0.084	0.895
Y= a+b2EL+ b3TL	0.058		0.053	0.048				0.233	0.187
Y= a+b2EL+ b4FL	-0.674		0.002		0.113			0.222	0.258
Y= a+b2EL+ b5HG	-1.750		0.025			0.123		0.144	0.690
Y= a+b2EL+ b6AC	-1.849		0.005				0.125	0.133	0.736
Y= a+b3TL+ b4FL	-0.654			0.013	0.105			0.222	0.261
Y= a+b3TL+ b5HG	-1.687			0.019		0.123		0.145	0.685
Y= a+b3TL+ b6AC	-1.936			0.024			0.121	0.129	0.749
Y= a+b4FL+ b5HG	-2.170				0.055	0.115		0.134	0.729
Y= a+b4FL+ b6AC	-2.136				0.036		0.116	0.128	0.755
Y= a+b5HG+ b6AC	-1.894					0.043	0.090	0.129	0.750
Y= a+ b1BL+ b2EL+ b3TL+ b4FL+ b5HG+ b6AC	-1.387	0.080	0.010	-0.004	-0.055	0.006	0.029	0.075	0.919

a-Intercept, b2 – regression, b3 - coefficient
Source: Data generated in a rabbit experiment conducted at Olusegun Agagu Teaching and Research Farm Okitipupa Ondo State, Nigeria.

In regression model with one variable, body length had the highest coefficient of determination (0.858) which means that 85.8% change in body weight could be attributed to change in body length.

Higher coefficient of determinations observed in this study among multiple regression models shows that the actual weight is better predicted by multiple models. In conclusion, the live body weight in American Standard rabbits could be better predicted by simple model (body length) and multiple regression models.

CONCLUSIONS

The growth traits of American standard chinchilla rabbit favoured female than male at eight weeks of age and the best predictor of

live bodyweight by simple model was body length and multiple regression model.

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FACTORS PRODUCTIVITY IN SMALL SCALE UPLAND VEGETABLE PRODUCTION IN THE SOUTH – SOUTH REGION OF NIGERIA

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Abstract

The study examined the social and economic characteristics of fluted pumpkin farmers and determined the extent of farm resource productivity. The study was carried out in the southern region of Nigeria. 100 leafy fluted pumpkin farmers were used in the study. Results showed that majority of the farmers (72.00%) were females, 74.00% were married, the mean age and farming experience stood at 42.97 and 14.96 years respectively. Social capital formation was very poor, while the mean household size and farm income were 6.00 members and ₦188, 560.00 respectively. The empirical result showed that; family labour, hired labour, quantity of seed, manure, fertilizer and farm size were significant farm inputs that influenced the production of fluted pumpkin. Apart from fertilizer utilization which occurs in irrational stage in a classical production surface, all other farm inputs' levels of utilization were in the rational stage. The study also found increasing rate of return (1.7847) among fluted pumpkin farms in the region. In addition, more family labour was substituting hired labour while more manure was substituting fertilizer usage in fluted pumpkin production in the region. The study recommends fertilizer subsidy and timely delivery to vegetable farmers in the rural areas of the State.

Key words**:** *farmers, productivity, fluted pumpkin, vegetable, Nigeria*

INTRODUCTION

According to Udoh and Akpan [35], vegetable crops are among the staple food components in the world and their productions have continued to increase over the years. For instance, in Nigeria, annual production stood at 6,001,932 tons in 2010, 6,502,565 tons in 2013, 6,870,068 tons in 2015 and 7,053,219 tons in 2016 [19]. Several studies have shown that vegetables are rich in minerals and vitamins [21, 13]. In the South-South region of Nigeria, prominent vegetable crops include water leaf, fluted pumpkin (*Telfairia occidentalis)*, pepper, cucumber, bitter leaf (*Vernonia amygdalina*), Amaranthus spp. and okra among others.

As noted by Mlozi, [28] and Francisca [20]; increased in vegetable production has improved food security and offered employment opportunities to many rural dwellers in Nigeria. However, the consumption of vegetables and fruits generally in Nigeria is far less than the World Health Organization recommended standard [4]. According to Kebede and Gan [27], the main source of farm income for small and resource poor farmers are basically arable crop production consisting of vegetable and non-vegetable crops. In the southern part of Nigeria, vegetable production and consumption has gained popularity due to several reasons including; lower set up cost, short gestation period, all year round cultivation, as well as it affordability [5].

In south – south region of Nigeria, fluted pumpkin (*Telfairia occidentalis*) had become one of the popular cultivated vegetable crops [3, 6]. The crop is cultivated on upland during rainy season and on wetland area during dry season. It is the most preferred homestead crop among the Ibibio, Annang and Efik tribes in the South-South region of Nigeria. The green succulent leaves are used to prepare the most popular traditional delicacy in the region known as "Edikan Ikong". The medicinal functions of *Telfairia occidentalis* have been reported by many researchers. In Nigeria, the herbal preparation of the plant has been employed in the treatment of several diseases such as anaemia, chronic fatigue and diabetes etc., [1, 31, 12, 16, 25, 26].

Fluted Pumpkin *(Telfairia occidentalis*) is among the most important leafy vegetables grown by the small-holder farmers in the region [8]. The crop has short gestation and payback periods in addition to all year-round production cycle [35]. Despite these advantages; the production of leafy *Telfairia occidentalis* in the region has been constrained by several factors, resulting in all season fluctuation in outputs and prices [9, 6, 17].

As observed by Hussian and Perera [22], agricultural production or output changes are explained by such factor as climatic, agronomic, and socio-economic and farm management factors. The need to increase food crop production and make food sufficient to all populace is one of the major challenges of the Nigerian government. Following the numerous setbacks, it is noted that farmers are not getting maximum returns or benefits from resources committed to their farm enterprises. Farm productivity is fundamental for real income growth and important for improving economic well-being and quality of life of farmers [5, 10].

Due to the population pressure, increasing urbanization and land fragmentation in the south – south region of the country; vegetable production as noted by Akpan *et al.,* [8] is sometimes done in marginal or less fertile lands. Sustained vegetable production in the region can be achieved under increasing agricultural resources intensification and dynamic economic environment only if farm resources are efficiently utilized. Given the important of the vegetable sub sector to the economy of the region; the constraints inherent in its production and various agricultural programmes or policies implemented in the region to boost vegetable production; it has become imperative to empirically analyze the productivity status (farm factor productivity) of vegetables farms in the region. According to Ogunfowara and Olayide [32], farm resources are not efficiently used or allocated under the small scale farming which is mainly traditional in style. Could this assertion be true for the small scale vegetable farmers in the Western region of Akwa Ibom State located in the southern region of Nigeria? Besides, the majority of rural farmers are resource and technology constrained due to increasing poverty. The need to assess their socio-economic features is obvious [11, 7]. In order to develop a good farm-based policy in Akwa Ibom State, it is important to understand the status of farm factors productivity especially among poor resource farmers like the vegetable farmers. Hence, the study was designed to analyze the socio-economic characteristics of fluted pumpkin farmers and determine the level of farm-input productivity in the study area.

Literature Review

Literature from different regions in Nigeria has revealed some social and economic characteristics of vegetable farmers in Nigeria. For instance, Nwalieji and Ajayi [30] in Anambra State in the eastern region of Nigeria, has showed that, majority (70.0%) of vegetable farmers in the region are males; had relatively large household size and long farming experience as well as operate an average farm size of 0.63 to 0.87 hectares. In a related study, Busari *et al.,* [15] revealed that, majority (76.15%) of women involved in vegetable production in the south western Nigeria fell in the age range of 41-60 years and had a mean age of 50.85 years. Also, majority of the women were literate and acquired farm land through gift. Besides, Fakayode *et al.,* [18] in Osun State, western region of Nigeria discovered an average age of 40.1 years for vegetable farmers in the region. In the same region, Balogun *et al.,* [14] reported the mean age and farming experience of 40.1 ± 1.1 years and 6.5±2.3 years respectively for vegetable farmers. Also, Sijuwade and Oladele [34] submitted an average household size of 6-10 members and farm size of 0.5-3.4 acres for the same category of farmers. The findings further revealed that majority of them acquired secondary school education and social capital as well as having considerably contacts with agricultural extension agents. It was further revealed that majority of the vegetable farmers had secondary school as educational qualification, belonged to organization and had contact with extension agents; however, majority never received any subsidy from the

government. In a similar Vein, Ajibola *et al.*, [2] studied Socio-economic status of women vegetable farmers in Kwara State the north central region of Nigeria. The findings showed that the mean age of vegetable farmers was 34.5 years and were well experienced (10- 14 years) in vegetable production. The result also showed mean family size of 12 people and a mean farm size of 2.45 ha. A large proportion of the farmers (78.4%) were males and married as well as attended one form of education or the other (88.0%). Majority of the vegetable farmers were non-indigenes constituting 87.0%. About 84.0%, 68.0 and 63.2% of the farmer sampled cultivated leafy, roots and fruit vegetables respectively.

In another dimension, many authors have reported the status of vegetable farm productivity in Nigeria. In the South eastern region of Nigeria, Ibekwe and Adesope [23] confirmed the significant important of the cost of labour, cost of fertilizer, cost of planting materials, cost of irrigation, level of education, size of household, farming experience and farm size on vegetable production in the area. In Borno State the northern region of Nigeria, Ibrahim *et al.*, [24] estimated significant inelastic coefficients of seeds, farm size, agrochemicals and fertilizer in vegetable production function. Their findings also include the decreasing marginal returns to scale in vegetable production in the area. Similarly, Shettima, *et al.*, [33], analyzed the efficiency of irrigated vegetable production farms in Borno State, Nigeria. They discovered inelastic and significant relationships between respondents' farm size, family labour, hired labour, organic and inorganic fertilizers, quantity of agrochemical, seedling, irrigated water and quantity of vegetables produced among vegetable farmers in the State. Also, increasing rate of returns was estimated for onion, tomato and pepper crops respectively. In a related study conducted by Akpan *et al.*, [10] in the southern region of Nigeria, on factors affecting the total factor productivity of fluted pumpkin found that, education, social capital formation, farming experience, agricultural extension visit, farm income, gender and farm size had positive impact while farmers' household size had negative effect.

From the reviewed literature, it is observed that no literature is found for the south – south region of the country on factor productivity of vegetable farmers. Owing to the fact that, the region's climate, soil features and demand preference slightly differs from the other regions, the research findings available in the literature for the other regions might not be sufficiently applied to the conditions of the south – south region of the country, hence the main reason to initiate this investigative study.

MATERIALS AND METHODS

Study Area

The study was carried out in Oruk Anam Local Government Area of Akwa Ibom State in the southern region of Nigeria. The area lies between latitude $4^{o}\ 40^{1}$N and 5^{o} N, and longitude $70^{o}\ 30^{1}$E and $70^{o}\ 50^{1}$E. It has a land mass of 511.73 km sq. representing 7.23% of the State total land mass of 7,081 km sq. The area is characterized by a typically humid tropics climate with a distinct dry and wet seasons. The agricultural season last for up to 9 months. The mean annual rainfall is heavy and lies between 2,000mm to 4,000mm and a temperature range of 26^{0}C – 28^{0}C per annum. The rainy season last from March to November and it's characterized by high relative humidity and heavy cloud cover while the dry season last from December to February. Its inhabitants are mostly farmers, Craft men and civil servants. The population of the local government is about 172,654 out of which males are 86,239 and females are 86,415 [29]. It is predominantly agrarian with notable food crops like yam, cassava, cocoyam, maize, fluted pumpkin, okra, melon, oil palm, plantain and banana among others.

Sampling Technique, Sample Size and Sources of Data

Combination of sampling methods was used to select vegetable farmers in the study area. The study area consists of 9 clans (Inen, Obio Akpa, Ibesit Nung Ikot, NungIkot, NungIta, Ndot, Ibesit, Ekparakwa, and Abak/Midim). The first stage involves random selection of 5 clans out of the 9 clans in Oruk Anam. In

second stage, two villages were randomly selected from each clan. A total of 10 villages were used in the study. The third stage involved random selection of 10 fluted pumpkin farmers from each of the selected village. A grand total of 100 fluted pumpkin farmers was randomly selected in the study area. Cross sectional data were then collected from randomly selected fluted pumpkin farming household heads in the study area.

Method of Data Collection

Data were collected using structured questionnaire and was complemented by personal interviewed to ensure consistency and accuracy of collected data. The structured questionnaire was administered to 100 farming household heads in the study area. Series of cross sectional data were collected, scrutinized and use for data analysis.

Analytical Techniques

Objectives of the study were analyzed using appropriate econometric and or descriptive tools. The Cobb Douglas production function specified was used to relate the fluctuation in output of fluted pumpkin and farm resources. The production parameters such as APP, MPP and production elasticity generated from the production function were used to analyse the level of resource used among fluted pumpkin farmers. Explicitly, the Cobb-Douglas production function envisaged in the research is specified as thus:

$$FLU = f(LAN, HHL, HIL, SED, FER, MAN) \ldots (1)$$

Implicitly, it is expressed as thus:

$$LnlNFLU = \varphi_0 + \varphi_1 LnLAN + \varphi_2 LnHHL + \varphi_3 LnHIL + \varphi_4 LnSED + \varphi_5 LnFER + \varphi_6 LnMAN + \mu_1 \ldots . (2)$$

Note, the model was adopted on the assumption of constant factor productivity such that,

$\varphi_1 + \varphi_2 + \varphi_3 + \varphi_4 + \varphi_5 + \varphi_6 = 1$ ($constant\ return\ to\ scale$)
$\varphi_1 + \varphi_2 + \varphi_3 + \varphi_4 + \varphi_5 + \varphi_6 > 1$ (Increasing return to scale)
$\varphi_1 + \varphi_2 + \varphi_3 + \varphi_4 + \varphi_5 + \varphi_6 < 1$ ($decreasing\ return\ to\ scale$)

where:

FLU = Output of fluted pumpkin of ith farmer measured in Kg

φ_0 = Total factor productivity

LAN = Land size of farmers in ha

HIL = Quantity of hire labour used by ith farmer measure in Mandays

HHL = Quantity of household labour measure in Mandays

SED = Quantity of fluted pumpkin seed used in the current farming season measure in Kg

FER = Quantity of fertilizer used (measure in Kg)

MAN = Quantity of manure used (measure in Kg)

The average physical product (APP}, marginal physical product (MPP) and elasticity (ELA) of inputs with respect to fluted pumpkin output was used to assess the level of input productivity among farmers in the study area.

RESULTS AND DISCUSSIONS

The socio- economic characteristics of fluted pumpkin farmers

The analysis of the socio-economic characteristics of fluted pumpkin farmers was done with respect to age, sex, household size, farming experience, farming experience, membership of social organization, farm income, and mode of farm land acquisition, secondary occupation of the farmers, educational qualification and farm size. The detail analyses of the socio economic features of fluted pumpkin farmers are as described below.

Gender Composition of Respondents

As revealed in Table 1, the result shows that majority of the fluted pumpkin farmers (72.00%) in the study area are females and only 28.00% are males. This finding contradicts the report submitted by [30, 2]. This implies that more female population in the study area is involved in *Telfairia* production compared to the male counterpart. It's suggested that female involvement in *Telfairia* production is related to the need for additional income to the family so as to

augment or complement other family income sources.

Age Distribution of Respondents

The age distribution of fluted pumpkin farmers as shown in Table 1 indicates that, 17.00% of the farmers fell in the age range of 20 to 30 years; about 26.00% fell in the age range of 41 to 50 years and 22.00% were above 50 years. The mean age among them stood at 42.97 years. This research finding is within the range submitted by [18, 14]. This result implies that; the labour force involved in the cultivation of fluted pumpkin are active and that most of the farmers in the study area are fast aging, as a result of this, output is less expected to increase in a sustainable manner. Given this scenario, it is pertinent that youths should be encouraged to cultivate fluted pumpkin as a business in the study area.

Marital Status and Farming Experience of fluted pumpkin Farmers

The findings show that only 1.00% of *Telfairia* farmer are separated, none is divorced, only 5.00% is single, 8.00% are widower about 12.00% are widowed and 74.00% are married.

This result corroborates [15]. This implies that most of the fluted pumpkin farmers in the study area are married and do so to comply with the culture and norms of their respective farming communities.

The finding further confirms that, the proportion of farmers with farming experience in the range of 1 to 5 years is 20.00%, 6 to 10 years is 18.00%, 11 to 15 years is about 25.00%, 16 to 20 years is 23.00% and greater than 20 is 14.00%.

The mean family experience is about 14.96 years. The finding of this study is in line with the report submitted by [2]. This result implies that; vegetable farming is a long surviving business in the study area.

Membership of Social Organization

As presented in Table 1, it is revealed that about 96.00% of fluted pumpkin farmers are not members of any social organization, while about 4% of these farmers belong to one form of social organizations.

This result implies that; majority of the *Telfairia* farmers do not belong to any social organization. This means that, the social capital formation among *Telfairia* farmers in the study area is very low and might likely hindered the extent of agricultural innovation adoption among them. Social gathering is known to be one of the best sources of information available to a rural farmer.

Table 1. The Socio-economic characteristics of *Telfairia occendentalis* farmers

S/N	Characteristic	Frequency	Percentage
1	Gender (number)		
	Male	28	28.00
	Female	72	72.00
	Total	100	100.00
2	Age Distribution (Years)		
	<20	0	0.00
	21- 30	17	17.00
	31– 40	26	26.00
	41– 50	35	35.00
	>50	22	22.00
	Total	100	100.00
	Mean	42.97	
3	Marital Status of Farmer (number)		
	Single	5	5.00
	Married	74	74.00
	Divorced	0	0.00
	Widowed	12	12.00
	Widower	8	8.00
	Separate	1	1.00
	Total	100	100.00
4	Farming Experience (Years)		
	<1	0	0.00
	1-5	20	20.00
	6-10	18	18.00
	11-15	25	25.00
	16-20	23	23.00
	>20	14	14.00
	Total	100	100.00
	Mean	14.96	
5	Membership of Social Organization (years)		
	<1	96	96.00
	1-5	0	0.00
	6-10	4	4.00
	>10	0	0.00
	Total	100	100.00
	Mean	0.36	

Source: compute by author, data from field work 2017.

Family Size of Respondents

The distribution of household size among fluted pumpkin farmers is shown in Table 2. The household size distribution of *Telfairia* farmers in the study area reveals that majority (67.00%) have 6 to 10 members' household size; while 33.00% of the farmers have family size of range 1-5 members.

An average household size of 6 persons was obtained for all fluted pumpkin farmers in the study area and is in agreement with the findings of [34].

This indicates that *Telfairia* farm families in the study area have moderate family size with

good proportion of family labour perhaps less demand for hired labour

Table 2. The Socio economics characteristics of *Telfairia occendentalis* farmers

S/N	Characteristic	Frequency	Percentage
6	Family Size of Respondents (number)		
	1-5	33	33.00
	6-10	67	67.00
	>10	0	0.00
	Total	100	100.00
	Mean	6.00	
7	Farm income per year (Naira)		
	<10,000	0	0.00
	10,001-20,000	0	0.00
	20,001-40,000	0	0.00
	40,001-60,000	0	0.00
	60,001-100,000	12	12.00
	>100,000	88	88.00
	Total	100	100.00
	Mean	188,560	
8	Mode of farmland acquisition		
	Inheritance	43	43.00
	Leased	47	47.00
	Contract	0	0.00
	Purchase farm	10	10.00
	Cooperative farm	0	0.00
	Community farmland	0	0.00
	Other	0	0.00
	Total	100	100.00
9	Distribution of Secondary occupation		
	Civil Servant	7	7.00
	Pensioner	3	3.00
	Artisan	1	1.00
	Okada / Bus driver / Keke driver	1	1.00
	Trading on Large Scale	0	0.00
	Petty Trading	27	27.00
	Others	61	67.00
	Total	100	100.00
10	Educational Qualification (Years)		
	No schooling	0	0.00
	Primary	63	63.00
	Secondary	25	25.00
	Tertiary	12	12.00
	Total	100	100.00
	Mean	7.89	

Source: compute by author, data from field work 2017.

Farm income per year (Naira)

The result for farm income reveals that majority of the fluted pumpkin farmers (about 88.00%) make above ₦100, 000 per year (about 262.33US$/year), while 12.00% earned income in the range of ₦60, 001 to ₦100, 000 per annum. The result gave a mean annual income of ₦188, 560 among the farmers. The size of the mean annual income indicates gradual evolution of vegetable farmers from subsistence to commercial or business oriented production.

This means that majority of farmers in the study area produced fluted pumpkin for commercial purposes and make considerable level of farm income (Note, tabulated result is shown in Table 2).

Mode of Farmland Acquisition

The finding further unveiled the mode of farm land acquisition among fluted pumpkin farmer in the study area. It is shown that about 43.00% of farmers acquired their lands for *Telfaria* production through inheritance, 47.00% acquired their land through lease arrangement, and only 10 .00% of farm land was acquired through direct purchased. This reveals greater percentage of the farm land used by vegetable farmers in the study area is gotten through lease arrangement (Check Table 2 for breakdown of results).

Distribution of Secondary Occupation

In the distribution of secondary occupations, the result reveals that majority (61.00%) of *Telfairia* farmers are involved in several unidentified occupations, followed by petty trading with 27%, civil servant with 7% and pensioner with 3%. This means that *Telfairia* farmers in the study area are not only engaged in farming but also into other occupations in order to use the income generated to finance their primary occupation and augment family income. The result also indicates that, there is likely high incidence of agricultural diversification among fluted pumpkin farmers in the study area.

Educational Qualification

The educational qualification of the fluted pumpkin farmers showed that majority (63.00%) of them went through primary school; 25.00% had their secondary education while 12.00% of the farmers had attended higher education. The result further reveals the mean year of formal education of 7.89 years. This finding is in agreement with [34]. The findings indicate that, *Telfairia* farmers are moderately educated meaning that, they have the ability to read and write and this implies that there is high probability to access agricultural technology and assimilation same as well. The positive relationship between educational status and farm productivity is an indicator that farmers with higher educational status enjoyed higher productivity compared to their counterparts with lower status as asserted by [14].

Analysis of the quantity of leafy fluted pumpkin produced by farmers in southern Nigeria

Categorization of the quantity of fluted pumpkin produced by farmers is presented in Table 3. The result revealed that, only 1.00% of farmers produced less than 1,000 Kg or 1 ton of leafy pumpkin per production cycle. About 20.00% produced in the range of 1.01 to 2.00 tons per annum, while 37.00% of them harvested from 2.01 to 3.00 tons of leafy fluted pumpkin per annum. Also, 27.00% produced from 3.01 to 4.00 tons and 13.00% as well 2.00% were able to produce from 4.01 to 5.00 tons and 5.01 to 6.00 tons per annum respectively.

Table 3. Level of Production of Leafy Fluted pumpkin (Kg) in the Study Area

Category (Kg)	Frequency	Percentage (%)
≤ 1,000	1	1.00
1,000.01 – 2,000.00	20	20.00
2,000.01 – 3,000.00	37	37.00
3,000.01 – 4,000.00	27	27.00
4,000.01 – 50,000.00	13	13.00
5,000.01 – 6,000.00	2	2.00
Total Number	100	100.00
Mean	**2,823.90**	
Minimum	**975.00**	
Maximum	**5,700.00**	

Source: computed by author, data from field work 2017.

The mean value of 2.823 tons per annum was obtained across all respondents while the minimum and maximum values of leafy output stood at 975.00 kg and 5,700.00 kg per annum respectively. The result shows that, majority of farmers in the region produced around 2.0 to 3.00 tons of leafy fluted pumpkin per year. Given the peculiar land issue in the area such as; low productivity due to continuous cropping, land fragmentation and increase urbanization leading to land scarcity; it is expected that, fluted pumpkin farmers have make the best use of their resources as revealed by the average output in the study area.

Investigating the Level of farm-inputs productivity among fluted pumpkin farmers in the study area

This objective was analyzed by using production parameters such as APP (Average Physical Product), MPP (Marginal Physical Product) and production elasticity generated from the Cobb Douglas production function. Table 4 presents the estimates of the production function and the diagnostic statistics. The estimated form has the R^2 of 0.582 and F- ratio (F-cal. = 19.97) that is statistically significant at 1% level probability level. This implies that, the estimated R^2 is significant and the overall equation has goodness of fit. Also, the normality test for the estimated equation was 18.57 and is significant at 1% probability level. This justifies the used of Ordinary Least Squares method of estimation.

The empirical results revealed that, all the coefficients of explanatory variables (farm inputs) in the production function were positive and significant at various levels of probabilities. (Note, the coefficient of farm inputs in Cobb Douglas production function represents the elasticity of production with respect to the corresponding input). This implies that, household labour has a positive production inelastic relationship with output of fluted pumpkin in the study area. The result revealed that, as household labour increases in the production process, the output also increases. It further showed that, the rate of change in household labour is greater than the corresponding change in output. The result corroborates [23, 33].

Similarly, increase used of pumpkin seed lead to increase in leafy fluted pumpkin. The coefficient is positive inelastic and is statistically significant at 5% probability level. It also implies that the percentage change in quantity of seed used is greater than the corresponding percentage change in output across farming households used in the study. Similar results have been reported by, [23, 33] elsewhere in Nigeria.

In the same Venn, increase use of hired labour impacted positively on the fluted pumpkin farmers' output in the region. The estimated coefficient is positive and inelastic in nature and is statistically significant at 1% probability level. Increase in mandays of hired labour would lead to increase in output of leafy fluted pumpkin crop produced. Similarly, it implies that, 1% increase in hired labour would result in less than corresponding 1% increase in output. The result is in consonance with the research finding of [33].

The coefficients of farm land and manure are positive, inelastic and statistically significant at 1% level of probability respectively. This means that, as quantity of land input and manure used in the production process increase, more of the leafy fluted pumpkin will be produced by farmers in the region. The finding suggests that, these farm inputs are crucial in the production of leafy *Telfairia* in the southern region of Nigeria. [33, 24] found similar result elsewhere in Nigeria.

Table 4. Estimates of Cobb Douglas Production function of *Telfairia* farms

Variable	Coeff.	Std. Error	t- value	Prob.
Constant	7.6946	0.3963	19.416***	0.0000
Factors of production				
HHL	0.0407	0.0105	3.876***	0.0010
HIL	0.1531	0.0206	7.432***	0.0009
SED	0.0142	0.0059	2.407**	0.0380
FER	1.1011	0.1581	6.965***	0.0010
MAN	0.0159	0.0052	2.944***	0.0071
Farm size	0.4597	0.0573	8.023***	0.0001
Diagnostic statistics				
RESET test		3.338**	R^2	0.5823
F-cal.		19.9775	White test	81.9***
Normality test (Chi-squares)			18.5762***	

Source: Extract from computer analysis *results.* The figures in brackets are t-ratio*** Significant at 1%, ** significant at 5% and * significant at 10%. (L) is the lead equation.

The increase use of fertilizer in *Telfairia* production impacted positively on it output. Alternatively, as the quantity of fertilizer used increase, the quantity of output produced also increase. However, the coefficient of fertilizer revealed elastic relationship with the level of output. This implies that, the change in output is far greater than the corresponding change in the quantity of fertilizer used in the production process. The result reveals conspicuous inadequacy in the used of fertilizer in fluted pumpkin production in southern region of Nigeria.

Production Parameters derived from the Cobb Douglas Production function

Table 5 shows the production parameters derived from the estimated production function presented in Table 4. (Note, the average productivities of farm inputs were calculated using summary of variables and marginal rate of substitution estimated at the average points of variables). The production parameters of interest were: production elasticity with respect to each farm factor, average productivity and marginal productivity of farm factors. The result revealed that, the production elasticity with respect to farm land was inelastic, while its average productivity stood at 6,505.048 and its marginal productivity stood at 4,150.63 units. This implies that, land utilization rate by fluted pumpkin farmers in the study area is in stage II in the classical production surface. The inference derivable from the result is that, farm land is rationally used by fluted pumpkin farmers in the region. The same relationship is applied to hired labour, family labour, quantity of seed and quantity of manure used. Their levels of utilization are depicted in stage II in the classical production surface because their production elasticity is less than unity and is positive and their average productivities are greater than their respective marginal productivity.

Hence, given these production parameters, it implies that, farm land, hired labour, family labour, quantity of seed and quantity of manure are rationally used by fluted pumpkin farmers in the production of fluted pumpkin in the study area, as such their level of utilization should be maintained. The implication is that a unit increase in farm land, hired labour, family labour, quantity of seed and quantity of manure used will lead to significant percentage increase in *Telfairia* output. Based on these findings, it is attestable that the utilization of most farm factors in *Telfairia*

production occurs in the rational stage in the classical production surface.

Table 5. Production Parameter for Fluted pumpkin production

Variable	MPP	APP	Elasticity	Input Utilization Stage
HHL	1.4389	35.356	0.0407	II
HIL	7.2177	47.144	0.1531	II
SED	0.0339	2.389	0.0142	II
FER	72.5427	65.882	1.1011	I
MAN	0.0659	4.145	0.0159	II
LAN	14,150.6	6,505.0	0.4597	II
Scale of Production and Marginal Rate of Substitution of factors of production				
Scale of production	1.7847			
$MRTS_{HHL, HIL}$	0.1994			
$MRTS_{HIL,HHL}$	5.0161			
$MRTS_{MAN,FER}$	0.00091			
$MRTS_{FER,MAN}$	1,100.7997			

Source: Computed by authors using 2017 field data; HHL represents household labour and HIL represents hired labour. Parameter computed at the average values.

On the other hand, the output of fluted pumpkin produced had positive but elastic relationship with respect to the quantity of fertilizer used. This means that, increase in fertilizer used will add irrational more to farm output compared to other farm inputs used in the model. By implication, the extent of utilization of fertilizer inputs shows that they are in stage I in the classical production surface. The inputs elasticity is greater than unity and its marginal productivity is greater than average productivity. Several reasons could be linked to these findings. They include high cost of fertilizer and increase land intensification as well as the cultural believes attached to the fertilizer utilization in the region. These constraints can negate the good intention of using fertilizer by fluted pumpkin farmers in the region. The result also showed the scale of return of 1.7847 and is greater than unity, hence depicting increasing return to scale. This means that, increase use of farm inputs by vegetable farmers would increase more the level of output produce by them.

Furthermore, the computed Marginal rate of technical substitution (MRTS) of household labour for hired labour is 0.1994. That is, for every unit of household labour, a farmer will require about 0.1994 units of hired labour. This implies that, fluted pumpkin farmer must give up 0.1994 unit of hired labour to obtain one unit of household labour. This means that, more household labour is substituting for hired labour in the production of leafy *Telfairia* in the region. Alternatively, the marginal rate of substitution of hired labour for household labour is 5.0161. That is, for every unit of hired labour, a farmer will require about 5.0161 units of family labour. That is, farmers will give up about 5 units of household labour to obtain one unit of hired labour. This confirms the previous result and still upholds that; more family labour is substituting for hired labour in the production of leafy fluted pumpkin in the region. This result suggests increasing incidence of wage rate for hired labour in the region. In the similar Vein, the marginal rate of substitution of manure for fertilizer is 0.00091 and is less than unity, meaning that more manure is currently being used instead of inorganic fertilizer in the production of leafy fluted pumpkin in the region. Alternatively, the MRTS of fertilizer for manure is 1,100.7997. This means that, about 1,100 units of manure will be given up to obtain a unit of fertilizer. This also confirms the previous result. The result showed one sided proportion of manure- fertilizer usage among farmers in the region. This disproportion is usually attributed to scarcity and probably high price of fertilizer in the market and sometimes the cultural believes of the people.

CONCLUSIONS

Leafy fluted pumpkin is more of cultural crop as it constitutes one of the major components of the daily dietary requirement of the south – south populace in Nigeria. The production of this crop provides reliable avenue to combat rural poverty and unemployment in the southern region of Nigeria. It is consumed by all classes of individuals in the society; hence the demand for the commodity is ever guaranteed. It is pertinent to note that the gap in vegetable consumption chain is mostly created by the supply side which is tailored to

efficient used of farm resources. Since the crusade for agricultural land expansion has made with hindrances such as increase urbanization and population pressure among others; hence targeting the most efficient small scale individual farm management is the key to sustainable vegetable production in the region. Based on this assertion, it is importance to generate workable agricultural framework established on sound empirical analyses to identify policy variables and also design sustainable framework aimed at achieving increase productivity of vegetables in the State and country at large.

Given the present economic predicament and deepen poverty incidence mask with insecurity in our rural areas, sustainable vegetable production might be just an illusion. Thus it is strongly recommended that governments at all tiers should initiate and implement workable policies to improve the socio-economic qualities of fluted pumpkin farmers in the State. Also, they should be implementation of a good policy on fertilizer subsidy programme for vegetable farmers in the region.

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THE TENDENCY OF THE PHOTOSYNTHETIC ACTIVITY OF THE GRAPEVINE GENOTYPES OF INTRASPECIFIC AND INTERSPECIFIC ORIGIN

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Abstract

Each genotype has a specific way of responding to environmental factors that are regulated by the genetic code. In the process of development, organisms have formed certain qualities that allow them to individually respond to climatic conditions. The main task of sustainable development of the wine and wine sector is to obtain high-quality derivatives, using minimal resources, in conditions of high economic efficiency and the use of technological methods that contribute to reducing energy dependence. The light curve allows us to determine the efficiency of photosynthesis and get an idea of the ecophysiological characteristics of a species, and, in turn, these indices allow us to compare different genotypes of plants in more or less similar conditions, thus determining productivity and resistance to environmental factors. The monitoring was carried out using the phytomonitor PTM-48A, which records data in automatic mode with an interval of 10 minutes, for 24 hours. The light curve can be used as a test method for assessing the photosynthetic activity of plants, and thereby, determining the productivity of intraspecific and interspecific genotypes of grapes at the early stages of study. And this, in turn, allows you to study a large number of hybrids and reduce the time of their assessment.

Key words: *genotype, photosynthesis, climate change, performance, grapevine*

INTRODUCTION

Climate change generates the need to create plant genotypes that grow and ensure increased performance in the new soil and climate conditions. Although intraspecific genotypes offer wide possibilities for use, they are not able to cope with the impact of climate change. That is why, taking into account the functionality of genotypes and the use of algorithms and interspecific hybridization techniques, more plastic rhizogenic interspecific genotypes should be created in terms of their adaptation to climate change, with beneficial repercussions on sustainable development. We specify that a human society develop sustainably if it consumes high quality natural derivatives, uses natural resources rationally and has a minimal negative impact on the environment. Sustainable development designates that way of evolving human society that motivates the satisfaction of the needs of the current generation without affecting the standard and quality of life of future generations. Each generation has the obligation not to leave to future generations debts of various kinds, including ecological - depletion of natural resources or pollution of soil, water, air, etc. [10; 8]. Adaptation of plants to the conditions of climatic factors of the environment is a result of the process of "*evolutionary adaptation*" of the ecophysiological properties of the genotype. In order to identify the genotype adaptation strategy, some stable characteristics of the plant structure were determined, growth indicators, which can be used in parallel with physiological processes such as photosynthesis, respiration, transpiration, etc. [9; 4]. The essential differences between the representatives of different types of plants are dependent on production indicators: growth rate, individual weight, distribution of biological mass in organs, which in turn reflect the intensity of physiological processes (photosynthesis, respiration, transpiration, mineral exchange and transportation). Photosynthesis is very

sensitive to biotic and abiotic factors of the environment. In the process of adapting genotypes to environmental factors, a key index is respiration, which is the essential source of energy for the plant and the main link of metabolism. The functional components of respiration are dependent on the use of energy to start vital processes. Respiration is a distinctive criterion of plant genotypes, which is directly proportional to the degree of resistance of plants to climatic factors, and at the same time allows the assessment of metabolism and the level of adaptability of plant genotypes to the environment. The activity of photosynthesis is dependent on solar energy, which in turn allows to determine the level of efficiency of the use of light energy by the plant. This principle is determined and guided by the genetic code of the genotype, which is represented by the mechanism of use of light energy and the functionality of the donor-acceptor system of plants. The light saturation curve for photosynthesis allows the perception of the ecophysiological properties of the genotype, and based on these indices it is possible to compare, in more or less similar conditions, different plant genotypes, to model productivity and determine the resistance of plant genotypes to environmental factors [5; 2; 4]. The light saturation curve for photosynthesis can be used as a method of testing / evaluating the photosynthetic activity of plant genotypes and therefore allows the possibility to determine the productivity of intraspecific and interspecific vine hybrids at the early stage of study. This criterion, in turn, allows to evaluate a large number of hybrids and reduce the time of their evaluation.

MATERIALS AND METHODS

As object of study are the rhizogenic interspecific grapevine genotypes (*V. vinifera* L. x *M. rotundifolia* Michx.): Alexandrina, Augustina, Amethyst, Nistreana, Malena, Algumax, BC_3-508, BC_3-576, BC_3-580 [1], the complex interspecific genotypes Regent and Viorica and intraspecific genotypes (*V. vinifera* L.) Muscat of Alexandria, Feteasca Neagra, Coarna Neagra. Following the investigations, the photosynthetic activity, perspiration, respiration, stomatal conductivity were evaluated in relation to climatic conditions such as: temperature, humidity, CO_2 concentration and other factors, based on the physiological element of performance - light saturation curve for photosynthesis. The monitoring process was performed using the PTM-48A, which allows measurements to be made in the form of a film-cardiogram, in automatic mode, at an interval of 10 minutes, for a period of 24 hours. Open ground plants were used, their leaves intact, located in the middle of the shoot. The measurements are performed through the analog contact points of the monitoring device and sensors: RTH-48 module for obtaining weather data; active photosynthetic radiation (RTH / R PAR, micromole/m2*s); air temperature (°C); absolute air humidity (g/m^3); relative air humidity (%); dew point (°C); CO_2 concentration in the air (ppm); atmospheric pressure (mbar) and soil temperature (°C). The LT-1P sensors from four measuring chambers allowed determining: the vapor pressure deficit (°C); leaf temperature (°C); CO_2 concentration (mbar). The SMS-5P sensor allowed the determination of soil moisture (%). The SF-5P sensor allowed determining the relative speed of the sap circulation in the shoot. The results of the following indicators were obtained: photosynthesis - micromoles CO_2/m^2*s, actual assimilation - micromoles CO_2/m^2*s, total respiration - micromoles CO_2/m^2*s, dark phase of respiration - micromoles CO_2/m^2*s, photorespiration - CO^2/m^2*s, perspiration - H_2O/m^2*s. The processing of the obtained results led to the determination of the physiological element of performance: light saturation curve for photosynthesis (micromole CO_2/m^2*s), crude and net photosynthesis (micromole CO_2/m^2*s). Statistical data processing was performed by applying the computer software programs Statistics 10 (Stat soft INC, USA) and Microsoft Excel 2010. For modeling and adjusting, two-dimensional data were used the methods of smallest squares and strongly weighted regression locally. The calculations

were performed at the significance level P ≤0.05 [2; 4].

RESULTS AND DISCUSSIONS

Photosynthesis is the process of converting solar energy into chemical energy, which is accumulated by plants in the form of chemical energy of organic substances synthesized from inorganic compounds under the action of light. The evaluation of photosynthesis contributes to the establishment of reciprocal links between the metabolic processes of the plant organism. Solar radiation is a decisive factor in productivity, but without a complex assessment, it is not possible to determine the level of performance of genotypes that is directly related to the efficient use of active photosynthetic radiation. The energy base of photosynthesis, as it is known, is provided by the rays of light absorbed by chlorophyll. The energy of active photosynthetic radiation represents about 50% of the total energy of solar radiation. The infrared rays of the solar spectrum, which also represent about 50% of the total energy of sunlight, do not participate in the photochemical reactions of photosynthesis. These rays are absorbed by the soil, heating the air at its surface and the plants themselves, improving plant perspiration and evaporation of moisture from the soil surface. An objective indicator of genotype performance is the use of active photosynthetic radiation (PAR). Not all solar energy participates in the photosynthesis process, but only the visible part - active photosynthetic radiation with wavelengths in the range of 380-720 nm (nanometers or mill microns). The action of light is reduced when the molecules go into an active state (high energy state), after which they are able to enter into chemical reactions. Not every amount of light can cause the molecule to activate and trigger photochemical transformations [5; 9]. Another important factor that influences the process of photosynthesis is the air temperature. The temperature range, as well as the concrete value of the optimal air temperature at which photosynthesis reaches the highest level depends on the genotype and the biological peculiarities of its range. The minimum temperature at which photosynthesis is triggered is 5^{o}C. At a temperature of 10-15^{o}C the process of photosynthesis is reduced; at a temperature of 20-26°C the process of photosynthesis reaches an optimal intensity, and at temperatures above 40°C it is reduced 6-7 times or it can stop due to the thermal instability of the enzymes and the dehydration of the leaves. The productivity of photosynthesis in the intraspecific vine genotypes of the *V. vinifera* group begins to decrease at a temperature of 30^{o}C, at a temperature of 35^{o}C it reaches a critical level, and at a temperature of 45^{o}C it ceases [5]. The influence of temperature on photosynthesis depends on the intensity of illumination. At low light, photosynthesis no longer depends on temperature. Consequently, at a low level of illumination and at a temperature of 15-25^{o}C, photosynthesis almost does not differ. Under high light conditions, the intensity of photosynthesis is influenced by the reactions that take place in the dark phase. The temperature of the leaf and its penetration by light depends on the thickness and consistency of the leaf. In order to obtain the value of real photosynthesis, the observed photosynthesis process is to be monitored, or, the organic matter accumulated by plants represents the difference between the organic substance formed during photosynthesis and the substance used for respiration. Daily weight gain of dry matter per unit area of a plant is the productivity index of photosynthesis [3; 5]. In order to obtain an optimal production of grapes in terms of quantity and quality, the ratio between photosynthesis (producing organic compounds) and respiration (consuming organic compounds) must be in favor of photosynthesis. Since the process of respiration takes place simultaneously with photosynthesis, in order to estimate the actual intensity of photosynthesis it is necessary to modify accordingly the intensity of photosynthesis observed. Thus, we obtain the weight gain of a unit area of the leaf or the plant as a whole, which can determine the photosynthetic productivity. The intensity of photosynthesis is directly proportional to the

degree of sunlight, so we can determine the level of use of light energy by the plant. This principle is determined and guided by the genetic code, represented by the donor-acceptor system of plants. The light saturation curve for photosynthesis can be used as a test method (express-test) of the photosynthetic activity of plant genotypes and therefore allows the possibility to determine the productivity of intraspecific and interspecific vine hybrids at the early stage of study. This criterion, in turn, allows evaluating a large number of hybrids and reducing the time of their evaluation. Evaluating the indicators of the light saturation curve for photosynthesis, we conclude that the interspecific genotypes in relation to the intraspecific grapevine genotypes demonstrate a much more advanced performance. (Tables 1 and 2).

Table 1. Photosynthetic activity of grapevine genotypes in relation to temperature.

Temperature, °C	*Photosynthesis, micromol (CO_2)/m^2*s*		
	Muscat of Alexandria	*Augustina*	*Ametist*
20	7.2	9.2	10.8
25	10.9	13.4	13.4
30	12.8	13.3	13.9
36	9.2	12.5	12.5

Source: Reflecting the obtained results. (Original).

Table 2. Photosynthetic activity of grapevine genotypes in relation to light intensity.

*Active photosynthetic radiation,RTH/R PAR, micromol/m^2*s*	*Photosynthesis, micromol (CO_2)/m^2*s*		
	Muscat of Alexandria	*Augustina*	*Ametist*
322	11.7	12.8	16.4
504	10.9	13.4	13.4
1009	12.7	14.2	16.3
1591	12.5	13	16.2
2002	12.9	14.2	14.4

Source: Reflecting the obtained results. (Original).

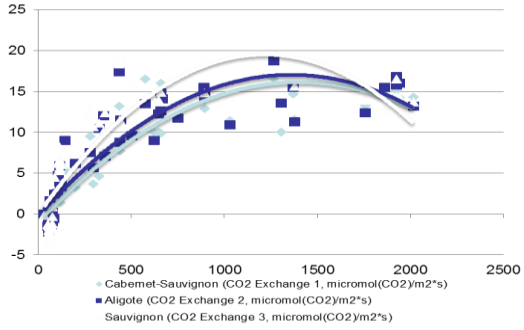


Fig. 1. Light saturation curves for photosynthesis. Cabernet Sauvignon. Aligote. Sauvignon. (Until flowering).Source: Own design reflecting the obtained results (Original).

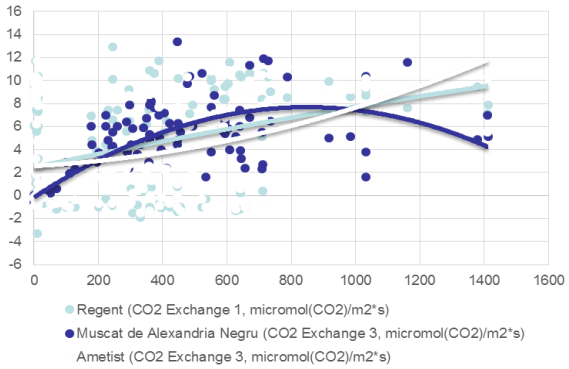


Fig. 2. Light saturation curves for photosynthesis. Regent. Muscat of Alexandria. Ametist. (Until flowering).
Source: Own design based on the obtained results. (Original)

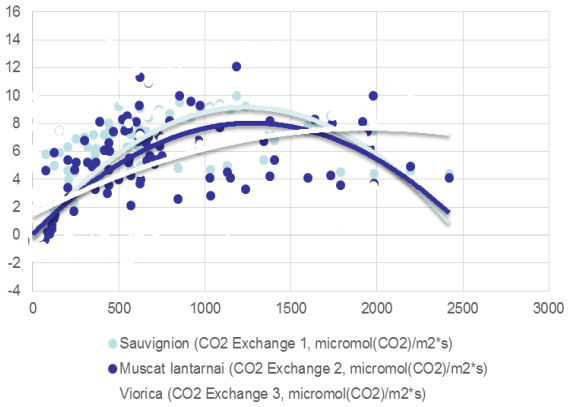


Fig. 3. Light saturation curves for photosynthesis. Sauvignion. Muscat Iantarnai. Viorica. (Formation of berries).
Source: Own design reflecting the obtained results (Original).

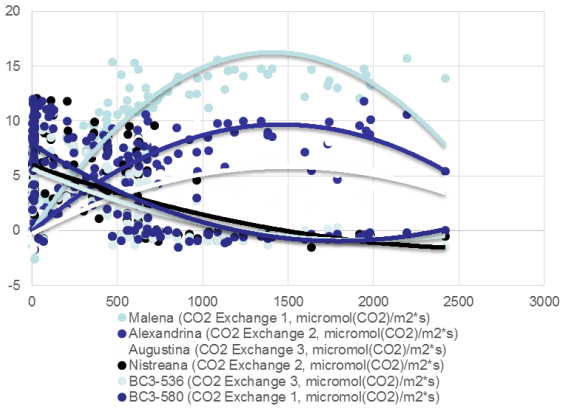


Fig. 4. Light saturation curves for photosynthesis. Malena. Alexandrina. Augustina. Nistreana. BC3-536. BC3-580. (Formation of berries).
Source: Own design reflecting the obtained results (Original).

The light curve parameters for photosynthesis in intraspecific and interspecific vine genotypes allow determining their

productivity and resistance to climate fluctuations, while noting that the dependence of photosynthesis on solar radiation allows the determination of the level of light energy use by grapevine genotypes. Therefore, taking into account the parameters of the light curve for photosynthesis, interspecific vine genotypes have an adaptability to climatic factors and a more advanced productivity compared to intraspecific vine genotypes. Proceeding from these criteria, it is necessary to direct the breeding process to the grapevine, using the techniques of interspecific crossing. (Figs. 1 - 8).

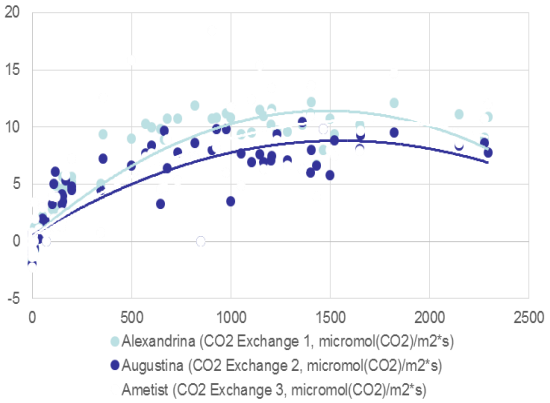


Fig. 5. Light saturation curves for photosynthesis. Alexandrina. Augustina. Ametist. (Formation of berries).
Source: Own design reflecting the obtained results (Original).

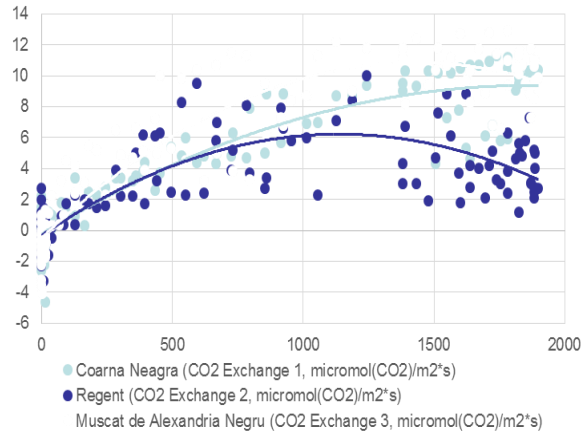


Fig. 6. Light saturation curves for photosynthesis. Coarna Neagra. Regent. Muscat of Alexandria. (Formation of berries).
Source: Own design reflecting the obtained results (Original)

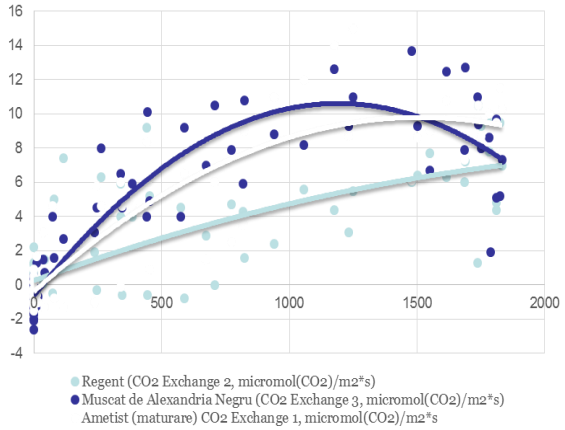


Fig.7. Light saturation curves for photosynthesis. Regent. Muscat of Alexandria. Ametist. (Maturation of berries).
Source: Own design reflecting the obtained results (Original).

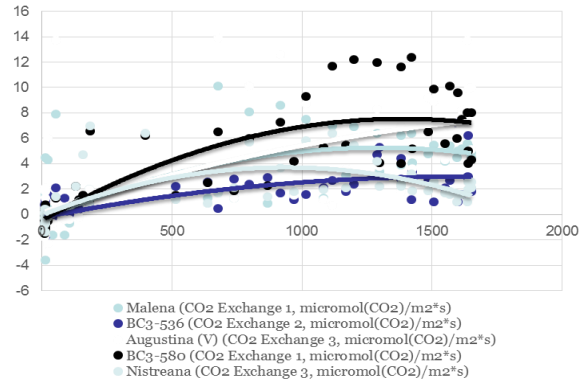


Fig. 8. Light saturation curves for photosynthesis. Malena. BC3-536. Augustina. BC3-580. Nistreana. (Maturation of berries).
Source: Own design reflecting the obtained results (Original).

The light saturation curve for photosynthesis is a criterion for determining the performance of grapevine genotypes and can be used as an element (test-express method) to assess performance. High-performing genotypes can be highlighted at an early stage, thus reducing evaluation time.

It has been established with a high degree of certainty that the phenomenon of climate change is growing and advancing at an accelerated pace, especially in the last three decades. According to the calculations of the experts of the intergovernmental group on climate change, during the last 160 years the average annual temperature at the Earth's surface has increased by about 0.8ºC. The early nineties of the twentieth century is

considered a "benchmark" for the phenomenon of global warming. This phenomenon was found on the basis of observations made at the Chisinau meteorological station, which established that in the period 1887-1980 the average annual air temperature increased on average, every 10 years, by about 0.05ºC, which, recalculated for 100 years, is an increase of 0.5ºC (Fig. 9).

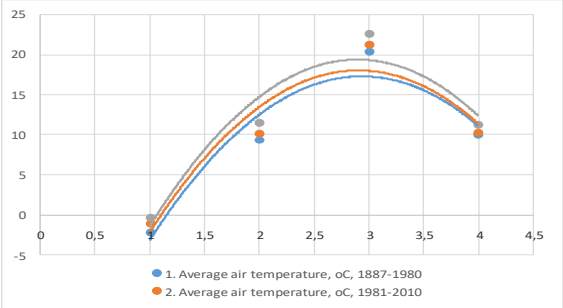


Fig. 9. Evolution of the average values of the seasonal temperature (ºC) for the periods 1887-1980, 1981-2010 and 2011-2018 at the Chisinau meteorological station
Source: Strategy of the Republic of Moldova for adapting to climate change by 2020 and the Action Plan for its implementation.

Applying the same methodology for the years 1981-2010, an average increase was established for every ten years by about 0.63ºC, which, recalculated for 100 years, is 6.3ºC. At the same time, the sudden increase in the average annual temperature for the period 1981-2010 was determined by the essential increase in the average air temperature during spring, summer and autumn [7, 6].
The trend of the average annual air temperature on the territory of the Republic of Moldova in the period 2004-2018 was found to be increasing.

Table 3. Average air temperature (ºC) by geographical areas in the periods 2002-2004, 2005-2009, 2010-2014 and 2015-2019. Republic of Moldova.

	2002-2004	*2005-2009*	*2010-2014*	*2015-2019*
North	9.0	9.22	9.2	10.09
Center	10.31	11.09	10.84	11.56
South	10.86	11.48	11.27	12.34
Anual average	*10.05*	*10.6*	*10.43*	*11.33*

Source: Reflecting the analyzed data. www.statistica.md; www.meteo.md, Accessed on Sept. 10, 2020.

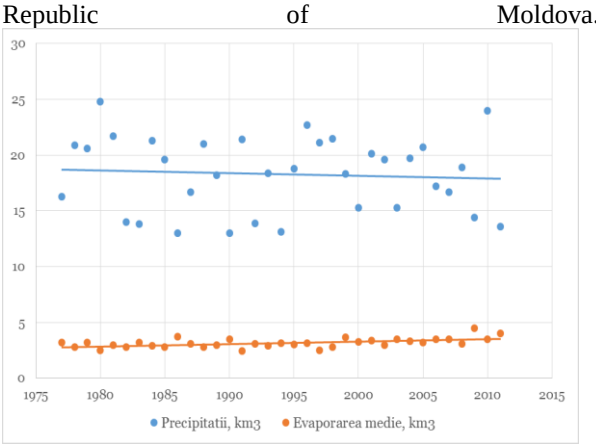
Table 4. Average air temperature (ºC) by seasons in the periods 2002-2004, 2005-2009, 2010-2014 and 2015-2019. Republic of Moldova.

	2002-2004	*2005-2009*	*2010-2014*	*2015-2019*
Winter	- 1.6	- 0.37	- 2.1	0.18
Spring	10.47	10.43	11.0	11.6
Summer	21.02	21.5	21.86	22.24
Autumn	10.32	10.85	10.98	11.32
Annual average	*10.05*	*10.6*	*10.43*	*11.33*

Source: Reflecting the analyzing data. www.statistica.md; www.meteo.md, Accessed on Sept. 10, 2020.

Based on the indices of the average values of the annual air temperature on the territory of the Republic of Moldova, we find that in the period 2002-2004 the average air temperature was 10.05ºC, for 2005-2009 - 10.6ºC, and for 2010-2014 - 10.43ºC and for 2015-2019 - 11.33ºC. Analyzing the evolution of the average values of annual and seasonal temperature (ºC) for the period 2002-2019 on the territory of the Republic of Moldova we observe an increase of these values (Table 3 and 4)

Fig. 10. The tendency of precipitation and evaporation. Republic of Moldova.



Source: http://meteo.md, Accessed on Sept.10, 2020.

Analyzing the evolution of precipitation on the territory of the Republic of Moldova, we find that the tendency of precipitation is decreasing, and the tendency of average evaporation is increasing (Fig. 10). Climate change is a real threat to the Earth, and this process has started and it is very difficult to stop it, or it may not be stopped. The point is that in some regions of the planet the annual precipitation level will decrease in the long term, while in other regions, fluctuations in precipitation and temperature will significantly affect the growing season of

some plants. In other geographic regions, annual precipitation may remain the same, but it will fall at long intervals, in the form of much stronger and more intermittent rainfall, causing increased droughts and floods. The intensity of severe storms and their type - hurricanes may increase. The potential impacts of climate change are diverse and extensive, and prevention of these impacts has become a high priority topic on the global agenda for sustainable development. [8; 10]. Taking into account the functionality of taxonomic entities used in vine crossing techniques in relation to climatic factors, in the end we can obtain varieties of recombinants by interspecific hybridizations, giving them an advanced ability to adapt to climate change.

CONCLUSIONS

Climate change imposes the need to create plant genotypes that will grow and demonstrate increased performance in the new soil and climate conditions.

The light saturation curve for photosynthesis allows the perception of the ecophysiological characteristics of the genotype, thus determining the productivity and resistance of the crop to environmental factors.

Existing intraspecific genotypes have a wide range of uses, but at the same time do not cope with climate change. Interspecific vine genotypes demonstrate higher productivity than intraspecific vine genotypes.

The light saturation curve for photosynthesis is a criterion for determining the performance of vine genotypes and can be used as an element (test-express method) to assess performance.

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DECENTRALIZATION OF RURAL AREAS THROUGH PUBLIC-PRIVATE PARTNERSHIP

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Abstract

The current state of economic development in Ukraine is characterized by the escalation of crisis processes that affected all spheres of public life. This is especially critical in rural areas. Modern approaches to crisis management in rural areas under conditions of decentralization are proposed by authors. The main concepts of the topic are considered and the authors' definition of the concept of "crisis public-private partnership in rural areas" is proposed. Crisis public-private partnership in rural areas is interpreted as a form of crisis cooperation between state, social and private sectors, based on the recognition that all parties benefit from the pooling of resources, innovations and managerial decisions for the purpose of realization of crisis principles and socio-economic development of rural areas. The basis of this is the application of the risk factor, which characterizes the ratio of the probabilistic value of the maximum possible loss to the normative value of the socio-ecological-economical component of rural areas. The purpose of the paper is to argue the necessity of decentralization of rural areas and to introduce proposals on its practical implementation. The research on decentralization of rural areas and its practical implementation is recommended to conduct by three stages. The anti-crisis approach to rural area management in decentralization conditions, which is based on the fundamentals of the public-private partnership is proposed. It is suggested to make calculation of the decentralization ratio, which will determine the category of the crisis level for the rural area in decentralization conditions and will supply adequate suggestions for its development.

Key words**:** *crisis management, rural areas, decentralization, crisis process, public-private partnership*

INTRODUCTION

In times of the current state of economic development in Ukraine is characterized by the expansion of the crisis processes that affect all spheres of life. The particularly critical situation becomes apparent in the countryside: production is reduced, massive labour migration takes place in big cities and other countries, and infrastructure is on the decline. Under these circumstances, the paper constitutes new reforms that should be implemented by the Ukrainian government. Now it is important to put crisis management in use taking into account the decentralization reforms to overcome the situation in the rural areas.

The significance of decentralization is defined as one of the key principles of the development of democracy in the states of the European Union and the Council of Europe, the basis of their regional policy, along with the principles of subsidiarity, concentration, complementarity, partnership, and program approach. This principle is obtained in the European Charter of Local Self-Government and the European Charter for Regional Democracy have their concerns about the redistribution of powers to regions in order to effectively use internal potential, encouraging regional initiatives, differentiating functions and powers between different levels of government (Bezverniuyk T. M., 2007) [3]. Decentralization is a candidate countries' prerequisite for full accession to the European Union and is based on all sectoral policies that are being developed and implemented within the EU.

Decentralization is a process of the functional division of power, people and things between the authorities (Stepaniuk, 2017) [20]. This issue is especially important for rural areas with a significant imbalance in the development and low socio-economic assessment. Generally speaking, the usage of crisis management is rather essential during the reform.

Crisis management of rural areas under decentralization involves making managerial decisions. It is often assumed in a high level of uncertainty, with lack of time, due to limited financial resources, and considering the development of crisis processes in rural areas, taking all these into account for new approaches to put into the reforms.

The crisis management provides for the presence of two necessary components - the subject of management (component making the managerial influence) and the object of management (part of the system which is influenced by the directions of the management).

Under the condition of decentralization, the management of rural areas is provided by local governing. In this condition, the system organized by the authority on a local level, due to the local community's demand, acquires a real possibility to solve problems related to the organization of their life in different ways, independently and regardless of the state. At the heart of local authority lies the territorial community (initial subject) – people, who in consequence with natural resettlement live on certain territory and have their right to solve their issues in their favour on a local level (Law of local governing in Ukraine, 1997) [10]. One of the objective reasons for the necessity of local governing existence in a modern state is the theoretical likelihood of having differences between national and local communities' interests. Therefore, a local governing mission is called upon to reasonably coordinate these differences. The state government cannot regulate all problems that appeared in rural areas.

The purpose of the article is to explore the crisis management of rural areas under the conditions of decentralization, to formulate a definition of its concept

In order to obtain the task, our main goals are:

-to state "the crisis management of rural areas under the conditions of decentralization" definition;

-to implement the stages of the crisis management of rural areas under the conditions of decentralization;

-to develop a comprehensive program-targeted approach towards the rural area growth based on a public-private partnership;

-to formulate the model of integration for the public, rural communities, business and science-based public-private partnerships.

Breadth and ambiguity of various aspects of the problem are being studied, their significance in the concept of sustainable development of agriculture determined the choice of research topic, the purpose, tasks and structure. Numerous publications of both domestic and foreign scientists are devoted to the problems of crisis management (Asaul A., 2007, Ligonenko L., 2005, Bonyar S., 2013 and others) [1, 11, 4].

The actuality of decentralization and management under the crisis put a wide range of scientists in the condition of discussing and finding suitable approaches to solving given issues. The researchers, such as (Averyanov V., 2002, Danylyshyn B., 2016, Hritsiak I., 2005, Karkovska, V. Ya., Perkhach, O. L., Vasiunyk, P. I., 2015, Kramon-Taubadel S., 2014, Myronova T., 2006, Nyzhnyk N., 1997, Oates W., 2008, Perkhach O. L., 2016, Perkhach O. L., Khymych O. V., 2016, Sakal O., Kovalenko A, Tretiak R, Tretiak N., 2019) [2, 5, 6, 8, 9, 12, 13, 14, 15, 16, 17].

investigate the essence and the content of decentralization the phenomena, analyze and diagnose the directions of government reforms, analyze foreign experience, make proposals to improving the efficiency and effectiveness of the government and the crisis management in Ukraine. According to the work of scientists, not enough attention has been paid to the crisis management approach, to the factors of decentralization and their impact on the development of rural areas which are not taken into deep consideration.

It can be assumed that the management of rural development which has been studied from the point of view of rural areas and agriculture identification, determines the limited scope of the search for measures to ensure the economic development of rural areas, taking into account growing crisis manifestations. In our opinion, it is necessary to study the rural areas, as economic subjects, within social and political relations. It should be notified that in many cases the consequences of decentralization are unpredictable.

MATERIALS AND METHODS

The methods used in the article are the following: the study of phenomena (object, subject), its division into parts; identification and analysis of the correlation between the factors and results (crisis management in conditions of decentralization). Various approaches were explored in the article to timely prevent and overcome crises, including the methods of economic analysis (studying the economic condition of rural areas), forecasting (revealing the factors of rural areas' development), social technologies (the aggregate directions of the professional impact on social objects in rural areas with the purpose of its improvement and ensuring the optimal usage under the different influence of decentralization process) and the development of crisis programs and complex investment projects, plans for restructuring and reorganization (methodical approach of management of projects). As we consider, it is worth using the inductive method in case of crises management study in Ukraine. As long as the purpose of crisis management of rural areas in the condition of decentralization is the developing economy state due to territorial growth including rural areas.

It has been a while since agriculture has been considered the basic development of Ukraine for years. Nowadays, the agrarian branch of the economy is less developed and even unprofitable due to different reasons.

Ukraine faced considerable difficulties, mainly: problems of uneven territories' development, significant differences in economic districts' development, an imbalance in relations between central executive power and institutions of local governing. It became necessary to solve these and other problems by reforming the public administration system and the introduction of decentralization policies.

Therefore, the authors consider it to be necessary to implement well-planned and carefully thought through reforms of decentralization in Ukraine. Under such circumstances an appropriate condition for bringing the power closer to the population, forming a flexible management system, assessment of the existing potential of rural areas, investigating the crisis sides of the development, it will ensure taking the initiatives and putting it into the development of the civil activity of rural residents.

In order to identify the crisis state of the territories in the conditions of decentralization we propose to determine the risk factor (K_p), characterizing the ratio of the probabilistic value of maximum possible loss (Z_{max}) to normative the value of a socio-ecological-economical component of rural areas (K_{0j}), calculated by the formula (1):

$$K_p = \frac{Z_{\max}}{K_{0j}} 100\% \quad \text{.....(1)}$$

As a result of determining the coefficient, the obtained value is estimated on a scale:

-up to 10% - favorable state;
-up to 10% to 30% - optimal state;
-up to 31% to 69% - alarming state;
-up to 70% - a crisis condition.

At the same time, it is appropriate to take into an account the total decentralization factor in decision-making (K_d), which allows assessing the degree of decentralization in a particular management system and is calculated by the formula:

$$K_d = \frac{r_i}{R_i} 100\% \quad \text{.....(2)}$$

where:

r_i - the number of decisions taken at the lower levels of the hierarchy in the *i*-th period;

R_i - the total number of decisions in this period.

Scale for calculating:

0.0-0.1 - the minimum degree;
0.1-0.3 - insignificant degree;
0.3-0.5 - average degree;
0.5-0.8 - a significant degree;
0.8-1.0 - high degree.

The lower the coefficient to one means the higher the degree of decentralization. But the number of decisions is insufficient because it is not taken into account the importance of the decisions taken at the lower levels of management and the degree of their independence, therefore, the definition of this indicator is of a general nature.

The initial data for the definition of this ratio was the data of the assessment of the financial capacity of the combined territorial communities operating in the regions, based on the results of the monitoring of the implementation of local budgets for 2017 and the following indicators, which reflect: its own income per capita; the level of subsidization of budgets (the share of basic/reverse subsidies of income); the specific weight of expenditures on management maintenance of the staff in the community's own resources (without any transfers from the state budget); capital expenditures per inhabitant.

According to the results of the research, we propose a model for identifying the crisis situation of rural areas in conditions of decentralization, taking into account the availability of potential (resource, labour), social, ecological and economic components of the development of territories, the risk factor for the crisis and the overall coefficient of decentralization:

$$N = E_s^{\gamma} + d_i + K_p + K_d. \quad \text{.....(3)}$$

where:

N – the identification of the crisis state of the territories in conditions of decentralization;

E^y_s– aggregate potential;

d_i – taxonomic index of the investigated cluster configuration;

K_p – risk factor;

K_d – total decentralization factor in decision-making.

The aggregate potential (E^y_s) is determined by the equation:

$$E_s^y = \frac{P_p^y}{V_s^y} = E_n \bullet d_n + E_l \bullet d_l + E_k \bullet d_k, \quad \text{.....(4)}$$

where:

d_n, d_l, d_k – the specific gravity of the natural, labour and stock potentials in the aggregate potential;

E_n, E_l, E_k– the potential of natural resources, the potential of labour resources and the potential of fixed capital.

RESULTS AND DISCUSSIONS

The calculation of these indicators significantly affects the approaches to making managerial decisions. Such calculation is important because of its local level where it is reserved for supporting and increasing economic growth, the formation of an effective management apparatus and an increase in the level of social well-being of the inhabitants.

One of the negative decentralization's effects on the development of the rural areas is strengthening interregional and intra-territorial differentiation of development. This is related to the different potential of territories' development and opportunities to accumulate financial resources while attracting investors.

In practice, a significant part of rural settlements does not provide constitutionally guaranteed public goods. As a result of insufficient diversification of production, many settlements (monofunctional villages) are in a stagnant stage.

Considering the above-mentioned methods, the authors of the research have developed and composed a classification matrix, which serves as a basis for the distribution of regions into the groups by their values according to the model of a territorial determination under the critical decentralization conditions Stepaniuk N. A., 2017 [20] (Table 1).

Table 1. Cluster grading of the regions of Ukraine

Clusters	Region	Calculated values				Index of crisis conditions of territories under decentralization *(N)*
		E^y_s	d_i	K_p	K_d	
V	Luhansk*	0.02	0.1	0.02	0.02	0.16
	Rivne	0.03	0.1	0.02	0.02	0.17
	Ternopil	0.04	0.1	0.02	0.02	0.18
	Khmelnytskyia	0.05	0.1	0.02	0.02	0.19
	Chernivtsi	0.08	0.1	0.02	0.02	0.22
IV	Kirovohrad	0.06	0.1	0.02	0.05	0.23
	Kherson	0.07	0.1	0.02	0.05	0.24
	Cherkasy	0.07	0.1	0.04	0.06	0.27
III	Chernihiv	0.09	0.1	0.07	0.09	0.35
	Volyn	0.03	0.2	0.07	0.06	0.36
	Zhytomyr	0.06	0.2	0.08	0.08	0.42
	Ivano-Frankivsk	0.08	0.2	0.10	0.10	0.48
	Mykolaiiv	0.13	0.2	0.12	0.13	0.58
II	Donetsk*	0.14	0.3	0.11	0.12	0.67
	Transcarpathian	0.16	0.3	0.14	0.14	0.74
	Kyiv	0.16	0.3	0.15	0.15	0.76
	Lviv	0.17	0.3	0.15	0.16	0.78
	Odessa	0.16	0.3	0.16	0.17	0.79
	Poltava	0.17	0.3	0.16	0.17	0.80
	Sumy	0.16	0.3	0.17	0.17	0.80
	Kharkiv	0.18	0.3	0.17	0.17	0.82
I	Zaporizhzhia	0.18	0.4	0.14	0.12	0.84
	Dnipropetrovsk	0.20	0.4	0.19	0.17	0.96

* The data are presented without the statistics on the temporarily occupied territories and the annexed Crimean AR.
Source: calculated by the authors.

The cluster grading, which is based on the level of factorial macro-economic indicators and coefficients of the mechanism of financial stable budget formation for the regions of Ukraine, has resulted in the formation of five clusters. Administrative regions of the I cluster are the closest to the reference, whereas the worst indices of the crisis conditions of territories under the decentralization are marked in the V cluster. Regions of the V cluster (Luhansk, Rivne, Ternopil, Khmelnytskyi, and Chernivtsi region) stay in the critical crisis conditions. In such a situation, it is urgent to take measures, which would develop the fundamentals of crisis management in a decentralization situation. To study the problem, the authors made a SWOT-analysis and analyzed the dynamics of economic development, as well as defined the priority directions of the anti-crisis strategy for the V cluster.

Based on detailed cluster analysis, the authors of the research made an attempt to forecast the general coefficient of the decentralization of crisis management of the national economy considering the probability of the three scenarios of the development (Table 2).

According to the forecasted calculations of the general coefficient of decentralization by the three scenarios, the authors argue the importance of crisis management for the development of the economy of Ukraine.

At present, Ukraine does not have effective approaches to crisis management of rural areas.

Today, there are many worldwide approaches and methods of decentralization and management of rural areas in conditions of crisis phenomena.

But at the same time, none of them in pure form can be used in Ukraine. We offer our own vision of the stages of crisis management of rural areas under the conditions of decentralization (Table 3).

The implementation of these stages will contribute to the strategic development of the crisis management process in rural areas in the process of decentralization.

Crisis public-private partnership is one of effective crisis response and socio-economic development of rural areas.

Table 2. Forecast of the general coefficient of the decentralization of crisis management for the national economy

Cluster	Forecast	Years			The average annual rate of growth, %
		2021	2022	2023	
I	pessimistic	0.25789	0.26652	0.26925	1.021788
	realistic	0.32812	0.32952	0.36285	1.051592
	optimistic	0.34255	0.42267	0.45091	1.147316
II	pessimistic	0.28532	0.30514	0.31125	1.044452
	realistic	0.33251	0.34178	0.37599	1.063373
	optimistic	0.35214	0.36224	0.47712	1.164009
III	pessimistic	0.30154	0.32519	0.33571	1.055139
	realistic	0.44652	0.44851	0.45128	1.005316
	optimistic	0.66225	0.67021	0.68828	1.019463
IV	pessimistic	0.30258	0.31147	0.31786	1.024939
	realistic	0.45127	0.47011	0.46854	1.018955
	optimistic	0.66675	0.67002	0.68141	1.010934
V	pessimistic	0.30699	0.31128	0.32593	1.030386
	realistic	0.56189	0.57741	0.58099	1.016854
	optimistic	0.68145	0.68856	0.69065	1.006728

Source: calculated by the authors according to statistical data of the State Statistics Service of Ukraine

Table 3. Stages of crisis management of rural areas under the conditions of decentralization

	Stages
1	Elaboration and confirmation of the crisis management plan for rural areas under the conditions of decentralization
2	Identification of financing sources for crisis management of rural areas under the conditions of decentralization
3	Carrying out a typology of rural areas, estimation of available potential and other calculations
4	Creating a commission on the study of rural areas development problems
5	Working out the state strategy of rural areas management under the conditions of decentralization (including by types of rural areas)
6	Elaborating and implementation of a legislative framework for the development of rural areas under the conditions of decentralization
7	Forming a system of training and retraining of personnel for crisis management of rural areas under the conditions of decentralization.
8	Developing and implementing regional and local rural development strategies for the areas.
9	Basic structural socio-economic transformations and ecologization in rural areas of crisis management under the conditions of decentralization

Source: developed by the authors.

The development of public-private partnerships in rural areas was considered to be the 50th plenary meeting of the UN Union between the public and private sector in the interests of agricultural development on July 23, 2004, which emphasized the importance of public-private unions and partnerships among subjects in different sectors to promote integrated rural areas development (Hubeni, 2007) [7].

In complicated modern political, economic and social conditions of Ukraine, public-private partnership is one of the best ways to implement long-term, capital-intensive and socially significant projects in rural areas. In our opinion, a private-public partnership can become an effective tool for the development of rural areas.

Based on the program-targeted method, we have elaborated on a comprehensive approach for the development of rural areas, which allows it to be synchronized combining the priorities of national projects in the model of rural areas (Figure 1).

The result of implementing this approach is the effective use of the potential state support and self-development of rural areas.

We consider defining the term "crisis public-private partnership in rural areas" as a form of crisis cooperation between the public, social and private sectors, based on the recognition that all parties benefit from pooling the resources, using innovations and managerial decisions for the purpose of implementation

of crisis principles and socio-economic development of rural areas.

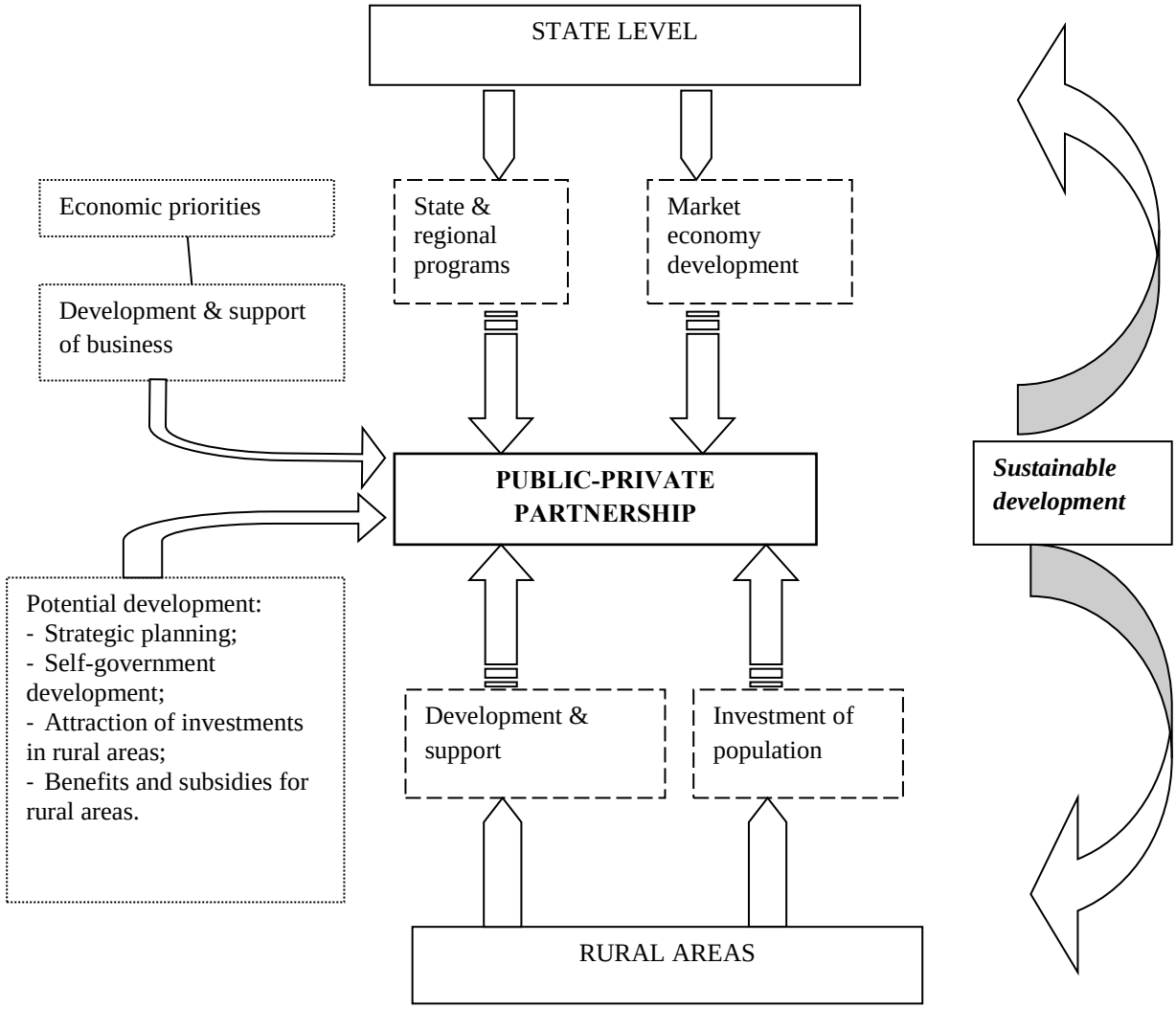

Fig. 1. A comprehensive approach to rural area development based on a public-private partnership
Source: developed by the authors

In Ukraine, we notice a very slow transition from the predominantly public administration to the public-private partnership, based on the principles of multilateral social, economic and environmental trends and the transfer of a part of the functions of public administration to the communities. In case of necessity for management in the conditions of crisis and decline of rural areas in Ukraine, the usage of public-private partnerships will have a need to be contributed to improving the quality of life of peasants.

The most important feature of the public-private partnership is functioning in a crisis economy, based on the interaction of state and private property, forming the specificity of appropriation relations. Such a partnership provides the choice of the most effective ways of using both state and private property as their transformation slowly takes place. As a result, a combined form of ownership is created that provides a synergistic effect.

The use of public-private partnerships should affect the main factors hampering the entry of businesses into rural space with innovative ideas due to financial problems, inadequate government support for innovation development, including low qualification staff. The methodical approach for the integration of the state, territorial communities, business and science on the basis of public-private partnership in the countryside with the object of rectifying the situation is proposed (Figure 2).

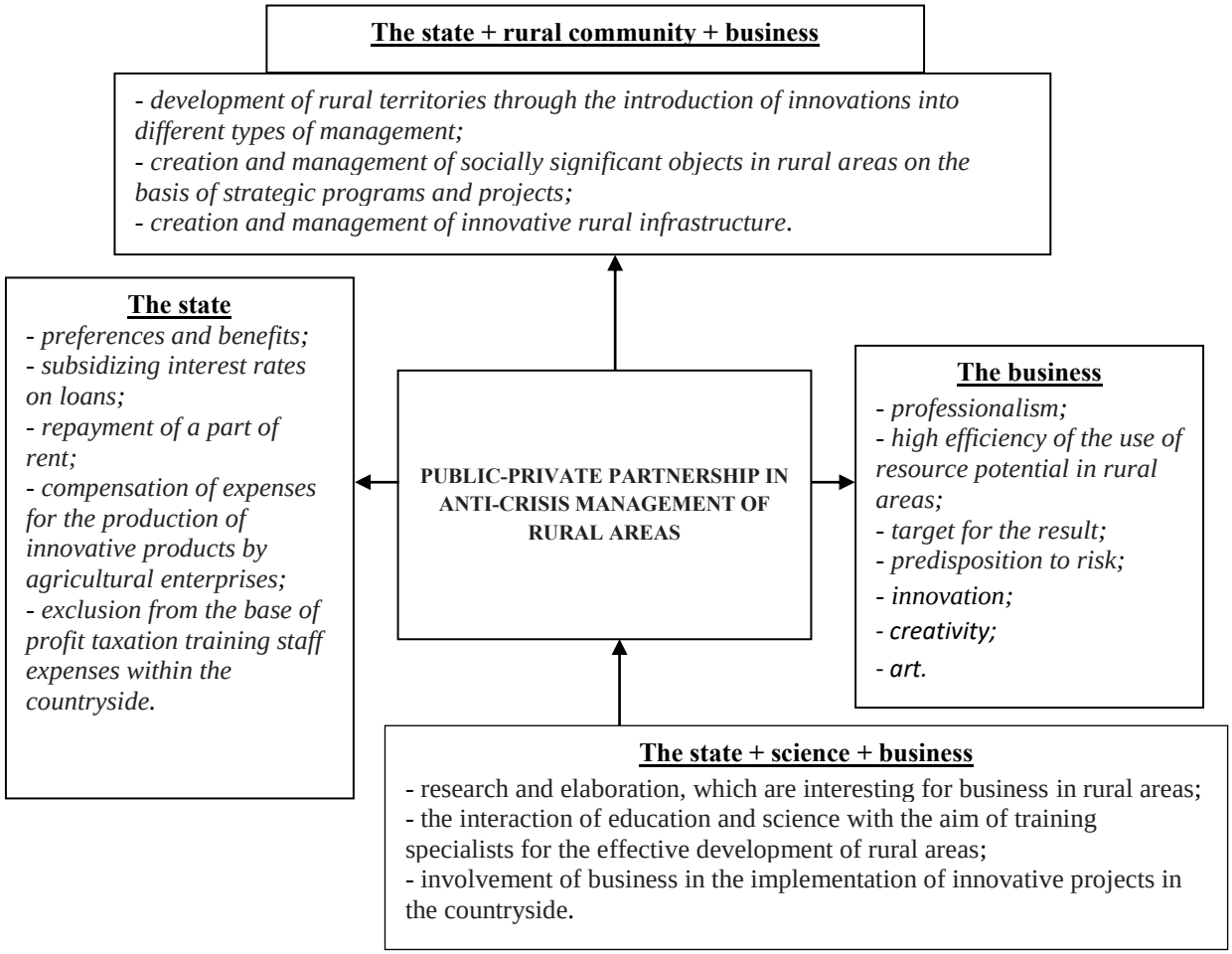

Fig. 2. Model of integration of the state, rural communities, business and science-based on public-private partnership (elaborated by authors)
Source: developed by the authors.

The proposed model will contribute to sustaining the demand for innovation in agriculture through financing the integration of science and business. However, in Ukraine, the demand for technological innovations remains extremely low compared to developed countries - the number of domestic industrial enterprises purchasing intellectual development for the purpose of implementation is less than 3% (Stepaniuk, 2015) [19].

The application of the proposed model will allow the development of rural areas increasing the efficiency of agriculture, bringing the country out of the crisis.

CONCLUSIONS

The obtained data allow us to determine the possibilities for the introduction of the authors' approach to crisis management in rural areas under decentralization. The basis of which is a public-private partnership, the integration of the state, rural communities, business and science.

Taking into consideration the large-scale crisis processing in Ukraine, significant potential in rural areas has already been lost. It is possible to stop this process only with prudent state policy. Therefore, the calculation of the decentralization factor will significantly affect the quality of the decisions taken in crisis management.

Above mentioned notion based on a methodical approach to a public-private partnership, however, the authors developed their own approach that takes the specific conditions of rural areas into account.

The implementation of the authors' recommendations will lead to positive changes, mainly: the growth of rural population, the renewal of productive capacity

in rural areas, increasing the interest of employees in original production activities or hiring on purpose to increase income increase of families' living standards, especially in villages.

The decentralization reform is aimed at the development of territories, including rural ones. The authors' vision encompasses an integrated approach and is aimed at the gradual implementation of decentralization in rural areas under the current conditions of crisis phenomena.

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ANALYSIS OF PROFITABILITY OF INTEGRATED PRODUCTION PROTEIN CONCENTRATE, LACTOSE POWDER WHEY

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Abstract

Whey is the main by-product of the dairy industry, which is formed during the enzymatic or acid treatment of milk, during the cheese production process. Due to its composition, whey is a good substrate for use in various biotechnological processes, which include the production of lactose, protein concentrates and hydrolysates, functional fermented beverages, enzymes, etc. Due to the numerous useful properties of whey, the aim is to establish new procedures in order to obtain products from it that would have daily application. In article according to performed research, proposes the possibility of applying the „SuperPro Designer software package" for modeling and analysis of technical and economic variability, including risk analysis and analysis of the impact of pollution reduction through the whey processing unit with integrated production of concentrated protein (WPC 80) and lactose powder (LAC 80). Based on the results of the economic assessment of the factories for the production of WPC 80 protein concentrate and whey lactose LAC 80 and the internal rate of return (IRR) after deducting all costs, it was determined that the production is economically justified and can be accepted.

Key words**:** *whey, protein concentrate, lactose powder, technical and economic analysis*

INTRODUCTION

When considering obtaining any new product, attention is paid not only to its placement, stimulating interest among consumers and its consumption, but also to the cost-effectiveness itself, ie. sustainability of production of such a product. A very important role in assessing the sustainability of production of a product has a techno-economic analysis that includes all possible investments and costs that may arise during production [5, 10]. Therefore, when it comes to whey utilization, economic indicators are crucial in It is profitable to process it and use it in the production of certain products.

The presented research proposes modeling and analysis of technical and economic variability, including risk analysis and analysis of the impact of environmental pollution reduction through a whey processing unit with integrated production of concentrated protein WPC 80 and lactose powder LAC 80 [1].

Simulation as a methodology is used to analyze and predict production costs in many industrial processes [2].

It has the ability to easily, quickly and without much money to estimate the total costs and effects of variables, such as rising raw material costs, utilities, changes in the composition of products and the introduction of new technologies. Based on request, through the development of a model for simulating certain conditions, it is possible to create different variants based on changes in information, which would check the sensitivity of the given parameters. Also, with the help of modeling it is possible to get information about how the process takes place, which contributes to a better understanding of the process [8, 11, 6].

The "*SuperPro Designer*" software package was used in these researches [9]. The selected simulator for presenting the analyzed process was previously successfully used in scientific and technical activities. He and co-workers cite "*SuperPro Designer*" as a powerful tool for performing the economic evaluation process, which offers the possibility of shortening the time required to design a

production process, which allows comparison of alternative processes based on consistency, so that many designed processes can be synthesized and interactively analyzed in a short timelines deadline [4].
Lima et al. used the "*SuperPro Designer*" software package during the analysis of the production costs of carbon activation from waste in poultry production [7, 3].

MATERIALS AND METHODS

The paper uses a methodology for techno-economic analysis of the cost-effectiveness of obtaining whey protein concentrate and lactose production, using the most modern computer program SuperPro Designer, which offers the possibility of shortening the time required to design the production process.
Also, in order to better explain theoretically the process of obtaining whey protein concentrate and lactose production, the paper uses the knowledge of domestic and foreign authors dealing with this issue, which are listed in the literature.

RESULTS AND DISCUSSIONS

Raw material and description of the process for obtaining whey and lactose proteins

Raw material

The paper discusses whey that remains after the production of cheese and sterile skimmed milk with a fat content of 0.5%, which is obtained from the domestic dairy industry Imlek a.d." (join-stock company Belgrade, Serbia). After collection, whey can be stored at a temperature of - 18ºC for a maximum of one week. The chemical composition of whey consists of: proteins 2.6 ± 0.012% (w/v); fat 1.05 ± 0.08% (w/v) and lactose 5.6 ± 0.114% (w/v).
The price of whey used as a raw material for the production of WPC 80 and LAC 80 can be considered negligible because it is a waste product of the mentioned dairy industry.

Description of the process of obtaining whey protein concentrate and lactose

The process of obtaining whey protein concentrate and lactose, according to Figure 1, begins with pre-processing, which represents the preparation of raw materials for the next stage of protein modification. Excluded possibilities of external contamination of the raw material were performed in a heat exchanger in the sub-unit marked P-2/HX-101 by pasteurization at + 60ºC for 60 minutes. After pasteurization, the mixture is cooled to + 37ºC via a heat exchanger marked P-6/HX-102 and passes into the ultrafiltration phase into the sub-unit marked P-19/UF-1, after which a retentate is produced in the sub-unit marked P-20/V -102. Drying the retentate in subunit P-21/SDR-101 yields whey protein concentrate in subunit P-23/FL-101 in the next step.
In the described manner, 17% of retentate was obtained from whey, and the rest was permeate. The powder may contain 35-85% protein in the dry matter. The process of isolating dry protein concentrates using ultrafiltration is shown in Fig 1.
In the same process, lactose isolation occurs after ultrafiltration via reverse osmosis (RO) in subunit designation P-3/RO-101. After RO isolating lactose is transferred to the evaporator in the sub unit marked P-4/ EV101, then taken to the tank where the crystallization process begins in the sub unit marked P-5/CR-101. After crystallization, the suspension passes into the spray dryer in the sub-unit marked P-7/SDR-102 where the crystals are dried at a temperature of + 92ºC (drying time is 15-20 minutes), then passes into the sub-unit marked P-8/FL-102 where the final lactose product in powder form is isolated.
The whey protein concentrate and lactose powder obtained in this way are lighter, easier to transfer and can be stored for a longer period of time.

Capital expenditures

The money needed to pay for equipment and auxiliary units, procurement and preparation of soil, civilian structures, facilities and control systems is a fixed capital investment. Based on the total selling price of the equipment (PC), the share capital was estimated, i.e. fixed capital. In the studies performed, the capacity/size ratio and the correction using cost indices are used as a method for estimating the cost of capital built

into the „SuperPro Designer“ software. Direct fixed capital represents fixed capital investment and is calculated for the complete process as the sum of direct, indirect and other costs associated with the complete capital investment in the plant.

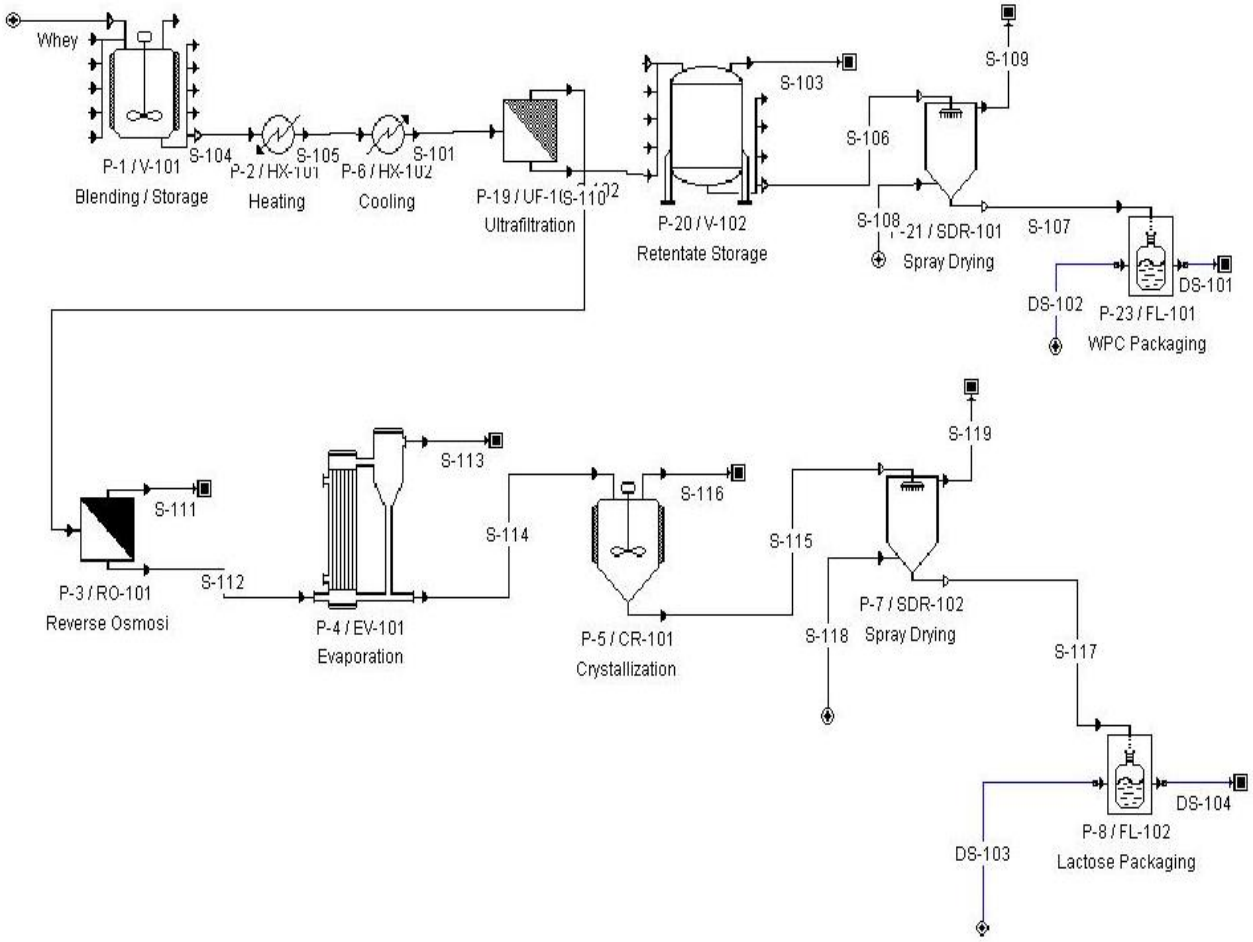

Fig. 1. Process of production of WPC 80 protein concentrate and LAC 80 lactose.
Source: Slavica Arsić (2018), Analysis of techno-economic justification of whey use in Serbia, Doctoral dissertation, Belgrade, 2018., University of Belgrade, p.63 [3].

Table 1, shows the total direct cost of fixed capital (DFC) of $ 19,634,000 and the individual cost items that contribute to direct fixed capital. Total capital investments include working capital as the cost of initiating validation, which totals $ 20,985,000 in the total capital investment costs of the WPC 80 concentrated protein and lactose powder production plant.

Operating costs

Table 2, which shows the basic operating costs of the WPC 80 and LAC 80 production plants, notes that the factory with a processing capacity of 1,000 kg h-1 in production has a total annual operating cost of $ 8,614,932. Unit production costs of WPC 80 are $ 15.84 per kg -1 and LAC 80 is $ 1.83 per kg -1.

The biggist item of operating costs in the production of WPC 80 and LAC 80 whey are equipment maintenance costs of 42.75%, labor costs of 40.60%, utility costs involved with 6.28% and laboratory equipment costs with 6.10%.

Based on the calculated costs, it can be stated that the most expensive point of the production process in the factory production WPC 80 and LAC 80 are the costs of equipment maintenance and labor costs.

Based on the total economic parameters of the WPC 80 and LAC 80 production plant, shown in Table 3, it can be concluded that the project is very favorable for the repayment period of all costs of 1.59 years, because in a very short time they can release funds for other purposes.

Table 1. Capital costs of factory production of WPC 80 protein and lactose LAC 80.

COSTS	Price per unit in ($)	Costs in ($)
Direct cost of fixed capital (DCF Capital)		**19,634,000**
Equipment procurement costs		**3,093,000**
Mixing tank	755,000	755,000
Heat exchanger	4,000	4,000
Ultrafiltration unit	149,000	745,000
Vertical tank	30,000	30,000
Spray dryer, SDR-101	147,000	147,000
Reverse osmosis unit	52,000	52,000
Evaporator	128,000	128,000
Crystallizer	441,000	441,000
Spray dryer, SDR-102	174,000	174,000
Equipment not on the list		619,000
Installation		1,762,000
Process pipelines		1,083,000
Measuring equipment		1,237,000
Insulation		93,000
Electrical equipment		309,000
Facilities (objects)		1,392,000
Landscaping		464,000
Auxiliary facilities		1,237,000
Designing		2,668,000
Construction		3,735,000
Fee for performing works		854,000
Contingency costs		1,707,000
Reversible capital		370,000
Start-up and validation costs		982,000
Funds (assets) allocated to research and development		0
Funds (assets) allocated for licenses and franchises		0
Total capital investment		**20,985,000**

Source: Results obtained by computer simulation in „*SuperPro Desinger*“ (3)

Table 2. Basic operating costs of the factory for production WPC 80 protein and lactose LAC 80.

COSTS	Annual costs ($ year $^{-1}$)	Unit costs ($ kg^{-1} WPC-a)	Unit costs ($ kg^{-1} Lactose)	Total operating costs (%)
Raw material costs	32,000	0.058	0.011	0.37
Labor costs	3,497,000	6.429	0.156	40.60
Equipment maintenance costs	3,683,000	6.771	1.203	42.75
Costs of laboratory equipment	525,000	0.965	0.174	6.10
Communal services	541,000	0.995	0.179	6.28
Water vapor	106,402	0.196	0.035	1.23
Cold water	160,298	0.295	0.053	1.86
Glycol	70,232	0.129	0.023	0.81
Other	0	0	0	
Advertising / sales	0	0	0	
Total operating costs	**8,614,932**	**15.84**	**1.83**	**100**

Source: Results obtained by computer simulation in „*SuperPro Desinger*“ (3).

Techno-economic analysis of profitability of protein and lactose production

The results of the economic assessment of the WPC 80 and LAC 80 whey production plant are shown in Table 10. For a plant with a basic capacity of 1,000 kg $^{h-1}$, the total capital investment is $ 20,985,000, the direct fixed capital cost is $ 19,634,000, and the operating cost is $ 8,614. .932 $ per year $^{-1}$, gross margin is 68.53% and return on investment is 62.70%.

The repayment period (number of years) required to recoup the funds invested in this research is 1.59 years. The shorter the repayment period, the more acceptable the project.

The maximum allowed repayment period in relation to which all investments of the company are compared is 6 years. Existing research has shown that with a repayment period of 1.59 years, a project for releasing funds for other purposes is much more suitable.

The internal rate of return (IRR) is compared to the minimum acceptable rate of return (MARR) or to the cost of capital of the enterprise. In this case, the IRR after tax is 45.86%, and the criterion for making a decision on accepting the project is that the IRR is higher or at least equal.

The net present value (NPV) with 7% tax is $ 68,118,000 -10^6 which is an indicator of the added value of the investment in the industry. In this case, the NPV is positive, which means that the investment should add value to the industry and thus indicate a production that is economically justified and can be accepted.

Table 3. Summary of economic parameters of the factory for the production of protein WPC 80 and lactose LAC 80

COSTS	AMOUNT
Total investment ($)	20,985,000
Direct costs of fixed capital ($)	19,634,000
Operating costs ($ year $^{-1}$)	8,614,932
Gross margin (%)	68.53
Return on investment (%)	62.70
Repayment period (year)	1.59
IRR after tax (%)	45.859
NPV at 7% ($ · 10^6)	68,118,000

Source: Results obtained by computer simulation in „*SuperPro Desinger*“ (3).

Analysis of investment sensitivity

For the production of WPC 80 protein concentrate and whey lactose LAC 80, using the SuperPro Desinger program that allows simultaneous design and production evaluation, the capital and operating costs of factory production are shown, to be successfully marketed as commercial products and their use in further research.

The two basic costs that are the criterion for making decisions on the economic feasibility of the production process are total capital costs and operating costs.

The basis for estimating these costs are: capital (fixed, labor and total), equipment, labor costs and total annual production costs (Table 1).

All costs arising from the regular activities of the industry (labor costs, utilities, laboratory costs, advertising), except for production costs, products and product sales prices, represent operating costs (Table 2).

Capital costs include the purchase of fixed assets, ie costs that contribute to increasing the value of fixed assets (costs of purchasing a new fermenter, storage tank, auxiliary building). Operating costs contribute to the reduction of the base for calculating income tax, while capital costs do not have a direct impact on the profit tax, (income) that the factory has to pay, but have an indirect impact.

CONCLUSIONS

Based on the results of the economic assessment of the factories for the production of WPC 80 protein concentrate and whey lactose LAC 80, according to Table 3, it can be concluded that if the total capital investment in the factory is $ 20,985,000, direct fixed capital costs $ 19,634,000, operating costs $ 8,614,932 per year $^{-1,}$ gross margin 68.53%, return on investment 62.70% and repayment period is 1.59 years, as well as if the internal rate of return (IRR) after deduction (payment) is 45.86% while NPV (net present value) with a 7% tax amounting to 68,118,000 $ -10 6 that production is economically justified and can be accepted.

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GENERATIVE PROPAGATION IN MAMMILLARIA IN ORDER TO OBTAIN ORNAMENTAL PLANTS

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Abstract

This research evaluated the different products as growth media influence on some Mammillaria species propagation, in order to ornamental plants obtained. Some Mammillaria species were tested: Mammillaria elongata - M.el; Mammillaria mazatlanensis - M.ma; Mammillaria neomystax - M.ne; Mammillaria obconella - M.ob; Mammillaria prolifera - M.pr; Mammillaria spinigemmatus - M.sp; Mammillaria blanckii - M.bl. Different substances, as growth media,were used: sand - San; garden soil - GS; perlite - Per; peat - Pea; hydroculture - HydC; agar-based medium - InVitro. Based on these, resulted the experimental variants: San+GS - V1; Per+GS - V2; Pea - V3; San+Pea - V4; HydC - V5; InVitro - V6. In Vitro method (V6) provided the best spread rate for most Mammillaria species tested, but Mammillaria neomystax recorded the best result in the V5 variant. Some Mammillaria species had good propagation rate in more growth media (eg. Mammillaria neomystax in V1 - San+GS; V4 – San+Pea; V5 - HydC), and others only in a growth media (eg. Mammillaria spinigemmatus in V6 - In Vitro). Based on Principal Component Analysis, 56.171% of variance was explained by PC1, and 25.00% of variance was explained by PC2. Cluster analysis, based on Euclidean distances, facilitated the grouping of the studied Mammillaria species, in conditions of statistical safety (Coph.corr. = 0.857). Mammillaria mazatlanensis (M.ma) and Mammillaria prolifera (M.pr) species, showed the highest degree of similarity, SDI = 2.027.

Key words: *Cluster analysis, Mammillaria, PCA, propagation, similarity indices*

INTRODUCTION

Cactaceae include different xerophytes and epiphytic plants species (more than 125 genera, and about 2000 species), and many species presented interest in being studied [20], [35], [34].

In the cactus group, Mammillaria represent a rich and representative genre. The Mammillaria group includes a large number of species (it is estimated between 140 - 180 species, or even more), in relation to the analysis and evaluation level [41], [23], [58], [6Various studies and researches have contributed to the identification, classification and analysis of new species of cacti, as well as to the evaluation of the ecophysiology of some species, or of their niche locations [22], [25], [31].

Cacti, as plants with specific ecophysiology, grow in different places in terms of ecological conditions, in different microhabitats and have the capability to colonize highly diverse areas [15], [30], [32], [52]. Cacti have an important functional role in natural ecosystems remediation [53].

The economical importance of cacti can be appreciated by their potential and use in the pharmaceutical industry and medicine [51], [14], food industry [11], [10], [57], as animal feed [2], [3], energy source [12], [5], as friendly dye [1], [18], and possibly others [24].

Cacti are a group of plants with a very high potential for arid and semi-arid, non-irrigated areas, and with a large number of uses, cacti have a huge potential to be a plant resource and even the food of the future [51].

At the same time, it is appreciated that there are areas around the world that are sensitive and prone to invasive species of cacti, such as Central Africa, East Asia and China [35], [36]. Techniques based on imaging and remote sensing, have facilitated studies at

different scales, to approach plants and the vegetal cover, in terms of individual and spatiotemporal variability [49], [50], different areas that included cactaceae being also the subject of such studies [9], [17], [29].

Cacti, however, are also important in the decorative aspect, being a special group of plants within the ornamental horticultural plants [4], [56], [13], [8], [35], [37]. *Mammillaria sp.* has a high weight in the group of ornamental cacti for the market, but also interest for the pharmaceutical industry [45]. Cacti have also been studied in the context of strategic management plans, including the tourist potential [26], tourism being approached in different studies from socioeconomic and cultural perspectives [42], [43], [44].

For both, ornamental plants and for interest in the pharmaceutical field, to different extracts obtaining, cacti proliferation in controlled conditions is of actuality. Different plant propagation techniques have also been used in the case of cactus multiplications [19], [28], [7], [27]. "In vitro" multiplication techniques generally have a higher success rate on plant propagation, aspects also reported in cacti by some studies [40], [27]. Various other studies and research have been conducted in order to improve techniques and methods of vegetative or generative plant propagation, through the use of nanoparticle treatments [48], by chemical or physical scarification of seeds [16], microwave treatments [54], or with certain bioactive substances [39].

In the presented context, this study evaluated the influence of different growth methods and substrates on the process of generative multiplication in several Mammillaria species, in order to obtain decorative plants.

MATERIALS AND METHODS

The study analyzed and compared the influence of some growth substrates and propagation methods, on generative multiplication in several *Mammillaria* species. Seven *Mammillaria* species represented the bilogical material: *Mammillaria elongata* - M.el; *Mammillaria mazatlanensis* - M.ma; *Mammillaria neomystax* - M.ne; *Mammillaria obconella* - M.ob; *Mammillaria prolifera* - M.pr; *Mammillaria spinigemmatus* - M.sp; *Mammillaria blanckii* - M.bl, Figure 1 (the abbreviations: M.el, M.ma, M.ne, M.ob, M.pr, M.sp, and M.bl, have only experimental significance in this study).


Mammillaria elongata


Mammillaria neomystax


Mammillaria obconella


Mammillaria blanckii

Fig. 1. Some images with *Mammillaria* species
Sources: selective photos for species studied.

Different components, alone or in a mixture, represented the growth substrates: sand - San; garden soil - GS; perlite - Per; peat - Pea; sand and nutrient solution for hydroculture - HydC; "*In Vitro*" technique with specific media - InVitro. From the combination of components, the following experimental variants resulted: San+GS - V1, Per+GS, Pea - V3, San+Pea - V4, HydC - V5, InVitro - V6. A control variant (Ct) as experience average for each species was considered. The number of seedlings, resulting for each species studied, was analyzed in accordance with the growth substrate considered.

The ANOVA test was used for the general analysis of the experimental data. Additionally, Variance analysis, Principal Component Analysis, and Cluster analysis were used. To assess and quantify the significance of the differences recorded, the limits of significance of differences (LSD) were calculated for 5%, 1% and 0.1% respectively. In addition, the Cophenetic coefficient as well as the Similarity and Distances Indices (SDI) were used in order to evaluate and interpret the safety of the results. PAST software [21], was used for the statistical processing of experimental data.

RESULTS AND DISCUSSIONS

The multiplication of each species of Mammillaria was tested under the same conditions as the growing substrates.

In the case of *Mammillaria elongata* (M.el) the V6 variant provided the best multiplication rate (13.00 plants, average value), compared to V2 variant, that provided 9.66 plants (average value), Table 1. The analysis of the experimental data, in the case of this species, confirmed the statistical safety of the differences ($LSD_{1\%}$), in the case of the San+GS (V1), HydC (V5) and InVitro (V6) variants.

In the case of *Mammillaria mazatlanensis* (M.ma) were obtained 9.00 plants on the San+Pea substrate (V4), and 14.00 plants on the InVitro conditions (V6), Table 2. Obtained results analysis, evidenced the differences between variants, in conditions of statistical safety for variant V5 - HydC ($LSD_{5\%}$), for variant V3 - Pea ($LSD_{1\%}$), and for variant V6 - InVitro ($LSD_{0.1\%}$).

Table 1. Number of plants resulting on experimental variants at *Mammillaria elongata*

Trial	Experimental variant	Average value	Relative value	Differences
V1	San+GS	12.66	129.71	2.90**
V2	Per+GS	9.66	98.97	-0.10
V3	Pea	11.00	112.70	1.24
V4	San+Pea	9.33	95.59	-0.43
V5	HydC	12.66	129.71	2.90**
V6	InVitro	13.00	133.19	3.24**
V7	Ct	9.76	100.00	-
LSD	$LSD_{5\%} = 1.67$; $LSD_{1\%} = 2.34$; $LSD_{0.1\%} = 3.31$			

Source: original data, resulting from own experiences.

Table 2. Number of plants resulting on experimental variants at *Mammillaria mazatlanensis*

Trial	Experimental variant	Average value	Relative value	Differences
V1	San+GS	10.00	105.04	0.48
V2	Per+GS	9.66	101.47	0.14
V3	Pea	12.33	129.52	2.81**
V4	San+Pea	9.00	94.54	-0.52
V5	HydC	11.66	122.48	2.14*
V6	InVitro	14.00	147.06	4.48***
V7	Ct	9.52	100.00	-
LSD	$LSD_{5\%} = 1.91$; $LSD_{1\%} = 2.68$; $LSD_{0.1\%} = 3.79$			

Source: original data, resulting from own experiences.

For the *Mammillaria neomystax* specie (M.ne) the number of plants obtained varied depending on the variants, between 9.66 plants in San+Pea (V4), and 13.66 plants at the HydC variant (V5), Table 3. The analysis of the experimental results evidenced the presence of differences and statistical safety, in the case of Pea (V3) variant (LSD5%), at the San+GS (V1), San+Pea (V4) and InVitro (V6) variants (LSD1%), and in the HydC variant (V5) for LSD0.1%.

Table 3. Number of plants resulting on experimental variants at *Mammillaria neomystax*

Trial	Experimental variant	Average value	Relative value	Differences
V1	San+GS	13.33	123.89	2.57**
V2	Per+GS	9.66	89.78	-1.10
V3	Pea	12.66	117.66	1.90*
V4	San+Pea	13.00	120.82	2.24**
V5	HydC	13.66	126.95	2.90***
V6	InVitro	13.00	120.82	2.24**
V7	Ct	10.76	100.00	-
LSD	$LSD_{5\%} = 1.44$; $LSD_{1\%} = 2.02$; $LSD_{0.1\%} = 2.86$			

Source: original data, resulting from own experiences.

For the *Mammillaria obconella* specie (M.ob), were obtained 7.33 plants at San+Pea (V4)

variant, and 14.00 plants at InVitro (V6) variant, with intermediate values for the other variants, Table 4. Analysis of the obtained results, confirmed the existence of negative differences, with statistical significance in conditions of $LSD_{1\%}$ (San+Pea, V4), and of positive differences, with statistical significance in conditions of $LSD_{5\%}$ (HydC, V5), and for $LSD_{0.1\%}$ (Pea, V3; InVitro, V6).

Table 4. Number of plants resulting on experimental variants at *Mammillaria obconella*

Trial	Experimental variant	Average value	Relative value	Differences
V1	San+GS	10.00	106.16	-0.58
V2	Per+GS	10.33	109.66	0.91
V3	Pea	13.33	141.51	3.91***
V4	San+Pea	7.33	77.81	-2.09oo
V5	HydC	11.00	116.77	1.58*
V6	InVitro	14.00	148.62	4.58***
V7	Ct	9.42	100.00	-
LSD	$LSD_{5\%}$ = 1.51; $LSD_{1\%}$ = 1.61; $LSD_{0.1\%}$ = 2.28			

Source: original data, resulting from own experiences.

In the *Mammillaria prolifera* specie (M.pr), the values recorded were 9.00 plants at San + GS (V1), and 13.00 plants at InVitro (V6), and for the other variants in this interval, Table 5. Analysis of the experimental data, evidenced positive differences, in condition of statistical safety, for $LSD_{1\%}$ (Pea, V3), and for $LSD_{0.1\%}$ (InVitro, V6).

Table 5. Number of plants resulting on experimental variants at *Mammillaria prolifera*

Trial	Experimental variant	Average value	Relative value	Differences
V1	SanGS	9.00	97.94	-0.19
V2	PerGS	9.66	105.19	0.47
V3	Pea	12.00	130.58	2.81**
V4	SanPea	10.00	108.81	0.81
V5	HydC	10.66	115.99	1.47
V6	InVitro	13.00	141.46	3.81***
V7	Ct	9.19	100.00	-
LSD	$LSD_{5\%}$ = 1.50; $LSD_{1\%}$ = 2.11; $LSD_{0.1\%}$ = 2.98			

Source: original data, resulting from own experiences.

At *Mammillaria spinigemmatus* specie, was registered 8.66 plants at San+Pea (V4) variant, and 14.33 plants at InVitro (V6) variant; for the others variants the results ranged between these values, table 6. Statistical analysis of the data, showed differences compared to the experience average, statistically assured for $LSD_{0.1\%}$ for San+GS (V1) and InVitro (V6) variants.

Table 6. Number of plants resulting on experimental variants at *Mammillaria spinigemmatus*

Trial	Experimental variant	Average value	Relative value	Differences
V1	San+GS	12.66	135.69	3.33***
V2	Per+GS	10.00	107.18	0.67
V3	Pea	9.66	103.54	0.33
V4	San+Pea	8.66	92.82	-0.67
V5	HydC	10.00	107.18	0.67
V6	InVitro	14.33	153.59	5.00***
V7	Ct	9.33	100.00	-
LSD	$LSD_{5\%}$ = 1.56; $LSD_{1\%}$ = 2.19; $LSD_{0.1\%}$ = 3.09			

Source: original data, resulting from own experiences.

At *Mammillaria blanckii* specie (M.bl), was recorded 6.66 plants in San+Pea (V4) variant and 14.00 plants in InVitro (V6) variant, and for other variants the plants number obtained were between these values, Table 7. The statistical analysis of the experimental data showed negative differences, which presented statistical safety for LSD0.1%, San+Pea (V4) variant. There were also positive differences who presented safety for LSD5% in Per+GS (V2) variant, for LSD1% in San+GS (V1) variant, and for LSD0.1% in Pea (V3) variant, and InVitro (V6) variant respectively.

Table 7. Number of plants resulting on experimental variants at *Mammillaria blanckii*

Trial	Experimental variant	Average value	Relative value	Differences
V1	SanGS	12.00	125.00	2.40**
V2	PerGS	11.00	114.50	1.40*
V3	Pea	13.00	135.42	3.40***
V4	SanPea	6.66	69.37	-2.94ooo
V5	HydC	10.66	111.04	1.06
V6	InVitro	14.00	145.83	4.40***
V7	Ct	9.60	100.00	-
LSD	$LSD_{5\%}$ = 1.38; $LSD_{1\%}$ = 1.93; $LSD_{0.1\%}$ = 2.73			

Source: original data, resulting from own experiences.

The analysis of the whole experimental data set by the ANOVA test (Alpha = 0.001), confirmed the presence of variance and data safety ($F_{crit}<F$; $p<0.001$).

The overall analysis of the data showed that the InVitro variant (V6) was the best method of propagation to the tested *Mammillaria* species, except for the species *Mammillaria neomystax* (M.ne), in which case, the HydC variant (V5) gave the better results. Analyzing the response of each species of Mammillaria to the method and substrate for propagation, it was found that the species *Mammillaria neomystax* (M.ne) recorded the best values in three of the growth substrates, San+GS (V1),

San+Pea (V4), and HydC (V5).
The species *Mammillaria obconella* (M.ob) had very good results on two growth substrates Per+GS (V2) and Pea (V3), and followed the *Mammillaria spinigemmatus* specie (M.sp), which had very good results only in InVitro variant (V6), Figure 2.

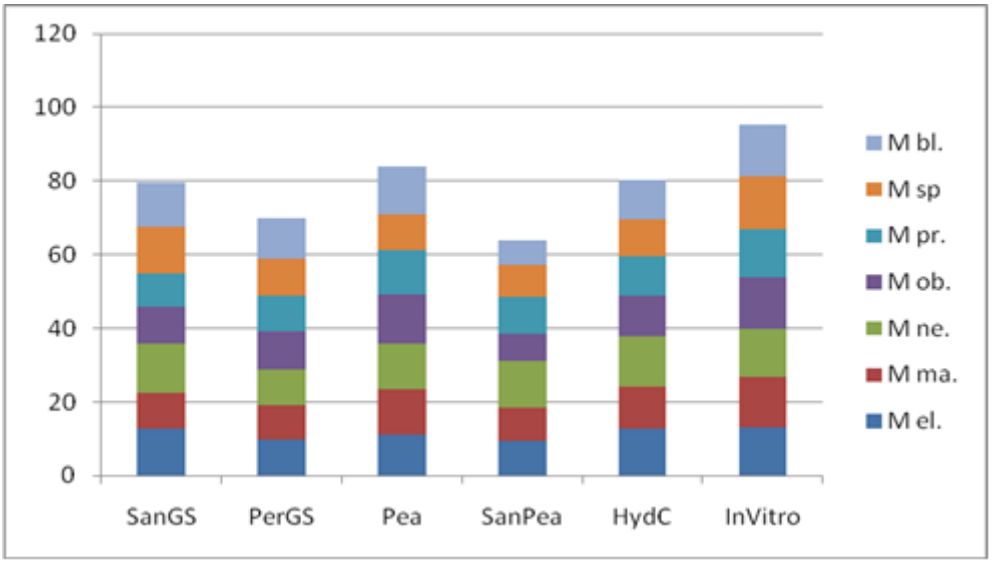

Fig. 2. Graphical distribution of the cumulative effect of propagation substrate at *Mammillaria* species
Source: original graph based on own experimental data.

The diagram shows the orientation and placement of the tested species, according to the response generated to the propagation media (San+GS, Per+GS, Pea, San+Pea, HydC, and InVitro). According to the PCA analysis diagram, 56.171% of the variance was explained by PC1, and 25.00% of the variance was explained by PC2.

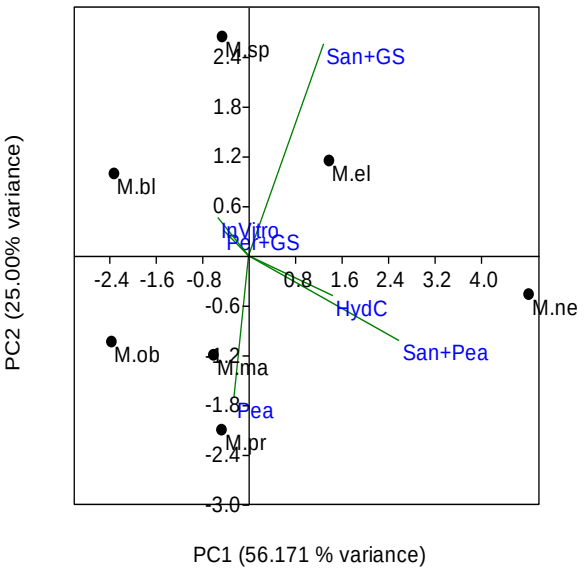

Fig. 3. PCA diagram regarding the spatial distribution of *Mammillaria* species in relation to growth substrate
Source: original graph based on own experimental data.

Cluster analysis led to the grouping of *Mammillaria* species, based on Euclidean distances, under statistical assurance conditions (Coph.corr. = 0.857), Figure 4.
The studied *Mammillaria* species (M.el; M.ma; M.ne; M.ob; M.pr; M.sp; M.bl) occupied positions in the dendrogram based on the similarity of the response to the propagation substrates.
The species Mammillaria neomystax (M.ne) occupied an independent position (cluster C1), based on the very good response to three propagation substrates, San + GS (V1), San + Pea (V4) and HydC (V5). Cluster C2 comprises three subclusters, C2-1 and C2-2 with common root, and subcluster C2-3.
Subcluster C2-1 grouped the species *Mammillaria mazatlanensis* (M.ma) and *Mammillaria prolifera* (M.pr), species that, according to similarity and distances indices (SDI), showed the highest degree of similarity, respectively affinity, SDI = 2.027.
Subcluster C2-2 grouped the species *Mammillaria obconella* (M.ob) with *Mammillaria blanckii* (M.bl), for which the similarity and distances index (SDI) had the value SDI = 2.2632.

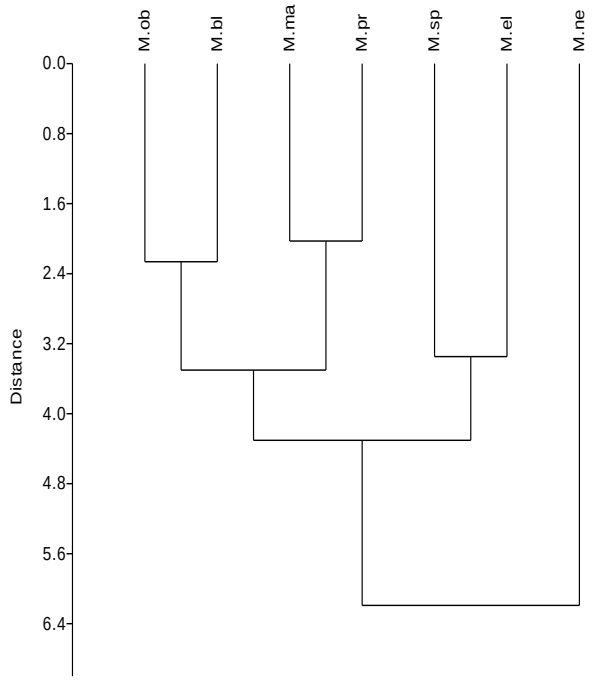

Fig. 4. Clustering of *Mammillaria* species, based on Euclidean distances
Source: original graph based on own experimental data.

Subcluster C2-3, grouped the species *Mammillaria spinigemmatus* (M.sp) and *Mammillaria elongata* (M.el), for which the similarity and distances index (SDI) had the value SDI = 3.3473.
The set of values, for SDI, associated with the values obtained on the experimental variants for *Mammillaria* species, are presented in Table 8.

Table 8. Similarity and distances indices for *Mammillaria* species in relation to propagation media

	M.el	M.ma	M.ne	M.ob	M.pr	M.sp	M.bl
M.el		3.3096	4.2040	4.5507	4.3410	3.3473	4.2849
M.ma	3.3096		5.6743	2.1618	2.0270	4.1594	3.5665
M.ne	4.2040	5.6743		7.2257	6.0979	6.6003	7.3400
M.ob	4.5507	2.1618	7.2257		3.3856	4.8509	2.2632
M.pr	4.3410	2.0270	6.0979	3.3856		4.7945	4.8940
M.sp	3.3473	4.1594	6.6003	4.8509	4.7945		4.1395
M.bl	4.2849	3.5665	7.3400	2.2632	4.8940	4.1395	

Source: original data resulted from our experiments.

In vitro propagation in Mammillaria has been used in many studies on MS environments with different supplements (BA, 2iP, NAA, sucrose, etc.), being the method with the highest success rate [38], [45], [46], [19], [33], [27].

Other alternative propagation media, such as sand, perlite, peat or other simple components or in different mixtures, are more accessible, do not require costly techniques and have been used in some *Mammillaria* species propagation studies, and have a good enough success rate [55], [47].

CONCLUSIONS

The "In Vitro" propagation method (V6 variant) represented the safest multiplication method for the tested *Mammillaria* species. The other propagating variants, based on different substrates, were positioned in descending order as follows: HydC > San+GS > Pea > San+Pea > Per+GS.
Mammillaria neomystax (M.ne) was the species with the best response to three of the multiplication variants tested, San+GS (V1), San+Pea (V4), HydC (V5). With good results in two variants Per + GS (V2), and Pea (V3) was placed *Mammillaria obconella* (M.ob), followed by *Mammillaria spinigemmatus* (M.sp) in the InVitro variant (V6).
Principal Component Analysis and Cluster analysis explained the source of variance, in the data set, and facilitated the grouping of variants in relation to specific results.

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ACHIEVING ENVIRONMENTAL PROTECTION THROUGH IMPLEMENTATION OF AGRO-ENVIRONMENTAL PRACTICES FROM AGRICULTURAL HOLDINGS

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Abstract

Agro-environmental practices lead to protection, maintenance and improvement the ecological quality of environment and limitation the negative impact on natural resources. Their implementation may be voluntary because of the participation in commitments with European and national funding programs or because of the implementation of national standards for good agricultural practices. The aim of the article is to analyze the role of agro-environmental practices for achieving environmental protection and make conclusions for the possibility of agricultural holdings to implement agro-environmental practices. The results in this paper are based on structured interview. Two surveys were conducted as follows: the first one is expert survey and the second one is survey among agricultural producers. The main results are related to the most important practices for environmental protection. The allocation of funds for support and diversification of activities, maximum use of resources obtained in each farm and the introduction of new technologies would lead to the implementation of agro-environmental practices and environmental protection.

Key words**:** *agro-environmental practices, environment, agroecology*

INTRODUCTION

Agroecology includes different approaches to solve a number of problems of agricultural production. Initially, the object of the theoretical study was mainly the aspects of production in terms of plant protection, but later scientist focused on various environmental, social, economic and ethical issues. Agro-environmental practices lead to protection, maintenance and improvement of the ecological quality of agricultural land and limitation of the negative impact on natural resources. Their implementation may be a voluntary consequence of commitments made due to participation in European and national funding programs or implementation in order to be followed the national standards for good agricultural practice. Agro-environmental practices cope specific problems, objectives and spatial scales depending on the current state of the agricultural, natural and cultural environment. Deterioration of water quality, soil pollution, air pollution and damage of landscape elements are major problems. Understanding what encourages farmers to implement agro-environmental practices is crucial for intensifying the process and to solve some of these environmental problems.

Agro-environmental practices are defined as a process of perception, not only in terms of the applicability of environmental standards in agriculture, but also as the internal perception and motivation of farmers [10].

Some authors [6] consider that agro-environmental practices combine both traditional agricultural methods with modern technologies in order to protect the environment.

Agro-environmental practices are used to increase agricultural production through ecological processes and ecosystem services as nutrient cycling, biological nitrogen fixation, soil, water and biodiversity conservation. They avoid the use of conventional methods such as chemical fertilization, synthetic pesticides and GMOs [9]. The implementation of agro-environmental practices contributes to improvement the resilience of agro-ecosystems.

Agro-environmental practices are also implemented in small farms, thus limiting farmers' vulnerability to climate change, resource degradation and volatile agricultural prices [7]. They are defined as the only possibility for some farms to produce products in order to obtain economic benefits while protecting the environment.

Some authors [1] consider agro-environmental practices as a rule, that should minimize the use of energy and resources by recycling or using resources close to the farm.

Practices such as reducing the need for water, pesticides and fertilizers, replacing chemicals with natural pesticides lead to increase in crop efficiency and productivity.

Agro-environmental practices with the highest implementation in modern agriculture are separate fertilization and use of different varieties in crop production [9].

According to some authors [3], practices such as drip irrigation management and the selection of appropriate varieties and crops have a high level of implementation and will continue to be improved and applied to a greater extent over the next decade.

Soil quality is defined as one of the key indicators for environmental protection. The implementation of practices such as minimal tillage, organic fertilization and reduced use of pesticides lead to improved statement, quality and fertility of the soil. According to some researchers [2] these agro-environmental practices, have a medium to high level of implementation. Their implementation will increase because of the actual requirements for environmental protection and growing environmental problems connected with tillage.

The implementation of practices such as different crop rotations lead to an increase in the biological activity of the soil, reduce the use of pesticides and increase the possibility of biological pest control.

Different authors [4] also consider that there is a connection between the implementation of agro-environmental practices and air quality protection. They consider that the implementation of voluntary mechanisms for the implementation of agro-environmental practices will lead to an intensification of the process and protection of the environment. In another study [8], they share the view that farmers' attitudes towards agro-environmental practices will reduce the negative impact of agriculture on both water resources and the environment.

Diversification has a significant role for the implementation of agro-environmental practices and these practices are related to growing new plant varieties, increasing the use of agroforestry in order to increase the resilience of agro - ecosystems, protecting the environment and biodiversity.

Focusing on the attitude of farmers towards environmental protection, the authors [5] classify four types of farmers as follows:

(1)active participants who apply voluntary practices, both with regard to the protection of the environment and because of the financial reasons;

(2)passive farmers who implement agro-environmental practices mainly from a financial point of view;

(3)conditionally non-accepting farmers who would participate in certain circumstances (for example, easier to adapt measures and higher payments);

(4)non-accepting agricultural producers.

Based on the literary review the conclusion is that there is a wide variety of practices related to the environmental protection. The theoretical review shows that the practices connected with the soil, air, water and landscape protection are the most common. The aim of the article is to analyse the role of agro-environmental practices for achieving environmental protection and make conclusions for the possibility of agricultural holdings to implement agro-environmental practices.

The paper structure includes: 1) Introduction, that contains theoretical views on the role of agro-environmental practices for environmental protection 2) Methodology 3) Analysis of the role of agro-environmental practices for environmental protection 4) General conclusions about the role of agro-environmental for environmental protection.

MATERIALS AND METHODS

Two field surveys were conducted in this research as follows: the first one is expert survey and the second one is survey among agricultural producers.

22 structural interviews were conducted in July 2020. The respondents were experts in the field of agroecology and agro-environmental practices. For the successful conduction of the survey the questionnaire was sent to three groups of respondents: 1) experts from the National Agricultural Advisory Service (NAAS); 2) experts from institutes (Institute for Economic Research at Bulgarian academy of science (BAS) and Institute of Agrarian Economics at BAS); 3) Experts from universities.

Figure 1 presents the distribution of experts who participated in the expert survey. Respondents who work in the universities (45%) have the highest share from all the experts, followed by the experts working in various institutes - 33%. The consultants in the municipal agricultural services and in the NAAS have the smallest relative share - 22%.

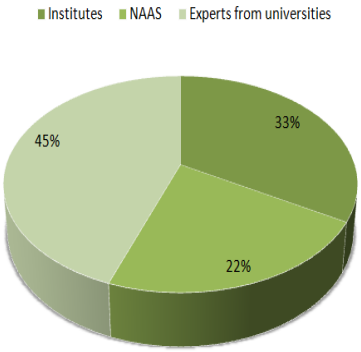

Fig. 1. Distribution of the experts according their workplace
Source: own survey.

The survey among farmers was conducted in September 2020. 61 structured interviews with farmers were organized. The managers of agricultural holdings participating in the survey are mainly men (71.7%). In the sample of women, farm managers are 23%. The average age of the respondents is 28.53 years. The largest is the relative share of the respondents under the age of 35 years - 33%. Only 5% of respondents fall into the 66-year-old category. The group of respondents between 36 - 45 years and 46 - 55 years covers respectively 23% of the respondents. The agricultural experience of the surveyed farmers varies from 2 to 35 years, with an average score - 6.83 years for all the respondents. The largest group of respondents has been engaged in agriculture for less than 10 years, while the smallest number of respondents have more than 30 years agricultural experience.

For the purposes of the article are used questions from the farmer's questionnaire aimed at assessing the impact of agro-environmental practices on environment. Some of the practices are separate fertilization, organic fertilization, spatial distribution of crops, use of organic substances such as compost, selection of suitable variety, replacement of chemical with natural pesticides, use of roof crops to protect soil and water etc. This question is assessed on a five-point Likert scale. Farmers also assess what are the main reasons for them to implement agro-environmental practices, and the question has the possibility of more than one answer. The used questions from the expert survey are related to assess the possibilities of agro-environmental practices for environmental protection and also their effect on natural resources. These questions were also assessed using a five-point Likert scale.

RESULTS AND DISCUSSIONS

Results and discussion based on the expert survey

The relationship between the implementation of agro-environmental practices in agricultural holdings and environmental protection and in particular water, soil, biodiversity is proportional (Figure 2).

Respondents assess the role of the implementation of agro-environmental practices for environmental protection. The prevailing opinion of the respondents is that agro-environmental practices has the strongest impact on the protection of biological diversity and protection of land resources (50%).

The second most important benefit for the environmental protection from implementing agro-environmental practices is protection of water resources (40%), followed by the positive impact on climate change and the reduction of the risk of floods, respectively 36%.

About one third from the respondents are agree to some extent that agro-environmental practices protect the environment and in particular have a positive impact on climate change, reducing the risk of floods, biodiversity, water and land resources.

The processes of erosion, pollution, swamping, lack of species diversity, as well as the pressure on the environment and natural resources are identified as a threat that would stimulate the implementation of agro-environmental practices.

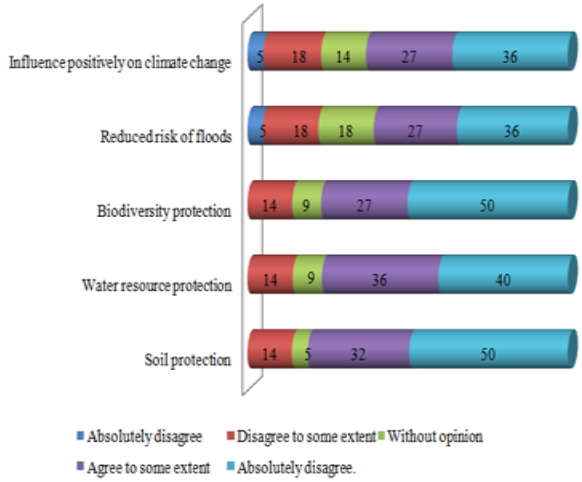

Fig. 2. Distribution of experts' opinion on the role of agro-environmental practices for the environmental protection
Source: own survey.

The ranked activities that can lead to environmental protection by agricultural holdings are presented in Figure 3.

Experts consider that three of the proposed activities have a significant impact and would lead to environmental protection. They are as follows:

-allocation of funds for support and expansion of activities (45%);

-maximum use of resources received in each farm (41%);

-introduction of new technologies (41%).

Most of the respondents consider that the proposed activities will partially protect the environment and the answers for the various activities vary from 41 to 54%.

Only 18% of experts are on the opinion that the use of new varieties on farms would lead to environmental protection. The skepticism may be due to the fact that most of the new varieties that come on the market are GMOs.

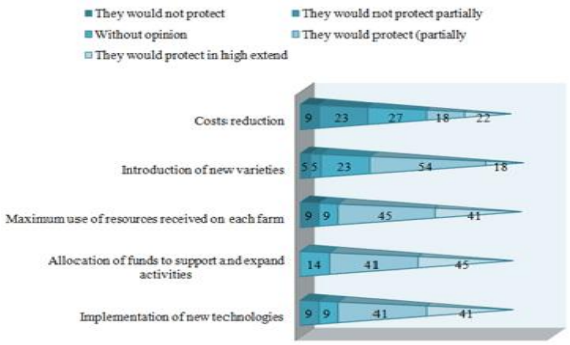

Fig. 3. Distribution of experts' opinion on activities that may lead to environmental protection
Source: own survey.

Experts agree that the most pronounced effect of the implementation of agro-environmental practices is to increase the maintenance and the improvement of the ecological condition of arable land (86%) (Figure 4).

It should be noted that both responses for the increasing the competitiveness of agricultural holdings and the introduction of new technologies, varieties and breeds of animals have the same effect from the implementation of agro-environmental practices, respectively 41%. The increase in the capital of agricultural holdings and the environmental protection have the smallest relative share, respectively 9% and 4%.

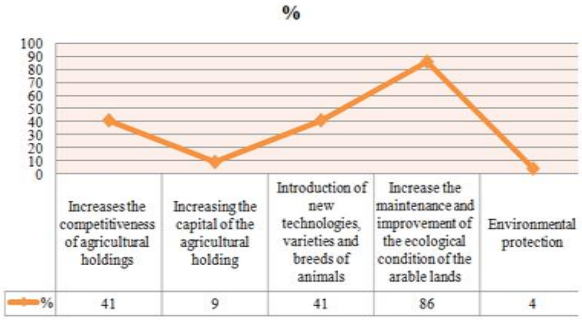

Fig. 4. Distribution of expert opinion on the effects from the implementation of agro-environmental practices
Source: own survey.

Results and discussion based on the survey with agricultural producers

The opinion of farmers on the effects of the implementation of agro-environmental practices and the main reasons for their motivation for implementation of these kind of practices was studied in term to assess the possibilities of agricultural holdings for environmental protection.

Based on the data from Figure 5 we could conclude that the prevailing respondent's opinion is that the implementation of agro-environmental practices in order to protect the environment is very important.

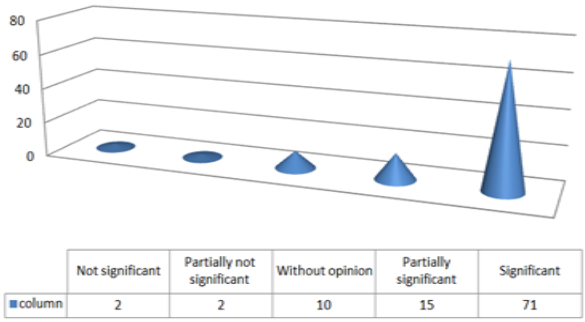

Fig. 5. Distribution of the farmer's opinion on the significance of the effects of the implementation of agro-environmental practices
Source: own survey.

15% of farmers partially or completely share the opinion that the implementation of environmental practices is important for the environment.

The most important reason for the implementation of agro-environmental practices is environmental protection. 60% of the respondents are partially or completely agree and they also define receiving of financial compensation as the second most important factor (Figure 6).

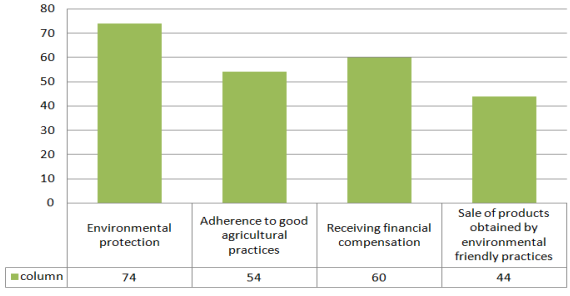

Fig. 6. Assessment of the main reasons for the implementation of agro-environmental practices
Source: own survey.

More than half of the farmers share that the adherence to good agricultural practices are the main reason for the implementation of agro-environmental practices. The sale of products obtained in an environmentally friendly way has the lowest relative share according to the other reasons - 44%.

CONCLUSIONS

Based on the results from the conducted surveys and realized analyzes, the following general conclusions could be made:

-There is a wide variety of practices related to the environmental protection. The most important for environmental protection are the protection of biological diversity and protection of land resources. Soil, water and landscape protection are also defined as important in terms of receiving environmental benefits.

-The allocation of funds for support and diversification of activities, maximum use of resources obtained in each farm and the introduction of new technologies would lead to the implementation of agro-environmental practices and environmental protection.

-Age, education of managers and experience in agriculture are important factors for implementing agro-environmental practices and achieving economically efficient, environmentally friendly, socially responsible and sustainable agriculture.

-Agro-environmental practices are more important at the environmental level than at the farm level, and the implementation of agro-environmental practices from agricultural holdings would be the most common reason for environmental protection.

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TAX EXPENDITURES AS AN INCENTIVE FOR THE AGRICULTURE IN BULGARIA

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Abstract

The government can use different ways to stimulate certain industries or categories of taxpayers. It can be achieved with direct payments and subsidies that increase the budget revenues. It is also possible to achieve this aim by reducing budget revenues by failing to collect some of them to be ceded to preferred groups of taxpayers. These are so-called tax expenditures. In Bulgaria, official statistics on their value and impact have been kept since 2007. Following the requirements of the EU, a national definition of the term tax expenditure is adopted in Bulgaria, which should correspond to the specifics of our tax system. Despite the relatively small share of the tax expenditures - about 2% of total tax revenues in Bulgaria, their values are subject to continuous analysis and control of their effectiveness. The lower it is, the state fails to collect additional revenues without generating benefits for the economy. At the same time, how our tax policy can use them to stimulate an industry such as agriculture, where employment is still quite high, is a priority of this study. The purpose of this article is to assess and analyze the tax expenditures applicable for agriculture in Bulgaria. Modern approaches and methods such as the method of analysis and synthesis have been used in solving the research tasks and achieving the main goal in the research; inductive and deductive methods, comparative methods, and logical description. Continuous analysis and assessment of each tax preference and relief are necessary to be made to establish their effectiveness. This also concerns tax expenditures. If they are ineffective, the state simply fails to collect additional budget revenues without creating benefits for society and the economy The tax legislation in Bulgaria provides for the application of a small number of tax revenues due to its broad tax base and low tax rates. However, a significant part of them is intended for agriculture. It can be concluded that along with tourism, agriculture enjoys the most tax reliefs.

Key words**:** *tax expenditure, agriculture, Bulgaria*

INTRODUCTION

The tax policy is a key tool for the state to achieve economic growth. This is a particularly pronounced trend in countries such as Bulgaria, where the rules of the existing Currency Board impose a ban on the monetary policy. This argument concentrates, even more, the attention of the economic life in our country to the implementation of an effective tax policy.

The main goal of the tax policy is the efficiency and transparency of the tax system. The tax system is effective if it provides the fiscal needs of the state, achieves high economic growth and a good standard of living for citizens. The compromise between fiscal, economic, and social goals is achieved through tax flexibility and stimulating taxpayers' behavior through tax incentives. The Bulgarian tax system provides some preferences aimed at supporting selected economic sectors and specific activities. Tax preferences can be various forms - low tax rates for income tax and dividend tax, reduced tax rates, tax holidays, investment tax credits, accelerated tax depreciation, tax losses carry forward, and others. The tax preferences mean a reduction of the tax liability, and hence tax revenues in the budget. Losses from tax revenues arising from the tax preferences are treated as tax expenditures.

Agriculture is a key sector for the Bulgarian economy. It forms over 10% of the GVA and GDP of the country in the years of the last century. Agriculture begins to gradually lose ground in total value added after 2000. In 2019, the share of the agricultural sector in GDP is 3.8% [13]. The average incomes [6] in agriculture remain significantly below the average incomes in other sectors of the economy. Agriculture is a risky, difficult, and

often expensive activity, which largely depends on the weather and climate. This in turn leads to an outflow of labor resources from this sector of the economy [7]. All these arguments require the need to apply different incentives in the agricultural sector, including tax preferences.

The purpose of this article is to assess and analyze the tax expenditures applicable for agriculture in Bulgaria.

The object of the present study is the tax system of Bulgaria, and the subject is the tax expenditures applicable for agriculture in Bulgaria in the period 2007-2019.

MATERIALS AND METHODS

For setting this research paper, the authors established the following more important tasks as:

• to structure the tax expenditures in Bulgaria by branches;

• to estimate the tax expenditures by beneficiary taxpayers - legal persons and individuals;

• to assess and analyze the tax expenditures for the agricultural sector in Bulgaria

• to make recommendations for improving the system of tax expenditures related to the agricultural sector.

Modern approaches and methods such as the method of analysis and synthesis have been used in solving the research tasks and achieving the main goal in the research; inductive and deductive methods, comparative methods, and logical description.

RESULTS AND DISCUSSIONS

Agriculture in Bulgaria is one of the traditional industries. Our tax policy applies various instruments and approaches to stimulate the sector, including the use of tax expenditures.

The number of taxpayers who benefit from these benefits also depends on the number of people working in the sector. Traditionally in Bulgaria, many people work in the agricultural sector. In the last several years the share of those employed in the agriculture is declining (Fig. 1).

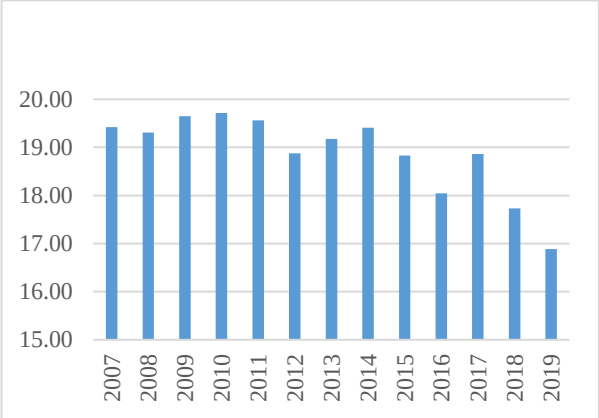

Fig. 1. Share of employees in the agricultural sector in Bulgaria 2007-2019 (%)
Source: Eurostat [8].

According to Eurostat, in the EU-28 in 2019 almost 10 million people work in the agricultural sector. This is 4.11% of total employment (Fig. 2).

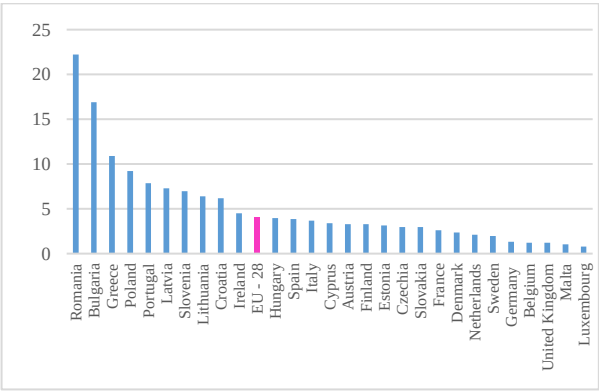

Fig. 2. Share of employees in the agricultural sector in EU-28 2019 (%)
Source: Eurostat [8].

There are only three countries where employment in agriculture constitutes more than 10% of total employment. These are Romania, Bulgaria, and Greece. Bulgaria's leading position shows good potential opportunities for applying different tax instruments to influence a large number of taxpayers.

Such an influence can be achieved in different ways. For example, to stimulate more companies to invest in the agricultural sector, the state can: 1/ grant direct subsidies; 2/ exempt from taxation part of the incomes of the companies in the agricultural sector. Even if the final effect is equivalent, the mechanism for achieving it is different. In the first case,

the subsidy is associated with an increase in the expenditure side of the state budget. In the second case, it is associated with a reduction of the revenue side and that part of it which the fiscal fails to collect. This is the main measure to differentiate the differences between the tax expenditures and other instruments of the tax policy. The tax expenditures are connected with less revenues in the budget. The other instruments are connected with more expenditures. Tax expenditures have economic as well as social objectives. Some of the tax expenditures are introduced either to ease the tax system or as a requirement of the EU member states.

The tax expenditures have a relatively short and dynamic history. The term was first introduced by the American tax specialist Stanley Surrey in 1967. In the early 1970s, only America and Germany use tax expenditures [12]. Five more countries are added by the end of 1983. These are Canada, Austria, Australia, France, and Spain. Almost all OECD countries apply tax expenditures by the end of 1996 [16]. Nowadays the tax expenditures are widely applied among the EU countries. Article 12 paragraph 2 of the Budgetary Framework Directive obliges member states to publish information on the impact of tax expenditures on budget revenues since 2014. The main aim of such a report is to provide transparency and public awareness concerning the application of such tax incentives. Most countries issue such a report usually annually with some exemptions.

In Bulgaria, Tax expenditure report is issued for the first time in 2011. It covers a three-year period from 2007 to 2009. The second one is issued for two years 2010 and 2011. The third report introduces its annual publication [14].

At the very beginning, our national legislation, unlike that of other European countries [2], does not provide a requirement to report tax expenditures. Therefore, at this point, its main purpose is to ensure transparency and clarity concerning the various preferences of the legislation. A new Public Finance Act is adopted in Bulgaria after the entry into force of the European directive. The new act replaces the existing Law for the Structure of the State Budget. According to Article 16 paragraph 4 of the new law, the Ministry of Finance must prepare an annual tax expenditures report. The additional provisions of the law introduce a definition of the term tax expenditures for the first time in our legislation.

When we analyze the different approaches in the definitions of tax expenditures in a huge number of countries, we realize their serious difficulties in adopting such a definition. Due to the serious differences in the tax systems of every single country, each one is encouraged to introduce its definition. There is no single definition of the tax expenditures to apply in all EU countries.

One of the first definition is in USA legislation in 1974. According to The Congressional Budget Act, tax revenues are “revenue losses attributable to provisions of federal tax laws which allow a special exclusion, exemption, or deduction from gross income or which provide a special credit, a preferential rate of tax, or a deferral of tax liability” [3]. According to Anderson [1], tax expenditures are “provisions of tax law, regulation or practices that reduce or postpone revenue for a comparatively narrow population of taxpayers relative to a benchmark tax”.

One of the most common definitions is adopted in Bulgaria before the introduction of the Public Finance Act. This is the definition of the OECD. According to it, tax expenditure means

"transfer of public resources that is achieved by reducing tax obligations with respect to a benchmark tax, rather than by a direct expenditure” [15].

After 2014 in our country a national definition is adopted. Within the meaning of §1, item 9 of the Additional Provisions of the Public Finance Act, tax expenditure means “indirect expense made through the tax system by virtue of a legislative provision which leads to reducing or deferring budget revenue in order to achieve a specific economic or social objective"[17].

For the annual Tax expenditures reports in Bulgaria, a broader definition is adopted. It specifies that tax expenditure “is an indirect

expenditure made through the tax system to promote economic or social goals by virtue of provisions of tax law or regulation that reduce or postpone revenue for a certain category of taxable persons relative to a benchmark tax for the respective tax".

The tax expenditures can take various forms as presented in Fig. 3.

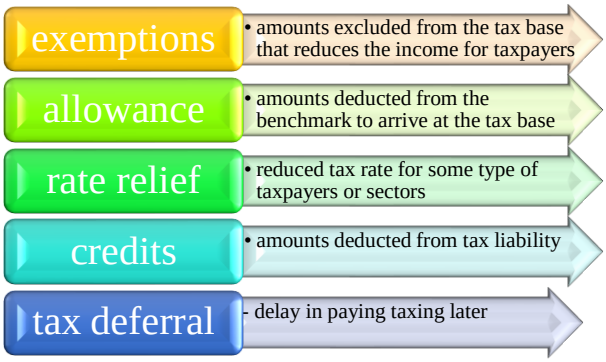

Fig. 3. Types of tax expenditures
Source: Own determination

The significance of the tax expenditures and their value in Bulgaria are shown in Table 1.

Table 1. Tax expenditures in Bulgaria 2007-2019

year	Total Amount of Tax Expenditures (in BGN)	% of GDP	% of Tax Revenue
2019	707,563,767	0.59	2.01
2018	634,804,219	0.59	1.97
2017	636,205,181	0.63	2.15
2016	641,987,825	0.69	2.39
2015	522,544,048	0.6	2.1
2014	494,296,293	0.6	2.15
2013	576,074,446	0.74	2.58
2012	562,778,019	0.72	2.61
2011	551,230,519	0.73	2.68
2010	464,302,410	0.66	2.44
2009	388,418,277	0.57	2.61
2008	402,298,663	0.58	2.4
2007	470,532,532	0.78	3.26

Source: Ministry of Finance [14].

These data allow us to conclude that the tax expenditures in Bulgaria show a smooth and secure downward trend in both as % of GDP and as % of total tax revenues. Nevertheless, every year the government fails to collect about 2% of its possible revenues to stimulate certain industries, taxpayers, etc. to achieve certain economic or social objectives.

Regardless of the form of the existence of the tax expenditures in Bulgaria, they affect two main categories of taxes:

(1) personal income taxes and corporate taxes and

(2) VAT and excise duties. In countries like ours with a broad tax base and low rates, the number of tax expenditures is not large and vice versa.

These four types of taxes treat in different ways the individual industries. The preferential ones in Bulgaria are namely agriculture, energy, tourism, financial sector, transport, and others. Transport is not treated as a preferential industry after 2015. The taxes that concern the agricultural sector in Bulgaria are three in number – individual and corporate income tax and excise duties. The overall distribution of tax expenditures by individual preferential sectors, including agriculture, are presented in Fig. 4.

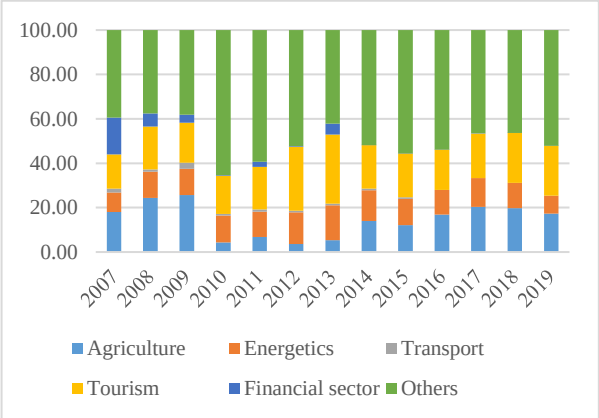

Fig. 4. Tax expenditures by industries 2007-2019
Source: Ministry of Finance [14].

From the above figure, we can summarize the conclusion that agriculture is one of the most preferred industries in Bulgaria. In the period 2007-2009, it has a leading position. In the period 2014-2019, it maintains its leading positions on a par with tourism. Both sectors have close competing shares. The exception is the period 2010-2013. The low values are due to the elimination and subsequent recovery in 2014 of one of the most serious preferences for the agricultural sector - remittance of excise

duty on purchased gas oil used in primary agricultural production.

The main tax expenditures intended for agriculture in Bulgaria are:

-Refund of excise duty on purchased gas oil used in primary agricultural production according to the Excise Duties and Tax Warehouses Act [9].

-Remission of up to 60 percent of the corporate income tax for registered agricultural producers according to Corporate Income Tax Act [4].

-Remission of the annual income tax up to 60 percent for sole proprietors registered as agricultural producers according to Income Taxes on Natural Persons Act [10]

Some tax expenditures are difficult to measure [5] and therefore to assess their impact. The lack of assessment is because often the tax returns do not contain the necessary data or contain summary information that cannot be used to assess the given tax expenditure [11].

For this reason, the authors focus on the three tax preferences aimed only at agriculture.

(1)The first preference has the highest share. This is the possibility for remittance of excise duty on purchased gas oil used in primary agricultural production according to the Excise Duties and Tax Warehouses Act.

Over the years, this measure has been applied and reported in various forms. In the period from 2010 to 2013, the measure is canceled. After 2013 it is recovered as special deducting excise duty in return for fuel vouchers in the form of State aid. In this form, the measure functions until June 2016, when it is canceled again. After that and until 2023 the measure is implemented as "special procedure for remittance of excise duty on purchased gas oil used in primary agricultural production" according to article 47a of the Agricultural Producer Support Act and article 45e of the Excise Duties and Tax Warehouses Act. According to the new rules, it is possible to return part of the value of the excise duty on the gas oil used for mechanized activities in the primary agricultural production.

The farmers that want to participate in this aid should apply to the Regional Directorate of Agriculture. In addition to the application, the farmers submit copies of the invoices for purchased gas oil and a certificate of presence or absence of obligations. Invoices should be issued to the registered farmer applying for the aid. An individual annual quota in liters is set for each farmer, which is lower than:

-the maximum admissible amount of gas oil, and

-the quantity of purchased gas oil on invoices.

Only the quantity of gas oil in the invoices is taken into account for the determination of the individual annual quota. The discount from the value of the excise duty per liter of purchased gas oil [5] is equal to the ratio of the total amount of state aid provided for the respective year in the State Budget Act and the sum of the individual annual quotas of the farmers for the respective year.

The remitted excise duty on purchased gas oil used in primary agricultural production has the largest relative share as % in the tax expenditures under the Excise Duties Act and as % in the tax expenditures.

This can be traced in Figure 5. The period 2010-2013 is not reflected in the figure due to the canceled measure during the mentioned years.

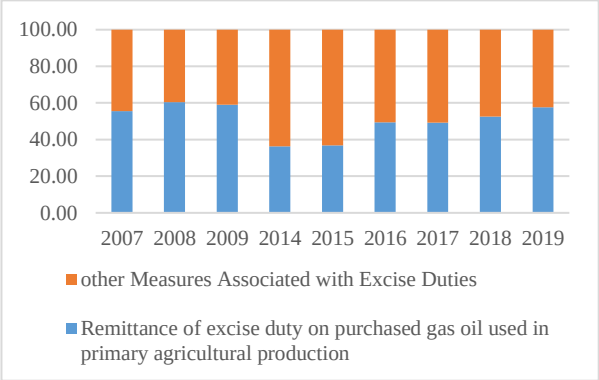

Fig. 5. Share of remittance of excise duty on purchased gas oil used in primary agricultural production 2007-2009/2014-2019 (%)
Source: Ministry of Finance[14].

In the period 2007-2009 and 2014-2019, taxpayers reimburse between 0.9% -2.23% of total excise revenues in the form of excise duty on purchased gas oil used in primary agricultural production. The amount of the remitted excise duties increases with the years. This fact shows that the tax preference is becoming increasingly popular among taxpayers (Table 2).

Table 2. Share of remittance of excise duty on purchased gas oil used in primary agricultural production and absolute amount 2007-2009/2014-2019

year	Amount (in BGN)	% of Tax Revenue from Excise Duties
2007	63,126,287	1.90
2008	80,846,524	2.00
2009	85,847,866	2.23
2014	43,214,075	1.07
2015	40,570,568	0.90
2016	72,590,105	1.51
2017	83,991,849	1.69
2018	83,993,454	1.61
2019	83,580,834	1.52

Source: Ministry of Finance [14].

(2)The second tax expenditure in the agricultural sector is a part of the corporate tax. It has existed since 2007. The measure allows a remission of up to 60 percent of the corporate income tax for registered agricultural producers according to the Corporate Income Tax Act.

Legal entities registered as agricultural producers enjoy tax relief under the Corporate Income Tax Act. According to this state aid, the corporate tax [4] shall be remitted in the amount of up to 60 percent to taxable persons, registered as an agricultural producer, for their taxable profit from the activity of production of non-processed plant and animal products. The tax could be remitted only where the following requirements have been met in aggregate:

-the remitted tax is invested into new buildings and new agricultural equipment, required for carrying out of the activity referred to the activity of production of non-processed plant and animal products and acquired by the end of the year, following the year, for which the remittance is applied;

-the assets are acquired under market conditions, corresponding to those for non-affiliated persons;

-the activity referred to the production of non-processed plant and animal products must continue being carried out for at least three years after the year of remittance;

-the remitted tax must not exceed 50 percent of the current value of the assets, determined as of the date of granting of the aid;

-the current value of all assets determined as of the date of granting of the aid may not exceed a limit of the equivalent in BG levels of EUR 500,000. The limit may not be by-passed through the artificial division of the assets;

-the assets do not replace the existing assets;

-as regards the assets the farmer is not recipient (beneficiary) under any other national or European aid.

The tax preference can be used together with the filing of the Annual Tax Return by the taxpayer.

The remitted tax on the profit of the agricultural producers constitutes about 10% of the tax expenditures associated with the Corporate Income Tax Act (Fig. 6).

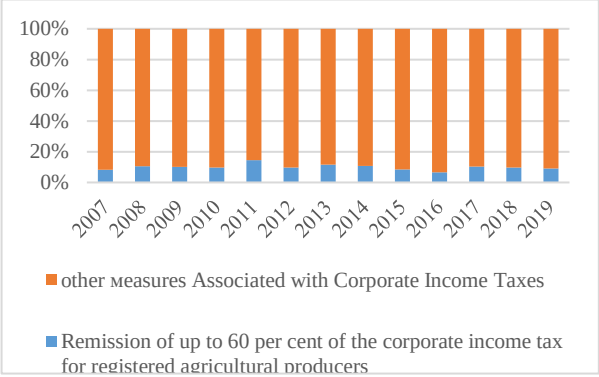

Fig. 6. Share of remission of up to 60 percent of the corporate income tax for registered agricultural producers 2007-2019 (%)
Source: Ministry of Finance [14].

Given a large number of possible tax reliefs under this law, 19 for the last 2019, we can conclude that farmers are actively taking advantage to reduce their tax liability. This measure is among those with the highest relative share within the measures associated with corporate tax in almost all years of the analyzed period.

The remitted tax for agricultural producers occupies a share ranging from 0.73% and 2.51% of total revenues under the Corporate Income Tax Act (Table 3).

The same trend in the amounts of tax expenditure during the period considered cannot be established.

The reason is that the analyzed measure allows for application only in cases of realized tax profit.

This cannot always be realized, especially in the different years of decline or growth in the national economy.

Table 3. Share of remission of up to 60 percent of the corporate income tax for registered agricultural producers and in absolute amount 2007-2019

year	Amount (in BGN)	% of Tax Revenue from Corporate Taxes
2007	21,510,000	1.07
2008	16,960,000	0.70
2009	14,129,000	0.73
2010	20,349,083	1.50
2011	37,475,865	2.51
2012	20,349,083	1.22
2013	31,055,219	1.90
2014	25,776,116	1.44
2015	22,598,164	1.14
2016	21,164,419	0.96
2017	27,691,708	1.13
2018	25,803,422	0.99
2019	25,629,746	0.90

Source: Ministry of Finance [14].

(3)The third tax expenditure for the agricultural sector has the smallest relative share. This measure allows the income from business activity as a sole entrepreneur to be remitted in the amount of 60 percent to persons, registered as agricultural producers, for an annual basis of taxation from the activity for production of non-processed plant and animal products Although this measure exists in this form and without changes since 2010, the statistical data for this tax expenditure in Bulgaria are collected later. The values are from 2016 to the present and can be traced in Figure 7.

Fig. 7. Share of remission of the annual income tax up to 60 percent for sole proprietors registered as agricultural producers 2016-2019 (%)
Source: Ministry of Finance [14].

The share of the remission of the annual income tax up to 60% for sole proprietors registered as agricultural is around 25% of the value of all tax expenditures associated with personal income taxation in the first three years. In the last 2019 year, this value is halved. The reason for such a reduction is related not to a change in the amount of this tax expenditure. It is due to the very quick increase in the amount of the other measures associated with personal income taxation. This conclusion can also be traced from the data shown in Table 4.

Table 4. Share of remission of the annual income tax up to 60 percent for sole proprietors registered as agricultural producers 2016-2019

year	Amount (in BGN)	% of Tax Revenue from Personal Income Taxes
2016	15,078,114	0.51
2017	18,012,663	0.54
2018	15,601,316	0.43
2019	13,306,734	0.33

Source: Ministry of Finance [14].

It would be recommended to analyze the values of this tax expenditure in the future, to see if it has become inefficient. In this case, the state simply fails to receive additional revenue, without generating benefits for economic growth.

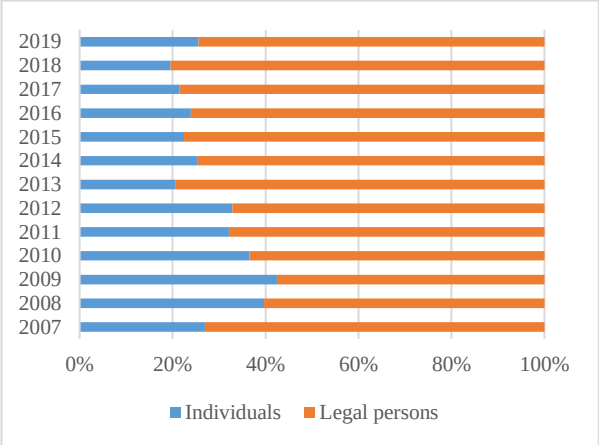

Fig. 8. Tax expenditure estimates by beneficiary 2007-2019
Source: Ministry of Finance [14].

These values may be due to the observed in the last 5-6 years a steady trend of a declining share of individuals benefiting from tax expenditures compared with legal persons. This conclusion can be traced from the data presented in Figure 8.

CONCLUSIONS

Tax relief may be granted to certain categories of taxpayers not only through direct payments as a part of the expenditure part of the state budget. A source of such relief may be the

reduced fiscal revenues, which the state fails to collect. These are namely so-called tax expenditures.

There are different definitions of the term tax expenditures. Due to the specific features of the tax system of the countries, each of them should adopt its own. For the first time in Bulgaria, such a definition has been available since 2014 with the adoption of the Public Finance Act.

Continuous analysis and assessment of each tax preference and relief are necessary to be made to establish their effectiveness. This also concerns tax expenditures. If they are ineffective, the state simply fails to collect additional budget revenues without creating benefits for society and the economy.

The tax legislation in Bulgaria provides for the application of a small number of tax revenues due to its broad tax base and low tax rates. However, a significant part of them is intended for agriculture. It can be concluded that along with tourism, agriculture enjoys the most tax reliefs. Tax expenditures must be clearly and comprehensibly defined for the taxpayers. This implies a continuous assessment of the degree of complexity of the tax reliefs. Tax expenditures should be aimed at stimulating investment, research and development, and energy efficiency, i.e. they should also bring future benefits to businesses and the economy as a whole.

Although the assessment and reporting of the tax expenditures, including those related to agriculture, requires time and resources, it is a necessary condition for increasing the efficiency and fairness of the tax system. It will give a chance to improve the tax system and structure more effective government incentives.

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SOME ASPECTS OF MANAGEMENT OF BIOLOGICAL AGENTS USED IN FOOD BIOTECHNOLOGY

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Abstract

Food sector is one of the major beneficiaries of biotechnology development, being able to ensure in the near future most of the elements needed of the human feeding. Most technological processes for obtaining food are biotechnologies that are based on the use of microorganisms or their metabolites. Food production must be carried out in accordance with domestic and international hygiene standards and in accordance with consumer requirements. The role of biotechnology is overwhelming in the food industry, becoming, at the same time, one of the most dynamic areas of research. Thus, global problems related to food, health, population aging and sustainable development can find many answers in the field of biotechnology. In order to make products or improve technological processes, food biotechnology involves the industrial processing of various raw materials with the help of added biological agents, the most important of which are enzymes and bacteria. Biotechnologies in the food industry have developed impressively through the use of exogenous enzymes and starter crops. This paper aims to provide a brief description of the most common enzymes and bacteria used in food biotechnology and some aspects about their management in the context of food safety and consumer protection. The most used bacteria in the food industry belong to the genera Streptococcus, Lactobacillus, Leuconostoc, Pediococcus, Streptomyces and Propionibacterium. From the point of view of the management of enzymatic preparations used in the food industry, they must be produced under conditions similar to a good food manufacturing practice, and by their use there should be no increase of the total number of germs.

Key words**:** *food, biotechnology, enzymes, bacteria, safety*

INTRODUCTION

The loss of genetic diversity in the last century can threaten food security and EU policies on sustainable agriculture, biodiversity protection and climate change mitigation strategies. Biotechnology is the one that supports the solution of this desideratum. It is a modern field, in full development, based on the application of biology in agriculture, in the food industry, but also other fields, which use biological systems, living organisms or their derivatives to obtain or modify products or processes for specific use.

The conventional biotechnology refers to the biotechnological classic concepts, applied in food industry, agriculture [8, 19], medicine or for environmental protection [3, 4, 20, 21], while the modern biotechnology presents biotechnological concepts based on advanced studies of molecular biology, ecology [11], genetics and genetic engineering, phytopathology [17, 18], Biochemistry [5, 22], etc.

According to the European Federation of Biotechnology-EFB, *"biotechnology is an integrated application of natural and engineering sciences with the aim of using living organisms, cells and their component parts for products and services"* [9].

On the one hand, research in food biotechnology aims to ensure food quality and availability (food safety and security) and on the other hand, ensuring the nutritional value and amplifying the biological effects of food.

Food biotechnologies have a vast field of exploitation throughout the world. World production of food preservatives, dyes, sweeteners, etc. has increased which gives the products a higher quality, and due to which the products have a longer storage period.

In the conditions of climate change, advanced soil degradation and lack of water, increasing food production will be almost impossible to sustain through conventional processes.

With the beginnings dating back to the time of domestication of animals and plants, biotechnology has become one of the most dynamic fields of research. Starting from genetics, microbiology or embryology, the science of modifying living organisms allows the production of superior drugs, the discovery of treatments for rare diseases or the efficient use of agricultural resources. For the first time, global issues related to health, population aging, nutrition and sustainable development can find answers in the field of biotechnology.

MATERIALS AND METHODS

This is a short review about the most common enzymes and bacteria used in food biotechnology and some aspects about their management in the context of food safety and consumer protection. To this end, we have briefly selected some of the most representative scientific communications in the field, given the importance of modern biotechnology in the food industry and ensuring the globally food security.

RESULTS AND DISCUSSIONS

The enzymes specific to plant and animal tissues are essential in the transformations offered by agri-food products: ripening of fruits and vegetables, cheeses and meat. However, enzymes can also have a deteriorating role with implications in changing the sensory characteristics and nutritional value of agri-food raw materials until their thermal processing. Microorganisms are also involved in fermentation of vegetable products (cabbage, olives, cucumber, etc.).

Biotechnologies in the food industry are based on the use of exogenous enzymes and starter crops in the dairy, beer, starch, meat, bakery, etc. industries. With the enzymes help, biochemical processes can be accelerated, production processes and food quality can be improved and the degree of diversification of food production can be increased.

The classification and nomenclature of enzymes are based on the principles and rules established by the International Union of Pure and Applied Chemistry (I.U.P.A.C.), namely: oxidoreductases, which catalyzes redox reactions by transferring hydrogen or electrons, or by combining a substrate with oxygen; transferases, which catalyzes the transfer of different chemical groups from one donor substrate to another acceptor substrate; hydrolases, which catalyzes the hydrolytic cleavage of different substrates, by adding water to different chemical groups; lyase, which catalyzes the addition or removal of chemical groups from substrates, by different mechanisms than hydrolysis; isomerases, which catalyzes intramolecular rearrangement reactions; ligases (synthetases), which catalyzes the synthesis of new bonds by combining two compounds into one, using nucleoside triphosphates as energy source [10].

Enzymatic preparations used in various biotechnological processes in the food industry are considered as processing aids. FAO and WHO Committee of Experts on Food Additives established some general rules for enzymatic preparations used in food industry. Thus, *"…the enzymatic preparations, used as additives in the food industry, are obtained from raw materials of animal origin (liver, pancreas, stomach or intestinal mucosa, heart, kidneys, brain), vegetables (seeds, germinated and ungerminated cereals, roots, leaves and in some cases even bark) or microbial (bacteria, yeasts, moulds), being made up of whole cells, parts of cells or extracts completely devoid of cells"* [10].

Enzymatic preparations are obtained from several categories of raw materials, which must meet certain requirements:

- Tissues of animal origin must comply with the veterinary rules applied to meat and their handling must meet the requirements of good hygiene practice;
- Materials of plant origin, used as sources of enzymes or as ingredients in the preparation of culture media for enzyme-producing micro-

organisms, must not release any residue harmful to health under normal conditions of use;
- Enzymatic preparations of microbial origin must be produced by the controlled use without penetration of microorganisms likely to lead to the appearance of toxic substances or other undesirable products.
From the point of view of the management of enzymatic preparations used in the food industry, they must be produced under conditions similar to a good food manufacturing practice, and by their use there should be no increase in the total number of germs and an increase in salt content above the permitted limits for a given foodstuff. Sources rich in the desired enzymes are usually used to obtain the enzymatic preparations, which are cheap, accessible and easily processed.
Enzymes obtained as crude or partially purified preparations, in liquid, semi-liquid or dried form, are used in the food industry as such, being added and acting in the media to be transformed as free enzymes, respectively solubilized in aqueous media and their activity, after having carried out the desired transformations, is usually stopped by various treatments, especially by thermal or chemical means (by acidification or alkalization) and in the finished product.
For the production of enzymatic preparations of microbial origin, two basic techniques can be applied:
- Surface fermentation, which uses a solid medium on which the microorganism is grown. This technique has the advantage that the culture medium will have a very high enzymatic activity;
- Deep fermentation, which takes place in reactors with liquid media, case in which all the parameters of fermentation (temperature, pH, aeration, concentration of C, N sources, etc.) are perfectly controlled.
Microorganisms are used in the food industry to obtain starter or pure cultures. They are used in the form of production crops (leavens) for the fermentation of acidic dairy products or cheeses, and in the form of concentrated starter cultures they are used in the processing of food products from meat, bread, etc.
Starter cultures of microorganisms are used to trigger biochemical processes that ensure the product a certain degree of safety and conservation; to improve sensory/nutritional properties. Concentrated starter cultures are cultures developed under controlled conditions, concentrated in a small volume and preserved by freezing or drying for storage and transport.
The management of starter crops in the food industry involves attention to the following aspects:
- It must contain as few undesirable microorganisms as possible [5, 6];
- The metabolic products must not present a danger to the health of consumers [14];
- The new species (strains) that are introduced into production must be registered and stored in collections with nomenclature; before use in production, they must be tested for safety in accordance with the legislation in force. Moreover, even if the strains have been declared safe, they must be inspected at regular intervals by specialized institutes for their purity;
- The species recognized as having toxicogenic potential must be rigorously monitored for each strain, with long-term toxicity, carcinogenicity and mutagenicity studies.
Another type of enzyme preparation (biomass) can be used as an ingredient for fermentation (baking yeast) or for enriching some protein foods, respectively as protein feed for birds, fish and pigs.
Molecular formula of baking yeast is C19H14O2 (Fig. 1); Molecular Weight: 274.3 g/mol. Synonyms: 11H-benzo[a]fluoren-11-ylacetic acid; 2-(11H-benzo[a]fluoren-11-yl)acetic acid or 2-{11H-benzo[a]fluoren-11-yl}acetic acid [1].

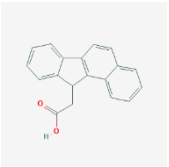

Fig. 1. The baker's yeast structure
Source: [1].

Yeasts are mainly used for alcoholic fermentation, obtaining biomass, in the meat

industry and in the dairy industry. Among the yeasts, for the food industry are those belonging to the family *Saccharomycetaceae*, the genus *Saccharomyces* which includes alcoholic yeasts used in the beer, wine, bread, alcohol industry, the genus *Kluyveromyces* which ferments lactose, the genus *Debaryomices* used in the meat industry. Also useful are the yeasts from the *Cryptococcaceae* family (genus *Torulopsis* for example) that are used as fermentation agents and biomass producers.

Metabolism consists of closely coordinated series of chemical reactions mediated by enzymes that take place in the plant organism, resulting in the synthesis and use of a wide variety of molecules in the category of carbohydrates, amino acids, fatty acids, nucleotides and polymers derived from them (polysaccharides, proteins, lipids, DNA, RNA, etc.). All of these processes are defined as primary metabolism and the respective compounds, which are essential for plant survival, are described as primary metabolites [16].

Among the primary metabolites can be listed: ethyl alcohol, preservatives (acetic acid, lactic acid, propionic acid, ethyl alcohol); antioxidants and synergists (ascorbic acid, citric acid, gallic acid, tartaric acid, etc.); thickeners (xanthan, dextran, mannitol, glycerol); flavour enhancers (glutamate); acidulants (acetic acid, citric acid, malic acid, gluconic acid, lactic acid, tartaric acid, fumaric acid); amino acids (lysine, tryptophan, phenylalanine, etc.); vitamins (riboflavin, cyanocobalamin, vitamin C, vitamin D); gas (CO2).

Secondary metabolites can be stimulant additives (gibberellins); preservatives (bacteriocins and antibiotics); peptide compounds.

The most used bacteria in the food industry belong to several genera. Within the *Streptococcus* genus, useful bacteria in the food industry can be mesophilic (*S. lactis, S. cremoris, S. diacetilactis*) and thermophilic (*S. thermophilus*). They are homofermentative, produce lactic acid and have fermentative activity (ferment lactose and glucose) and proteolytic activity.

The *Leuconostoc* genus includes Gram-negative bacteria, optionally anaerobic, which are necessary for the development of vitamins (nicotinic acid, thiamine, biotin) and fermentable sugars. This genus includes species: *L. cremoris; L. lactis; L. dextranicum; L. mezenteroides*. In dairy products, leukonostocs have two basic functions: they produce flavour compounds (diacetyl, acetoin); CO2 formation in some types of cheese (eg Goude cheese).

The *Pediococcus* genus comprises, in terms of importance for the food industry, the bacteria *P. acidilacti* and *P. pentosaceus*. The metabolism of these bacteria is predominantly fermentative, homolactic. Racemic lactic acid is produced from glucose, fructose and mannose. These bacteria exert an inhibitory action against pathogenic and altering microorganisms: staphylococci, botulins, bacilli, gram-negative enterobacteria, etc. Also, the lactic acid produced contributes to the denaturation of meat proteins, which contributes to the achievement of a firm texture of the finished product [2, 7, 13].

Bacteria of the *Lactobacillus* genus are asporogenic, immobile, Gram positive, anaerobic or facultative anaerobic. They have low proteolytic and lipolytic activity. The best fermented carbohydrates are lactose, maltose, sucrose (especially in the development phase), then hexoses (glucose, fructose, galactose).

Depending on the optimal temperature development, lactobacilli can be thermophilic (*L. lactis, L. helveticus, L. bulgaricus, L. acidophilus*, the optimum temperature being 37-45^{0}C) or mesophilic (*L. casei, L. plantarum, L. brevis* etc., the optimal development temperature being 26-30^{0}C).

Among the species of bacteria of the *Micrococcus* genus are *M. aurantiacus* and *M. varians*, useful in the meat industry, for their ability to reduce nitrates to nitrites, their catalase activity and acidification activity, proteolytic and lipolytic.

For the dairy industry, micrococci form the main part of the non-dairy population in raw milk and cheeses made from raw milk, respectively. *Micrococcus freundenreichii* was isolated from Cheddar cheese made from raw milk, which was later used as a pure

culture in order to accelerate the formation of the aroma of cheese made from pasteurized milk due to proteolytic and lipolytic activity [15].

Of the *Staphylococcus* genus, the most interest present the non-pathogenic bacteria *S. carnosus*, *S. xilosus* and *S. simulans*. Efficient management of combinations of micrococci and staphylococci are effective for nitrate-reductase and catalase activity, because in these combinations, *S. carnosus* acts better than micrococci in color formation, reducing nitrates to nitrites and nitrites to nitric oxide respectively, even under conditions of high acidity of the substrate. The aroma of the products in which the starter culture of *Staphylococcus carnosus* is used is superior [12].

Bacteria of the *Streptomyces* genus can alter food, producing unpleasant odors and tastes [23, 24]. The *Propionibacterium* genus is represented by bacteria that ferment carbohydrates, the most useful for food industry being *P. freundreichii, P. theonii, P. acidipropionici* and *P. jensenii*.

CONCLUSIONS

The food industry is a priority area of the national economy, food being of strategic importance. By biotechnological means, using selected bacterial cultures or their mutants are obtained products with a higher economic value: proteins, amino acids, lactic acid, acetic acid, etc.

From the point of view of the management of enzymatic preparations used in the food industry, they must be produced under conditions similar to a good food manufacturing practice, and by their use there should be no increase in the total number of germs and an increase in salt content above the permitted limits. Some sources rich in the desired enzymes, which are inexpensive, easily accessible and easy to process, are usually used to obtain the enzymatic preparations.

The management of starter crops in the food industry assumes that they contain a certain number of viable microorganisms and as few undesirable germs as possible and the primary and secondary metabolic products do not pose a danger to the health of consumers.

In the current century, a century of biotechnologies, modern strategies to approach this concept will certainly lead to obtaining of the new food products with improved qualities, but also new food pigments, food flavours, food preservatives, etc.

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FINANCING OF ORGANIC AGRICULTURE IN THE NORTH-EAST DEVELOPMENT REGION OF ROMANIA. A TERRITORIAL PROFILE ANALYSIS

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Abstract

The North-East Development Region of Romania has a relatively longstanding history of practising organic agriculture. This paper introduces the way adopted by the farmers from this region, either they are certified or under conversion, for accessing the financing packages for organic agriculture within Measure 11 of National Programme of Rural Development (NPRD)2014-2020, in 2019. If we run a territorial profile analysis, there were requests for granting the compensatory aid for 81.17% of the organic agricultural area (certified or under conversion) in all six counties of the North-East Region. There are territorial differences within the region partly due to each county's particularity along with the durable experience gathered in practising this type of agriculture. The analysis relies on the official data released by the Ministry of Agriculture and Rural Development (MARD) about the state of the areas utilized in organic system and, also by the Agency for Payments and Intervention for Agriculture (APIA) about accessing Measure 11 – Organic Agriculture in 2019.

Key words**:** *organic agriculture, measure 11, organic agriculture, rural financing, NPRD 2014-2020, North-East development region*

INTRODUCTION

The organic agriculture is a key sector of the European strategies. New Green Deal and Farm to Fork have established a series of targets for the EU states, geared toward the development of the organic farming system. Accordingly, the areas cultivated in compliance with the rules and principles of organic agriculture must reach a procentage of 30% of the total farmland by 2030 [5].

In Romania, although it has been practised since time immemorial, the organic agriculture was officialy enacted and acknowledged in 2000 [7] The areas cultivated in organic system, despite recording an increase in the later years, hold a small fraction of the country's total agricultural area, approximately 2.73%, which is far from the EU intended target. The North-East Development Region of Romania (RDNE) is an area where the organic farming has been well-represented since the early days of this agricultural practice in the country. In 2013, the farmers from the region were working nearly 20% of the total organic areas (certified) from Romania [4].

It is common knowledge that practising an organic agriculture brings vital contributions to the water, soil, air pollution, and provides safer working conditions for farmers, not to mention a superior comfort level for animals too [10]. However, at the same time, adopting an organic farming system can generate a series of income losses, namely crop losses, high operating costs and additional expenses for certification.

Romania's status of EU member-state secures similar rights with other European farmers for the Romanian farmers. Among these, a key role is played by the funds for agriculture and rural development, while a significant element of these funds is represented by financial allocations for compensatory aids addressing organic farmers, allocations laid down in the specific measures within the National Programme of Rural Development (PNDR) 2014-2020.

To financially compensate the negative side effects of the agricultural practices of organic farming, EU, through the policies supported

from European funding for agriculture and rural development, provides the possibility of granting compensatory payments for the farmers engaged in an environmentally friendly type of agriculture. According to the Rules of Rural Development no. 1305/2013, minimum 30% of the allocation of the European Agricultural Fund for Rural Development (EAFRD) is directed to the measures contributing to the achievement of climate change and environmental objectives.
The Romanian governance, through Measure 11 – Organic Agriculture within NPRD 2014-2020, makes specific compensatory payments on two directions: support for conversion to the methods and practices of organic agriculture (sub-measure 11.1) and support for maintenance of the organic farming practices (sub-measure 11.2). These compensatory payments for the farmers involved in organic farming and who have signed agreements with APIA (Agency for Payments and Intervention for Agriculture) are directed to compensating the extra costs and income losses resulted from applying the particular practices of the organic farming. Additionally, these payments are set as fixed amounts on hectar, paid annually and vary depending on the stage of certification and crop category (Table 1).

Table 1. The value of compensatory payments within Measure 11 – Organic Agriculture, 2019

Measure 11 – Organic Agriculture	Value of the compensatory payment (Euro/ha/an)	
	Sub-measure 11.1	Sub-measure 11.2
Package 1 – agricultural crops on arable land (including fodder plants)	293	218
Package 2 – vegetables	500	431
Package 3 – orchards	620	442
Package 4 – vineyards	530	479
Package 5 – medicinal and aromatic herbs	365	350
Package 6 – permanent pastures	-	-
6.1 (appliable at national level on areas without engagement M.10)	143	129
6.2 (appliable in eligible areas along with engagement M.10)	39	73

Source: [2].

The recipients of these payments are active farmers who are registered in the organic agricultural system with certified or under conversion farming areas. The granding of compensatory payments depends on assuming voluntary engagements; for instance, in the case of sub-measure 11.1, maintaining the organic practices for annual crops for a 2-year period and for perrenial crops for a 3-year period, while in the case of sub-measure 11.2 maintaining these certified practices for 1 5-year period. The Measure 11 – Organic Agriculture has been implemented through APIA in Romania.

MATERIALS AND METHODS

The main objective of this research relies on analyzing the way in which Measure 11 – Organic Agriculture was accessed in the North-East Development Region of Romania, in 2019.
The study has been conducted within the North-East Development Region of Romania, on each county, and it has employed the data released by the Ministry of Agriculture and Rural Development (MARD) in 2019 regarding the certified areas in organic system, as well as the data taken from the Agency for Payments and Intervention for Agriculture (APIA) on the situation of the requests for compensatory payments within Measure 11 of NPRD 2014-2020. Further, data coming from the National Institute of Statistics, literature review and ministry structures have been employed for completing the analysis in this paper.
Additionally, an analysis on the compliance with specific packages of measure 11 has been run for each county, and the requested sums of money (registered in 2019 as compensatory payments) have been calculated as well. The graphic representation has been made by using QGIS 3.16.0 "Hannover" [9].

RESULTS AND DISCUSSIONS

The North-East Development Region broadly covers the historical provinces of Moldova and Bukovina, and has a total area of 3685 ha, which represents 15.5% of the country's total area and makes it the largest region in terms of terrain expanse in Romania. It borders Ukraine in the North, Moldavia, on Prut river, in the East, the South-East Development Region of Romania in the South, and the

Central and North-West Development Regions of Romania in the West.

The landscape features a wide range of forms, such as mountains, hills, depressions, valleys, fields, streams, lakes, and meadows, and it has a scale-arrangement, ranking from the highest forms in the West (Călimani and Ceahlău are the high-profile massifs) to the lowest land configurations in the East. The region climate is continental temperate, strongly shaped by each zone's landforms and Eastern influences, namely frequent draught periods in summer and snow blizzards in winter. The annual medium temperature rises from the West to the East, in inverse proportion with the rainfall which is decreasing to the East. The hydrographic network is abundant in streams, among which Prut, Siret, Moldova, Bistrița, Suceava, Jijia, Bârlad and Trotuș are the most important rivers, flowing from North to the South. Flora and fauna is also rich and diverse, displaying esquisite natural parks (Ceahlău, Cheile Bicazului – Hășmaș, Rodna, and Călimani) and boosting an impressive forest coverage (including forest areas) of 33.4% of the total regional area [3].

The national land fund of the North-East Development Region of Romania, according to the latest data made available in 2014, is represented by 57.66% agricultural area, and 42.24% non-agricultural land. At county level, in 2014, the land fund ranges between 498.6 thousand ha (Botoșani) and 855.4 thousand ha (Suceava) per total area, having the following uses: agricultural land – 281.6 thousand ha (Neamț) and 401.0 thousand ha (Vaslui); arable land – 168.9 thousand ha (Neamț) and 298.8 thousand ha (Botoșani); pastures – 68,8 thousand ha (Neamț) and 90.5 thousand ha (Suceava); meadows – 7.9 thousand ha (Vaslui) and 74.2 thousand ha (Suceava); vineyards and vine nurseries – zero thousand ha (Suceava) and 11.7 thousand ha (Iași); orchards and fruit tree nurseries – 1.8 thousand ha (Neamț) and 6.8 thousand ha (Iași); non-agricultural land – 105.8 thousand ha (Botoșani) and 507.7 thousand ha (Suceava); forests and other forest vegetation – 58.3 thousand ha (Botoșani) and 453.7 thousand ha (Suceava); land covered by water, ponds – 8.3 thousand ha (Vaslui) and 15,0 thousand ha (Bacău); developed land covered with buildings and railroads – 7.9 thousand ha (Neamț) and 10.6 thousand ha (Vaslui); degraded and unproductive land – 13.5 thousand ha (Bacău) and 26 thousand ha (Iași) (Table 2).

Table 2. The structure of the land fund in the North-East Development Region

Indicator	RDNE	County (ha)					
		Bacău	Botoșani	Iași	Neamț	Suceava	Vaslui
Total	3,684,983	662,052	498,569	547,558	589,614	855,350	531,840
Agricultural area	2,124,775	320,756	392,761	381,256	281,649	347,632	400,721
Arable land	1,381,790	186,332	298,741	256,098	168,906	179,954	291,759
Pastures	491,639	86,323	75,146	84,231	68,145	90,512	87,282
Meadows	200,983	39,503	14,635	22,465	42,283	74,179	7,918
Vineyards and vine nurseries	31,238	5,930	1,680	11,679	548	0	11,401
Orchards and fruit tree nurseries	19,125	2,668	2,559	6,783	1,767	2,987	2,361
Non-agricultural land, total	1,560,208	341,296	105,808	166,302	307,965	507,718	131,119
Forests and other forest vegetation	1,231,943	280,918	58,370	97,890	260,950	453,661	80,154
Land covered by waters, ponds	72,964	14,955	13,797	13,106	10,623	12,232	8,251
Developed land covered with buildings	102,444	21,719	11,632	19,022	15,224	19,405	15,442
Ways of communication and railways	55,811	10,244	8,396	10,285	7,912	8,293	10,681
Degraded and unproductive land	97,046	13,460	13,613	25,999	13,256	14,127	16,591

Source: data processed based on [8].

In 2019, in the North-East Development Region of Romania, 35,837.47 ha were administred (Table 3) in accordance with the rules and principles of organic agriculture, which translates into 1.68% of the agricultural area reported in the region in 2014 [8], and 9.06% of the total organic agricultural area from Romania in 2019.

In Iași county, the significant percentage of areas used in organic system stands out: 41.19% of the total certified area in the region, followed by Botoșani (22.47%) and Suceava (20.77%). Regarding the

implementation stage of the organic practices in all six counties of the region, it has been noticed an increased interest in this agricultural system for the past 2 years, especially in the case of the farmers from Iași and Botoșani, which has been also outlined by the areas registered in the first and second year of conversion.

Table 3. Structure of the areas registered in the organic agriculture of the North-East Development Region of Romania in 2019 (ha)

County	Total area in organic system	Area under conversion			Organically certified area
		1st Year	2nd Year	3rd Year	
Bacău	1,933.75	774.94	376.84	1.60	780.37
Botoșani	8,055.32	2,482.53	1,372.50	54.18	4,146.11
Iași	14,764.88	2,201.28	1,509.64	11.83	11,042.13
Neamț	1,663.62	274.36	612.70	22.95	753.61
Suceava	7,444.40	780.21	872.19	25.54	5,766.46
Vaslui	1,977.49	543.89	399.92	7.30	1,026.38
RDNE	35,839.46	7,057.21	5143.79	123.40	23,515.06

Source: own calculus based on data supplied by MARD, 2020 [6].

In 2019, the farmers registered in the organic agriculture from the North-East Development Region of Romania have applied for compensatory payments associated with Measure 11, for a total area of 29,092.96 ha (Table 4), which represents 81.17% of the total organic area in the region and 1.37% of the agricultural area. The areas concerned vary depending on package and county. Thus, according to the data held in table 4, it can be seen that 60.8% of the areas for which were submitted requests for aid are organically certified (17,697.55 ha), and the rest of 39.2% are under conversion (11,395.41 ha). This feature highlights that organic farming, in these parts of the country, is a state of consolidation. If we run a territorial profile analysis, there are major differences between counties concerning the percentage of the certified areas in terms of areas under conversion.

Accordingly, in the counties of Iași and Suceava, there are certified areas covering 72.7%, and 71.6% of the total areas for which were submitted request for aid, while, by contrast, there are the counties of Bacău (23.7%) and Vaslui (34.5%).

Table 4. Structure of the areas for which were submitted applications for compensatory payments in the North-East Development Region of Romania, in 2019 (ha)

Package	RDNE	Bacău	Botoșani	Iași	Neamț	Suceava	Vaslui
11.1.1	7,192.01	775.34	3,021.68	1,869.60	382.68	206.06	936.65
11.1.2	124.13	5.87	75.77	39.37	0.40	0.30	2.42
11.1.3	512.02	45.87	103.98	73.57	154.61	61.34	72.65
11.1.4	8.92	0.39	0.20	6.18	0.31	0	1.84
11.1.5	64.35	8.93	18.45	5.70	1.64	2.33	27.30
11.1.6.1	2,557.74	38.66	878.86	548.54	314.89	283.35	493.44
11.1.6.2	936.24	132.27	0	0	33.69	770.28	0
11.2.1	14,512.87	222.81	4,438.82	6,235.55	1,466.62	1,462.10	686.97
11.2.2	34.77	6.00	1.64	17.93	4.28	0.40	4.52
11.2.3	542.88	30.32	217.3	131.03	60.08	74.57	29.58
11.2.4	72.66	0	0	7.34	0.11	0	65.21
11.2.5	14.57	0	0	0	3.37	0	11.20
11.2.6.1	963.32	52.34	19.51	334.07	147.34	397.85	12.21
11.2.6.2	1,556.48	0.56	0	35.21	117.19	1,403.52	0
TOTAL	29,092.96	1,319.36	8,776.21	9,304.09	2,687.21	4,662.10	2,343.99

Source: own calculus based on data supplied by APIA, 2020 [1].

Concerning the requested amounts as compensatory payments associated with Measure 11 – Organic Agriculture, in the North-East Development Region in 2019, they reach the amount of 6,613,081 Euros in compliance with the packages on organic areas and specific value on area unit for each package (Table 5). The territorial profile analysis shows there are two counties in the region, namely Iași and Botoșani, where the sum requested exceeds the amount of 2,000,000 Euros, and three counties, namely Neamț, Suceava and Vaslui, where the amount is slightly 600,000 Euros. In the remaining county, specifically Bacău, the requested amount of money as compensatory payments is nearly 340,000 Euros. As percentages, 56% of the requested amount of money in the region is associated with the sub-measure 11.2 – aid for maintaining the

organic farming practices, while 44% is related to sub-measure 11.1 – aid for conversion to organic farming methods.

Table 5. Distribution of requested amounts as compensatory payments in the North-East Development Region of Romania, in 2019 (Euro)

Package	RDNE	Bacău	Botoșani	Iași	Neamț	Suceava	Vaslui
11.1.1	2,107,259	227,175	885,352	547,793	112,125	60,376	274,438
11.1.2	62,065	2,935	37,885	19,685	200	150	1,210
11.1.3	317,452	28,439	64,468	45,613	95,858	38,031	45,043
11.1.4	4,728	207	106	3,275	164	0	975
11.1.5	23,488	3,259	6,734	2,081	599	850	9,965
11.1.6.1	365,757	5,528	125,677	78,441	45,029	40,519	70,562
11.1.6.2	36,513	5,159	0	0	1,314	30,041	0
11.2.1	3,163,806	48,573	967,663	1,359,350	319,723	318,738	149,759
11.2.2	14,986	2,586	707	7,728	1,845	172	1,948
11.2.3	239,953	13,401	96,047	57,915	26,555	32,960	13,074
11.2.4	34,804	0	0	3,516	53	0	31,236
11.2.5	5,100	0	0	0	1,180	0	3,920
11.2.6.1	124,268	6,752	2,517	43,095	19,007	51,323	1,575
11.2.6.2	113,623	41	0	2,570	8,555	102,457	0
TOTAL	6,613,081	344,055	2,187,155	2,171,063	632,207	675,617	603,706

Source: own calculus based on data supplied by APIA, 2020 [1] and [2].

A territorial profile analysis for 2019, in view of the sums requested as compensatory aid by the farmers (from RDNE) registered in the organic farming system and eligible in compliance with the specific requests of Measure 11 within PNDR 2014 – 2020, reveals the agricultural particularity of each county in accordance with the temporal experience of practising organic farming (Figure 1).

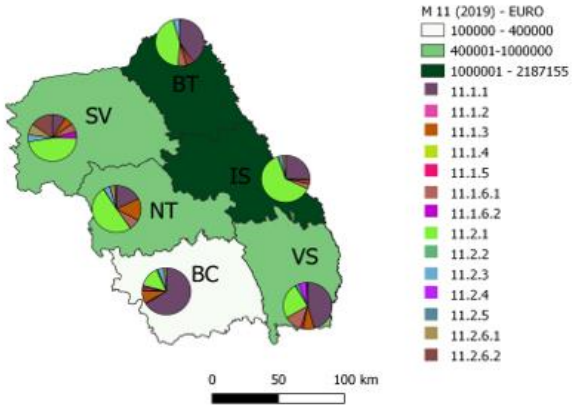

Fig. 1. Distribution of requested sums as compensatory payments for agricultural practices in the North-East Development Region of Romania, in 2019
Source: [10].

The counties that have attracted the highest amounts through this measure, namely Iași and Botoșani, are ascertained by significant percentages of the crops grown on arable lands. In 2019, in Iași county, 88% of the sums requested were for the areas from packages 11.1.1 (25%) and 11.2.1 (63%), agricultural crops grown on certified arable or under conversion lands which make an important feature of the county's organic agriculture. The farmers from Botoșani county managed to develop the organic farming system at a sustained pace, and, accordingly, in 2019, 44% of the sums requested as compensatory payments are associated with crops grown on arable, under conversion lands.

When analysing the compliance of the sums of money requested on specific packages, in Suceava county, which has a long-standing of organic farming, we can notice that 75% of the sums are requested for certified areas, out of which 23% for areas included in the packages 11.2.6.1 and 11.2.6.2 (permanent pastures), and 47% in the package 11.2.1. Further, the aids requested for areas covered by crops on arable lands (fodder plants too) and under conversion, represents merely 9% of the total amount of aids requested by farmers in this county.

Neamț and Vaslui county, despite being counties of a different agricultural specificity, are on the same level in terms of amount of the sums requested through measure 11-organic agriculture in 2019. The differences emerge in the context of compliance with eligible crops on various specific packages. Thus, Neamț county, the main percentage of the sums requested (51%) represents the input

of the crops grown on certified arable land (package 1.1.2.), while in Vaslui county, the main percentage (45%) corresponds to the crops grown on arable, under conversion lands (package 11.1.1).
In Bacău county, the amount claimed as compensatory payments for organic practices mainly (66%) fits package 11.1.1, namely crops grown on arable, under conversion lands. Bacău county occupies the last position among the counties of the region.

CONCLUSIONS

In the North-East Development Region of Romania, the organic farming covers merely 1.68% of the agricultural lands, which is a very low percentage by comparison with the targets set by EU about the development of this agricultural sector by the end of 2030. The financial aid granted as compensatory payments through Measure 11 – Organic Agriculture is a stimulus for the development of this sector in the region. In 2019, the organically certified farmers have applied for compensatory payments associated with a significant percentage (81.17%) of the areas operated in organic system in the region, and the amount claimed exceeded 6 million Euros. The high level of financial support granted for each package within Measure 11 has presented an appealing feature for farmers, especially in the case of perennial crops of high-economic value (orchards, vineyards). The continuity of financial aids for the organic agricultural sector through compensatory measures, along with introducing new stimulative measures for developing the zootechnical sector, organic product processing and valorification, can create hallmarks for increasing the organically certified areas in the North-East Development Region of Romania.

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STUDY ON THE POSSIBILITY OF APPLYING THE PRINCIPLES OF TOTAL QUALITY MANAGEMENT TO THE RURAL TOURIST PENSION "FRAȚII JDERI", PASCOAIA VILLAGE, VÂLCEA COUNTY, ROMANIA

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Abstract

The paper aimed to carry out a detailed and complex study on the possibility and opportunity of applying total management to the boarding house Frații Jderi in Păscoia, Vâlcea County using a modern research methodology and perfectly adapted to the proposed topic. First of all, the tourist potential of the area, represented by the richness and beauty of the natural and anthropic tourist resources, was analyzed very well from all points of view. Also, data were collected on the position and accessibility in the area, the architectural style of the pension which is one adapted to the specifics of the area with a perfect fit in the beauty and harmony of the local landscape. At the same time, the main indicators that define the application of total quality management in the "Frații Jderi" holiday village and which reflect the evolution of the rural tourism activity as: accommodation capacity, number of arrivals in boarding house, number of overnight stays in boarding houses were realistically and pertinently analyzed. Along with them, other indicators were approached: indicators of tourist demand, indicators of tourist circulation, indicators of tourist offer, indicators of the quality of tourist activity. At the end of the research, it was found from the processing of all data, that the administrator and staff working in the pension apply a management that fully respects the principles of total quality, because almost all indicators analyzed have grown steadily from year to year, significantly exceeding average values national.

Key words**:** *rural tourism, agrotourism, tourist resources, management, quality*

INTRODUCTION

As is well known, a number of international bodies overseeing the economic development and social progress of humanity, such as the UN, or regional political bodies such as the European Union, have recognized the importance of tourism in the development process, due to its direct and indirect economic effects it has them over a territory [16, 33]. But the effects of tourism are not limited to its impact on the economic sector [31, 9]. The jobs thus created, the infrastructures made for tourism purposes, the investments made for the training and formation of a specialized workforce, for the encouragement of entrepreneurship, the actions of valorisation of the heritage and resources of a region through tourism contribute to the local development [7, 20]. Due to tourism, even declining rural or industrial regions have managed to find activity that has the power to recycle devalued objects and give them new meanings and values [7, 41].

In the context of generalizing the model of sustainable development, which respects the environment, local specifics, protects and conserves resources to ensure the next generation the opportunity to meet their own needs, tourism has undergone a series of changes and transformations: from a mass phenomenon to a responsible activity, concerned with the environment in which it is implemented [39, 34]. Its relationship with the territory has also evolved: from an economic activity whose main function was the exploitation of the territory's resources, to an activity that has the capacity to organize and animate the territory, acting as a lever for development [37, 17]. This capacity results from the syncretic character of tourism, which, due to its multiple dimensions - geographical, economic, social, anthropological, ethnographic, political, technical (spatial planning) - is articulated

with the economic, environmental and social dimensions of sustainable development, offering and the tools needed to achieve such a development [25, 5]. In many cases, tensions are created between the local population and tourists, especially in destinations where the local population has been reduced to the role of service provider. This approach corresponds to Sen's theory, which considers that, in the development of a territory, the most important thing is what is achieved with the available resources [3, 19]. The differences in development between territories are, in the author's opinion, the result of the ability of individuals to convert resources into achievements [22, 35]. Our research starts from the finding of a low level of development of the area even if in the region there are resources that can be used for tourism, but which are the subject of a limited number of tourism development projects aspect also reported by [8, 1]. The main problems identified in the study region are: the low number of investment projects in both tourism and other economic activities, given the possibility of accessing European development aid funds; the underdeveloped entrepreneurial spirit of the local population and the interpersonal mistrust that does not allow the creation of partnership groups, effects of the planned economy from the communist period aspect also reported by [10, 23].

The scientific novelty of the paper is determined by the results of the complex analysis of rural tourism in the researched area and by the conclusions and recommendations resulting from the research conducted.

The theoretical importance and applicative value of the paper consists in mapping the rural tourism activity of the area, in order to address the methodical aspects of total quality in rural tourism from the perspective of the two principles and propose solutions that can help ensure the efficient functioning of rural tourism structures, phenomenon also observed by [36, 38].

MATERIALS AND METHODS

In order to outline a research methodology specific to the study, you must first know very well the area and location of the tourist destination. Păscoia is located in the north of Vâlcea County, Romania, over 35 km north of Râmnicu Vâlcea and 66 km south of Sibiu, at the confluence of the Lotru River with the Olt River, in the largest inter-Carpathian depression, known as Loviștei Country [2, 42]. The access to the area can be made through the branch DN7A (Brezoi – Voineasa – Petroșani) of the national road 7 (European road E81) or on the railway, the afferent station bearing the name of Lotru [18, 40, 4].

Frații Jderi Holiday Village is located in a charming natural area, at an altitude of 500 meters, between Lotrului and Căpățânii Mountains, only 6 km from Cozia Natural Park and 27 km from Voineasa, 46 km from Râmnicu Vâlcea, 90 km from Sibiu airport, 60 km to Transalpina road and ski domain, 190 km from Brasov, 100 km to Transfagarasan route, close to a few Nature Reserves, Cozia and Buila Vanturarita, in the middle of southern Carpathian Mountains. It is picturesquely named after the activities of the shepherds in the area "Jderi Brothers-Green Utopia" being isolated from civilization, hidden among the mountains in the heart of the country [12, 18, 40].

The principles that govern the place are: respect for nature, simplicity and concern for people. Utopia Verde can accommodate about 55 guests, in 3-star conditions (daisies). The holiday village has 23 double rooms, 1 triple room and 2 quadruple rooms. The destination is signalled by a 0 km terminal called "Jderi Brothers-Green Utopia", which marks the beginning of a journey into another world - green, clean and with special energies, and a large wooden gate allows access to the area of 20,000 sqm [12, 18, 40].

Ways to obtain processed data and information - Data were collected from the National Association of Rural, Ecological and Cultural Tourism - Vâlcea branch, from the owner of boarding houses, staff employed and from tourists, method used and by [6, 14, 4]. Following our own research, we obtained a

series of fairly complete data on the physical and economic side of rural tourism in the area. In order to characterize rural tourism from an economic, natural and social point of view, bibliographic sources such as geography studies, monographs, local public administration publications, web pages were used [4, 12, 18, 40]. The normative acts and the laws in force elaborated by the relevant Ministry were studied, as well as numerous works from the country and abroad that refer to rural tourism, quality management and total quality management method also used by [13, 19]. In order to meet the proposed objectives, the following methods were used: statistical monograph, selective survey, statistical report, records, questionnaire, method of statistical indices and indicators, adjusted trends method, scalar method, methods used and [29, 38].

(1)Statistical monograph. In order to achieve this, information was obtained following the discussions with the "actors" who participate in the entire rural tourism activity (tourists, pension owners, ANTREC members, local authorities, etc.), directly observing the tourist reception structure, the neighboring localities or researching informative materials (flyers, tourist guides, magazines, etc.) [30, 15, 11].

(2)Selective surveys were conducted both in the tourist boarding house and in places frequented by tourists only for landscapes [38, 28, 11].

(3)Statistical reports. They were consulted statistical reports made by A.N.T.R.E.C. Valcea. Were used data collected by total registration, from all staff employed in the tourist reception structure, or by partial registration [32, 4, 11].

(4)Occasional recordings were made during events at the boarding house. The direct registration was used, through the direct contact of the team with the pension, the tourist, the owners of the pensions, the employed staff. Interrogation recording was also approached, based on the interrogation of A.N.T.R.E.C. Vâlcea members. [4, 38, 11].

(5)The questionnaire was designed to contain filter and control questions, to identify the interviewed subject with the representativeness requirements of the sample (30 people). The purpose of the questionnaire was to detect the degree of satisfaction of the tourist regarding the quality of services offered in terms of comfort, at the Pension "Frații Jderi Utopia verde" in Păscoia, as a structure with accommodation, dining and leisure [2, 27].

(6)Method of statistical indices and indicators. For the processing and interpretation of information, the method of statistical indicators was used, respectively the comparative analysis of the researched phenomena based on them. The main indicators that reflect the evolution of the rural tourism activity are: accommodation capacity, number of arrivals in the pension, number of overnight stays in the pension. Along with them, other indicators were approached: indicators of tourist demand, indicators of tourist circulation, indicators of tourist supply, indicators of the quality of tourist activity [38, 30].

RESULTS AND DISCUSSIONS

First of all, in order to carry out a careful and pertinent analysis on the total quality management applied in the studied pension, we must aim in addition to the data presented in the introduction and the types of services and activities it offers. In the boarding house Frații Jderi - Utopia Verde, you will have real experiences in an enchanting environment. In addition to a comfortable sleeping place, which includes accommodation is also offered - a large, hearty and varied breakfast; - access to all holiday village facilities, except the meeting room; - daily dose of hydration, vitamins and minerals - with spring water and seasonal fruits throughout the stay; - more than the typical bed & breakfast - here you will also have a beautiful landscape, so: bed & breakfast & beautiful nature [18, 21].

Meals are served as a varied buffet of the day's menu, set by Grandmothers Jder, at a convenient schedule for all guests. Tourists choose what they want from the prepared dishes and eat to their heart's content, but without leaving anything on the plate. The menus are created according to the season, using the freshest vegetables, fruits and

seasonal ingredients - one of the secrets of the perfect taste of kitchen dishes [18].

The activities are organized for groups of at least 20 tourists. They run for half a day or days. For optimal performance, they need to be requested in advance. In Green Utopia are organized: - Campfire for 2 hours with seats, stories and laughter. Optionally, a snack with fire on the spikes, browned over the flame; - Games and competitions with team trials, extremely fun and entertaining; - Refreshment sessions, energetic gymnastics and stretching, barefoot walking through the grass for natural acupressure: - Jumping on the stunt mattress, zip lines, archery, climbing on a climbing tower and ice bathing [18].

Nearby: Ratfing & kayaking on the Olt River for a maximum of 32 adventurers, in favorable weather and water levels. Hiking and trekking: at Scoruș and Lotrișor waterfalls, where you can take an invigorating swim, at Stânișoara Monastery, where the landscape is very picturesque, or on the slope that shelters Utopia Verde, following a wild route, up to the height of expectations - above, pictures with the background of the holiday village. Excursion on the Latorița mountains, starting from Curmătura Vidruței, from 1,600 to 2,000 m altitude, with a superb panorama over the high surroundings, which take your breath away. Optionally, a light lunch can be prepared on the top of the mountain, with traditional food in a cauldron for everyone [18].

Educational, socialization and imagination activities, at the temple in utopia or in the shelter of weather: Seminars on nutrition and healthy living; Seminar on the philosophy of the pension - The Mechanical Path; Motivational and inspirational documentation sessions; Discussion sessions on stress and career attitudes; Drawing sessions - life map; Discussion sessions, jokes and stories between group members; Cartoon workshops; Team improvisation workshops - theatre stage [18].

Camps for children: Through these camps, children are offered a complex education, interactive and at the same time complementary to school or family education, following the aspects as: - development of tenacity, fighting spirit; - increasing self-confidence; - formation of (self) discipline; - improving communication and judgment; - formation of the principles of healthy eating; - increase of immunity; - development of motor skills; - developing curiosity and knowledge of the world; - inoculating respect for nature; - learning the ABCs of the techniques and skills necessary for life in the middle of nature; - discovering simple pleasures; - discovering real life at the expense of virtual life [18].

Based on the methodology presented above, statistical indicators were analyzed and characterized that define the rural tourism activity in the "Frații Jderi" pension, from the perspective of total quality.

The period subject to research was 2018-2019, and the approached indicators are:

(a)Accommodation capacity: The pension has an accommodation capacity of 55 seats, equipped with the comfort category for which it received classification (minibar, TV).

(b)Arrivals: As can be seen from Table 1, the number of arrivals at the Frații Jderi boarding house has constantly increased year by year, so in 2017 it was 305, in 2018 it is higher, 320 arrivals, the evolution is still upward in 2019, reaching at 336 arrivals. Viewed from the perspective of the total quality management, tourists preferred accommodation at a pension classified only with 3 stars, but with a very good quality/price ratio, to the detriment of other pensions in the area classified with 4 stars.

Table 1. Number of arrivals at the boarding house "Frații Jderi" in 2017-2019

Year	Number of arrivals
2017	305
2018	320
2019	336

Source: after processing the field survey, 2020.

(c)Overnight stays: Regarding this indicator at the pension level, the same phenomenon of slight growth is observed from year to year, from 735 in 2017 to 845 in 2019, with the constant improvement of the quality of services offered to tourists (Table 2).

A higher number of overnight stays was directly influenced by the number of arrivals

and indirectly by the offer, respectively by the quality and diversity of the services offered.

Table 2. Number of overnight stays at the „Frații Jderi pension in 2017-2019

Year	**Overnight stays**
2017	735
2018	768
2019	845

Source: after processing the field survey, 2020.

(d)Tourism demand indicators: Comparing the tourist demand with another pension in Păscoaia, it is found that it was higher at Frații Jderi pension by about 8 percent (Table 3).

Table 3. Tourist demand for rural tourist pensions in Păscoaia Village in the period 2017-2019 (%)

Specification	2017	2018	2019
"Valahia" tourist pension 4 daisies	53	56	59
"Frații Jderi" tourist pension 3 daisies	61	64	68

Source: after processing the field survey, 2020 and reference [27]

This result reinforces once again that the studied boarding house met the client's requirements in terms of comfort and thus the quality of services offered.

(e)Average number of tourists per day: The average number of tourists per day, in 2017 in Păscoaia, the boarding house "Frații Jderi" is 0.84, and the highest percentage was reached in 2019, when it approached the value of 1 (0.97). Highlighting the intensity of tourist traffic was done using the following indicators: number of days - tourists (ZT) and average length of stay (Ds) (Table 4.).

Table 4. The average number of tourists arriving daily at the Pension „Frații Jderi" in 2017-2019

Year	The average number of tourists arriving daily
2017	0.84
2018	0.88
2019	0.97

Source: after processing the field survey, 2020.

(f)Number of days – tourists: The number of days - tourists in 2017 was 224,175, in 2018 it increased by 21,585, and in 2019 they increased more than in 2017, by over 59,745, reaching 283,920 days-tourists (Table 5.).

Table 5. Number of tourist days at the „Frații Jderi" Pension in 2018-2019

Year	Number of tourists	Overnights	Number of tourist days
2017	305	735	224,175
2018	320	768	245,760
2019	336	845	283,920

Source: after processing the field survey, 2020.

Analyzing the data in Table 5, it was found that the number of tourist days was directly influenced by the number of arrivals and overnight stays and indirectly by the offer, respectively by the quality of services offered in terms of high comfort and quality of services.

(g)Average length of stay: During the analyzed period, the average duration of the stay experienced a slight increase (Table 6.) influenced by the increase in the number of tourists and overnight stays.

Table 6. Average length of stay at Pension „Frații Jderi" in 2017-2019

Year	Number of tourists	Overnights	Average length of stay
2017	305	735	2.41
2018	320	768	2.40
2019	336	845	2.51

Source: after processing the field survey, 2020.

(h)Accommodation capacity in operation: The increase of the number of tourists in 2019 determined the increase of the number of operating days and implicitly the accommodation capacity in operation (Table 7.), meeting the clients' requirements.

Table 7. Accommodation capacity in operation (places-days) of the Pension „Frații Jderi" in 2017-2019

Year	Number of operating days	Accommodation capacity in operation
2017	301	16,775
2018	324	17,600
2019	339	18,480

Source: after processing the field survey, 2020.

(i)The maximum theoretical offer at the Pension „Frații Jderi" is 365 units-days both in 2017 and in 2019. This demonstrates that the reception structure can operate at the level of the classified comfort category, satisfying customers' expectations.

(j)The actual offer is 324 units-days in 2018, respectively 339 units-days in 2019. In order to characterize the efficiency of using the technical-material accommodation base, the following indicators were taken into account: the index of use of accommodation capacity in function and occupancy of the accommodation unit (Occupancy Rate, OR, %).

The capacity utilization index in operation

Following the calculations performed, in 2018, the Pension „Frații Jderi" actually used 13.96% of the accommodation capacity in operation. In 2019, there was an increase in the actual use of accommodation capacity in operation, to 15.36%. The pension faces a short period of tourist stay in the area, reflected by the index of use of accommodation capacity in operation. The capacity utilization index is almost 5% higher than at the national level, and the average length of stay of tourists is 2.51, compared to about 2.35 nationally.

Occupancy rate of the accommodation unit (OR, %)

Table 8. Occupancy rate of the accommodation unit (%) at the boarding house „Frații Jderi" in 2017-2019

Year	Total number of tourists	Average length of stay of tourists	Total number of accommodation places	Occupancy Rate (%)
2017	305	2.41	55	36.61
2018	320	2.40	55	37.33
2019	336	2.51	55	38.93

Source: after processing the field survey, 2020.

The main factor that contributed to obtaining these values was first of all the satisfaction of the client's requirements regarding the degree of comfort and then the natural tourist factors existing in the area. The occupancy rate increased in 2019, reaching 38.93% (Table 8.) As a result of the improvement of the services offered following the conclusions from the surveys conducted among tourists. To these was added the promotion of the pension by "living speech" from those who stepped on the threshold of this tourist reception structure and on the website www.fratiijderi.ro.

Also, from this Table 8, it can be seen that the occupancy rate of the pension for the three years of study is 6-9% higher than the occupancy rate of the tourist reception structures at national level, which is about 31%.

It is also significantly higher than the national occupancy rate of tourist pensions which is only 20.3%, and compared to that of agritourism pensions is more than 2 times higher, it is only 16.4 %.

The constant increase of the indices attesting the quality level of the pension management and services, is due to the spirit of competitiveness, the desire to resist on the market and last but not least to the profit of the pension administrator, who became more and more interested in the permanent pursuit of the needs of tourists in order to fully, quickly and efficiently meet their requirements. In order to measure the degree of customer satisfaction, you first need to know their needs, and this can be done by conducting surveys that can be the basis for assessing whether or not the situation has improved and, last but not least, the basis for substantiating decisions.

Thus, following the applied questionnaire, which aimed to detect the degree of satisfaction of the tourist in relation to the quality of services offered in terms of their comfort, originality and diversity, half of the tourists were for the first time in the pension, and a significant percentage (44.7%) visited the pension several times which proves the existence of a reason to return, most likely the quality of management and services provided.

Almost half of the tourists know the pension from the stories of friends and relatives, which strengthens the expression regarding quality, in the sense that a satisfied tourist makes the reception structure prosperous. More than 69.6% of the number of tourists were very satisfied with the quality of services offered by the accommodation structure with accommodation function, none of them expressing their dissatisfaction.

The analysis of the activity carried out is the basis for identifying the most appropriate decisions to be taken, in order to improve the performance of the pension in terms of applying the principles of total quality management.

CONCLUSIONS

First of all, from the detailed analysis of all the elements regarding the location of the pension, in a quiet area without pollution, easy access on the national road DN 7, the special construction system, respecting the specific elements of local traditional architecture and especially perfect framing in the local landscape, originality, diversity and quality of the tourist offer, it can be said that this is a pension that fully deserves the 3-star classification level conferred, it far exceeds the requirements and expectations of tourists, aspect presented above and based on the level of quality indices analyzed in this work.

Although it has a lower accommodation capacity than the other 3 and 4 daisy boarding houses in the area, the "Frații Jderi" pension was ranked first in terms of arrivals, overnight stays, number of tourist days, tourist demand, average number of tourists per day, the accommodation capacity in operation, the actual offer and the degree of occupancy in this comfort category. The number of overnight stays was directly influenced by the number of arrivals and indirectly by the offer, respectively by the quality of the services offered in terms of the high degree of comfort.

By implementing total quality management, the structure of new accommodation capacities must be shaped according to the requirements of tourists, with great adaptability to the quality/price ratio, which began to be more and more a determining factor in choosing a tourist destination, especially in the last year in which the pandemic left its mark on the local, national and especially international tourism activity. Improving the quality of rural tourism products and services, by implementing the principles of total quality management, would determine the other tourist reception structures to give more importance to customer expectations. This would increase their competitiveness in the internal and external tourism market.

The values of the indices of utilization of the accommodation capacity in operation, indicate a very low efficiency at the level of the studied area. The main element of the low occupancy rate in the area is the short duration of stay, respectively the average length of stay being about 2.51 days, amid the lack of tourism programs, complementary accommodation facilities and poor tourism promotion in the area and county. The estimated values of the number of tourists according to the linear trend for the period 2017-2019 are increasing, the largest increase being reported in 2019.

Finally, it can be concluded that research is just a beginning in terms of approaching total quality management in rural tourism in the Valea Lotrului - Păscoia area, and is intended to be a start in informing regional rural tourism entrepreneurs about quality management, of the total quality and their formation in order to implement it at the rural tourist pensions.

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STUDY ON THE EVOLUTION OF PRODUCTION AND SURFACES OF FRUIT TREE PLANTATIONS IN THE PERIOD 1988-2018 AND THE IMPORTANCE OF FRUIT PRODUCTION FOR HOUSEHOLDS AND AGRITOURISTIC FARMS IN ROMANIA

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Abstract

The paper aims to draw attention to the need, importance and efficiency of obtaining high quality fruits both in terms of taste and food, by cultivating them in the classic system in households and agritouristic farms. It was also considered very important to promote this traditional way of producing fruit, applying environmentally friendly natural and built cultivation technology, as the effects of climate change are increasingly felt, even if some important states of the world no longer recognize this. We support this mode of cultivation even if it is known that the productions obtained in intensive and super-intensive cultivation system are much higher, but from the research carried out in over 25 years of activity in the field of agrotourism we found that the production obtained in agrotourism capitalized on a higher price, by selling "directly from the farm" as organic products or by serving tourists as fresh fruit or as culinary preparations in a local cuisine specific to the area, households or agritouristic farms. Fruits obtained in this type of crop are generally much tastier and must not contain any chemical residues, as the amount of inputs such as pesticides, insecticides and herbicides applied to crops is much lower or even absent, pensioners must to be very responsible, as they have the obligation to ensure the health and food safety of the guests who visit the tourist reception structure.

Key words**:** *agritourism, agritouristic households, fruits, taste quality, food safety, chemical residues*

INTRODUCTION

The constant interest shown by tourism organizations in the country and abroad in identifying new holiday formulas, which represent as accurately as possible the preferences of tourists, has led to the emergence of an alternative form of tourism that tends to become a mass phenomenon. meaning rural tourism or agrotourism [15, 22]. The new unknown places, the clean air, the human ambiance different from the one of the places of origin, the different urban framework, correspond to the modern tourism. Holiday villages, especially "tourist villages" with a stay on farms and agro-tourist households have recently established themselves both as a necessity and as a "tourist fashion", along with combined holidays mountain-sea, sea-mountain, spa treatment, trips [27, 4].

An interesting aspect of contemporary tourism is the specific tourist behavior, which in turn involves a set of appropriate motivations. It is about the ever-increasing demand for tourism in rural areas, the reorientation of some aspirations, tastes, traditions and rural way of life, folklore, purity of nature etc. [31, 18].

First of all, in carrying out this research we started from the motivations and tourist needs related to the rural area such as: return to unaltered nature which is the result of the need for conservation, health, physical and spiritual comfort for all ages, sex, socio-professional, social status [26]. This motivation demonstrates that modern man cannot break away from the original framework of life, his contact with the rustic environment, having wide echoes in the mechanism of functional balance; accession and temporary knowledge of specific groups belonging to rural areas such as: patriarchal family, local community, work group, folk

group [32]; knowledge, understanding, inventory and elaboration - rustic holidays can turn into a real process of assimilating new and numerous knowledge, acquiring skills, by initiating local crafts and traditional occupations, tourists can manifest their own creative skills [28]; aesthetic motivations derive from the need for naturalness, purity, harmony, order, the need for beauty. Tourists who come into contact with their villages and neighborhoods can be considered privileged due to the possibility to visit attractive places through their picturesqueness and charm [16]; curiosity about popular hospitality, gastronomic habits, village rituals, determines wide categories of tourists to know on the spot and to keep lasting memories from unique holidays [2, 22]; rest, the cure of air and fruit, the consumption of fresh and ecological food, the occupational therapy that those who take care of their health on holiday want to benefit, meet har regime offered by the resorts spa [13, 8].

The Romanian village through its natural, ethnographic, cultural-historical and socio-economic qualities can become a "tourist product" of great originality, representative of Romanian tourism. In order to imprint the real image of the Romanian rural space, with its ancestral spirituality, it is necessary to promote rural tourism and agrotourism as tourist offers, in the context of the “tourist village” and the ethnographic area in which it is integrated [10]. Rural tourism in Western Europe, in the post-war conditions, has evolved in an interesting way, appearing as a necessity with prospects of expansion in the following years, because the tourist demand has surpassed the possibilities of the existing hotel units. The search for the rural environment for rest and recreation is a general trend in the world practice of tourism [7].

Also, to motivate the need for research, the advantages of this form of tourism were taken into account, which are highlighted in the literature by:

- capitalizing on the rural potential;
- source of jobs and income;
- improving the standard of living;
-saving investments for the creation of accommodation capacities, public catering, leisure;
- reduction of serving staff;
- decongestion of overcrowded tourist areas [1].

At the same time, based on these advantages and specific conditions identified at local level, we found that among the 7 types of tourist villages discovered in our country were noted with outstanding results in rural tourism and agrotourism so-called tourist villages - where the characteristic their predominance is the cultivation of fruit trees and vines, the tourist activity being possible throughout the year, both during the harvest and after [6]. It offers fruits, grapes and their preparations, fruit-based dietary preparations. Comforting and refreshing fruit-based drinks and wine tastings can be sources of attraction and income. Among the representative villages we list: Lerești (Argeș), Agapia (Neamț), Recaș and Giarmata (Timiș), Polovragi (Gorj) Leleasca (Vâlcea) Voinești (Dâmbovița) and others [5].

The research aims to establish an assortment, which is suitable for cultivation in households and farms, respectively those that are not demanding of climatic conditions and have increased resistance to disease and pests [9, 17].

To achieve the goal, the following **research objectives** were proposed:

(i)Presentation of the main assortments of fruit trees that can be cultivated in our country;

(ii)Highlighting the positive characters of the assortment of varieties that can be cultivated in the agritouristic households of the population.

MATERIALS AND METHODS

Ways to obtain processed data and information

For the aspects related to the activities of rural tourism and agrotourism data were collected from the National Association of Rural, Ecological and Cultural Tourism, from the owners of boarding houses, the staff employed and from tourists method used by

[12, 33]. Following our own research, we obtained a series of fairly complete data on the physical and economic side of rural tourism and agrotourism in the area. In order to characterize rural tourism from an economic, natural and social point of view, bibliographic sources such as geography studies, monographs, local public administration publications, web pages were used [21]. The normative acts and laws in force elaborated by the relevant Ministry were studied, as well as numerous works from the country and abroad that refer to rural tourism, quality management and forms of organization in rural tourism and agrotourism [25, 24].

Statistical monograph. For its realization, information was obtained from National Institute of Statistics (NIS) and from discussions with "actors" who participate in the entire rural tourism activity (tourists, pension owners, ANTREC members, local authorities, etc.), observing directly tourist reception structures, localities in the vicinity or researching informative materials (leaflets, tourist guides, magazines, etc.) [20]. *Selective surveys* were conducted both in tourist guesthouses and in places frequented by tourists only for landscapes. Statistical reports.

The statistical reports made by the A.N.T.R.E.C. Data collected by total registration, from all staff employed in several tourist reception structures, or by partial registration were used [29, 23].

From the point of view of the activities related to fruit production, the researches aimed at following some varieties of trees grown in our country, in order to reconsider and promote these crops, in conditions of high productivity and superior fruit quality, for its efficiency.

Aim of the research work

The research covered a period between 1988-2018, as agrotourism and rural tourism emerged as specific forms of tourism in our country after 1989, and several materials were studied in both electronic and listed form. The biological material used in this paper is represented by several species of fruit trees, which tried to highlight the positive characters, so that they can be recommended for cultivation in the agrotouristic households of the population [3]. They were targeted both at the positive characteristics of the tree (precocity, growth force, type of fruiting, resistance to the main diseases and pests specific to each species, ecological plasticity, affinity for grafting, production capacity, or other specific characteristics), and the characteristics positive effects of the fruit (fruit size, fruit color, pulp characteristics, taste, fruit quality, time of harvest) [11].

RESULTS AND DISCUSSIONS

The research starts from the consideration that fruit is one of the indispensable components of rational human nutrition. With few exceptions, due to the balance and harmony between their different elements (shapes, sizes, colors, flavors, fragrances, tastes, physico-chemical components, etc.), fruits are almost the only food ready in nature, which can be eaten fresh without no addition or any processing [19].

The first objective of the research is to highlight their taste quality and nutritional value, because when tourists arrive at a farmhouse or even an agritourism farm want to eat fresh fruit with a very good taste quality and high nutritional value, healthy and free of any chemical residues.

The nutritional value is due to their chemical components and forms easily accessible to the human body, to which are added various olfactory, visual and gustatory stimulants, which make the fruits highly acceptable in consumption and to be enjoyed with pleasure.

Table 1 shows that the fruit contains water and dry matter (organic matter and mineral substances). The content of fresh fruit in water varies depending on the species, within wide limits: 78.7% for plums, 80.4% for cherries, 83.7% for cherries. 84.2% for apples, 85.3% for apricots and 89.1% for peaches (Table 1). The juice extracted from the fruit, in addition to the components of the dry matter, is mostly water, is the best regulator of metabolism, helping to restore the water regime in the body, and by the contribution of other components, to comfort it. Sugars form the main mass of the dry matter components in fruits (about 90%). The most common are monosaccharides (glucose, fructose,

sorbose), disaccharides (sucrose) and polysaccharides (cellulose, starch and pectin). Their total content in fresh fruits also varies with the species within wide limits, from 3.4% in gooseberries to 16.72% in apples [11, 13].

Table 1. The nutritional value of the main fresh fruits

Components	Plums	Apricots	Cherries	Cherry	Peaches	Apples
Water (%)	78.7	85.3	80.4	83.7	89.1	84.2
Protein (g%)	0.8	1.0	1.3	1.2	0.6	0.2
Fats (g%)	0.2	0.2	0.3	0.3	0.1	0.6
Carbohydrates (g%)	19.7	12.8	17.4	14.3	9.7	14.1
Ash (g%)	0.6	0.7	0.6	0.5	0.5	0.2
Energy (cal.)	75	51	70	58	38	56
Mineral substances						
Ca (mg%)	12	27	22	22	9	7.6
P (mg%)	18	23	19	19	19	10.6
Fe (mg%)	0.5	0.5	0.4	0.4	0.5	0.3
Na (mg%)	0.1	1.0	2.0	2.0	2.0	1.0
K	170	281	191	191	202	110
Vitamins						
A (U.I)	300	2,700	110	1,000	1,330	94
B1 (mg%)	0.03	0.03	0.05	0.05	0.2	0.03
B2 (mg%)	0.03	0.04	0.06	0.06	0.05	0.02
B3 (mg%)	0.05	0.6	0.4	0.4	1.0	0.1
B6 (mg%)	0.05	0.07	0.05	0.06	0.02	0.03
Panthotenic acid	0.19	0.24	0.26	0.14	0.17	0.10
Ascorbic acid (mg%)	4	10	10	10	7	7

Source: after [11], 1991.

Cellulose, contained in larger or smaller quantities in all fruits, plays an important mechanical role, in the sense that it stimulates intestinal peristalsis and promotes the elimination of residues from digestion; it also causes a laxative action when large quantities of nuts are consumed. Laxative properties have especially pears and quinces, fruits rich in pectin and cellulose. Mineral substances are found in the form of compounds (oxides) of the main metals (K, Na, Ca, Fe, etc.) or salts of phosphoric, hydrochloric, carbonic, sulfuric acids, etc. The content in mineral salts varies from one species to another, depending on the variety, but also on the pedological conditions, climate, applied technologies, etc. (Table 1) [11]. Consumption of 100 g of dried apricots per day contributes to the formation of 1.8 g of hemoglobin, the same amount of prunes provides 1.6 g of hemoglobin, while 100 g of poultry or beef gives only 0.7 g and 0.5 g of hemoglobin, respectively [30, 3]. At the same time, the more or less pronounced potential alkalinity, specific to all fruits, has a favorable influence on the body's alkaline reserve. Expressed in cm^3 of normal alkali solution per 100 g, the potential alkalinity varies between 0.81 and 12.38. The daily need of the body in salts depends on age, sex, body weight, etc., being 4-5 g of sodium, 2-4 g of potassium, 0.5-0.7 g of calcium, 0.5 g magnesium, 0.9-2.2 g phosphorus [11, 30, 3]. The fruit content in organic acids is directly related to the genetic character of the species and varieties, but it is also dependent on the degree of fruit ripeness, ranging between 0.29% for pears and 2.32% for currants, expressed in citric acid [30]. Acids imprint the sour taste of the fruit, but the ratios in which they are found towards the sugary substances ensure the harmony of the taste and the degree of sweet or sour. The acidity of some fruits is the result of the presence of several acids: malic, citric, tartaric, succinic, etc. They are found free or in the form of salts or esters [11, 33, 3].

Protein, although in small amounts, is present in all fruits. Being nitrogenous substances, they mainly fulfill a plastic role in the constitution of different tissues and as a reserve substance with high biological activity. The main components of proteins are amino acids, of which more than 25 have been identified in fruits. Like protein, fats are found in small amounts in fruits (between 0.1–1.0%) except for almonds, hazelnuts and walnuts where the content is between 50-75%. Also, the lipid content is much higher in the seeds and seeds of fruits (8-42%) [11, 33, 3].

The nutritional value of fruits, in addition to their content in carbohydrates, salts, fats, etc., is mainly due to the significant amounts of vitamins they synthesize. Vitamins are biocatalysts of vital processes, indispensable

for life, their lack in the body causing serious functional disorders of metabolism. The human body, with certain exceptions, is unable to synthesize the necessary vitamins. Of the vitamins absolutely necessary for the proper functioning and development of the human body (A, B1, C, D, E, F, K, PP) most are found in fruits, in different quantities, depending on the genetic nature of species and varieties (Table 1) [11].

The second major objective of the research is **the production obtained per unit area** as a determining factor of the profit that can be obtained from them, as well as the possibility to ensure tourists a regular consumption of fresh fruit throughout their stay and throughout the year. World fruit crops have grown continuously, initially as the area under cultivation has grown, and in recent decades due to increased yields per unit area. thus, from a production of 393,724 thousand tons in 1988, it reached in 2018 a production of 867,774 thousand tons (about 3.5 times higher) (Table 2). It is found that of the total world fruit production, about 20% is the fruits of the temperate zone (apples, pears, plums, quinces, apricots, peaches and nectarines, strawberries, cherries, cherries, chestnuts, hazelnuts, currants, raspberries), in while the difference of 80% is represented by the fruits from the tropical area (oranges, bananas, coconut, mango, tangerines and clementine's, lemons and limes, pineapple, olives, grapefruit and pomelo, dates, papaya, cocoa, tea, kiwi). In the temperate zone, the largest share of production, at the species level, is found in apple (9.92%), followed by peach and nectarine (2.81%) and hair (2.73%).

Table 2. Evolution of world production and areas for the main fruits in the temperate area in the last three decades

Species	Production – thousands of tones					Surface – thousands of hectares				
	1988	1998	2008	2018	% of production word	1988	1998	2008	2018	% of surface word
Apples	42,688	54,929	69,041	86,142	9.92	5,162	5,736	4,669	4,904	7.20
Pears	10,211	14,849	21,138	23,733	2.73	1,103	1,444	1,564	1,381	2.02
Quince	334	395	480	688	0.08	53	42	59	82	0.12
Plums	6,579	7,402	10,167	12,608	1.45	1,424	2,042	2,433	2,649	3.89
Apricots	2,221	2,500	3,685	3,838	0.44	395	512	548	1,532	2.25
Peaches and nectarines	8,662	11,479	19,723	24,453	2.81	1,324	1,232	1,502	1,712	2.51
Strawberries	2,383	3,873	5,978	8,337	0.96	209	274	322	372	0.54
Cherries	1,459	1,636	1,856	2,547	0.29	289	327	378	432	0.54
Cherry	953	994	1,220	1,529	0.17	197	227	226	215	0.31
Chestnuts	497	833	1,796	2,353	0.27	246	325	502	612	0.89
Hazelnuts	609	802	1,068	863	0.10	452	498	590	966	1.41
Currants	115	158	314	682	0.09	35	49	74	109	0.16
Raspberries	381	377	523	870	0.10	73	74	98	124	0.18
Total world	**393,724**	**524,126**	**707,618**	**867,774**	**-**	**44,074**	**51,808**	**58,897**	**68,047**	**-**

Source: after processing Faostat.org, 2020 [14].

Analyzing the evolution of cultivated areas with the main species of temperate climate, it is found that in the last 3 decades, worldwide, significant increases in areas have been achieved with apple, hair, plum, apricot, peach and nectarine, cherry, hazelnut, chestnut and currant (Table 2). As in the case of fruit production, the share of the area occupied by temperate species worldwide is about 22% of the total area.

Table 3. The evolution of production and areas in fruit crops in Romania in the last three decades

Species	Production – thousands of tones					Surface – thousands of hectares				
	1988	1998	2008	2018	% of production 2018	1988	1998	2008	2018	% of surface 2018
Apples	609	364	459	643	18.40	81	79.5	54.70	54.0	16.07
Pears	97	64	52	60	1.71	9.9	6.5	4.6	3.11	0.92
Quince	14	7	6	6	0.17	2.85	1.0	0.92	0.87	0.25
Plums	534	404	475	842	24.09	91	99.2	75.3	66.0	19.63
Apricots	35	36	32	35	1.00	8	5.5	2.93	2.0	0.58
Peaches and nectarines	57	17	16	22	0.63	8.50	5.0	1.61	1.7	0.50
Strawberries	39	11	21	26	0.74	5.60	1.45	2.6	3.3	0.98
Cherries	79	77	67	90	2.57	18	12.0	7.65	7.1	2.10
Total on the country	**3,202**	**2,581**	**2,717**	**3,493**	**-**	**476.35**	**509.38**	**369.0**	**335.6**	**-**

Source: after processing Faostat.org, 2020 [14].

In Romania, trees are successfully cultivated throughout the territory, except for the alpine area and part of the coniferous area. And economically, the conditions for the development of fruit growing are particularly favorable. Due to its geographical position, our country can export fruits to both southern countries, deficient in apples, pears, plums, and the Nordic countries, deficient in peaches, apricots, nuts and other fruits. In addition to fruit for fresh consumption or export, fruit growing provides raw materials for the processing industry. The assortments in which the fruits can be transformed and the derivatives in which they are used are more and more diversified: concentrated natural juices, nectar, jams, jams, candies, ice cream, dehydrated, frozen, candied fruits, etc. All these products are made from the raw material provided to the food industry by the fruit sector.

Fruit production in Romania increased from 401 thousand tons in 1950, until 1986, when it recorded the maximum value of 4028 thousand tons. During the study period, fruit production increased from 3,202 thousand tons in 1988 to over 3,494 thousand tons in 2018 (Table 3), even though the cultivated area decreased from 476.35 thousand hectares, in 1988, to 335.60 thousand hectares, in 2018.

Another very important component regarding the determination of the efficiency and profit that can be achieved from the cultivation of fruit plants in our farms and agro-tourist households in the country is the production obtained per unit area.

As can be seen from Table 4, world production increased significantly compared to 1988, when it was only 8.93 t/ha, in 2018 reaching 12.75 t/ha, which indicates that the technology of applied culture was a modern one, which allowed to obtain a very high yield per unit area. Also, from this table it is found that the highest production was obtained for strawberries 22.41 t/ha, followed by apples with 17.56 t/ha, and the lowest production was obtained for hazelnuts, of only 0.89 t/ha.

Table 4. Evolution of world production per unit area of the main fruits of temperate zone in the last three decades - tons/ hectare

Species	**1988**	**1998**	**2008**	**2018**	**% of world production/ 2018**
Apples	8.3	9.57	14.79	17.56	9.92
Pears	9.26	10.28	13.51	17.18	2.73
Quince	6.3	9.40	8.13	8.39	0.08
Plums	4.62	3.62	4.17	4.75	1.45
Apricots	5.62	4.88	6.42	2.50	0.44
Peaches and nectarines	6.54	9.32	13.13	14.28	2.81
Strawberries	11.34	14.13	18.56	22.41	0.96
Cherries	5.05	5.0	4.91	5.89	0.29
Cherry	4.84	4.38	5.40	7.11	0.17
Chestnuts	2.02	2.56	3.58	3.84	0.27
Hazelnuts	1.35	1.61	1.82	0.89	0.10
Currants	3.29	3.22	4.24	6.25	0.09
Raspberries	5.22	5.10	5.33	7.01	0.10
Total world	**8.93**	**10.12**	**12.01**	**12.75**	**-**

Source: after processing Faostat.org, 2020 [14].

Table 5. The evolution of production per unit area in fruit crops in Romania in last three decades - tons/hectare

Species	**1988**	**1998**	**2008**	**2018**	**% of world production/ 2018**
Apples	7.52	4.58	8.4	11.9	18.40
Pears	9.80	9.85	11.3	19.9	1.71
Quince	4.92	7.0	6.52	6.9	0.17
Plums	5.87	4.1	6.31	12.76	24.09
Apricots	4.37	6.55	10.92	17.5	1.00
Peaches and nectarines	6.70	3.4	9.94	12.9	0.63
Strawberries	6.84	7.58	8.1	7.8	0.74
Cherries	4.38	6.42	8.76	12.7	2.57
Total	**6.72**	**5.07**	**7.36**	**10.41**	**-**

Source: after processing Faostat.org, 2020 [14].

Regarding the production per unit area obtained in our country during the study period (Table 5), it is observed that it is comparable to that obtained worldwide in the temperate zone, the best results being obtained in pears 19.9 t/ha and for plums 12.76 t/ha, and the lowest production was for quince 6.9 t/ha and for strawberries with only 7.9 t/ha, a crop that was achieved worldwide the highest production of 22.41 t/ha (Tables 4 and 5).

From those presented in Tables 4 and 5 it is observed that both globally and nationally, large and quality fruit production can be obtained per unit area, which confirms the fact that their use in households and agritouristic farms in the South-West Oltenia development region, as well as at national level, can bring a considerable profit compared to other field crops or vegetables and can be an attractive factor for tourists eager to consume quality and tasty fresh fruit, or who want to carry out the so-called "occupational therapy" by participating in some work or picking fruit from the orchard.

At present, the strategy for the development of fruit growing in the European Union must be oriented towards sustainable development, which involves optimizing commercial fruit farms, direct support to producers through subsidies to ensure efficient production and very good food and taste quality. This can be ensured by:

- shortening the production time of the planting material, the use of high yielding varieties, low vigor rootstocks, fast fruiting, very high yields and good quality;
-use of virus-free propagating material (Virus Free);
- increasing the share of worldwide organic (organic) production through the use of disease and pest resistant varieties that do not require pesticide treatments;
- reducing production costs and streamlining fruit production for all species.

CONCLUSIONS

First of all, the research approached a topic with new objectives that perfectly adapts to the evolution trend of modern agriculture, towards the production of high-quality products with a special taste quality, which do not contain any chemical residues, applying a friendly technology. with natural or even built environment. It is absolutely imperative in the current conditions in which climate change is increasingly evident, even if some important countries of the world no longer recognize them, that agricultural production be directed towards a technology with as few jobs as possible, as well as with a number very low chemical treatments whose remnant is not found in the fruits consumed and including in the soil and the environment in which the crop is grown.

World and national fruit production must follow the same trends as all agricultural production, with a substantial reduction in inputs that are harmful to the natural and built environment and to humans. Therefore, the specialists who conducted the research focused on the need, importance and impact of obtaining high quality fruit in households and farms, which have the so-called taste of the past, "the taste of fruit in the garden of grandparents."It is known that in households and agritouristic farms there is a much lower production than in intensive or super-intensive farms, but by their superior capitalization, by selling organic products, directly from the farm at a higher price or by serving them. at the table to tourists in fresh form or transformed into homemade dishes. The proposed capitalization can greatly increase the economic efficiency and profit obtained from the practice of this new form of cultivation of fruit plants, which in addition to the productive character can also have a psychic character of recreation on the guests who visit us, as they can participate directly to some works in the orchards or to the collection of fresh fruits, which they can consume or buy for home.

From the point of view of fruit crops, it was found that the assortment of varieties grown in our country includes both foreign and native varieties (predominantly native varieties, newly created varieties, which generally have immunity or are very resistant to disease and specific pests). The proposed assortment must have a number of positive

characteristics, both in terms of the tree (early fruiting, growth vigor, type of fruiting, resistance to specific diseases and pests, ecological plasticity, affinity for grafting, rusticity) and fruit (size, color, characteristics of the pulp, taste, quality of the fruit, time of harvest). It is also proposed for agritouristic households an assortment that can offer the consumption of fresh fruit for as long as possible, but also fruits that can be industrialized in various forms (juice, syrup, nectar, jam, pulp, compote, dehydrated, etc.) and which are as resistant as possible to the attack of specific diseases and pests, so as to be as easy to maintain as possible (small number of phytosanitary treatments), with large fruits, pleasant-looking, tasty and capable of be consumed with great pleasure by tourists.

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RESEARCH REGARDING THE ECONOMICAL EFFICIENCY AND QUALITATIVE ASPECTS OF SOME NEW APPLE VARIETIES DURING STORAGE UNDER MODIFIED ATMOSPHERE

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Abstract

The research carried out at the Faculty of Horticulture in Bucharest for the Fuji, Luna, Golden, Orange and Sirius apple varieties have given a proof of the superiority of storing the fruit in modified atmosphere in comparison with the classic storing method in the refrigerator (cold storage). The atmosphere modified by approximately 3% O_2 and 5% CO_2 was obtained 3 weeks after storage and after packing the fruit in semi-permeable low-density polyethylene film (LDPE). The recorded losses at the end of the storage period were 2.6 times lower for the fruit that were stored in modified atmosphere in comparison with those stored in normal refrigeration conditions for the Luna variety. As far as the economic efficiency is concerned, profit between 331.7RON/ton for the Fuji I and 771.3RON/ton for the Luna variety was obtained when the fruit was stored in modified atmosphere, compared to those stored in normal refrigeration conditions.

Key words**:** *economic efficiency, cold storage, modified atmosphere, total losses*

INTRODUCTION

Extending storage duration as well as maintaining an adequate level of quality for the apples to be consumed fresh during the winter and spring season represents one of the main objectives of the higher exploitation of these fruit varieties.

An intense concern in this regard is storing apples in modified atmosphere conditions, which is obtained with low costs and can be kept constant throughout the whole storage period [1].

The results of the research carried aut worldwide have highlighted the superiority of this storage method, in comparison to keeping the fruit in cold storage with normal atmosphere [3, 4, 6].

Research carried out at the Horticulture Faculty in Bucharest aimed to highlight the main aspects (weight losses, qualitative depreciation and economic efficiency etc.) regarding the behaviour of some new apple varieties when being stored in modified atmosphere, in comparison to the same varieties being stored in cold storage with normal atmosphere [2].

MATERIALS AND METHODS

Research was carried out on 4 new apple varieties from the 2019 harvest (Fuji, Luna, Golden Orange, Sirius), which originated from the didactic – experimental field of the Faculty of Horticulture in Bucharest from an intensive orchard.

The degree of ripening of the fruit was measured so that good storage could be ensured. The optimum moment of harvesting was decided based on experience from previous years.

The main physical-chemical characteristics of the apples at the moment of harvesting are shown in Table 1.

The apples were inserted in the climatic chamber one day after having been harvested, on October 5th 2019. Only fruit that observed the technical requirements for Extra Quality and Quality I were used, in conformity with the Regulation (EC) 543/2011.

The experimental variants with the 4 varieties were put together by 3 repetitions each – one repetition meaning a crate with around 2kg fruit.

Table 1. The main physical-chemical characteristics of the apple fruits at the harvesting time

Variety	Average weight -g-	Firmness kgf/cm^2	Soluble dry matter -%-	Total Titratable acidity -%-	Ascorbic acid mg/100g
FUJI	170	6.0	14.20	0.41	5.50
LUNA	185	6.2	13.40	0.57	6.60
GOLDEN ORANGE	225	6.8	13.80	0.49	6.20
SIRIUS	200	5.8	12.40	0.64	7.80

Source: own determination.

Based on the results of the research obtained worldwide and due to the limited possibility of creating modified atmosphere, different from the ambient one, the experiences were carried out by obtaining a gaseous composition with 3% O_2 and 5% CO_2 [7].

This type of modified atmosphere was done by covering the fruit wrapping with a semi-permeable low-density polyethylene film having a thickness of 15µ (microns) [5], Photos 1, 2, 3, and 4.

The average temperature in the climatic chamber during the storage period was 3 – 3,5^{o}C and the relative air humidity was 80-85% in normal refrigeration conditions, and respectively of 85 – 90% inside the wrappings with modified atmosphere.

The observations and measurements carried out after harvesting and during the storage period of the apples tracked:

-the evolution of the main physio-chemical characteristics of fruit (the firmness of the pulp, the soluble dry matter, the total titratable acidity and the content of ascorbic acid).

The measurement of the firmness of the fruit pulp was carried out using the Effegi penetrometer with the 11 mm diameter. plunger. The measurement of the content of soluble dry matter was done using the Atago electronic refractometer. The measurement of the total titratable acidity was done by titration with a NaOH 0.1N solution. The measurement of the ascorbic acid content was done through the iodometric method.

-the determination of the weight losses and qualitative depreciation, expressed by quantity and rendered percentage;

-the determination of the concentration of the main component gases (O_2 and CO_2) from the modified atmosphere gases, using the Oxybaby gas analyser.

Photo 1. Fuji variety – packed in modified atmosphere
Source: Original.

Photo 2. Luna variety - packed in modified atmosphere
Source: Original.

In order to analyse the economic efficiency of storing the apples in modified atmosphere conditions, calculations were made regarding the valorisation of the remaining production at the end of the 6 month storage period, taking into study the fruit categories Extra Quality and Quality I (suitable to be consumed when

fresh), the downgraded fruit (suitable for industrial processing for compotes and juices) and the bad fruit (suitable for processing by distillation).

The retail price of the apples at the end of the storage period at the beginning of April 2020 was 5.4RON/kg for Extra Quality and Quality I, 2.5RON/kg for the downgraded fruit and 0.45 RON/kg for the bad fruit.

Photo 3. Golden Orange variety - packed in modified atmosphere
Source: Original.

Photo 4. Sirius variety - packed in modified atmosphere
Source: Original.

RESULTS AND DISCUSSIONS

Because of the apple fruits perspiration, after 3 weeks a composition of the atmosphere was created inside the modified atmosphere wrappers, which was different from the one of the air. The concentration of Oxygen varied between 2.8% and 3.5% and that of Carbon Dioxide was between 4.5% and 5%.

These values had very little oscillations inside each wrapper and were constant throughout the entire apple storage, thanks to the semi-permeable low-density polyethylene film, LDPE.

By examining the data in Table 2, showing the weight losses, one can see that in the same storage duration the highest values recorded for normal cold storage were for the Golden Orange and Sirius varieties.

Thus, after 6 months of storage these losses amount to 7.45% for Sirius and 7.07% for the apples in the Golden Orange variety.

The fewest weight losses are shown for the Luna variety, the value recorded after 6 months of storage being of only 5.29%.

In the case of storing the fruit in modified atmosphere there is a decrease of the weight losses and the lowest values were recorded for the Luna variety, 3.52% after 6 months and the highest for Sirius, 4.26%.

Another aspect that is highlighted is that the positive influence of the modified atmosphere is stronger mainly for the apple fruits in the Golden Orange and Sirius variety.

In comparison with the cold storage the fruit stored in modified atmosphere show weight losses decreased by 3.19%, while for the Luna variety the decrease is only by 1.77%.

Generally, for the 4 varieties studied, the weight losses recorded at the end of the 6 storage months were 6.38% in cold storage and only 3.8% for the fruit stored in modified atmosphere, which means they were lower by 1.7%.

This general reduction of the weight losses is owed mainly to the positive effect of the modified atmosphere on the slowing down the metabolic processes in fruits.

As far as qualitative depreciations are concerned, from the results shown in table 3 it should be pointed out that all the fruit that did not meet the technical requirements for the Extra and I quality after sorting were included, according to the Regulation EC 543/2011.

Table 2. Weight losses registered during the apple fruits storage in different conditions (%)

Variety	Cold storage		Modified atmosphere	
	after 3 months	after 6 months	after 3 months	after 6 months
FUJI	2.97	5.71	2.25	3.55
LUNA	3.08	5.29	2.19	3.52
GOLDEN ORANGE	4.15	7.07	2.70	3.88
SIRIUS	4.52	7.45	2.81	4.26
AVERAGE	3.68	6.38	2.48	3.80

Source: Own determination.

These depreciations were grouped into 2 categories: Quality II fruits for those which can still be processed by industrialization (compotes, juices) and rotted fruits, which can be processed through distillation.

For the Quality II fruits the physiological disorder called lenticular spot was mainly visible (Photo. 5).

Photo 5. Lenticelar spot of the Sirius variety
Source: Original.

As for the apples stored in modified atmosphere, in comparison to those kept in cold storage, it can be seen that the qualitative depreciations have fairly high variations depending on the variety and on the storage condition.

Thus, in modified atmosphere conditions, after 6 months of storage, the qualitative depreciations are as follows:

-the lowest values for the downgraded fruits are recorded for the Fuji variety (1.28%) and Luna (1.78%) and the highest for the Golden Orange (2.29%);

-for the rotted fruits the lowest losses were recorded for the Luna variety (3.36%) and Sirius (3.98%), and the highest for the apples of the Golden Orange (6.07%) and Fuji varieties (5.44%). The rottenness of the fruit was mainly caused by the grey mould *Botrytis cinerea* (Photos 6 and 7).

Photo 6. Rotted fruits in the Luna variety
Source: Original.

Photo 7. Rotted fruits in the Fuji variety
Source: Original.

As a result of the data obtained regarding the qualitative depreciations for the fruit stored in cold storage, the following should be mentioned:

-the lowest values for the II category fruit are recorded for the apples of the Sirius (7.26%) and Fuji (8.9%) varieties, and the highest for the Luna variety (22.52%);

-for the rotten fruits the lowest values are for the Luna variety (6.88%) and Sirius (6.92%). The highest values were recorded for the apple fruits of the Golden Orange variety (9.84%).

On the whole of the 4 varieties analysed, the total of the qualitative depreciations resulted after storing the apples for 6 months is that of 20.77% for cold storage and 6.53% for the fruits stored in modified atmosphere, which represents 3.2 times decrease.

Table 3. Qualitative losses registered during the apple fruits storage in different conditions (%)

Variety	Cold storage				Modified atmosphere			
	after 3 months		after 6 months		after 3 months		after 6 months	
	second class	rotted fruits	second class	rotted fruits	second class	rotted fruits	second class	rotted fruits
FUJI	3.23	2.16	8.90	7.34	0.88	2.64	1.28	5.44
LUNA	2.86	1.93	22.52	6.88	1.04	1.47	1.78	3.36
GOLDEN ORANGE	2.24	3.46	13.41	9.84	1.24	3.16	2.29	6.07
SIRIUS	1.11	2.47	7.26	6.92	1.02	1.86	1.92	3.98
AVERAGE	2.36	2.51	13.03	7.75	1.05	2.28	1.82	4.71

Source: Own determination.

After analyzing the apple fruits behavior during storage as far as the total losses are concerned (Table 4), after 6 months of storage the following results are visible:

-in modified atmosphere conditions, the best results are obtained for the Luna (8.66%) and Sirius (10.16%) varieties and the lowest for the Golden Orange variety (12.24%);

-for the fruits stored in normal cold storage conditions, the lowest total losses were visible for the Sirius variety (21.63%), and the highest for Luna (34.69%) and Golden Orange (30.32%);

-the average of the total losses as a result of the storage of the 4 apple varieties is only 10.22% for the fruit stored in modified atmosphere, which is 2.6 times lower than the average for the fruit stored in normal cold storage conditions (27.15%).

-in general, the positive influence of modified atmosphere is manifested mainly for the apple fruits in the Luna variety, in comparison to those stored in normal cold storage conditions.

The fruits kept in modified atmosphere have recorded lower total losses by 26%, while for the Sirius variety, this reduction was by only 11.47%.

Table 4. Total losses registered after 6 month of apple fruits storage in different conditions (%)

Variety	Cold storage	Modified atmosphere	Cold storage/ Modified atmosphere
FUJI	21.95	10.27	2.14
LUNA	34.69	8.66	4.01
GOLDEN ORANGE	30.32	12.24	2.48
SIRIUS	21.63	10.16	2.13
AVERAGE	27.15	10.33	2.63

Source: Own determination.

During the storage of the apples, as a result of the development of the metabolic activity, the main physio-chemical characteristics of the fruits underwent changes compared to the values measured at harvesting, and the results obtained are to be seen in Table 5 [8, 9].

As far as the firmness of the pulp is concerned, it could be seen that during the storage period the values decreased in comparison to those at the moment of harvesting, both depending on the variety and on the storage conditions.

Table 5. The main physio-chemical characteristics of the apple fruits after 6 months of storage in different conditions

Variety	Firmness - Kgf/cm^2 -		Soluble dry matter -%-		Total titratable acidity -%-		Ascorbic acid - mg/100 g-	
	cold storage	modified atmosphere	cold storage	modified atmosphere	cold storage	modified atmosphere	cold storage	modified atmosphere
FUJI	4.4	5.2	15.2	14.8	0.28	0.35	4.6	5.0
LUNA	5.0	5.6	14.2	14.0	0.42	0.48	5.4	5.9
GODEN ORANGE	5.2	6.0	14.8	14.4	0.38	0.42	5.0	5.4
SIRIUS	4.0	5.0	13.6	13.3	0.50	0.56	6.4	6.9
AVERAGE	3.65	4.45	14.45	14.10	0.40	0.45	5.35	5.8

Source: Own determination.

Table 6. The economic efficiency of apple fruits storage after the 6 months, in different conditions (calculation performed for 1 tone of fruits)

Variety and fruits category	Cold storage		Modified atmosphere		The value difference -lei-
	Quantity -kg-	Value -lei-	Quantity -kg-	Value -lei-	
FUJI Extra and I-st quality	780.5	4,214.7	897.3	4,845.4	
Second quality	89	225.5	12.8	32	
Rotted fruits	73.4	33	54.4	24.5	
TOTAL		4,470.2		4,901.9	431.7
LUNA Extra and I-st quality	653.1	3,526.7	913.4	4,932.4	
Second quality	225.2	563	17.8	44.5	
Rotted fruits	68.8	30.96	33.6	15.1	
TOTAL		4,120.7		4,992	871.3
GOLDEN ORANGE Extra and I-st quality	696.8	3,762.7	877.6	4,739	
Second quality	134.1	335.3	22.9	57.2	
Rotted fruits	98.4	44.3	60.7	27.3	
TOTAL		4,142.3		4,823.5	681.2
SIRIUS Extra and I-st quality	783.7	4,231.9	898.4	4,851.4	
Second quality	72.6	181,5	19.2	48	
Rotted fruits	69.7	31.4	39.8	17.9	
TOTAL		4,444.8		4,917.3	472.5

Extra and I-st quality = 5.4 lei/kg
Second quality = 2.5 lei/kg
Rotted fruits = 0.45 lei/kg

Thus, after 6 months, the values registered for the fruits stored in normal cold storage conditions were between 3 kgf/cm^2 and 4 kgf/cm^{2,} with an average of 3.65 kgf/cm^2 for the 4 varieties.

For the apple fruits stored in modified atmosphere, the values varied between 4 kgf/cm^2 and 5 kgf/cm^2, the average of the 4 varieties being of 4.45 kgf/cm^2.

The highest increases in comparison with the initial value were registered after 6 months of storage for Sirius (2.8 kgf/cm^2 in normal cold storage conditions and 1.8 kgf/cm^2 in modified atmosphere) and Golden Orange (2.6 kgf/cm^2, 1.8 kgf/cm^2 respectively), and the lowest for the apple fruits of the Luna variety (2.2 kgf/cm^2 in cold storage and 1.6 kgf/cm^2 in modified atmosphere).

As far as the other measured characteristics are concerned, the soluble dry matter, the total titratable acidity and the ascorbic acid, during the storage of the apples a decrease of the determined values was found.

The decrease was higher in the case of the apple fruits stored in normal cold storage. Thus, after the 6 months of storage, the average of the relative values for the 4 varieties analysed was – 14.45% soluble dry matter, 0.4% total titratable acidity and 5.35 mg/100g ascorbic acid.

For the fruits kept in modified atmosphere the average values were 14.15% soluble dry matter, 0.45% total titratable acidity and 5.8mg/100g ascorbic acid.

In order to assess the economic efficiency of the two storage methods, Table 6 shows a number of economic calculations regarding their comparative situations, starting from the apple quantities for each quality ranking left at the end of storage and the average retail prices.

The additional expenses required for the modified atmosphere storage method with the semipermeable low-density polyethylene film consisted solely of the price of the film and the costs needed for the handling of the fruit wrappings.

These expenses amount to around 100 RON/ton annually.

From the data shown in Table 6 it can be seen that in the case of the apples stored in modified atmosphere, in comparison to those in cold storage, profit ranging between 331.7RON/ton for Fuji and 771.3RON/ton for Luna was obtained (after the additional 100 RON/ton were deducted for the fruit in modified atmosphere).

CONCLUSIONS

As a result of storing the apples in modified atmosphere, carried out using the semipermeable low-density polyethylene film (LDPE), superior results are obtained in comparison to the fruits kept in cold storage.

The weight losses recorded after 6 months of storage were 1.7 times lower in modified atmosphere than in cold storage.

The quality depreciations recorded after 6 months of apple storage were 3.2 times lower in the case of the modified atmosphere method, in comparison with the cold storage.

The total losses determined at the end of the storage period were 2.6 times lower in the case of the modified atmosphere method, in comparison with the cold storage.

The positive influence of the modified atmosphere was visible mainly for the Luna variety, the total losses being lower by 26%, which represents a decrease of 4 times in comparison to the normal cold storage.

As a result of the development of the metabolic activity during the storage of the apples, the main physio-chemical characteristics of the fruits showed a descending tendency, with the exception of the soluble dry matter, because the fruits continued their maturation even after harvesting. The decreases were more important in the case of the cold storage.

The calculations regarding the economic efficiency of apple storage have highlighted the advantage of the storage in modified atmosphere, the profit obtained being between 331.7 RON/ton for the Fuji variety and 771,3 RON/ton for the Luna variety, in comparison with cold storage.

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ANALYSIS OF THE DEGREE OF THE RURAL POPULATION INVOLVEMENT IN THE DECISION MAKING ACT. CASE STUDY, CĂLĂRAŞI COUNTY, ROMANIA

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Abstract

The public participation is seen as a political principle or as a public practice, and it is also recognized as a right of the citizens, with the aim at facilitating the involvement of the segment of citizens affected or interested in a public decision. The citizen's participation in making decisions regarding the community where he lives is an indicator of how everyone socializes, is involved in making decisions that concern him directly, regarding a new project of the local authorities. As the human resource is extremely dynamic, it is the one that highlights the other types of resources: economic, social and cultural, we elaborated a survey in four rural localities in Călăraşi county to capture the degree of citizens' participation/involvement from the rural area in the development decisions at the level of the community in which they live. The research was achieved using on the questionnaire-based survey method and the data were processed by the analysis and comparison method, using also the χ^2 test. The survey-questionnaire was used with a number of 7 items, to survey the opinion of the population, to which a number of 377 persons answered. The questions were structured on 2 levels, respectively, filter questions and grid questions. The answers in the questionnaire were analyzed according to 5 criteria, namely: by locality, by respondents' age, by level of education, by gender and by social status. The differences in the conception of participation in the decision-making act are different between the analyzed communes, even if overall 58.27% answered that the group participation is the best. The group activities are appreciated to the detriment of the individual activities, by those aged between 30 and 60 years old, by those with high school education, farmers, employees, without status and pensioners. From the analysis of the citizens' participation in the respective decision-making in a current way, occasionally or not at all, there is a significant and very significant differentiation at the commune level, age, studies and social status.

***Key words**: commune, questionnaire, rural development, rural area, rural population*

INTRODUCTION

The participation in the decision-making processes is recognized and practiced at international level [20, 6]. The intergovernment organizations and European countries have adopted, through various documents, rules to strengthen, guide and ensure the participation of the public and various civil society organizations in the adoption of their decisions [5]. Although some of these documents are not binding force, they set out a framework of clear rules in order to strengthen the legal framework and participatory practice [5, 6].

In Romania, too, a growing trend of interest in public participation has been found out in recent years, leading to a development of the institutional and non-institutional framework of the social dialogue and public consultation, subject to occurring since the 2000s, of the legislative framework that governs the public participation processes (information, consultation, transparency), but also against the background of the evolutions in the area of public administration reform, of the consolidation of the civil society and of the imperative to comply with the European and international standards [1, 13].

The perception is that the biggest obstacles are still, the lack of will on the part of the administration, but also the low degree of structuring and efficiency of public participation [2, 4]. Thus, there is a great lack of trust in the good intentions of public administration regarding the access to public

information and the organization of public consultations and the steps initiated by public authorities are seen as purely formal, the civil society perceiving a lack of authenticity of the framework of dialogue.

OCDE methodology for the notion of rurality leads to different figures, but it allows comparisons with other Member States [11].

Thus, it is found that the territory of Romania is in accordance with this definition 59.8% rural, 39.4% intermediate and only 0.8% urban [8]. Regarding the distribution in the territory, Romania population has a fairly high level of rurality, the share of rural population in Romania reflects its higher incidence compared to other EU countries, where rural settlements are less populated and on a smaller scale, as an alternative to urban concentrations. Many of these rural communities contribute, to a small extent, to economic growth but retain their social structure and traditional way of life [18].

In relation to the data Eurostat of 2017, 45.5% of the population is in rural area, 43.9% in intermediate regions and 10.6% in urban area [17, 18]. The surface of Călărași county has 5,088 square km, respectively, 2.1% of Romania territory, being ranked 28 of the 42 counties. Regarding the population, Călărași county has 308.6 thousand inhabitants (1.64% of the country population) [16]. Regarding the areas of residence, 61.55% of the country inhabitants live in the rural area and 38.45% live in the urban area.

Research shows that there is a contemporary trend of changing the rural lifestyle into an urban one, but this process is relatively new in history, it is an exclusive characteristic of modernity [12].

Modernization in this sense is seen as a global trend of societal transformation, initiated by deliberate efforts of political, economic leadership, oriented towards objectives such as: industrialization and related forms of economic development; qualitative change of the educational process; extending participation in the decision-making act; increasing the role of the media [7, 6].

In the contemporary specialized literature, in research centers, in university centers of the world, valuable theories were developed regarding the modeling of rural communities through co-participatory actions and through self-organization actions. The model is given by the study of Kenneth P. Wilkinson, which is rich in the issues addressed and his bibliographical references [15]. It starts from the "power structure" identified by: "community leaders"; "Social forces" and "group performances" and the concept of social process is briefly analyzed as "relations between actors and the activities between them", which materialize through action program, events, etc. and through which the community evolves.

In our country it is appreciated that the community development is a social innovation, meaning to participate in solving social problems, to fight poverty, to open the way to certain resources depending on the community ability to organize and mobilize, a rediscovered social innovation [1, 4, 12, 17].

MATERIALS AND METHODS

Starting from the hypothesis that citizen participation is an important indicator in rural development, we made a survey based on interviews in four rural localities in Călărași county to capture the degree of citizen participation/attraction in the community regarding the involvement in rural development decisions at the level of the community in which they live. The research was based on the questionnaire-based survey method and χ^2 test. The survey - questionnaire with a number of 7 items was used to survey the opinion of the population, to which a number of 377 people answered. The questions were structured on 2 levels, respectively, 4 filter questions and 3 grid questions, with 3 or 4 predefined answers, regarding the citizen's participation/consultation by the local authorities in making decisions for economic and social development of the community.

The answers from the questionnaire were analyzed according to 5 criteria, namely: by locality, by respondents' age, by level of education, by sex and by social status.

The 377 respondents were distributed as follows: by locality: Borcea 99 respondents,

Manastirea 100 respondents, Modelu 99 respondents, Independenta 79 respondents; by age: up to 30 years 65 respondents, between 31-40 years 107 respondents, between 41-50 years 102 respondents, between 51-60 years 52 respondents, over 61 years 51 respondents; by level of education: 12 respondents have primary school, 82 respondents have secondary school, 201 respondents have high school and 82 respondents have higher education, by sex: 227 men respondents and 150 women respondents; by social status: farmer 52 respondents; employees 2111 respondents; registered unemployed 14 respondents; unregistered unemployed 13 respondents; without status 53 respondents, pensioners 34 respondents.

The concordance test $\chi 2$ ("hi-square") is a general test, which can be applied to any statistical distribution to which we can calculate the cumulative distribution function. The $\chi 2$ test is applied to grouped data (or frequency data) and aims to associate the columns and rows of a table with two inputs, crossed frequencies concerning discrete or discretized variables and is calculated after making some contingency tables, in which the data are classified according to one, two, or more segmentation variables [10].

The steps taken in evaluating the results of the questionnaire using the $\chi 2$ method are the following: formulating the null hypothesis H0, which states that there is no causal link or association between the two variables-questions; choosing the level or threshold of significance α and calculating the number of degrees of freedom of the table, according to the formula (r-1)*(c-1); based on which, its value, $\chi 2$ theoretically, is taken from the distribution table $\chi 2$; comparison of the obtained results [9, 19]. for which there are the following situations: if the null hypothesis is rejected and therefore there is an association or potential relation between variables or if the existence of a null hypothesis is admitted and therefore there is no association or potential relation between the studied variables; calculation of the contingency coefficient C**,** which has the role of measuring the degree of association between the variables of the contingency table. Compare $\chi 2$calculated with $\chi 2$theoretical for different probability thresholds. The Pearson coefficient is calculated regardless of the variables nature (continuous or discrete) and regardless of the nature of their distribution (normal or not), within the research population, according to the mathematical model proposed by the statistician Karl Pearson [14]. The closer the value of C is to *1*, the more closely the variables are correlated. In the present study, the questionnaire was completed by 377 people, from four representative communes of Călărași county.

RESULTS AND DISCUSSIONS

The citizen's participation in making decisions regarding the community where he lives is an indicator of how everyone socializes, is involved in making decisions that concern him directly, regarding a new project of the local authorities.

Participation can be active, when community members discuss with their elected officials or with the administration and passive, the community members participate in a public meeting, only to be informed of the decisions already made [3].

At the question: *Have you been consulted in decision making at the community level?*, which reflects the way in which the elected officials in the local communities are concerned with the education of the inhabitants but also with the creation of a support in the execution of the decisions, we find that the answers are significantly differentiated at the level of the communes (Table 1). Thus, not at all 68 respondents from Borcea commune, 44 from Manastirea commune, 35 from Modelu commune and 39 respondents from Independenta commune appreciated, which as percentage represents 49.08% **of the total answers, for** $\chi 2$ theoretical of 12.59.

Because of those who respond, just a few have always been consulted, it results that the local elected officials have a group of acquaintances who are always called to fulfill the formality in elaborating minutes of the citizens' meetings, in making decisions.

Table 1. Correlation between the participation in decision making and respondents domicile

Commune	UM	Have you been consulted in decision making at the community level?			Total	
		a. Always	b. sometimes	c. not at all	No	%
Borcea	No	5	26	68	99	26.25
Manastirea	No	15	41	44	100	26.50
Modelu	No	13	51	35	99	26.25
Independenta	No	6	35	39	79	21.00
Total	No	39	153	186	377	100
	%	10.50	40.42	49.08	100	X
CHIINV (Chi theoretical)	≥	8.56	10.64	12.59	16.81	22.46
CHIINV (Chi calculated)	27.47					***

Source: own calculations**.**

To the question: *What do you think are the ways to involve the citizen in decision-making at the local level ?*, The form of participation, individually or in groups, shows the degree of respondent understanding to how he sees this participation. The differences in the conception of this participation is different (very significant), between the analyzed communes, even if on the whole 58.27% answered that the group participation is the best (Table 2).

Table 2. Correlation between the modalities of respondents involvement in making decisions and commune of residence

Commune	UM	What do you think are the ways of citizen involvement			Total	
		a. individual	b. group	c. I do not know	no	%
Borcea	no	18	71	10	99	26.25
Manastirea	no	25	56	19	100	26.50
Modelu	no	41	50	8	99	26.25
Independenta	no	18	43	18	79	21.00
Total	no	102	220	55	377	100
	%	27.03	58.27	14.70	100	X
CHIINV (Chi theoretical)	≥	8.56	10.64	12.59	16.81	22.46
CHIINV (Chi calculated)	24.73					***

Source: own calculations.

From the analysis of the citizens' participation in the decision-making, at the commune level, a very significant differentiation is found between the studied communes. The current participation is very low, respectively by 18 persons in Modelu commune, 14 persons in Manastirea commune and only 8 persons in Borcea commune. The occasional participation is higher in Modelu commune 50-persons, in Manastirea commune of 49 persons and the lowest in Borcea commune, of only 27 persons, with a total percentage of 42.26%. (Table 3).

Table 3. Correlation between the frequency of participation in local decision making and studied communes

Commune	UM	Participation in local decisions			Total	
		a. currently	b.ocasionally	c. not at all	no	%
Borcea	No	8	27	64	99	26.25
Manastirea	No	14	49	38	100	26.51
Modelu	No	18	50	31	99	26.25
Independenta	No	9	32	36	79	21.00
Total	No	49	159	169	377	100
	%	13.12	42.26	44.62	100	X
CHIINV (Chi theoretical)	≥	8.56	10.64	12.59	16.81	22.46
CHIINV (Chi calculated)	24.14					***

Source: Own calculations.

Non-participation represents 44.62% of the answers of 169 interviewed persons. By age categories, participation in local decisions is different (distinctly significant), being large differences, depending on the age of community members.

Analyzing the correlation between the ways in which respondents are involved in decision-making and the respondents' ages, it is found that the answers between the different age categories are significantly different.

Table 4. Correlation between the ways of respondents' involvement in decision making and the respondents' age

Age	UM	What do you think are the ways to involve the citizen			Total	
		a. individual	b. group	c. I do not know	No	%
Up to 30 years old	No	13	41	11	65	17.32
Between 31-40 years old	No	34	60	13	107	28.35
between 41-50 yeas old	No	36	55	11	102	27.03
Between 51-60 years old	No	11	33	8	52	13.65
Over 61 years old	No	8	31	12	51	13,65
Total	No	102	220	55	377	100
	%	27.06	58.35	14.59	100	X
CHIINV (Chi calculated)	14.72		*			

Source: Own calculations.

Thus, the age categories between 31 years and 50 years old appreciate the group activity (115 respondents) and individual (70 respondents) and only 24 answer 'I do not know' (Table 4).

The age groups under 30 and over 60 years old mainly appreciated the group participation. Analyzing the same question according to the respondents training, we find a very significant differentiation of answers, in the sense that the citizen's involvement in the group is appreciated by respondents with high school education (124 persons), followed by those with higher education (44 persons) and high school (47 persons) (Table 5).

Table 5. Correlation between the ways of respondents involvement in decision making and the respondents training level

Last school graduated	UM	What do you think are the ways for citizen involvement			Total	
		a. individual	b. group	c. I do not know	no	%
Primary	No	1	5	6	12	3.41
Secondary	No	16	47	19	82	21.78
High school	No	54	124	23	201	53.02
Higher education	No	31	44	7	82	21.78
Total	No	102	220	55	377	100
	%	27.06	58.62	14.32	100	x
CHIINV (Chi calculated)	23.18					***

Source: Own calculations.

The participation in group or individual participation of those with high school and higher education confirms the finding that with advancing age or transition to a high social status, the persons become members of associations [20, 3]. By professional groups, the respondents answered very differently (significantly significant), being preferred group activities of over 50% by farmers, employees, without status and retirees (Table 6).

Table 6. Correlation between the ways to involve the respondents in decision making and the respondents' professional status

Professional status	UM	What do you think are the ways to involve the citizen			Total	
		a. individual	b. group	c. I do not know	No	%
Farmer	No	11	32	9	52	13.79
Employee	No	65	128	18	211	55.97
Registered unemployed	No	4	7	3	14	3.71
Unregistered unemployed	No	4	3	6	13	3.45
No status	No	14	29	10	53	14.05
Pensioner	No	4	21	9	34	9.03
Total	No	102	220	55	377	100
	%	27.05	58.35	14.60	100	X
CHIINV (Chi calculated)	28.01				**	

Source: Own calculations.

Of course, the citizen participation is effective when community members gather to discuss future public administration decisions [3]. The participation of the community members helps the members of the governing bodies to make better decisions, to understand more comprehensively the citizens' problems, to train the community members to achieve the decisions at the community level.

To the question: *What were the main forms of collaboration with the local decision makers you participated in?,* the respondents had four pre-established answer options, respectively: *a. Meetings at the request of the local decision makers; b. meetings on its own initiative; I participated, but I am interested if they asked me; d. I did not participate and I am not interested.*

The analysis of Table 7 shows that a number of 178 respondents, namely 46.7%, actually participated in decision-making, of which 77 respondents, 20.2%, on their own initiative. Also, a number of 122 respondents would have participated if they were asked, which represents 32%.

Regarding the respondents participation according to age, we notice very big differences between the respondents' answers. Thus, if we add up the respondents who participated in the decision-making within the communities with those who intend to participate, we find that the respondents answered in the affirmative as follows: 87.9% those between 31-40 years old, 85.4% those between 41 -50 years old, 72.7% those up to 30 years old, 67.3% those between 51-60 years old and 65.3% those over 61 years old. From the analysis of the answers, depending on the level of studies, it is found that there are very significant differences between the respondents' answers. Thus, the respondents who participated in the decision-making within the communities and those who intend to participate, answered as follows: 38.4% those with primary education, 61.4% those with secondary education, 82.6% those with education high school and 92.7% those with higher education (Table 8).

Table. 7 Correlation between the involvement in local decision making and the respondents' age

Age	UM	What were the forms of collaboration with the local decision makers you participated in?				Total	
		a.	b.	c.	d.	no	%
Up to 30 years old	no	18	9	21	17	65	17.25
Between 31-40 years old	no	25	22	48	12	107	28.38
Between 41-50 years old	no	37	22	29	14	102	27.05
Între 51-60 de ani	no	16	8	11	17	52	13.79
Peste 61 ani	no	5	16	13	17	51	13.53
Total	No	101	77	122	77	377	100
	%	26.80	20.42	32.36	20.42	100	X
CHIINV (Chi theoretical)	≥	15.81	18.55	21.03	26.22	32,9	
CHIINV (Chi calculated)	38,40					**	

Source: Own calculations.

Table 8. Correlation between the involvement in local decision making and respondents training level

Last school graduated	UM	What were the main forms of collaboration with the local decision makers you participated in ?				Total	
		a.	b.	c.	d.	no	%
Primary	no	1	2	2	7	12	3.41
Secondary	no	6	16	29	31	82	21.78
High school	no	49	38	80	34	201	53.02
Higher education	no	45	21	11	5	82	21.78
Total	no	101	77	122	77	377	100
	%	26.51	20.21	32.02	21.26	100	x
CHIINV (Chi theoretical)	≥	12.24	14.68	16.92	21.67	27.88	
CHIINV (Chi calculated)	84,10					****	

Source: Own calculations.

We can mention that the participation and interest for collaboration with the local decision makers is directly proportional to the level of education of the respondents.

From the analysis of the answers regarding the main forms of collaboration with the local decision makers in which they participated according to the respondents gender, it was found that there are no significant differences between the answers. Thus, the gender responses for those who participated in the community decision-making together with those who intended to participate were 79.9% for men respondents and 79.3% for women respondents (Table 9).

Table 9. Correlation between the involvement in the local decision making and respondents' gender

GENDER	UM	What were the main forms of collaboration with the local decision makers you participated in ?				Total	
		a.	b.	c.	d.	no	%
Male	No	52	45	84	46	227	60.10
Female	No	49	32	38	31	150	39.90
Total	No	101	77	122	77	377	100
	%	26.51	20.21	32.02	21.26	100	x
CHIINV (Chi theoretical	≥	4.64	6.25	7.81	11.34	16.27	
CHIINV (Chi calculated)	7.14		*				

Source: Own calculations.

Table 10. Correlation between the involvement in local decision making and the respondents' professional status

Professional status	UM	What were the main forms of collaboration with the local decision makers you participated in?				Total	
		a.	b.	c.	d.	no	%
Farmer	No	19	15	11	8	52	13.91
Employee	No	71	43	69	28	211	55.64
Registered unemployed	No	2	0	7	5	14	3.67
Unregistered unemployed	No	3	1	3	6	13	3.41
No status	No	4	9	23	17	53	54.00
Pensioner	No	2	9	9	14	34	9.19
Total	No	101	77	122	77	377	100
	%	26.51	20.21	32.02	21.26	100	X
CHIINV (Chi theoretical)	≥	19.31	22.31	25.00	30.58	37.70	
CHIINV (Chi calculated	55.45					***	

Source: Own calculations.

The analysis of the answers regarding the main forms of collaboration with the local decision makers they participated depending on the respondents' social status shows that there were significant differences between the answers. Thus, we find that among those who participated effectively in decision-making, the answers according to the social status are as follows: registered unemployed 14%, no

status 24%, unregistered unemployed 30%, pensioners 31%, employees 53% and farmers 64% (Table 10).

CONCLUSIONS

The respondents' participation in the form of organization, of involvement in decision-making is different by commune, age, education and social status. The group activities are appreciated compared to those face to face, of over 50% by those from Borcea commune, by those aged between 30 and 60 years old, by those with high school education, farmers, employees, no status and pensioners.

From the analysis of the citizens' participation in the respective decision-making in a current way, occasionally or not at all, there is a significant and very significant differentiation at the commune level, age, studies and social status.

Overall, the current participation is only 13.12%, respectively of those with secondary and higher education, of those in the age category 41 years old to 60 years old and of those with the social state of farmers and employees.

We find that a number of 300 respondents, namely 79.5% of respondents have a proactive attitude of participation, which is a very good aspect, thus proving that the respondents' answers in this questionnaire can be treated responsibly.

Analyzing the answers to the question depending on the degree of professional training, we find that there is also a very significant difference between the answers at the level of communes, at the level of training, at the level of the socil status. It was also found that those who belong to employed categories are not consulted in very large proportions: employed persons, registered unemployed, unregistered unemployed and pensioners.

The analysis of the answers to the question regarding the main forms of collaboration with local decision makers found that there are very significant differences in education and social status, distinctly significant regarding municipalities and age and insignificant regarding gender.

It should be noted that of the respondents a percentage of 26.5% participated in (a) meetings at the request of local decision makers; (b) in meetings on own account 20,2%; (c) did not participate, but they are interested if they were asked 32.02%; and (d) I did not participate and I am not interested in, 21.2%. The percentage of those who participated or are interested is very high of 78.8%, demonstrating the respondents interest to collaborate with the decision makers.

Every citizen should be informed and given the opportunity to be consulted during the elaboration of the normative documents, with a focus on the groups potentially aimed by the future regulation. The participants' selection (citizens or NGO representatives) must be done in an open manner and based on predefined criteria, in order to ensure the credibility of the process. The participation should be ensured equally for all stakeholders, facilitating the involvement of the disadvantaged groups.

The civil society organizations can play an important role in this process - by facilitating public involvement, representing the interests of stakeholders and informing them about the results.

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STUDY ON THE AGRICULTURAL PRODUCTION EVOLUTION IN CĂLĂRAȘI COUNTY, ROMANIA

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Abstract

Romania is one of the European countries with the most favorable soil and climate conditions in order to obtain quality agricultural productions and in significant quantities, which can cover an important segment of the domestic demand for agri-food products. Despite the considerable potential, the profitability in Romanian agriculture is still modest, indicating a use of production factors below the level of optimal values. Based on these considerations and predicting that in 2021, the population need for agri-food products consumption will increase, as a result of the repatriation of approximately two million Romanian citizens, who worked in the European Union countries due to the crisis generated by Covid-19, we initiated the present study on the agricultural production evolution in Călărași county, in comparison to South Muntenia Region, of which it is part and with the production at national level. For the data processing and interpretation, the method of statistical indicators was used, respectively, the comparative analysis of the researched phenomena. The comparison method was used in the analysis of the data series that covered time periods between 2000 and 2007 and 2008 and 2018, depending on the available data. For each period, the indicators were calculated: average, standard deviation, coefficient of variation and annual growth rate. It results clearly that for the next period it is important to intensify some measures to provide subsidies, to use on large scale the need for irrigation, fertilization and other activities that will give perspective to evolution in this area and lead to the agrio-food security and independence of Romania.

Key words**:** *Calarasi County, agricultural crops, indicators, agricultural production, resources*

INTRODUCTION

Experts appreciate that there is a process of structural transformation worldwide, following the occurrence of new global challenges with long-term effect, that requires the elaboration of a strategic vision in the field and the implementation of concrete actions by the competent authorities in our country [1, 4, 20]. The highly numerous global population, increase of pressure on the natural resources and global warming determine a new framework at national and international level [12].

In Europe, the population aging process is also an additional challenge. All these aspects will have profound implications for agriculture and rural areas [11].

World food demand is growing, increased urbanization, higher prices in input, pressure on water resources and increasing vulnerability of crops and animals to climate change will limit food production [3, 12]. Globally, the food demand is projected to increase by 70% until 2050 due to the growing population and income increasing [7, 8]. The developing countries will contribute the most to this trend, with their demand for food that will double in the next years. It is estimated that the world population will increase from the current 7 billion to 9 billion by the middle of this century, and 95% of this growth will take place in the least developed countries [20]. The growing global income will be largely associated with the increased urbanization (70% of the world population is expected to live in urban areas until 2050, compared to 49% today) and with rapid economic growth in some the most populated countries (namely Brazil, China, India and Russia). For the agri-food sector, these aspects are both an opportunity and a challenge. The growth prospects of the agri-food market are a significant advantage for the farmers worldwide [19, 6].

Agriculture plays an important role in Romania, in relation to the size of the rural population and the degree of employment. About 45.7% of the Romanian population lives in the rural area, compared to about 23.6% in EU member states [4]. There are major differences between rural and urban areas, the former being marked by a significantly higher level of poverty and a correspondingly lower living standard [21]. The development of agriculture and the supply of public goods in rural areas is therefore essential for the European integration of Romania and for achieving the social cohesion objectives [2, 11].

The insufficiency of the domestic food supply to support the population consumption needs has become more acute in Romania in the last decade, under the pressure of increasing consumption of products with high nutritional value (animal products, vegetables, fruits, fish), due to economic growth and implicitly the increase of the population income. [7, 9].

In 2019, Romania compared to some EU States registered positive results in the agricultural sector. The agricultural production index in 2019 compared to 2018 was 96.2% on the total branch, of which 94.4% on plant production and 99.2% on animal production [13]. Thus, for maize grains and sunflower it was on the first place, both in the grown area and in the achieved production; wheat in fourth place, both grown area and production, after France, Germany and Poland, and potatoes in fourth place grown area, after Poland, Germany, France, and in seventh place in production, after Germany, France, Poland, Holland, the United Kingdom and Belgium [13, 12].

In 2020, over 44% of farms in Romania were economically affected by the Coronavirus crisis, feeling an impact especially on supplies of inputs and spare parts for machinery and equipment [16, 2].

For Romania, included in the group of the developed countries, according to the results of the FAO study, the degree of exposure to Covid-19 shock is high intermediate on the supply side and low intermediate on the demand side [15, 12]. According to these evaluations, Romania is in a somewhat different situation from other EU member states, through a higher exposure to the shock of demand (due to the high share of food costs) and lower to the shock of supply (due to relatively low total exports) [22].

MATERIALS AND METHODS

The research methodology is specific to the study; the bibliographic sources cited in the paper were used, such as studies in the field, statistical reports elaborated by the National Institute of Statistics and Calarasi County Directorate of Statistics, reports of the Ministry of Agriculture and Rural Development, the European Commission, Călărași County Council and the County Directorate for Agriculture and Rural Development in Calarasi. [19, 20, 5,18, 13].

We analyzed the agricultural production of Călărași county through vegetable production with areas, crops and average productions and animal production through livestock and productions obtained for periods of time starting with 1990 and until 2018, depending on the data available at national level, for comparisons between the counties of South Muntenia Region and the situation at national level.

For the data processing and interpretation, the method of statistical indicators was used, respectively, the comparative analysis of the researched phenomena. The comparison method was used in the analysis of the data series that covered time periods between 2000 and 2007 and 2008 and 2018, depending on the available data. As this period is quite long, we divided it into two: until 2007 and 2008-2018, which meant 11 years, depending on the available data. For each period, the indicators were calculated: average, standard deviation, coefficient of variation and annual growth rate. The data obtained for the two periods were compared by the differences between the averages and growth rates of the analyzed technical-economic phenomena and the statistical evaluation of these differences for probabilities of 95%, 99% and 99.9% [17].

As this period is quite long, we divided it into two: until 2007 and 2008.

We calculated the average achieved for the analyzed period, with the formula:

$(x) = \Sigma(x)/ n,$

where:

x is the technical, economic or social analyzed phenomenon;

n is the number of years.

The coefficient of variation (C%) is given by the formula:

$C\% = \sigma/ x *100,$

where:

x = average of phenomenon during the analyzed period;

σx = standard deviation, which is calculated as a square average of the deviations of all series elements from their arithmetic average [10].

The significance of the coefficient of variation is evaluated if the values obtained are: less than 10% - small variation; between 10.1% and 20% - medium variation; over 20 – high variation.

The annual growth rate (r%) was calculated with the formula:

AGR (annual growth rate) = $((\text{sqrt}(\prod p1/po)^{1/n})-1)*100,$

where:

$\prod p1/po$ = chained growth indicators;

n - the number of years of the period [4].

RESULTS AND DISCUSSIONS

Călăraşi County has the most productive agricultural lands in Bărăgan, an aspect that was not ignorant by investors, among the few foreign investments being highlighted those made in agriculture [5].

It is a real "horn of abundance" for agriculture, being on the second place in the average cereal production by counties, on the third place according to the share of agricultural lands in total and on the fifth place according to the agricultural area. Almost everything in Călăraşi implies the production of cereals, sunflowers and rapeseed, and a large part of the business in the industry is in animal husbandry and meat processing, which means a close connection with farmers crops [14].

From the analysis of the areas by use, during 1990-2018, in Călărași county, it is found that the agricultural area of the county decreased by 1.2%, as a share of the total area of the county, from 430,825 ha in 1990 to 425,798 ha in 2018.

Significant increases are found in the category of pasture use, where the area increased by 5,711 ha, and in hayfields by 104 ha, respectively an increase of 200%. A dramatic decrease is recorded in orchards, where the area decreased from 820 ha to 207 ha, which represents only 25.2% of the area of 1990. The analysis of the structure of crops shows the following aspects: a slight increase in areas with cereals that occupied in 2018 an area of 251,844 ha (102.6% compared to 1990); an increase in the share of wheat crop to 31.7% (128,306 ha); a decrease in the areas of barley by 3,207 ha and maize by 11,184 ha, the area of sunflower was increased by 3,025 ha (from 8.2% to 9.3%), the rapeseed crop was introduced which reached 17%; vegetable areas were reduced by 8,863 ha. This image shows a reduction in the areas that needed labour force consumption and crops that provided animal feed. Highly mechanized crops extended and those with a high consumption of nutrients, especially K_2O and P_2O_5, such as rapeseed (Table 1).

Analyzing the degree of irrigation compared to the developed areas, it is found that during 2008-2018, it remains relatively low, respectively around 7% at the country level, a decrease from 5.74% at the level of South-Muntenia Region in year 2008 to 3.74% in 2018, a share of around 4%, at the level of Călărași county. An important decrease occurs in Teleorman county, from 6.53% in 2008 to 0.39% in 2018 (Table 2).

From the analysis of the average productions per hectare of crop, for the periods 2000-2007 and 2008-2018 it is found the following: in Călărași county, in 2018, an average production of 5,579 kg/ha was obtained for wheat crop, with an average of 2008 -2018, of 3,780 kg/ha. Although the production obtained during this period is higher by 1,230 kg/ha, this increase is not significant compared to the previous period.

Statistically significant increases are registered at country level, and in Giurgiu, Ialomița, Prahova counties, and insignificant

in Dâmbovița (N) and Teleorman (N) counties (Table 3).

For rapeseed crop, in Călărași county for the period 2008-2018, the average production was 2,457 kg/ha, 976 kg/ha higher than the average of the period 2000-2007, which is a significant increase. Significant increases in the average production of rapeseed are also found in South Muntenia Region (2,440 kg/ha), in Giurgiu county (2,858 kg/ha) and in Ialomița county (2,195 kg/ha). At the level of the country and at the level of the other counties, the increases of the average productions for the rapeseed crop were insignificant [13].

Analyzing the livestock, in Călărași county, during the years 1990-2018, very large decreases are found (Table 4).

Analyzing the evolution of the number of animals per 100 ha at the level of Călărași county, we find very significant decreases to all species of animals (Table 5).

For the cattle species per 100 ha, at the level of Călărași county the herds decrease from 13.8 head/100 ha, with 7 heads/100 ha to 6.8 head/100 ha.

For the total pig species per 100 ha, at the level of Călărași county, the herds decrease from 111.8 heads/100 ha, with 76 heads/100 ha to 35.8 heads/100 ha. In the species of breeding sows, per 100 ha, at the level of Călărași county, the herds decrease from 9.5 head/100 ha, with 6.4 heads/100 ha to 3.1 head/100 ha.

Table 1. The structure of crops, in Călărași county

Crops	1990		2000		2010		2018		2018 vs 1990	
	Ha		Ha		Ha		Ha		(+/-)ha	
Total	420,631	*100.0*	392,909	*100.0*	412,599	*100.0*	404,528	*100.0*	-16,103	*6.2*
Grain cereals	245,456	*58.4*	252,587	*64.3*	251,151	*60.9*	251,844	*62.3*	6,388	*102.6*
Maize and rye	90,111	*21.4*	126,112	*32.1*	146,230	*35.4*	128,306	*31.7*	38,195	*142.4*
Barley	30,523	*7.3*	14,819	*3.8*	29,072	*7.0*	27,316	*6.8*	-3,207	*9.5*
Grain maize	103,343	*24.6*	105,455	*26.8*	64,118	*15.5*	92,159	*22.8*	-11,184	*89.2*
Grain legumes	14,207	*3.4*	3,815	*1.0*	5,332	*1.3*	12,940	*3.2*	-1,267	*91.1*
Sunflowers	34,505	*8.2*	71,117	*18.1*	62,370	*15.1*	37,530	*9.3*	3,025	*108.8*
Rapeseed	145	*0.0*	10,116	*2.6*	65,744	*15.9*	68,869	*17.0*	68,724	*47495.9*
Soy beans	25,896	*6.2*	19,817	*5.0*	5,637	*1.4*	17,228	*4.3*	-8,668	*66.5*
Legumes – total	10,328	*2.5*	3,797	*1.0*	3,047	*0.7*	1,465	*0.4*	-8,863	*14.2*
Fruit orchards	590	*0.1*	313	*0.1*	180	*0.0*	85	*0.0*	-505	*4.4*

Source: The County Directorate for Statistics, Călărași, series 2000 to 2019 [18].

Table 2. The evolution of the degree of irrigation of the arable areas arranged for irrigation at country level, South-Muntenia region level and by counties

Area, years UM	2008			2018		
	Arranged	Effectively irrigated	Degree of irrigation	Arranged	Effectively irrigated	Degree of irrigation
	thousand ha		%	thousand ha		%
Total country	2,895.4	204.2	7.05	2,892.7	209.4	7.24
South Muntenia Region	1,017.5	58.5	5.74	1,012.8	37.8	3.74
Argeș	28.2	1.1	3.74	27.7	-	
Călărași	***347.8***	***15.2***	***4.36***	***346.6***	***14.0***	***4.03***
Dâmbovița	35.5	1.4	4.02	35.1	-	
Giurgiu	156.6	7.0	4.46	157.6	3.9	2.46
Ialomița	199.6	18.1	9.06	198.7	18.5	9.32
Prahova	22.0	0.9	3.87	21.5	0.6	2.88
Teleorman	227.8	14.9	6.53	225.5	0.9	0.39

Source: NIS, 2019, Tempo online [13].

Table 3. Comparative analysis of average wheat and rye crop production, at country level, South-Muntenia region and counties level

Area, years, UM	Period 2000-2007				Period 2008-2018				Deviations	
	Average (M1)	Variation coefficient		Current rate	Average (M2)	Variation coefficient		Current rate	M 2-M1	
	kg/ha	%	Sign.	%	kg/ha	%	Sign.	%	%	Sign.
Total country	2,311	28	High	4.7	3,302	27.4	High	12.2	991	*
South Muntenia Region	2,258	45.9	High	0.8	3,397	31.5	High	15.1	1,139	N
Argeș	2,273	41.9	High	6.5	2,988	22	High	9.6	715	N
Călărași	***2,540***	***56.4***	High	***-0.7***	***3,780***	***37.4***	***High***	***16.9***	***1,230***	***N***
Dâmbovița	2,112	40.7	High	9.7	2,809	24.1	High	10.1	697	N
Giurgiu	2,177	37.3	High	-0.4	3,283	27.3	High	14.4	1,106	*
Ialomița	1,959	57.0	High	-3.8	3,861	37.8	High	17.4	1,902	*
Prahova	1,726	55.4	High	2.8	3,234	27	High	11.4	1,508	**
Teleorman	2,343	44.2	High	3.6	3,153	32.3	High	15.9	810	N

Significance (GL=16, tcal > t: >0.05 *; >0.01**; >0.001***;<0.05^{0} ;<0.01^{00}; <0.001^{000};<0.05:N)
Source: NIS, 2019,Tempo online [13].

Table 4. Analysis of the evolution of livestock, at the level of Calarasi county

Categories of livestock, years, UM	Period 1990-2018						Deviations	
	1990	2018	Average	St dev	Variation coefficient		2018 vs 1990	
	Thousand heads				%	Signif.	Thousand Heads	%
Cattle	113.6	22.7	39.2	21.3	54.3	High	-11.2	20.0
Cows, buffaloes and heifers	…	10.9	18.5	6,2	33.6	High	-8.7	
Pigs	597.2	132.4	264	172.1	65.2	High	-464.8	22.2
Sheep	352.8	139.3	183.5	74.6	40.7	High	-213.5	39.5
Goats	16.2	33.7	18.3	8.8	47.8	High	17.5	208.0
Poultry	2,737	3,461	2,882	847.4	29.4	High	724	126.5
Laying poultry	…	785.3	1,033.6	208.8	20.2	High		
Bees families	18.4	21.9	16.8	3.8	22.5	High	3.5	119.0

Source: The County Directorate of Statistics, Călărași, series 2000 to 2019 [18].

Table 5. Comparative analysis of the number of animals per 100 ha, at the level of Calarasi county

Area, years, UM	Period 2000-2007				Period 2008-2018				Deviations	
	Average (M1)	Variation coefficient		Current rate	Average (M2)	Variation coefficient		Current rate	M 2-M1	
	no/ha	%	signif	%	no/ha	%	signif	%	no/ha	signif
Cattle	13.8	42	High	-11.91	6.8	21.7	High	-2,28	-7	Θ θθ
Pigs	111.8	26.4	High	-10.02	35.8	9.8	low	-0,07	-76	θθθ
Breeding sows	9.5	29.6	High	-11.28	3.1	17.3	Medium	-1,84	-6,4	θθθ
Sheep	66	23.45	High	-7.17	37.7	10.44	Medium	0,19	-28,3	θθθ
Goats	47	21.4	High	-5.21	30.9	9.1	low	0,12	-16,1	θθθ

Significance (GL=25, tcal > t: >0.05 *; >0,01**; >0,001***;<0.05^{0} ;<0,01^{00}; <0,001^{000};<0,05:N
Source: the County Directorate of Statistics, Călărași, series 2000 la 2019 [18].

Table 6. Comparative analysis of the total agricultural value production at country level, South-Muntenia region and counties level

Area, years, UM	Period 2000-2007				Period 2008-2018				Deviations	
	Average (M1)	Variation coefficient		Current rate	Average (M2)	Variation coefficient		Current rate	M 2-M1	
	lei/ha	%	Signif	%	lei/ha	%	signif	%	%	semf
Total country	2,892	26	High	12,9	4,623	13,5	High	4.3	1,731	***
South Muntenia Region	2,982	28.4	High	11	5,187	17.8	Medium	6.3	2,205	***
Argeș	3,350	30.3	High	15.7	5,353	11.1	Medium	0.8	2,003	***
Călărași	**2,493**	**32.9**	**High**	**6.6**	**4,748**	**28.2**	**High**	**12.1**	**2,255**	***
Dâmbovița	5,144	28.1	High	16.3	8,951	6.9	Low	0.8	3,807	***
Giurgiu	2,925	27.6	High	6.8	4,862	25.1	High	8.9	1,937	**
Ialomița	2,469	33.9	High	12.1	5,026	30.3	High	14.5	2,557	***
Prahova	3,201	31.2	High	14	5,451	12.9	Medium	4.3	2,250	***
Teleorman	2,363	7.9	High	5.3	3,728	3	High	8.4	1,365	*

Significance (GL=25, tcal > t: >0.05 *; >0,01**; >0,001***;<0.05^{0} ;<0,01^{00}; <0,001^{000};<0,05:N
Source: NIS, 2019, Tempo online [13].

For the cattle species per 100 ha, at the level of Călărași county the herds decrease from 13.8 heads/100 ha, with 7 heads/100 ha to 6.8 heads/100 ha. For the total pig species per 100 ha, at the level of Călărași county, the herds decrease from 111.8 heads/100 ha, with 76 heads/100 ha to 35.8 heads/100 ha. In the species of breeding sows, per 100 ha, at the level of Călărași county, the herds decrease from 9.5 heads/100 ha, with 6.4 heads/100 ha to 3.1 heads/100 ha.

For the total number of sheep and goats per 100 ha, at the level of Călărași county the herds decrease from 66.0 head/100 ha, with 28.3 heads/100 ha to 37.7 head/100 ha). At the country level, the decrease is 12.4 heads, and in South Muntenia Region of 24.3 heads/100 ha [13].

There are also significant decreases at the county level. In the case of sheep and goat per 100 ha, at the level of Călărași county the herds decrease from 47.0 heads/100 ha, with 16.1 heads/100 ha to 30.9 heads/100 ha. At the country level, the decrease is 2.6 heads (N), and at the level of South Muntenia Region of 14.2 heads/100 ha. Significant decreases are also at the level of all counties in South Muntenia Region [13].

The synthetic indicator of agricultural activity is the value of agricultural production. We analyzed this indicator as total agricultural production and its component parts: vegetable agricultural production and animal agricultural production, at national level, of South Muntenia Region for the periods 2000-2007 and 2008-2018 as well as comparatively between these periods.

From the analysis of the total value production (lei/ha) it is found at the level of Călărași county that it increased from 2,493 lei/ha in the period 2000-2007 to 4,748 lei/ha, in the period 2008-2018, the increase being very significant of 2,255 lei/ha. At the country level, the increase is 1,731 lei/ha, at the level of South Muntenia Region of 2,205 lei/ha. (Table 6).

From the analysis of the agricultural value of animals, compared to the hectare of agricultural land, in Călărași county, the average increase is 489 lei/ha in the period 2008-2018, respectively at 1,339 lei/ ha, compared to 850 lei/ha, in the period 2000-2007. The annual rate of growth being 17.7% in the first period and 3.2% in the second period. At the country level, the increase was 500 lei/ha, with an annual rate of growth of 13.6% for the first period and 2.8% for the second period. At the level of South Muntenia Development Region, the increase of the value animal production per hectare was of 441 lei/ha in the second period, compared to the first period, with a growth rate of 14.1% for the first period and of 1.7% for the second period. And at the county level, the increases are very significant. Prahova county has an increase in animal production

of 820 lei/ha, the average being 2,146 lei/ha the period 2008-2018 of [13].

CONCLUSIONS

The chronic problem of Romania, that characterizes the period of the last decades after 1990, refers to the unsatisfactory level of agricultural production in many groups of food important for quantitative and qualitative aspects of food security, and we mention here mainly animal products (meat, milk), vegetables, fruits and processed products.

There is a growing global demand for agri-food products while supply is relatively the same. Romania has easy access to the world markets through the Black Sea and Danube ports, and being EU member has given it access to substantial funding, as well as access to important markets. Domestic demand is strong and is met both by domestic production and by imports of processed agricultural products.

Romania, gradually, and as a result of an agricultural year unfavorable to vegetable production in the first place, was not able to cover the necessary agri-food products required by the population. In this perspective, imports of agri-food products, especially dairy products, as well as processed, meat and other products have increased.

Climate change will have an increasing impact on EU food security in general. Global warming is expected to generate mixed and unfairly distributed effects across the EU. In a moderate warming scenario, it is expected that Europe as a whole will benefit from small increases in productivity in the plant sector, in parallel with regional variations.

For the next period, it is important to intensify the measures to grant subsidies in time, for the wider use of irrigation, fertilization and other activities that give perspective to the evolution in this field both regarding quantity and quality.

For Călărași County, due to a period, unfavorable to the agricultural sector, from October up to present, it is assumed that this year, 2021, the vegetable, animal and agricultural production will decrease.

This is also due to the fact that the level of agri-food production is determined by the source of agricultural raw materials (animal and vegetable), which will not be able to meet the needs.

Romania, included in the group of developed countries, according to the results of FAO study, the degree of exposure to Covid-19 shock is high intermediate on the supply side and low intermediate on the demand side. This crisis brought to our attention the vulnerabilities of the agri-food sector in Romania. Some of these vulnerabilities are not easy to solve, but it should start now with intervention measures that support medium- and long-term targets.

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ANALYSIS OF CUSTOMER SATISFACTION AT THE RESTAURANT REFORMA 9 - AGRONOMY COMPLEX

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Abstract

The notion of quality is an attribute of products and services that can be evaluated in terms of good or bad. Quality represents customer satisfaction through the best product at the most reasonable price. Modern culinary production, defined by the terms cook-chill = cooked and refrigerated, cook-freeze = cooked and frozen and sous vide = cooked and vacuum-packed, has emerged as a necessity of the modern times we are going through. In this paper, we aimed to analyze the degree of customer satisfaction within the Restaurant Reforma 9 - Complex Agronomia. We completed a questionnaire, which we applied to the restaurant's customers, between January and March 2020. Due to the fact that in March 2020 started the COVID-19 pandemic, and the restaurant was closed, we managed to apply only 60 questionnaires, some of which had incomplete answers. In this study, we received help from several students from the Master of Quality Management and Management in Agrotourism and Public Catering from our Faculty. The results of the study show that, although the restaurant is a student one, where many students from our faculty work, customer satisfaction with the quality of food and services is high. Unfortunately, the COVID-19 pandemic led to the closure of the restaurant for a long time, but managers have found modern solutions to partially maintain the business.

Key words**:** *customer satisfaction, public catering, quality, questionnaire*

INTRODUCTION

Modern culinary production, defined by the terms cook-chill = cooked and refrigerated, cook-freeze = cooked and frozen and sous vide = cooked and vacuum-packed, has emerged as a necessity of the modern times we are going through [2].

Cook-freeze production refers to the feeding system based on the integral heat treatment of the raw materials followed by the rapid freezing with storage at -18˚C and reheat before serving [10].

The technological process involves nine stages, from the raw material to the serving of the preparation: raw materials, storage of raw materials, preparatory operations, heat treatment, portioning, blast freezing, cold storage, distribution and regeneration [3].

Cook-chill production designates the culinary production system based on complete heat treatment, followed by rapid cooling with storage at low temperature, controlled above freezing temperature, at 0-3˚C, followed by complete reheating just before consumption. The process includes also nine stages: raw materials of very good quality, storage of raw materials at optimal conditions of temperature, humidity, time, preliminary preparation, heat treatment, portioning, air cooling (blast chilling), cold storage, distribution and regeneration [4].

Basic principles of cook-freeze and cook-chill systems:

• all raw materials must be of good microbiological quality;

• the initial heat treatment of the food will ensure the destruction of the vegetative phases and of any pathogenic microorganism;

• as certain microorganisms are in the form of spores which are not killed by normal heat treatment processes, it is necessary to exceed + 60˚C for their destruction;

• contamination must be avoided during the technological process between raw and prepared foods. The physical separation of the preliminary preparation areas with those of heat treatment to be distinct;

• the storage conditions of refrigerated or frozen preparations must be strictly controlled to ensure quality and safety;
• reheating and serving processes must be strictly adequate to ensure food safety, the temperature being strictly controlled.

The organoleptic and nutritional quality of cook-freeze and cook-chill preparations is related to:
• quality of raw materials;
• general storage conditions. The longer fresh vegetables are stored before cooking or left in water, the weight and nutritional value loss is greater;
•processing time. Any excess of the preparation-refrigeration-freezing or storage time any period of time between reheating and consumption leads to the loss of vitamins and taste qualities [14].

Sub-vacuum production involves the processing of quality raw materials, pre-heat treatment when needed, packaging in special plastic bags, vacuuming, gluing bags and then steaming at pasteurization temperatures - max. 80˚C. The preparations can be served directly to the consumer after this phase or cooled rapidly to +1 - + 3˚C and stored between 0- + 3˚C for a maximum of 21 days. [8] This method increases the validity of preparations in three ways: [11]
• By extracting air from the bags, the development of most bacteria is prevented;
• The preparations are heat treated at pasteurization temperatures, helping to destroy most microorganisms;
• The preparations are sealed in plastic bags, thus protecting themselves from contamination during storage and regeneration (reheating) [15].

Vacuum preparations have a number of very important advantages:
• Nutritional, taste qualities, flavours are superior, close to normal, due to the absence of air and temperature below 100˚C;
• The packaging is convenient for handling and distribution and prevents contamination;
• Decreasing the weight of cooked products reduces specific consumption by 20%;
• Offers a convenient production method, with a la carte applications and event menus;
• Long-term storage of sensitive products (fish) by excluding germs;
• Preparations indicated in any kind of diets;
• No large investments are required for a diversified offer;
• Conscious use of steam appliances and, thus, a lower consumption and less work with washing dishes;
• Possibilities to sell directly on the street;
• Low energy consumption due to previous preparation of raw materials;
• Efficient distribution of operations during the work process [10];
• Storage and heating in located stores.

Advantages of centralized production:
• separation of production and serving activities with all the advantages of this, mainly by separating the time and place from the serving activity;
• concentration of qualified production staff in a central unit, making possible a high-quality standard;
• energy consumption can be reduced by carefully scheduling the production of a certain type of product;
• the total surface requirements of all kitchens can be reduced by about 60% [13].

The notion of quality is an attribute of products and services that can be evaluated in terms of good or bad [7].

Quality represents customer satisfaction of the best product at the most reasonable price. In the food sector there are several terms derived from the general notion of quality, namely:
• Designed quality;
• Prescribed quality;
• Quality delivered;
• Real quality.

HACCP - Hazard Analysis and Critical Control Points

HACCP is the most advanced method of self-control and achievement of food quality and food safety.

This translates into Hazard Analysis and Critical Control Points and is a preventative measure used to increase the safety of food, cosmetics and medicines [12]. The method appeared in 1971 in the USA.

MATERIALS AND METHODS

In this paper, we aimed to analyse the degree of customer satisfaction within the Restaurant Reforma 9 - Complex Agronomia. We applied a questionnaire to the restaurant's customers, between January and March 2020. Due to the fact that in March 2020 started the COVID-19 pandemic, and the restaurant was closed, we managed to apply only 60 questionnaires, some of which had incomplete answers [1] and [6].

For applying this study, we received helped by several students from the Master of Quality Management and Management in Agrotourism and Public Catering from our Faculty [5].

The questions to which the customers in the sample had to respond have been the following ones:

Study on customer satisfaction Reform 9

Dear Madam/Sir, Thank you for visiting us, through your contribution you will help us to improve our results:

Your sex ? Male, Female.

What age group do you belong to?

<20 years
21-30 years
31-40 years
41-50 years
51-60 years
60+ years

Which are your latest studies completed?

Gymnasium
High school
Post high school
University
Post university

Which is your marital status?

Married
Unmarried

Which is your occupation?

Student
Full time employee
Part time employee
Housewife
Unemployed

What category of income group do you belong to?

<500 lei
500-1,000 lei
1,000-2,000 lei
> 3,000 lei

How often do you visit the restaurant Reforma 9?

Several times a week
Daily
Once a week
Several times a month
Once a month
Several times a year
Once a year or less
I only visited once

What is your level of satisfaction with Reforma 9 services?

Very unsatisfied
Unsatisfied
Neutral
Satisfied
Very satisfied

Please mark your level of satisfaction with the following services:

The food was served hot and fresh.
The menu has a wide variety.
The quality of the food is excellent.
The amount of food is excellent.
The bill was brought without error.
Drinks were served quickly.
The food was served quickly.
The price was right.
The exterior of the restaurant was clean.
The interior of the restaurant was clean.
The toilets were clean.

The following set of questions was designed to measure the effectiveness of staff.

Please mark the performance level of Reforma 9 employees achieved in the following categories*:*

Efficiency
Kindness
Knowledge of the menu / offer
Speed
How to serve in general

The following set of questions was designed to measure the quality of home delivery service.

Delivery was received within the estimated time of taking the order.
The food delivered was properly packaged.
The food was delivered warm and fresh.
The person who delivered the order was kind.

RESULTS AND DISCUSSIONS

Founded in 2017, in a place belonging to history, with a story started in 1915, Reforma 9 restaurant is an urban, authentic location, where the taste of food and well-being will make you come back with pleasure. The staff will always welcome you with professionalism and service that can satisfy any customer.

The restaurant has a maximum capacity of 150 seats (50 indoor/100 outdoor).

Reforma 9 restaurant has been designed as an oasis of privacy and comfort. The menu consists of the finest and most sophisticated ingredients.

The statistically processed results at the questions mentioned above are graphically illustrated in the figures presented below.

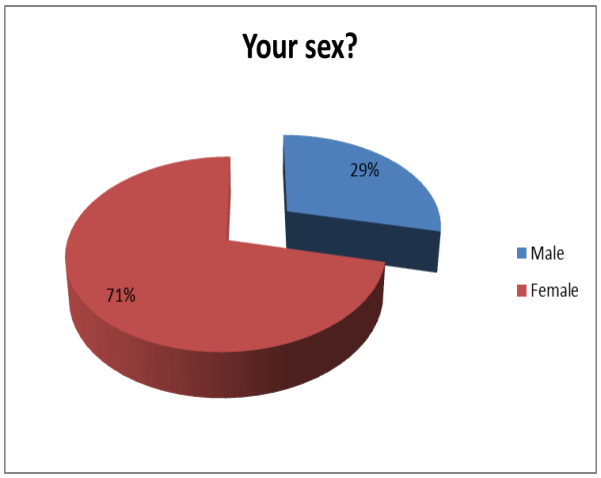

Fig. 1. Respondents' structure by gender.
Source: Own calculation.

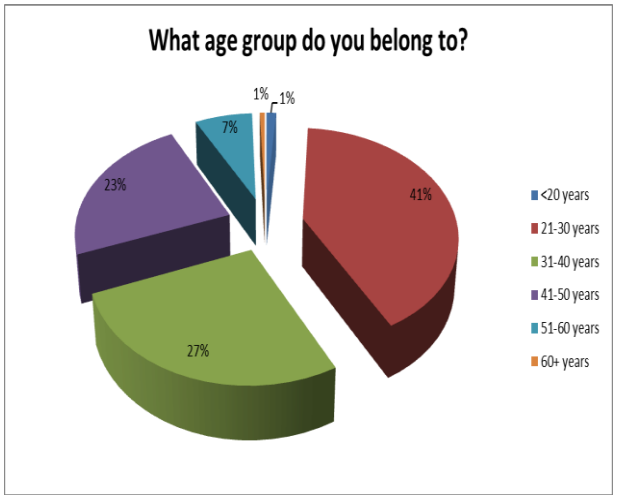

Fig. 2. Age structure of the respondents included in the sample
Source: Own calculation.

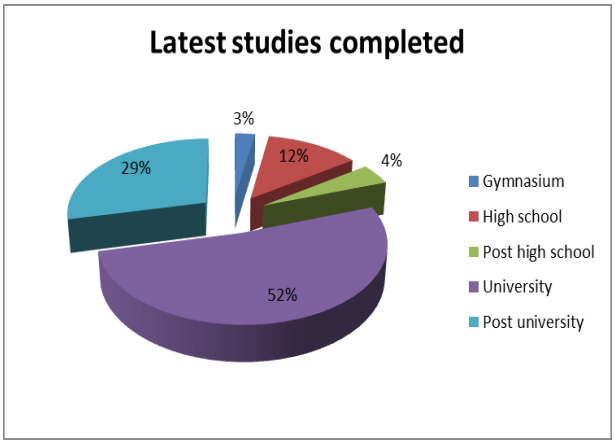

Fig. 3. Respondents' structure based on the latest studies completed
Source: Own calculation.

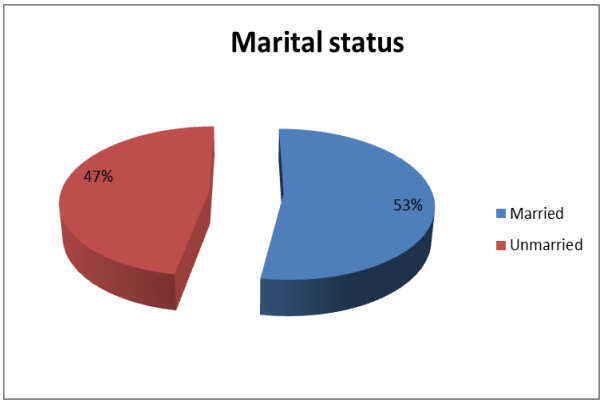

Fig. 4. Respondents structure by marital status
Source: Own calculation.

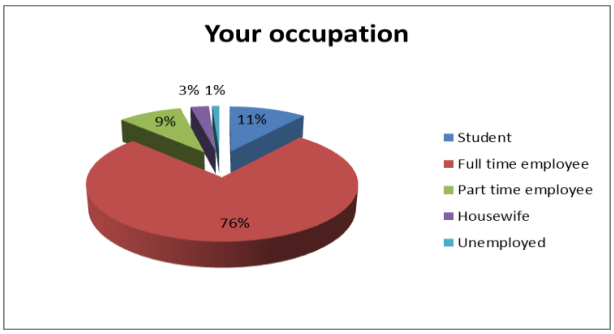

Fig. 5. Respondents' structure by occupation
Source: Own calculation

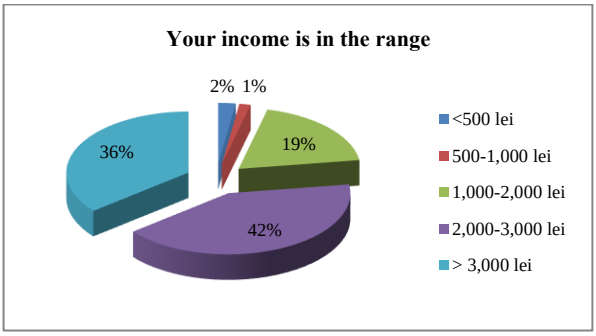

Fig. 6. Respondents' structure depending on their income
Source: Own calculation

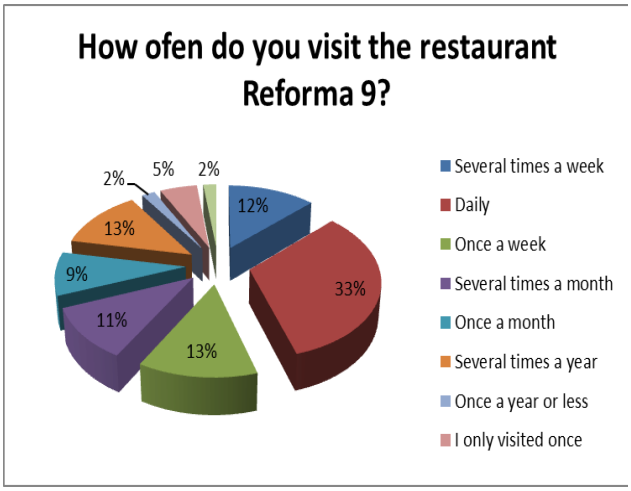

Fig. 7. Answers given to the question: How often do you visit the restaurant Reforma 9?
Source: Own calculation

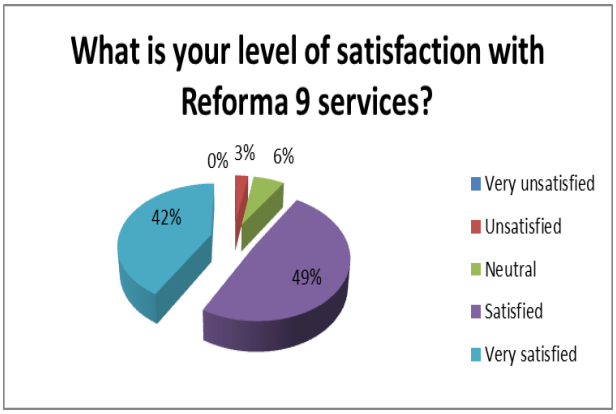

Fig. 8. Answers given to the question: What is your level of satisfaction with Reforma 9 services?
Source: Own calculation.

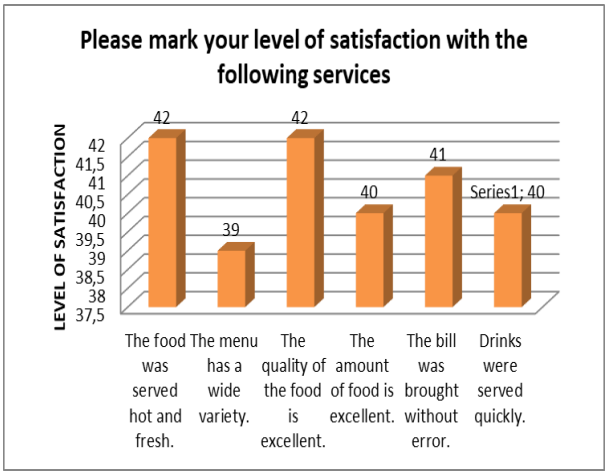

Fig. 9. Answers reflecting the customers' level of satisfaction with the services
Source: Own calculation.

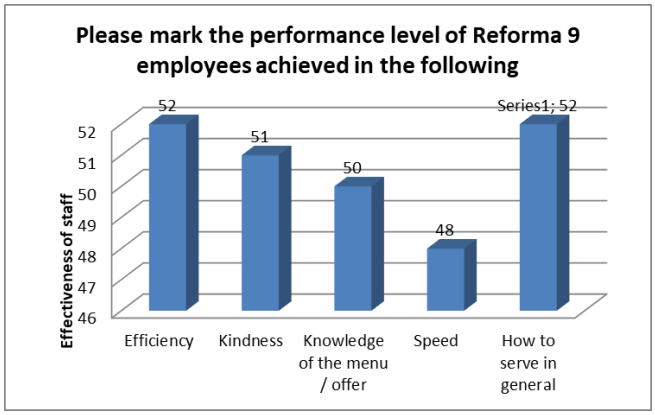

Fig. 10. Answers reflecting the performance level of Reforma 9 employees
Source: Own calculation.

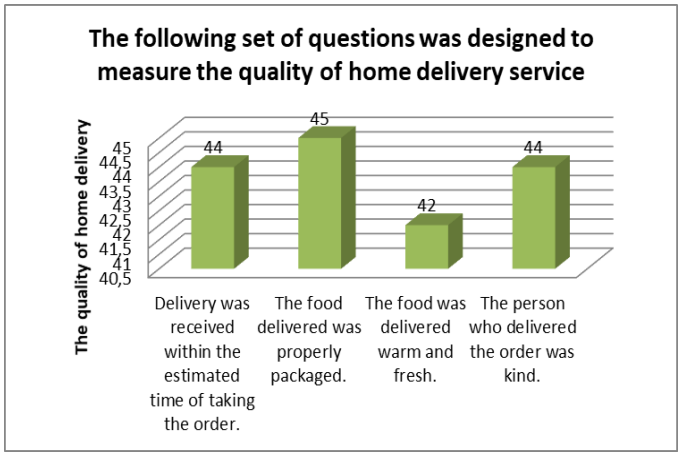

Fig. 11. Measure the quality of home delivery service.
Source: Own calculation.

CONCLUSIONS

The results of the study show that, although the restaurant is a student one, where many students from our faculty work, customer satisfaction with the quality of food and services is high. Unfortunately, the COVID-19 pandemic led to the closure of the restaurant for a long time, but managers have found modern solutions to partially maintain the business.

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APPLYING THE EXPERT SYSTEM-CROM FOR THE MANAGEMENT OF PEACH TREE LANDS AND ORCHARDS

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Abstract

At the level of the European Union, Spain was the largest peach grower in 2019, with an area of 47.94 thousand ha and a production of 940.50 thousand tons, followed by Italy and Greece. Romania's peach production amounted to 17.19 thousand tons, far behind other states in the eastern part of the EU. Although it had the largest number of peach trees, 296,424, Constanța County was surpassed in terms of production by Bihor County, which obtained in 2019 5,718 tons of peaches. In order to support this sector, the Fruit-Growing Trees Subprogram of the NRDP (PNDR) 2014-2020 made available to fruit growers the non-reimbursable funds for the reconversion and establishment of new fruit plantations. For this purpose, the paper presents some aspects concerning the management of natural and anthropic resources for peach fruit trees, lands and orchards in expert system-CROM. Following the application of the expert System-CROM, the peach plots and the orchards at Research and Development Station for Tree Culture -SCDP Băneasa, Bucharest received 138 points and were included into the class with natural and anthropic restrictions. Recommendations for the improvement of the peach orchards have also been established.

Key words**:** *expert system, fruit trees lands, orchards, peach*

INTRODUCTION

Originally from the N-W of China, where it grows spontaneously, the peach (*Prunus persica*) arrived in Europe brought by the Greeks and Romans, around 300-400 B.C. [8].

Today, peach culture has spread to all continents, but favorable conditions meet between 50 degrees North latitude and 35-49 degrees South latitude. This fruit tree ranks 2nd worldwide, in the list of tree species with falling leaves, after apple tree, in terms of economic value [7].

At the Research and Development Station for Pomiculture (SCDP) Băneasa, the genetic treasure for the species apricot, peach and nectarine from the southern part of Romania, is kept in the national collections. While our country has lost many of the old plant varieties, SCDP Băneasa has formed a gene bank with over 655 varieties of apricot trees and 950 varieties of peach trees. At the same time, 11 varieties of peaches have been approved here: Flacara, Splendid, Superba de toamna, Congres, Triumf, Victoria, Antonia, Amalia, Alexia, Eugen and Dida [9], also the Research Station won numerous prizes at national and international competitions for apricots and peaches [14].

In Romania the cultivation of peach trees is restricted by the requirements it manifests for

high temperatures and by its sensitivity to cold [8].

Most recent research on fruit ecology has shown that in a fruit ecology system, one factor cannot be replaced by another, by the phenomenon of compensating the action of vegetation factors, but the effect of an unfavorable factor can be attenuated if one or more complementary factors of the ecosystem replace its biological role [4].

Knowing the factors that compensate, as well as the nature and quantitative limits to which this phenomenon can occur in order not to deteriorate the equilibrium of the ecosystem, is in fact the essence of the research within the CROM Expert System [4].

Only on the basis of the knowledge of the fruit ecosystem natural potential and of the relation of compensation for its factors, it is possible to elaborate technologies that lead to the obtaining of large production with high quality fruits, in the conditions of maintaining and even increasing the soil fertility [4], [11].

MATERIALS AND METHODS

The Expert System CROM was used to characterize the natural and anthropic resources of the peach orchards from SCDP Baneasa. This system was developed in accordance with the original methodology by "I.C.P.A.", which quantifies the soil, climate, land and infrastructure resources, the production and the quality of fruits [3], [16], [17], [18].

The peach orchards are located at the Fruit Research Development Station from Băneasa, Bucharest. The species studied is Prunus Persica and the varieties used are: Springold, Springcrest, Crimsongold, Independence, Jerseyland and Jerseyglo. The age of trees in the orchard is 14 years old. The peach orchard area is 1.08 ha, it is intensive, with planting distances of 4 m between rows and 3 m between trees/row.

At the same time, the paperwork presents the areas occupied with peach trees in the main cultivating states of the EU and the main producers. It also presents for Romania the situation of the number of peach specimens and the production obtained, by Macroregions, Regions and counties.

For this analysis, statistical data taken from the Eurostat and NIS sites were used, and were processed and interpreted graphically.

RESULTS AND DISCUSSIONS

The National Rural Development Program, PNDR 2014-2020 [12], encouraged the development of the tree sector by implementing the Fruit-Growing Trees Subprogram [13], [15] (Figure 1), and in particular the cultivation of peach trees on the basis of *the Principle of priority tree species (peach / nectarine / apricot, shrubs, cherry, apple)*, which gave to peach trees the maximum score – 10 points [1].

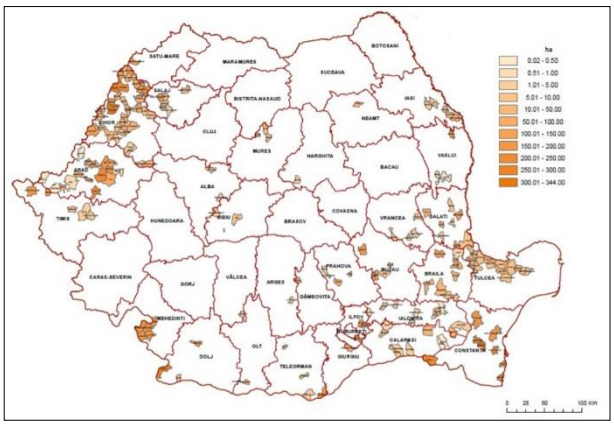

Fig. 1. Territory of the fruit-growing trees-themed sub-programme – Peach and nectarine culture
Source: [13].

However, despite the fact that peaches are particularly tasty and fragrant, appreciated by consumers, Romania cannot boast of large areas and productions in this category, as we will see in the following analysis.

The biggest peach grower in the European Union in the year 2019 was Spain, with 47.94 thousand ha, followed by Italy (41.93 thousand ha) and Greece (33.61 thousand ha) - Figure 2.

Romania occupied the 9th place, cultivating 1.72 thousand ha. Analysing the areas in 2015 - 2019, we see an increase of 1.78% in 2019 compared to 2015.

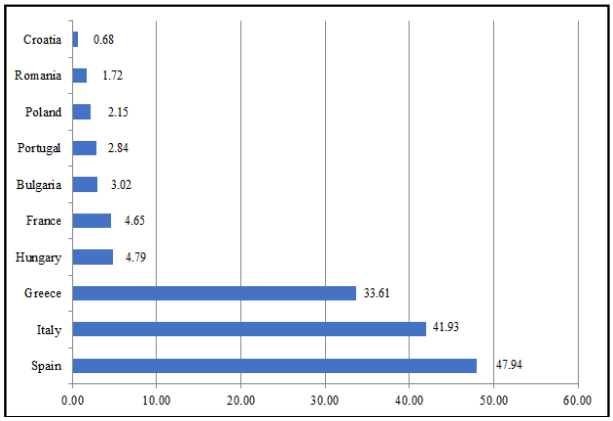

Fig. 2. Top 10 peach growers in the European Union
Source: [6], own interpretation.

Regarding the production of peaches for the year 2019 (Figure 3), the first places in the European ranking were also occupied by Spain, 940.50 tons and Italy 809.89 tons. Our country ranked 8th, with a harvest of 17.19 tons of peaches. For the period 2015-2019, there is a decrease in the peach production by 17.67% in 2019 compared to 2015.

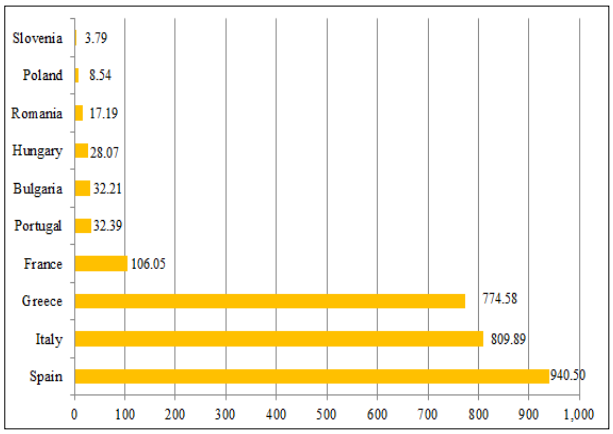

Fig. 3. Top 10 peach producers in the European Union
Source: [6], own interpretation.

Most peach trees (408,594) were grown in the year 2019 in Macroregion Two and accounted for 35% of all peach trees in Romania (Figure 4).
Macroregion Three recorded the lowest number - 117,946, meaning 10% of the total peach trees.
By county, the situation was presented as follows: in 3 counties there were more than 100,000 specimens - Constanța, 296,424, Bihor - 228,586 and Timiș - 137,783; in the other counties we counted less than 50,000 peach trees (Figure 5). Buzau County is an exception, with 55,367.

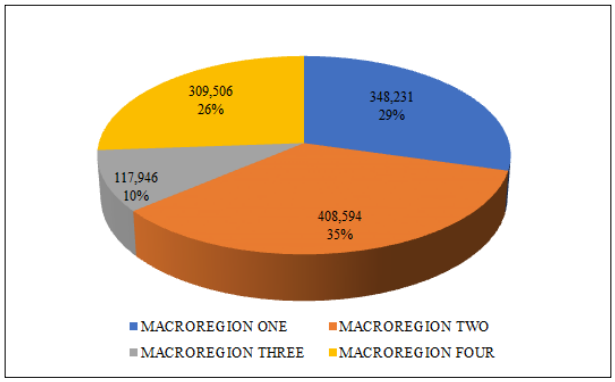

Fig. 4. Number of peach trees cultivated by Macroregions of Romania in 2019
Source: [10], own interpretation.

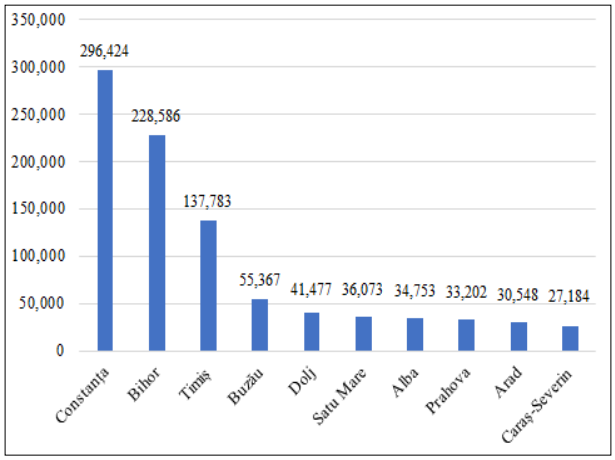

Fig. 5. Number of peach trees in Romania, by counties, in 2019
Source: [10], own interpretation.

Romania's peach production in 2019 resulted from: Macroregion One - 7,703 tons (44%), Macroregion Two - 4,249 tons (24%), Macroregion Four - 4,092 tons (23%) and Macroregion Three - 1,590 tons (9%), as we can see in Figure 6.
Among the Regions of Development, the North-East Region stands out with 6,658 tons (representing 86% of the production of peaches obtained in Macroregion One).
Also the South-East Region harvested 3,829 tons (representing 90% of the production of peaches obtained in Macroregion Two) and the West Region 2,967 tons (representing 73% of the production of peaches obtained in Macroregion Four).
The county with the highest peach production was, in the year 2019 Bihor - 5,718 tons. It was followed by Constanța - 2,504 tones and Timiș, 2,015 tons. In the other counties the registered production was less than 1,000 tons (Figure 7).

We have to mention that after 1990 Bihor County ranked 2nd countrywide in terms of quantity of exported peaches [5], although the number of peach trees and the production obtained were on the 3rd place after plums and apples at county level [2].

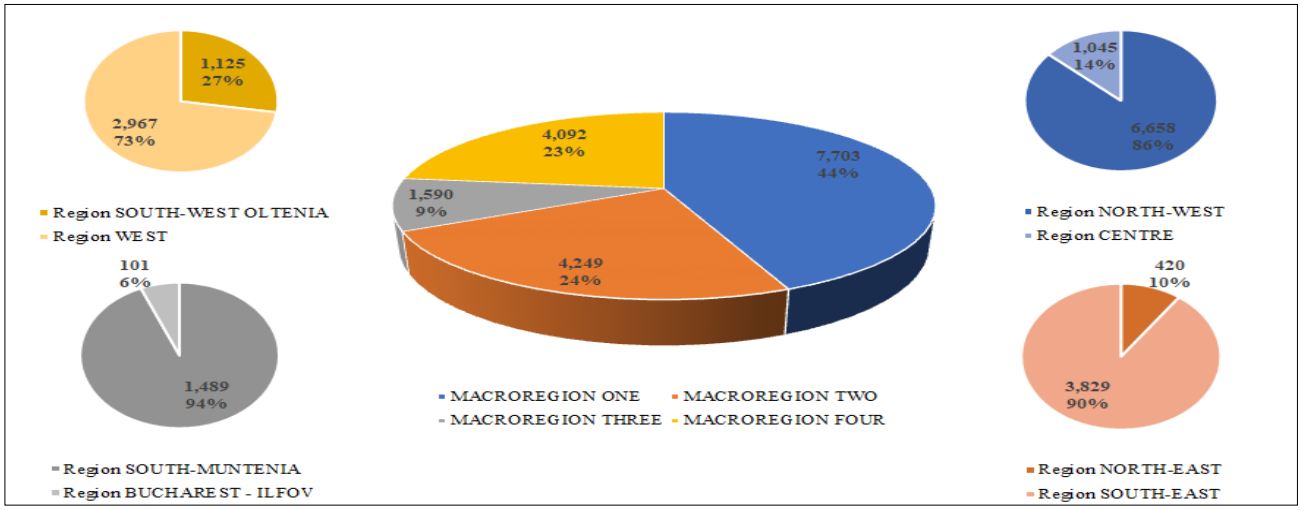

Fig. 6. Peach production obtained in Romania in 2019
Source: [10], own interpretation

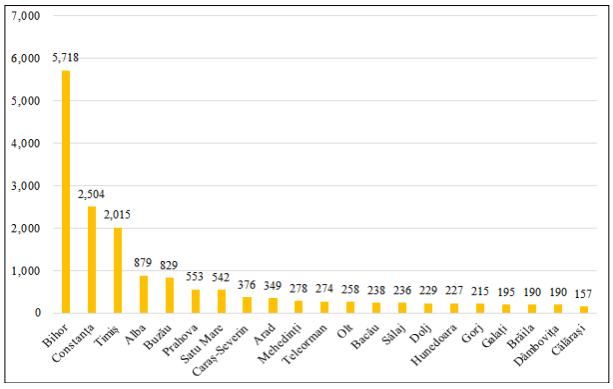

Fig. 7. Largest peach producers in Romania, by counties (tons)
Source: [10], own interpretation.

In the following we will analyse, in the light of the Expert-CROM System, the climate, land and soil resources present at SCDP Băneasa and the private production sector in its area of influence. It should be noted that this research station has expanded its area of activity to some counties from the south of Romania, of which we mention: Călăraşi, Ilfov, Ialomiţa, Teleorman [14].

Climate resources expertise

The optimal annual temperature must be above 8.5°C and in the study period it was 12.2°C. The frequency of repetitiveness of the optimal temperature was 90-100%, in ten years. The rainfalls were quantified for May-July, and the optimal quantity is 200-250 mm.

For the peach plantation studied, the rainfall quantity was 120 mm and the frequency of repetitiveness of the optimal quantity was 60-80%. (Table 1).

Table 1. The quantification of the climatic resources for peach tree lands and orchards from SCDP Băneasa, Bucharest

Species/variety/rootstock/age	Class of expertise	Addition points
Prunus Persica/Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence /Mirobolan/14	Excluded for peach	30

Source: [4].

The peach yields were studied in connection to the thermal amplitude for November-February (Figure 8).

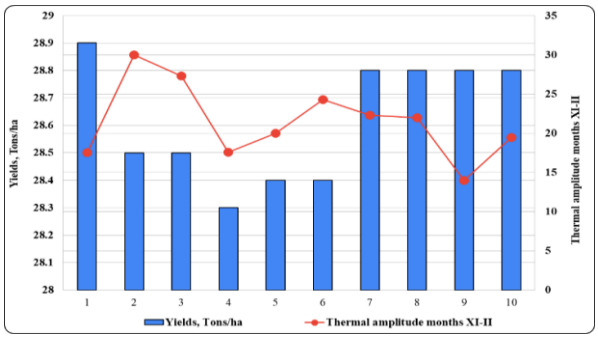

Fig. 8. The variation of the yield levels in relation to the thermal amplitude (°C, XI-II months) for peach trees, Springold variety, at SCDP Băneasa, Bucharest
Source: [4], own interpretation.

Soil resources expertise

By quantifying the soil resources in the Expert System-CROM (Table 2), the following were found:

-the active edaphic volume is 100%,
-the soil reaction pH (H_2O) is 5.10,
-exchangeable Al content is < 50 ppm,
-absent salinization,
-absent alkalization,
-absent active $CaCO_3$ from carbonate horizon,
-the industrial pollution is the threshold alert.

The peach orchards were included in the class without soil restrictions.

Table 2. Quantification of climatic resources for peach tree lands and orchards from SCDP Băneasa, Bucharest

Species/variety/rootstock/age	Class of expertise	Addition points
Prunus Persica/Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence /Mirobolan/14	Without soil restrictions	22

Source: [4].

Land resources expertise

The next indicators concerning the relief conditions were characterized:

-the general slope is < 5%,
-the land is flat with S-W orientation,
-surface and deep erosion is absent,
-landslides are absent,
-the aeration porosity is between 16 and 30%.

The relief conditions were granted 15 addition points and the peach orchards were included in the category without land restrictions (Table 3).

Table 3. Quantification of land resources for peach orchards from SCDP Băneasa, Bucharest

Species/variety/rootstock/age	Class of expertise	Addition points
Prunus Persica/Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence/Mirobolan/14	Without land restrictions	15

Source: [4].

Expertise for peach orchards characterization criteria, production and the quality of the fruits

The indicators for characterization of the peach orchards are:

-the age of the trees (14 years),
-the assortment of varieties recommended for Bucharest and authorized for fresh consumption (mixed),
-the stage of vegetation for the peach orchards (good).

All of these are granted 84 addition points in the Expert System-CROM (Table 4).

Table 4. Expertise of the peach orchards from SCDP Băneasa, Bucharest

Species/variety/ rootstock/age	**Class of expertise**	**Addition points**	**Indicators for characterization**
Prunus Persica /Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence/ Mirobolan/14	5-20 years	34	Age of the trees
	Mixed	33	Assortment of varieties
	Good	17	Stage of vegetation for orchards
	Total Addition points	84	-

Source: [4].

Expertize for peach orchards infrastructure

The degree of technical equipment of the plantation was evaluated and the following were found:

-the existence of sufficient storage spaces for equipment, materials and production,
-the existence of the locally arranged irrigation and drainage system,
-the mechanized means owned.

The possibilities for valorizing fruit production for fresh consumption and for industrial processing are at medium level.

Proximity to the market and access to the market is good.

In this case 13 depreciation points are marked, for the equipping degree of the plantation and for the possibilities for valorising the fruit production (Table 5).

Table 5. Expertise of peach orchards infrastructure from SCDP Băneasa, Bucharest

Species/variety / rootstock/age	**Class of expertise**	**Depreciation points**	**Indicators for characterization**
Prunus Persica /Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence / Mirobolan/14	Medium	8	The equipping degree of plantation
	Medium	5	Possibilities for valorising fruit production
	High	0	Proximity of the market
	High	0	Possibilities of access to the market
	Total depreciation points	13	-

Source: [4].

The method of calculating the value of the peach trees, lands and orchards in the Expert System-CROM is presented in Table 6.

Table 6. Evaluation of peach tree lands and orchards in the Expert System-CROM

Species/ variety/ rootstock /age	Class of expertise	Natural resources			Anthropic resources		Total points
		Climate	Land	Soil	Indicators for characterization of orchards	Orchards infrastructure	
Prunus Persica/ Springold, Springcrest, Jerseyland, Jerseyglo, Crimsongold, Independence / Mirobolan / 14	With natural and anthropic restrictions	30	15	25	84	13	138

Source: [4].

Collaboration between farmers, business and researchers for research initiatives through operational groups is important especially for the fruit-growing sector [12], as the restructuring and modernization of this sector requires both new varieties and new management techniques.

CONCLUSIONS

From the analysis presented in this article we can conclude that:
-Peach trees have the second most important economic value, after apple trees, in terms of tree species with falling leaves;
-In 2019, Spain was the largest peach cultivator in the EU followed by Italy and Greece.
-Romania ranked 9th in terms of area cultivated with peach trees, having 1.72 thousand ha.
-There is an increase in the peach trees areas of 1.78% in 2019 reported to 2015.
-Considering the peach production in 2019 Spain and Italy also occupied the first places in the European ranking.
-Romania was of the 8th place regarding harvest with only 17.19 tons of peaches.
-Compared to 2015 there is a decrease in the peach production by 17.67% in 2019.
-Macroregion Two had the most peach trees - 408,594 in 2019 meaning 35% of all peach trees in Romania. On the opposite side is Macroregion Three with 117,946, representing 10% of the total peach trees.
-Only 3 counties from Romania had more than 100,000 specimens - Constanța, 296,424, Bihor - 228,586 and Timiș - 137,783
-As expected, the highest peach production was obtained in 2019 in Bihor County - 5,718 tons, followed by Constanța - 2,504 tones and Timiş - 2,015 tons.
Following the application of the Expert System-CROM, the peach tree lands and orchards from SCDP Băneasa received 138 points and were included in the class with natural and anthropic restrictions.
In order to improve the possibilities for valorising the fruit production, it is recommended to use a larger assortment of varieties.
The equipping degree of plantation needs to be improved by creating high-performance irrigation and drainage systems.
The peach plantation from SCDP Băneasa has a special economic importance, because by applying some improvement measures, the obtained production can be high and the incomes can be important.

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MANAGEMENT OF NATURAL RESOURCES FOR PEAR TREES IN EXPERT SYSTEM-CROM

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Abstract

The paper analyses the areas cultivated with pear trees in the EU and the productions obtained in 2019. It is noted that Italy placed first in both categories, and Romania was on the 9th place, with 3.08 thousand ha and a production of 46.16 thousand tons, according to Eurostat. At the country level, Macroregion One recorded the highest number of pear trees, 994,193 of the total number of pear trees, and in terms of production, 29% was harvested in Macroregion Three. In 2019, in Romania, 100 kg of pears were sold for 116.64 Euro, a higher price compared to that of the large pear-producing states. Also, the study presents some specific research concerning the management of natural resources for pear trees, land, and orchards in Expert System-CROM which quantifies through points of creditworthiness and penalty the climatic resources, the soil and infrastructure resources, the production, and the quality of the fruits. Following the application of the Expert System-CROM, the pear lands and the orchards received 32-100 addition points and were included into three categories: without natural restrictions, with natural restrictions and excluded for the pear trees.

Key words**:** *expert system, orchards, pear, production, Romania*

INTRODUCTION

Cultivated for the first time in Persia, pear trees later reached the capital of the Roman Empire. The inhabitants consumed the fruits fresh or cooked, a fact recorded in "Roman cookery recipes" published in the 1st century AD, "De re coquiaria". As we will observe from the analysis of the data presented in the article, Italy keeps its tradition and preference for these fruits, occupying the 1st place in the EU in terms of areas occupied by pears and pear production - 28.71 thousand ha, respectively 429.29 thousand tons [3].
Pears occupy the fourth position in the top of the most consumed fruits in the European Union. What was the basis of consumer preferences? The fact that they contain a lot of water and are rich in vitamins A, B_1, B_2, B_6, C and PP, Potassium, Magnesium, Boron, Iodine, Sodium, Calcium, Phosphorus, and Iron. Pears help reduce fever, have anti-inflammatory properties and the juice lowers blood pressure [5].
The fruit is widely used in cosmetics as an additive for creams, masks, lotions and shampoos [11].
Pears are sensitive to transport and storage. Many researchers, including Garcia J.L. [4], studied the influence of fruit pulp firmness on post-harvest damage. In order to preserve their freshness and aroma for as long as possible, the pears must be stored in suitable conditions [6]. The ideal pear storage temperature varies from -1°C to +1°C.
Starting from the tradition and characteristics of these fruits, the paper analyzes the areas cultivated with pears and the productions

obtained in the EU and in the macro-regions of Romania, in order to identify the conditions that orchards have in our country and what are the factors that underlie a success in terms of pear production, using Expert System-CROM.
Unlike annual plants, plants with a low habitus, which complete their biological cycle in a year or less, trees are plants with a large habitus, with longevity and much higher biomass production. The foliar development and the permanence of these species are the main factors that determine the establishment and maintenance of a state of balance within the fruit ecosystem.
But like any ecosystem, the state of equilibrium has a labile character and any anthropogenic intervention, without a biological and ecological motivation, can upset the achieved balance, with direct consequences on the trees and the fruit production. This explains why fruiting on fruit species depends on both the conditions of that year and the conditions of previous years [2], [12].
The lability of the balance of fruit ecosystems is greatly influenced by the biological features specific to trees. If in annual plants the growth process once completed is followed by the fruiting process, in trees both processes overlap, there are moments in the vegetation period, when there is simultaneous growth of vegetative formations, fruit growth and bud differentiation, for the future harvest.
The way in which the trees go through these critical moments are determined on the one hand by the biological requirements specific to the development processes, and on the other hand by the degree of their satisfaction, in relation to the natural potential of the formed ecosystem [8], [13].

MATERIALS AND METHODS

In the first part of the paper are analyzed the following indicators: areas cultivated with pears in the EU and by Macroregions in Romania, the number of pears existing in our country and pear production obtained in the main EU producing states, as well as in Romania, by Macroregions. The selling prices of pears in several EU countries are also analyzed. These data were taken from the Eurostat and NIS websites and are valid for 2019.
In the second part of the paper, the Expert System-CROM was used to characterize the natural resources of the pear trees lands and orchards in Romania. This system was developed in accordance with original methodology by "I.C.P.A.", which quantifies the soil, climate, and land resources by addition points [1], [2], [12], [13], [14].

RESULTS AND DISCUSSIONS

Figure 1 shows the main pear growers in the EU, for 2019. It is observed that the first place was occupied by Italy, with an area of 28.71 thousand ha, followed by Spain - 20.62 thousand ha and Portugal - 12.50 thousand ha. It should be noted that Estonia, Ireland, and Malta do not grow pears, according to Eurostat, and the other EU Member States, which were not mentioned, recorded less than 100 ha cultivated with pears. In Romania, only 3.08 thousand ha were cultivated, which placed our country on the 9th place in 2019. Although it has favorable conditions for cultivating fruit trees, Romania does not capitalize on its natural potential at its true value.

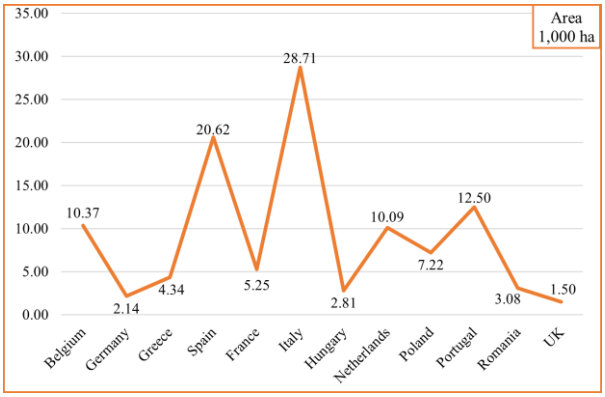

Fig. 1. Main pear growers in the EU, for 2019
Source: [3], own interpretation.

In Romania, in 2019, 3,147,062 specimens of pear trees grew. They represented 4.26% of the total fruit trees that were cultivated in our country.

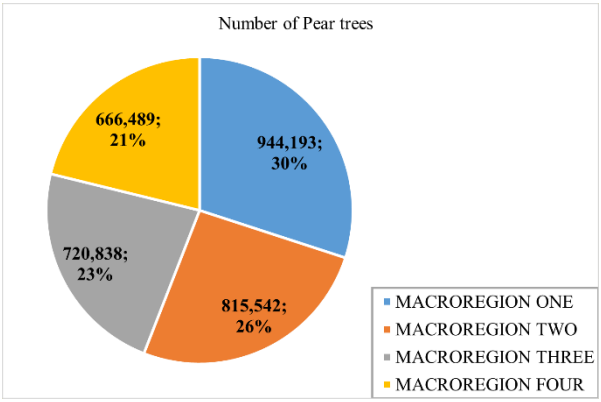

Fig. 2. Number of pear trees in Romania by macroregions, in 2019
Source: [7], own interpretation.

As it can be seen in Figure 2, Macroregion One recorded the highest number of pear trees, which accounted for 30% of all pear trees. Macroregion Four recorded the lowest percentage - 21%. In the private sector, 99.89% of the total pear trees in the country were cultivated.
Figure 3 shows the main pear producers in the EU, for 2019. Italy stands out, with 429.29 thousand tons. A production of over 300 tons was also obtained by the Netherlands, Belgium and Spain.

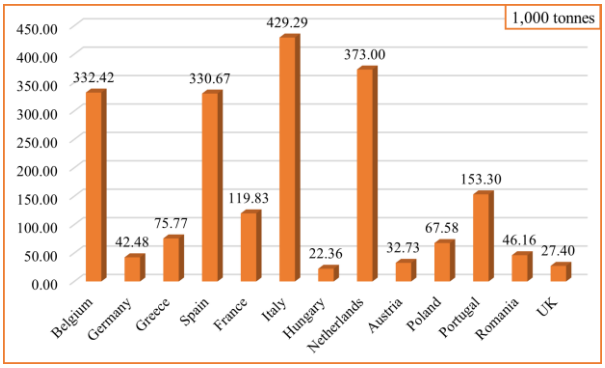

Fig. 3. Main pear producers in the EU, for 2019
Source: [3], own interpretation.

Romania appears in this ranking with 46.16 thousand tons, thus ranking 9th. In other EU member states, pear production was below 10,000 tons. It should be mentioned that the entire area and production of pears in Romania is intended for fresh consumption.
In Romania, the pear production for 2019 was distributed by macro-regions (Figure 4), as follows: Macroregion Three - 29%, Macroregions One and Two - 25% and Macroregion Four - 21%.

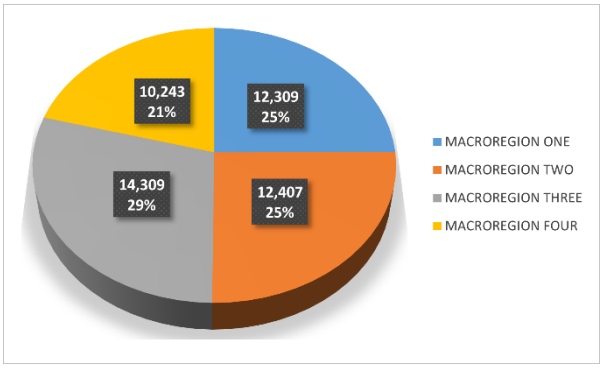

Fig. 4. Pear production in 2019 distributed by macroregions (tonnes, %)
Source: [7], own interpretation.

Of the total fruit production from 2019 pear production represented 3.31%. 99.96% of pear production came from the private sector, of which individual holdings accounted for 99.02%.
From the data presented by Eurostat, selling prices for pears (Figure 5) had the highest value in 2019 in Luxembourg - 165.00 euro/ 100 kg. At this indicator, Romania ranked 3rd in the EU with a value of 114.64 euro/100 kg.

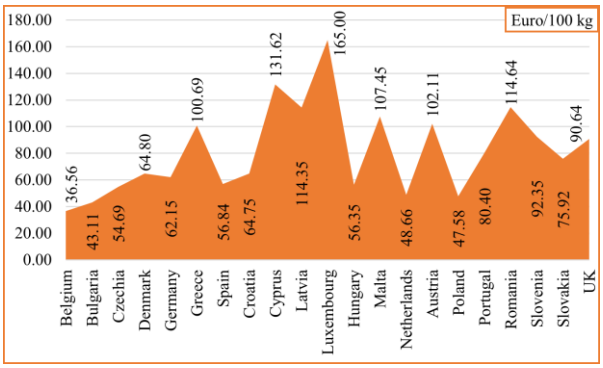

Fig. 5. Selling prices for pears in the EU, for 2019
Source: [3], own interpretation.

According to Soare *et al.* [10], pear imports were higher than exports, which led to a deficit in international trade for this category.
The use of the Expert System-CROM can allow pear tree growers to identify and know more easily the problems they may face, so that in the future we can benefit from a higher domestic production of pears and fruits in general.

In the following we will analyze using the Expert System-CROM the climate resources, the land resources and soil resources.

Climate resources expertise

The parametric assessment of the climatic resources of the lands is based mainly on the frequency of repetition of the optimal thresholds and intervals that favor the growth and fruiting of the pear trees from 10 years. Among the climatic conditions, the decisive factor is the thermal resources necessary for the normal development of the growth and fruiting processes expressed in the form of thresholds and intervals:

-The average annual air temperature receives 5-16 addition points;
-Average temperature (months V-X) receives 3-18 addition points;
-Average temperature (month V) receives 4-10 addition points;
-Absolute minimum air temperature (decreases suddenly or slowly) receives 0-4 addition points;
-Thermal amplitude of air (months XI-II receives 1-2 addition points;
-Precipitation (months V-VII) receives 8-10 addition points (Table 1).

Table 1. Climate resources expertise for pear culture

Class of expertise							Without climatic restrictions	With climatic restrictions	Excluded for pear trees
Climatic thresholds and intervals	Average air temperature (^{0}C)		Annual		08-10	Frequency, %	90-100	60-80	<60
			Addition points				*16*	*11*	*5*
			Months	V-X	≥16	Frequency, %	90-100	60-80	<60
			Addition points				*18*	*9*	*3*
			Month	V	>12	Frequency, %	90-100	60-80	<60
			Addition points				*10*	*7*	*4*
	Absolute minimum temperature (^{0}C)		Decreases abruptly		<-20	Frequency, %	90-100	60-80	<60
			Addition points				2	2	0
			Decreases slowly		<-30	Frequency, %	90-100	60-80	<60
			Addition points				*4*	*4*	*0*
	Thermal amplitude of air (^{0}C)		Months	XI-II	>20	Frequency, %	90-100	60-80	<60
			Addition points				*2*	*1*	*2*
	Rainfalls	(mm)	Months	V-VII	250-300	Frequency, %	90-100	60-80	<60
			Addition points				*8*	*8*	*10*
Addition points	*Total*						*60*	*42*	*24*

Source: [2].

Land resources expertise

For the efficient cultivation of pear trees, an analysis of land resources is based on their characterization indicators, resulting from specific research. Land characterization indicators are graded into three categories: without land restrictions, with land restrictions and lands excluded for the pear cultivation.

Land characterization indicators receive addition points, differentiated:

-The general slope receives 1-2 addition points;
-The land exposure receives 1-2 addition points;
-Surface erosion receives 0-2 addition points;
-Deep erosion receives 0-2 addition points;
-Landslides receive 0-6 addition points;
-V.S.N.P.G. receives 1 addition points;
-The aeration porosity receives 1 addition points (Table 2).

Soil resources expertise

Characterization indicators resulting from specific research, namely: active edaphic volume, soil reaction, exchangeable Al, Calcium carbonates in the soil, salinization and alkalization, industrial pollution receive differentiated addition points:

-Active edaphic volume receives 0-3 addition points;
-Soil reaction receives 1-2 addition points;
-Calcium carbonate receives 0-3 addition points;
-Soil salinization receives 1-2 addition points;
-Soil alkalization receives 0-4 addition points;
-Industrial pollution receives 0-9 addition points (Table 3).

The method of calculating the value of natural resources for pear fruit trees, land, and

orchards in the Expert System-CROM is presented in Table 4.

Table 2. Expertise of land resources for pear culture

General slope	Class of expertise			Without land restrictions		With land restrictions	Excluded for pear trees
	%			0-10		10-15	> 15
	Addition points			*2*		*2*	*1*
Aspect	Orientation			Plan E, NV, S, SE		V, SE, N-NE, in Dobrogea	N, NE, with the exception of Dobrogea
	Addition points			*1*		*2*	*2*
Relief conditions	Erosion	Surface erosion	Characterization	without erosion	weak erosion	moderate-strong erosion	very strong-excessive erosion
			Addition points	*2*		*1*	*0*
		Deep erosion	Characterization	absent	stream, drain	low density deep erosion	high density deep erosion
			Addition points	*2*		*2*	*0*
	Landslides	Characterization		absent		stabilized landslides	semi-stabilized and active landslides
		Addition points		*6*		*2*	*0*
Drainage conditions	Non-gleyed and non-pseudo gleyed soil volume (V.S.N.P.G.)	% vol.		> 60		60-20	> 20
		Addition points		*1*		*1*	*1*
	Air porosity (PA)	% vol.		5-15		15-20	> 20 | <5
		Addition points		*1*		*1*	*1*
Addition points		*Total*		*15*		*11*	*5*

Source: [2].

Table 3. Expertise of soil resources for pear culture

Class of expertise		Without soil restrictions		With soil restrictions		Excluded for pear trees
Active edaphic volume (V.E.A.)	%	≥100		101-76		<75
	Addition points	*3*		*1*		*0*
Soil reaction	pH (H_2O)	5.9-7.2	7.3-8.4	>5.8 exchangeable Al content ≥10 ppm	8.5-8.7 V_{Na}≥5%	>8.7
	Addition points	*2*		*2*		*1*
$CaCO_3$	Depth of Cca, Cpr, Rrz horizons (cm)	≥101		51-100		≤ 50
	Addition points	2		1		1
	Active $CaCO_3$ in carbonates horizon - %	3-7.0		7.1-10		>10
	Addition points	*3*		*1*		*0*
Salinization	Characterization	Non salinized	Poor salinization >100 cm	Salinization >100 cm		Salinization <100 cm
	Addition points	*2*		*2*		*1*
Alkalization	Characterization	Non alkalized		Alkalization >100 cm		Alkalization <100 cm
	Addition points	*4*		*2*		*0*
Industrial pollution	Pollutant concentration ppm	Pollutant concentration < alert values		Alert threshold		Intervention threshold
	Addition points	*9*		*5*		*0*
Addition points	*Total*	*25*		*14*		*3*

Source: [2].

Italy, the largest pear producer in the EU, currently has a pear germplasm in Sardinia, which is an important resource for genetic diversity [9]. The study of pear germplasm will allow obtaining varieties adaptable to climate change.

Table 4. Evaluation of the natural resources for pear fruit trees lands and orchards in the Expert System-CROM

Class of expertise	Natural resources			Total addition points
	Climate	Land	Soil	
Without natural restrictions	60	15	25	100
With natural restrictions	42	11	14	67
Excluded for pear trees	24	5	3	32

Source: [2].

CONCLUSIONS

In terms of marketing analysis, Italy ranks first in the top pear growers in the EU for 2019, with an area of 28.71 thousand ha, followed by Spain - 20.62 thousand ha and Portugal - 12.50 thousand ha.
In Romania, only 3.08 thousand ha were cultivated with pear trees, which placed our country on the 9th place in 2019.
3,147,062 specimens of pear trees grew in Romania, in 2019, representing 4.26% of the total fruit trees cultivated in our country.
Macroregion One recorded the highest number of pear trees - 30% of all pear trees.
99.89% of the total pear trees in the country were cultivated, in the private sector, in Romania.
Italy also stands out as the main pear producer in the EU, for 2019 with 429.29 thousand tons. Romania appears ranking 9th in this top with 46.16 thousand tons.
The entire area and production of pears in Romania is intended for fresh consumption.
In Romania, the pear production for 2019 was distributed by macroregions as follows: Macroregion Three - 29%, Macroregions One and Two - 25% and Macroregion Four - 21%.
Pear production represented 3.31% of the total fruit production of 2019 in Romania. Most production came from the private sector, more exactly the individual holdings.
Selling prices for pears had the highest value in 2019 in Luxembourg - 165.00 Euro/100 kg. At this indicator, Romania ranked 3rd in the EU with a value of 114.64 Euro/100 kg.
Following the application of the Expert System-CROM, the pear trees land and orchards received 32-100 addition points for natural resources.
Climate resources receive 24-60 addition points, land resources receive 5-15 addition points and soil resources receive 3-25 addition points.

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AN OVERVIEW OF THE MEANS TO ENHANCE TOMATO SEED PHYSIOLOGICAL QUALITY IN THE CONTEXT OF SUSTAINABLE HORTICULTURE

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Abstract

The tomato (Solanum lycopersicum L.) is one of the most cultivated vegetable species worldwide, both in protected areas, as well as in open - field conditions, due to the preferences of consumers for this vegetable, its nutritive and nutraceutical value, also its multiple processing possibilities. At the same time, tomatoes are model plants for studies on fruit growth, development and ripening. Along with many other common factors that influence the quality of tomatoes (variety, cultural practices, timing and method of harvesting, handling, transport and storage) and taking into account the various growing conditions and possible exposure to the action of various stress factors, the primary condition for good growth and development of plants (including for promoting yield, fruit quality value, as well as technological properties) is the use of a seed characterized by a high physiological quality. In this context, the different seed priming techniques have proved effective both in favor of the germination process and increasing the vigor of the seedlings, as well as in terms of enhancing the crop productivity within the different cultivation systems. Besides these, the quality of the fruits at the time of harvest, as well as their behavior in the post-harvest period proved to be beneficially influenced by the treatments applied to the seeds. This short overview presents some noteworthy research results obtained in the last decade for tomatoes, which have proven to be of interest from the economical, environmental protection and human health viewpoint in the context of increasing sustainability.

Key words**:** *Solanum lycopersicum* L., *seed germination, seedling vigor, stress, priming*

INTRODUCTION

The seed represents the connection between the past and the future, as Bareke [6] mentioned.

A fast germination of the seeds and an early stabilization of the seedlings are absolutely necessary characteristics for the production of seedlings, in favorable, but especially in unfavorable environmental conditions. Therefore, the physiological quality of the seed is a basic precondition in order to obtain a uniform crop, a large and quality harvest, both in terms of nutritional and / or nutraceutical quality, maintaining post-harvest quality, including extending fruits shelf life, and obtaining of a good quality product after processing [45], [29]. Additionally, quality seeds provide a substantial profit for farmers who produce seed material, as well as for seed dealers [76].

The tomato (*Solanum lycopersicum* L.) is one of the most cultivated vegetable species worldwide, considering the possibilities of cultivation throughout the year, regardless of the season, both in protected areas (greenhouses, solariums), as well as in open - field conditions, due to the preferences of consumers for this vegetable, given its nutritive and nutraceutical value [24],[17], [54], also its multiple processing possibilities and tomato based products [68]. At the same time, tomatoes are model plants for studies on fruit growth, development, and ripening [31]; [73], and last but not least for the study of plant-microbe interactions [46].

Especially in the last decade, the exploitation of beneficial microorganisms present in the

rhizobiome of tomatoes (but also at the level of phyloplane), whether we are talking about species of bacteria that promote growth, mycorrhizal and/or antagonistic fungi, or various microorganisms that have been shown to produce different hormones has become of interest. Their research in the view of recommending as possible bio stimulants for plant nutrition (in other words bio fertilizers), as bio control agents of some biotic stress agents, or simple promoters of seed germination and increasing seedling vigor and last but not least, as increasing agents of plant productivity, have become major topics in multidisciplinary research. All these conducted studies, as well as those that will be done will assure notable results for the practice of sustainable horticulture.

Given that conventional agriculture involves the use of phytopharmaceuticals to control diseases and pests and to achieve high production and has effects of deteriorating soil health and negative impact on human safety, the practice of biological solutions alternatives (as for instance bacterial endophytes) becomes to be taken into account, in the general context of environmental benefits [23], [21].

There are also recent promising results of Giuliani et al. [32] studies, that lay the foundations of a bio-economic analysis to support policy makers in charge of promoting the sustainability of the tomato growing systems.

Considering the above mentioned, in this mini review there are included some results obtained in the last decade, in connection with the need of use of a quality seed when setting up a tomato crop, as well as the practicing of the procedures that enhance the germination capacity of the seeds and early seedling growth, tolerance to the action of stresses and not finally obtaining a large crops with high nutritional and functional quality, objectives that are in the current and future attention of researchers and farmers.

MATERIALS AND METHODS

This bibliographic synthesis was prepared based on the results of research conducted in the last decade and published in prestigious journals, indexed in internationally recognized databases. Only the scientific articles were considered and the results of interest, in accordance with the theme of the paper were systematized and discussed. The importance of the new measures for the practice of a sustainable system for tomato cultivation is highlighted, in the context of constrains caused by different stress factors, without neglecting the possible undesirable effects that such practices may have.

RESULTS AND DISCUSSIONS

Obtaining, characterizing and preserving the tomato seed physiological quality

Over time, the connection between the morpho-anatomical characteristics of seeds and their germination has been demonstrated. The attention in the research was focused on the good development during embryogenesis and the profound transformations that take place during this process [71].

The techniques of investigation of some seeds morphological characters have been perfected in the last years and in tomatoes. Thus, the study of embryo morphology and the presence of free spaces through X-rays image analysis can be an alternative method for characterizing the physiological maturity and selection of high tomato quality seeds [10].In this regard, Gargiulo et al. [30] carried out a three-dimensional study of the seeds and the results proved to be predictive regarding the germination, although the authors recommend caution when using X-ray micro-tomography (micro-CT) in order to develop industrial systems for testing or sorting tomato seeds. In-depth studies on germination speed, based on quantitative trait locus (QTL) analysis have highlighted the involvement of QTL chromosome 1 and its usefulness for breeding cultivars capable of germinating at low temperatures [53].

During the development period of the seeds, numerous metabolites are biosynthesized and the metabolic profile together with the specific genetic variability can have marked effects in the regulation of the metabolism and the behavior of the seeds. Therefore, the

analysis of the metabolome in combination with genetic resources can lead to the development of comprehensive strategies to improve crop quality, to characterize unknown genetic functions and to faster screen metabolic phenotypes [42].

Besides the conditions for achieving embryogenesis and respectively the actual characteristics of the seed, the way of their storage will influence their physiological quality. So, the extension of the time storage period is a desideratum that must be taken into account. As studies by Jacob et al. [38] have shown, the use of a hydrophilic polymer (Disco Clear) film coating can have practical applicability as an alternative to save seed storage. Such a treatment has been shown to ensure tomato seed quality maintenance for a longer period of time, as compared to untreated seeds. In addition, after exposure to freely available water, the presence of the polymer facilitated a faster and more controlled seed imbibition, which had the effect of reducing the average germination time.

Accelerated aging of seeds can also contribute to lowering their quality. In this regard, studies conducted by Nigam et al. [55] have highlighted the involvement of mitogen activated proteins kinases (MAPK) pathways in achieving physiological (germination percentage, seedling vigor, vigor index) and biochemical changes (reducing sugar, soluble proteins, lipids peroxidation, enzymatic antioxidant system) in tomato seeds.

Moreover, in addition to the modern methods used today in the breeding process, must not be forgotten the use of local tomato varieties (e.g. tomato germplasm preserved ex-situ in Gene Banks) as a way to consider the breeding programs [60].

Directing atention to understanding the quality of seeds during development and maturation, dormancy, germination process, and their longevity during storage leads to the successful operation of seed genebanks and respectively to ensure efficient conservation of plant genetic resources [75].

Enhancing tomato seed physiological quality by biological means

Increasing the physiological quality of the seeds and improving tolerance to stresses can be achieved by "seed priming" using conventional and advanced methods [74]. Seed priming is a technique with favorable effects on metabolic processes involved in achieving a uniform and rapid germination [19], thanks to the reduction of imbibition period, activation of enzymes involved in biodegradation of reserve substances and biosynthesis of new metabolites, DNA repair and regulation of water absorption by osmosis [58].The agricultural systems that counteract the negative impact of climatic change must be in the attention of practitioners [20] and priming beneficial effects seem to be due to what is called "priming memory", fixed during the priming procedure and manifested later, when the seeds are exposed to stresses that occur during germination [14].

In the context of the need to practice a sustainable horticulture and the implementation of low cost, safe and environmentally friendly cultivation technologies, many recent studies are focused on enhancing the physiological quality of seeds by bio priming (or some combined seed treatments), in order to promote plant growth and productivity under conditions of abiotic and biotic stress [56].Various microorganisms from the categories of plant growth promoting bacteria and plant growth promoting fungi (PGPB and PGPF) are exploited and recommended by the researchers. Such microorganisms have proven to be effective in favoring the activity of absorption of water and mineral nutrients from the soil, the production of hormones, but also concerning the changes they induce in the sense of activating systemic resistance mechanisms against the attack of biotic stresses.

The rhizobiome (or in other words, the root associated microbiome) of tomatoes is a potential source of beneficial microorganisms, including some that are capable of producing indole acetic acid (IAA), the main growth stimulant phytohormone. For example, Rushabh et al. [65] researches led to the selection of a bacterial isolate (7MM11) identified as *Providencia* sp., which was subsequently studied *in vitro* to ensure

optimal culture conditions for the production of IAA (a high production of 89.22 μg/mL, in a period of 24 h incubation period). *In vivo* studies have highlighted the bacterium's ability to improve germination, increase seedling vigor, and promote plant growth. Rocha et al. [64] studied the antagonistic activity against the fungus *Fusarium oxysporum* f. sp. *lycopersici* (*Fol*), of bacteria of the genus *Bacillus* that colonize tomato plants and highlighted the control provided by *B. cereus* against *Fol* race 1, *B. magaterium* controlled 100% the *Fol* race 2 and *B. toyonensis* controlled 100% of disease caused by *Fol* race 2 and race 3 isolates. At the same time, the functional activity they have on plant growth was highlighted.

The use of plant growth promoting rhizobacteria (PGPR) based elicitors suppress plant disease by ensured a deterioration of the cell wall of *Alternaria solani* fungus, an inhibition of colony development, also enhanced the plant growth.It was registered an induced systemic resistance (ISR) based on different metabolic indicators, such as total phenols, free proline, peroxidase and polyphenoloxidase activities increase, also increasing the contents of IAA, abscisic acid (ABA), salicylic acid (SA) and jasmonic acid (JA)[4]. Karthika et al. [41] emphasised the eficacity of the PGPR, the isolate KTMA4 (*Bacillus cereus* - MG547975) against *F.oxysporum* (66%) and *A. solani* (54%) after seven days of incubation.*In vitro* studies highlighted its capacity to produce IAA, ammonia, catalase, siderophore and 1-aminocyclopropane-1-carboxylate (ACC) deaminase. Moreover, it has nitrogen biological fixation ability, besides to the production of lytic enzymes (amylase, cellulase, xylanase, lipase, and protease).Further, the bacterium *B. cereus* KTMA4 effectively produced biofilm, biosurfactants and salt-tolerant (5% NaCl).Beneficial effects have been noticed also *in vivo*, as regard as seed germination and seedling vigor improving. So, this new isolated rhizosphere bacterial strain can be used as a posible biocontrol agent against different pathogens, as well as a biofertilizer inoculant for tomato cultivation.

Furthermore, research conducted in laboratory conditions, but also in the greenhouse by Gowtham et al. [34] demonstrated the possibility of using of ACC deaminase produced by *Bacillus subtilis* Rhizo SF 48 isolate, as a bio inoculant for sustainable production of tomatoes in water deficit conditions, as is the case in arid and semi-arid areas.

Promising beneficial effects were also obtained by Shrivastava et al. [72] who used a combination treatment consisting of *Pseudomonas* (a PGPR), the antagonist fungus *Trichoderma harzianum* and the arbuscular michorizal fungus (AMF) *Glomus intraradices* against the same fungus. Seed priming with *T. harzianum* and *Pseudomonas* increased seed germination and reduced average germination time, while the combined treatment with the three factors provided a disease reduction by 81% and 74% in pots and field culture, while production yield increased by 33%.

If we refer to mycorrhizal fungi, besides their known beneficial effects on water and mineral nutrients at the root level, Sanmartin et al. [66] also emphasizes the positive responses induced at the level of the above-ground part, by the *Rhizophagus irregularis*, through what is called Mycorrhiza-Induced Resistance (MIR). The proof are the results of metabolomics analyzes that revealed an increase in the content of lignans, oxocarboxylic acids, the metabolism of amino acids and phytohormones in the mycorrhizal roots, also the signaling assured by oxylipins between the accumulation of yatein in roots and leaves during MIR. The lignan yatein had *in vitro* antimicrobial activity against the *Botrytis cinerea* fungus, as well as a protective function in the case of tomato plants.

Panda et al. [57] demonstrated too, the beneficial effects of colonizing tomato roots with mycorrhizal fungus *Piriformospora indica*, in terms of promoting growth, but also inducing systemic defense against the pathogen *A. solani*. A systemic modulation of some key components of the signaling cascade was found to regulate transcription, namely CBL-interacting protein kinases

(CIPK), mitogen activated protein kinases (MPKs), lipid transfer proteins (LTPs), WRKY1, ethylene responsive transcription factors (ERF) and jasmonate zim domain 1 (JAZ1), a negative regulator of jasmonic acid (JA), demonstrating the potential ability of colonization with *P. indica* in providing durable basal defense against pathogens.

Also, Bona et al. [7], [8] emphasized that the use of *Pseudomonas* sp. 19Fv1T or *P. fluorescens* C7, as a treatment applied to tomato plants has reduced fertilization, while the amount of fruit obtained has been higher and their nutritional value (e.g.soluble sugars, organic acids, carotenoids and ascorbate) has also been shown to be improved.

In addition to the known beneficial effects on metabolism and the induction of tolerance mechanisms against biotic stresses, Brilli et al. [11] demonstrated experimentally that *Pseudomonas chlororaphis* (a PGPB) also improves the tolerance of tomatoes to water stress. Its effects are multiple: it stimulates antioxidant activity, limits the accumulation of reactive oxigen species (ROS) in leaves, increases the content of proline and abscisic acid (ABA), which results in better control of stomatal movement. Thus, it ensures better water use efficiency (WUE) and not in lastly, an increase in biomass accumulation.

One of the possibilities to mitigate the effects of abiotic stress (such as drought) is the expolatation of the microbiome of arid zone plants. In this regard, Eke et al. [26] studied 191 endophytic bacteria (13-genera and 18-species) isolated from wild cactus and demonstrated that in the case of tomato seeds bacterization (especialy with the endophytic strain *B. amyloliquefaciens* - CBa_RA37) the seeds germination, also seedlings growth have been promoted. So, the species has been characterized as a possible bio-inoculant, in a low-cost, efficient and environmentally friendly technology, in order to counteract the effects of drought in arid areas.

As Singh et al. [69] emphasised, the application of an integrated seed priming treatment (with ascorbic acid - AA, *Trichoderma asperellum* BHU P-1 and *Ochrobactrum* sp. BHU PB-1) ensured an improvement of the physiological parameters related to germination (higher germination with 80% at a low concentration of AA - 1 pM) and also activated the defense response against the attack of the pathogenic *F.oxysporum* f. sp. *lycopersici* fungus, that causes tomato wilting (disease incidence reduction to 28% in tomato plants at 10 days). From a biochemical point of view, there was registered an increase in the total phenol content and in the activity of some enzymes activated in plant as a defense response against to the pathogen atack (phenylammonia lyase, peroxidase, chitinase and polyphenol oxidase), while the production of ROS represented by hydrogen peroxide was reduced, compared to the untreated control.

Studies have also shown the possibility of using beneficial microorganisms isolated from other plant species, or some active plant tissues/plant extracts. Thus, the application as a fertilizer of the halotolerant actinomycete *Streptomyces* sp. KLBMP5084 obtained from the root of the halophyte *Limonium sinense* has been shown to have antifungal activity against the fungus *A.solani*, *in vitro* and also had the effect of promoting seedling growth under conditions of salt stress [33].

On the other hand, Abdel-Motaal et al. [1] demonstrated the role of *Aspergillus flavus* (isolated from the medicinal plant *Euphorbia geniculata*) in improving tomato plant growth, as well as in increasing the content in secondary metabolites, which enhanced the plant's resistance to the attack of pathogen *Alternaria phragmospora*, that causes early blight disease.

Along with a quality seed, the nutritive substrate has a major influence on the seeds germination and growth of the seedlings. In this context, Kadoglidou et al. [40] studied the possibilities of improving soil properties and growing tomato seedlings by incorporating aromatic plant tissues (such as dried spearmint -*Mentha spicata* and sage - *Salvia fruticosa*) into the seedbeds. The results highlighted the favorable effects of *M. spicata*, whose presence increased microbial populations and the decomposition of organic matter at the substrate level, while the pH of the soil remained within the optimal limits, specific to tomato cultivation.

Enhancing the physiological quality of tomato seed by other modern means

Hormonal treatments and beyond

Hormones produced by plants, but also those produced by microorganisms have a great influence on plant metabolism, including effects on seeds germination [47] and inducing mechanisms of tolerance to stresses [25].

Effects of interest were also highlighted in the case of the of different secondary metabolites, which normally occur in plant metabolism, which perform specific functions, but whose biosynthesis and involvement in signaling defense responses under stress is evident [37], as well as to use nanomaterials with a view to adaptation of cultivated plants in stressful conditions [59].

Jasmonic acid is one of the hormones with a major impact on plant tolerance to biotic and abiotic stress. Bali et al. [5] studies showed that tomato seed treatment with JA (100 nM) reduced the heavy metal phytotoxicity of lead (Pb) by stimulating the biosynthesis of assimilatory pigments, secondary metabolites, osmotically active substances, compounds that chelating heavy metals, organic acids, and polyamines in tomato seedlings. The obtained results suggested that JA mitigated the oxidative damage by lowering the expression of the *RBO* and P-type ATPase transporter genes and by modulating antioxidative defense system activity.

On the other hand, Król et al. [43] emphasised that the application of methyl jasmonate (MeJA) at a dose of 0.1 mM for 1 h, as a seed priming procedure ensured a significant increase in the resistance of tomato seedlings to the soil borne fungus pathogen *F.oxysporum* f.sp. *lycopersici* (4 weeks after inoculation). Due to the treatment, there were registered high levels of phenolic (such as salicylic acid) and flavonols compounds (e.g. quercetin and kaempferol).

Madamy et al. [44] highlights for the first time the potential of hormonal treatment of seeds with IAA (0.09 mM) or salycilic acid (SA - 1 mM) in terms of mitigating the negative effect of stress caused by the parasitic weeds *Orobanche ramosa*, especialy by increasing the antioxidant defence markers metabolites and enzymes.

The involvement of the phytohormones abscisic acid (ABA) and gibberellic acid (GA) in the control of the germination process is known, and the studies carried out by Yang et al. [77] led to the identification of a tomato mutant, salt tolerant cultivar (LA2711), whose germination was fast in such stressful conditions. It has been shown experimentally that the *SICY707A2* gene encoding the enzyme involved in ABA catabolism has a high level of expression and may play a decisive role in ensuring rapid germination.

As Moles et al. [51] noticed, natrium chloride (NaCl) treatments have been shown to promote the germination process by activating the hydrolysis of galacto mannans (endo-β-mannanase, β-mannosidase and α-galactosidase) as well as the biodegradation of starch, counteracting oxidative stress.These processes have determined the increase of the content of total soluble carbohydrates and at the same time the amount of metabolic energy necessary for organogenesis and the counteracting of oxidative stress was ensured. Regarding the mechanism of the action of seed priming with 300 mM NaCl, Nakaune et al. [52] highlighted the major bioactive role of gibberellic acid (GA_4), materialized by activating the genes involved in its biosynthesis, while the effects on ABA degradation were minor during germination. The genes involved in endosperm cap weakening were overexpressed by priming.

Cold plasma seed priming modulates the seed coat and has a beneficial effect on germination. Moreover, it induces a certain potential for drought tolerance of seedlings by promoting growth, activating the antioxidant system, phytohormones, and the expression of defense genes, which causes a series of signalings cascades at the cell level and changes in biochemical and physiological parameters [2].

Shikimic acid treatment (60 ppm) for seeds soaking has been shown to marked increase of plant growth, fruit productivity and quality of tomatoes plants grown in field conditions. Thus, there were registered an increase of total leaf conductivity, transpiration rate and

photosynthetic pigments (Chl. a, chl. b and carotenoids) of tomato plants. Also, there was noticed a significantly increased of nitrogen, phosphorus and potassium concentration in tomato leaves, as compared to control (non-treated tomato plants) [3].

Qiao et al. [61] conducted *in vitro*, greenhouse and field studies on the effects of carvacrol treatments, applied to seed, foliar alone or in combination with copper, to reduce the severity of bacterial spot ot tomato (BST) produced by *Xanthomonas perforans*. The results showed that a dose of 32 mg L^{-1} promoted germination and improved seedling vigor. The combined foliar treatment (at 32 mg L^{-1} + copper at 76.8 mg L^{-1}) was more effective in reducing the severity of BST. In addition, carvacrol increased the effectiveness of copper against *X. perforans* copper resistance. So, the authors indicated a posible sustainable way of control the BST. Promising results as regard as activation of defence genes were also obtained by Chandrashekar and Umesha [12] by seeds priming with 1.0 mM 2,6-dichloroisonicotinic acid (INA) as an abiotic inducer of resistance to *X. perforans*.

The use of economical, renewable, efficient and environmentally friendly fertilization methods are primary conditions for promoting sustainable agriculture, so the exploitation of natural resources as organic fertilizers is a current concern. Thus, Chanthini et al. [13] analyzed the potential to stimulate seed germination and tomato plant growth of the liquid extract of green seaweed *Chaetomorpha antennina* (CA-LSE). Its effects on the biochemical profile of plants were also demonstrated and it was established which are the main mineral elements (oxigen - O, natrium - Na, magnesium - Mg, sulphur - S, chlorine - Cl and calcium - Ca) that provided the potential for biostimulation.

Additionally, the use of a water-soluble vitamin K3 derivative, respectively menadione sodium bisulphite (MSB) for the treatment of the root system under saline stress conditions has been shown to have a positive effect on photosynthesis, regulating stomatal movement and maintaining optimal water balance. At the same time, the treatment favored the accumulation of proline, the maintenance of cellular homeostasis by activating the expression of genes that control ion transporters, as well as the antioxidant activity at the cellular level [39] .

Selim and El-Nady [67] demonstrated the protective effect against the water deficit of seed treatment with magnetized water and irrigation with magnetized water (especially at levels of 60% and 40% of field capacity). The positive effects were manifested in connection with the growth characteristics, water relationship, proline content and assimilatory pigments, as well as the anatomical structure of some plant organs.

Use of nanotechnology

Another proof of the concerns in the field of agrotechnology is the promising results presented by Colman et al. [16] with reference to the commercial potential of chitosan microparticles (CS-MP) and their possible introduction as input into the sustainable tomato production system. The application of the treatment to the seeds ensured a better germination, as well as an index of vigor with high values before transplanting, both regarding the root system and the stem. The explanations were easy to specify given the low level of ROS, the marked antioxidant activity and the modulation of defense marker proteins, including the participation of cytokinin and auxin signaling pathways during root formation.

Favoring plant growth, but also marked protection (72.9 %) against the attack of the fungus *Phytopthora infestans* which produces the late blight of tomato were recorded if seed was primed with mycogenic selenium nanoparticles (SeNPs).It has been shown that this treatment has resulted in the obvious accumulation of compounds involved in cellular defense processes, such as lignin, callose and hydrogen peroxide. The activity of some enzymes (lipoxygenase - LOX); phenylalanine lyase - PAL; β-1,3-glucanase - GLU; superoxide dismutase - SOD)) has also been intensified in treated plants with this nano-biostimulat fungicide [36]. At the same time, the results obtained by Chun and Chandrasekaran [15] confirmed that chitosan

(CS) and chitosan nanoparticles (CNPs) induced the expression of pathogenesis-related (PR) proteins genes: (PR-1; PR-2 - β-1,3-glucanase; PR-8-chitinase and PR-10) in the case of tomato - *Fusarium andiyazi* system, with an up-regulation of PR-proteins and antioxidant genes, also.

On the same note, studies carried out by Cumplido-Nájera et al. [18] emphasised that the simultaneous application of copper and silicon nanoparticles has been shown to induce tomato tolerance to *Clavibacter michiganensis*.The explanation given was that the treatment positively modified the enzymatic activity (SOD, PAL, glutathione peroxidases - GPX and ascorbate peroxidase - APX), reduced glutathione concentration and the phenol content in the leaves.

The use of eco-friendly nano-fungicides has also been shown to be effective in controlling the fungus *Alternaria alternata* [27]. Thus, after the biosynthesis of titanium dioxide nanoparticles (TiO_2NPs) and silver nanoparticles (AgNPs), by *Aspergillus versicolor* KY509550 through surface resonance peaks at 340 and 400 nm, respectively, and testing them, the expression of an antifungal activity of 100% inhibition in the laboratory trials was obtained in the case of TiO_2NPs. In greenhouse and field conditions, the significant effect of reducing the severity of the disease was also recorded at TiO_2NPs, while AgNPs showed a moderat effect.

Comparative studies conducted by Derbalah et al. [22] in the greenhouse on the antifungal effects against *A. solani* fungus of mesoporous silica nanoparticles (MSNs) as compared with metalaxyl (a recommended fungicide) have also led to promising results in terms of an effective and save alternative control of this disease. Furthermore, Hajiahmadi et al. [35] transformed tomatoes with MSNs containing pPZP122: 35S: GUS (pDNA-MSNs) and then transferred the *cryIAb* gene through pPZP122:35S:*cryIAb*-MSNs into tomatoes for *Tuta absoluta* control. The obtained results were successfully, so the system was characterised as a new and more efficient technique in crop genetic engineering.

For an overview of the advantages and doubts about the possible environmental and human risks of nanotechnologies applied in horticulture, it is recommended to consult the synthesis paper of Feregrino-Perez et al. [28]. A strong regulatory system regarding the use of nanoparticles is necessary [48].

Use of agrohomeopathy

In recent years, one of the newest approaches in agricultural research is agrohomeopathy. The scientific studies have shown the ability of the potentised homeopathic medicines to modify the physiological processes in plants and to provide some degree of resistance to the attack of biotic / abiotic stresses.

The use of four homeopathic medicines for human in two centesimal dynamizations (7CH and 13CH) [(*Silicea Terra* (SiT), *Natrum muriaticum* (NaM), *Zincum phosphoricum* (ZiP) and *Phosphoricum acidum* (PhA)], specifically improved tomato development depending on the dynamization or power used and the development stage [9].

Also, high dilution preparations of *Arsenicum album*, *Nitricum acidum* and *Staphysagria* at 6, 12, 25, 30, 50, 60, 80 and 100 CH (centesimal Hahnemannian dilution scale) were studied in vitro as a treatment against *A. solani.*

The dilution preparations have different effects on mycelium growth, according to the dynamization level.A decrease of *A. solani* colonies diameter was determined by *A. album* 80 CH, by *N. acidum* 80 and 100 CH, and by *Staphysagria* 6, 30 and 60 CH compared with the control, when applied over potato dextrose agar (PDA) medium [50].

Generaly spaking, applications of the homeopathy to seed invigoration [63], as well as a viable alternative to the use of agrochemicals [62], including on replacing pesticides in organic tomato production system [49] will be of interest in the future [70], after the better knowing of the action mechanisms of such eco-friendly treatments [9].

CONCLUSIONS

The tomato (*Solanum lycopersicum* L.) is one of the most cultivated vegetable species

worldwide, both in protected areas (greenhouses, solariums), as well as in open - field conditions.

The use of seeds with high physiological quality for the establishment of crops, as well as for a better plants growth and productivity is a precondition for successfully overcoming the constraints caused by abiotic and biotic stress factors to which tomato plants can be exposed.

In the last decade, besides some well-known common priming techniques, researches have been focused on procedures for enhancing the tomatoes seeds physiological quality mainly based on the rhizobiome microorganisms exploatation as a sourse of bio priming agents, as well as modern novel emerging technologies (such as nanotechnology and agrohomeopathy), that have proven to be of interest from the economical, environmental protection and human health viewpoint in the context of increasing sustainability.

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RURAL SOCIAL DEVELOPMENT IS A KEY CONDITION FOR INCLUSIVE GROWTH AGRI-FOOD SYSTEM OF RUSSIA

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Abstract

It is substantiated that mobilization of efforts to achieve the Sustainable Development Goals (SDGs) against the background of the consequences of the COVID-19 pandemic provides for a radical rethinking of the priorities of agri-food policy. This concerns the improvement of the social development policy of the countryside and the solution to the problems of sustainable development of rural areas. The specificity of the concept of sustainable development of rural areas as interconnected into a single system of economic, social, and environmental goals and objectives is revealed. These include sustainable growth of the rural economy, diversification of its structure, the achievement of food security; increasing employment, the level and quality of life of the rural population, reducing interregional and intraregional differentiation, eliminating poverty, bringing the countryside closer to urban living standards; rationalization of the use of natural potential and preservation of the natural environment. Solving the problems of social development of the countryside contributes to the transition to an inclusive development model. The author's methodology made it possible to substantiate the criteria and indicators that characterize the level of social inclusion. By this approach, an empirical research base was formed and a comprehensive assessment of the social development of the village was given in the context of the following aspects: poverty of the population, the risk of poverty and poverty fields depending on the place of residence of the population; urban and rural unemployment; resources and final consumption expenditures, on average, per household member; physical and economic accessibility of basic food products for the urban and rural population. Measures have been formulated to facilitate the transition of the agri-food system to an inclusive development model and overcome negative trends in the post-pandemic economy.

Key words**:** *agri-food system, inclusive growth, sustainable rural development, poverty risk, unemployment rate, food security*

INTRODUCTION

Recently, the development of the world agri-food system has been characterized by two oppositely directed trends. On the one hand, the process of urbanization is actively underway, which is one of the most important demographic mega-trends and is changing the composition and structure of the population. On the other hand, there is a tendency towards the de-urbanization of society, which has intensified in the context of the COVID-19 pandemic. Thus, the population of large urban agglomerations is decreasing, which leads to a more uniform density of population in the country's territories, and a decrease in the risk of the spread of infections. We believe that the village could, in a certain sense, act as a «security territory», reducing the threat of severe consequences of the current crisis. However, the Russian village is still significantly inferior to the city in terms of living standards in general, including in terms of food security.

Despite several government measures aimed at creating conditions for the sustainable development of rural areas, several problems remain unresolved: unemployment, an increase in poverty, underdeveloped social infrastructure in the countryside, aggravation of social problems, moral degradation of the rural population, depopulation of the village, shredding of the settlement network. The

problems of irrational exploitation of natural resources and technological backwardness of agriculture are still not resolved, which leads to an increase in the degradation of agricultural land and an increase in environmental risks. Social polarization is growing, which is manifested in the increasing differentiation of population groups in terms of the level of physical and economic availability of food. The shortage of qualified personnel associated with insufficient investment in human capital led to a low level of labor productivity. The current situation is aggravated by the ineffectiveness of public administration and the irrational nature of support.

Sustainable rural development should become a priority of the state agri-food policy. In the context of new global and national challenges, the urgency of substantiating a new vector of development of the agri-food system is increasing [29]. The transition to an inclusive growth model contributes not only to the realization of economic goals but also to ensure social sustainability. Priority should be given to the following areas: focus on human interests, ensuring the mobilization of all resources, creating non-discriminatory conditions, including the possibility of participation of all actors in the processes of production, distribution, and consumption of food, reducing poverty, preserving and developing small forms of agribusiness, solving environmental problems [17, 18] Identification of potential growth points and vectors of future development will allow not only to draw a conclusion about the viability of rural areas but also to answer the main question - does the Russian village have a future?

The degree of elaboration of the problem. The author's approach to the study of the social development of the village as the main condition for the inclusive growth of the agri-food system is based on the conceptual provisions of the theory of sustainable development. The problems of sustainable development are comprehended in the world and domestic science from different positions: first, the study of the actual stability of the world economic system (including the agricultural sector); secondly, from the point of view of solving environmental problems; thirdly, in the context of solving social problems of rural areas. It should be noted that studies of sustainable rural development are based on a triune paradigm, since not only economic problems of growth, but also socio-ecological problems are reflected here in a concentrated form.

From a neoclassical perspective, sustainable development is seen as striving to achieve a balance between capital accumulation and population growth, supported by investment (for example, the Solow model). The Keynesian theory considers development due to changes in technical and economic parameters but does not touch on socio-economic prerequisites.

The limitations of these approaches have prompted researchers to turn to the study of the social and environmental aspects of sustainable development. In the work of G. Daley and R. Costanza «Natural Capital and Sustainable Development,» sustainable development is defined as «development without growth», i.e. «Socially sustainable development, in which gross economic growth should not go beyond the carrying capacity of life support systems» [3].

Various models of sustainable development are described in the works of G. Atkinson, D. Pierce, K. Williams, E. Millington, R. Turner [33].

Researchers have focused on the interdependence of such aspects of development as environmental, economic, and social. The so-called triune concept of sustainable development has been formed, one of the founders of which is Ed. Barbier, who made a fundamental conclusion that the goals of environmental protection and economic development not only do not contradict each other but, on the contrary, can contribute to mutual reinforcement [2].

Historically, the concept of sustainable development is linked to environmental issues. Since the 80s. of the last century, this category began to enter the scientific turnover, but it received recognition after the report «Our Common Future», which was prepared

in 1987 by the International Commission on Environment and Development [25].

Sustainable development was defined in the report as development that «meets the needs of the present, but does not jeopardize the ability of future generations to meet their own needs». In 1992, the UN conference «Environment and Development» [26]. Researchers have addressed the problems of sustainable development in the framework of various projects, many programs have been adopted, in which the concept of sustainable development has received additions and refinements.

The ecological-systems approach is implemented in the works of such scientists as E. Leroy, [19] Teilhard de Chardin, Semyonova S.G. Pilgrim to the future [28]. The theory and methodology of sustainable economic development are reflected in the works of V.V. Artyukhov, V.I. Danilov-Danilyan, K.S. Losev, A.S. Martynov, N.N. Moiseev, O.S. Pchelintsev, N.F. Reimers, L.N. Semenova, and others.

Domestic scientists define sustainable development as «development in which environmental impacts remain within the economic capacity of the biosphere so that the natural basis for the reproduction of human life is not destroyed» [4]. A.G. Granberg gives the following definition of the term: sustainable development is «stable balanced socio-economic development that does not destroy the natural environment and ensures the continuous progress of society» [16].

The most important contribution to the formation of the concept of sustainable development was made by the institutional theory, according to which development is not just ensuring economic growth, but investment in human capital and the elimination of poverty. Institutions ensure the well-being of society, equal access for all segments of the population to the created benefits. This is the approach that is implemented in the inclusive growth model.

The concept of sustainable development, systematically covering the consideration of economic, social, and environmental aspects, forms the scientific basis for sustainable rural development. At present, world and domestic science have accumulated rich experience in research on sustainable development of rural areas, social development of the countryside. These problems are investigated within the framework of various theoretical schools and concepts.

Studies of the problems of sustainable development of agriculture as a branch of the economy have a long history and are reflected in the works of the classics (N.I. Vavilov, S. Yu. Witte, V. V. Dokuchaev, N. D. Kondratyev, A. B. Chayanov).

From the standpoint of the institutional theory, sustainable development of rural areas is viewed through the prism of mechanisms, which are formal and informal institutions. The role and operation of regulations, laws, government programs for sustainable rural development as elements of the system of formal institutions have been studied by foreign researchers [1].

A number of foreign scientists have studied the impact of the institutional environment on economic growth [14]. There are various methodological approaches to assessing the impact of institutions, for example, through the index method [21] as well as using econometric methods.

The institutional approach to the problem of sustainable rural development in Russia is implemented in the works of S.K. Wegrena [32], where the reasons for the depopulation of the village are analyzed.

Practically productive is the methodological approach presented in the work of Russian researchers [20]. which pays special attention to the formation, implementation, control, and improvement of legislation in this area. Taking this approach as a basis, the authors considered a solution to the problem of reducing regional institutional imbalances in the field of sustainable development of rural areas.

The study of various aspects of sustainable rural development was carried out by such Russian scientists as V.M. Bautin, L.V. Bondarenko, I.N. Buzdalov, T.I. Zaslavskaya, V.V. Kozlov, A.V. Merzlov, V.V. Miloserdov, T.G. Nefedova, B.P. Pankov, V.V. Patsiorkovsky, A.V. Petrikov, A.F. Serkov, N.G. Tarasov, I.G. Ushachev V. Ya.

Uzun, N. Shagaida. All studies emphasize the need to equalize the standard of living in the city and in the countryside, increase employment and income of the rural population, social development of the village, development of local self-government, and ensure equal access to social benefits for all segments of the population, regardless of where they live. Sustainable development of rural areas is interpreted as a purposeful process of transition of the rural community to a qualitatively new level, taking into account the implementation of the sustainable development goals (SDGs). Then the sustainable development of rural areas will become an imperative of world globalization processes.

In all studies of the problem of sustainable rural development, great attention is paid to the state agrarian policy. Sustainable development of the agri-food system is not possible without an effective agricultural policy aimed not only at achieving food security parameters, but also solving economic, social, and environmental problems.

The influence of the current agri-food policy on the sustainable development of the agricultural sector is disclosed in the works of S.V. Kiselev, V.I. Nazarenko, A.G. Paptsov, L.S. Revenko, E.V. Serova, B.A. Chernyakov and others. The experience of the agrarian policy of foreign countries is generalized, trends in the development of the world food market, the level of achieving food security parameters from the point of view of the implementation of sustainable development goals (SDGs) are identified.

Methodological approaches to the definition of indicators of sustainable development of rural areas are considered in the works of domestic scientists S.N. Bobylev, L.V. Bondarenko, O.V. Kozlovskaya, L.S.Korbut, V.M. Laverov, L.A. Ovchintseva, N.P. Tarasova and others.

The world practice of solving the problems of rural development testifies to the constant search for ways to increase the stability of rural areas, including all its aspects. The issues of sustainable development of rural areas have been investigated in the framework of projects of many international organizations (FAO, European Union, United Nations Commission on Sustainable Development, OECD) [10, 12, 13, 15].

Unresolved problems in the development of the village have updated the research data. Thus, the EU decided to gradually reorient from supporting the agro-industrial complex as a whole to support rural areas. In 2005, the Council of the EU issued a Directive on the Support of Rural Development by the European Rural Development Fund (EAGGF), which is mandatory for inclusion in the national programs of EU countries. In 2015, the Rural European Parliament Campaign was initiated by three pan-European non-governmental organizations [30]. European countries have collected ideas from rural communities aimed at rural development. Proposals from national conferences and rural parliaments from these countries were also used. This allowed in 2015 at the European Rural Parliament, which was attended by 240 people from 40 countries, representatives of governments and international organizations, to adopt the European Rural Manifesto. In 2018, FAO produced the report Making Rural Areas More Attractive to Young People, examining the situation around the world [22, 24]. The analysis of the reasons for abandoning agricultural activity is presented. In September 2019, the European Parliament prepared a report «Research for the Agro-Industrial Committee - Megatrends in the Agri-Food Sector», which provides a certain vector for predicting the future of the village, although the very concept of «rural areas» is not used in it [23].

Russian legislation introduced the concept of «sustainable development of rural areas» by the Federal Law of December 29, 2006, N 264-FZ «On the development of agriculture». The term received the current definition in the Concept of Sustainable Development of Rural Territories of the Russian Federation for the period up to 2020 approved by the order of the Government of the Russian Federation dated November 30, 2010, N 2136-r. In 2013, the Federal Target Program «Sustainable Development of Rural Areas for 2014–2017

and the period until 2020» began to be implemented. In 2017, the Government approved the Strategy for Sustainable Development of Rural Areas of the Russian Federation for the period up to 2030.

In 2018, the FTP was integrated into the State Program for the Development of Agriculture and the Regulation of Agricultural Products, Raw Materials and Food Markets for 2013–2020 (which has been extended until 2025). The departmental target program «Sustainable Development of Rural Areas» is referred to as the process part of the State Program. Thus, this target program is deprived of its independent status, which further exacerbates the insufficient effectiveness of the measures taken. This actualizes the search for ways to increase the sustainability of rural development, the formation of a new agri-food policy aimed at effective rural development.

The works of many Russian scientists are devoted to the theory and methodology of researching rural poverty, analyzing its level and structure, and federal and regional aspects of policies to overcome rural poverty.

MATERIALS AND METHODS

Studying the system of scientific theories, concepts, modern socio-economic problems of sustainable development, the authors identified the specifics of the concept of sustainable development of rural areas as interconnected into a single system of economic, social, and environmental goals and objectives: sustainable growth of the rural economy, diversification of its structure [9], the achievement of food security; increasing employment, the level and quality of life of the rural population, reducing interregional and intraregional differentiation, eliminating poverty, bringing the countryside closer to urban living standards; rationalization of the use of natural potential and preservation of the natural environment.

Solving the problems of social development of the countryside contributes to the transition to an inclusive development model. The research methodology is based on a set of conceptual provisions that substantiate the relationship between the rates of economic growth and the solution of a whole range of social problems. The model of inclusive development is quite relevant, it has been widely studied by international organizations (UN, IMF, OECD, World Bank). The authors have developed methodological approaches to assessing the level of inclusive development about the agri-food system [7, 8].

Coping with the consequences of the COVID-19 pandemic and mobilizing efforts to achieve the Sustainable Development Goals (SDGs) provide a rationale for new priorities in agri-food policy. This concerns the processes of improving economic integration within the global agri-food system, developing social protection to combat poverty, ensuring food safety and trade, increasing the resilience of small forms of agribusiness to recovery, preventing the next zoonotic pandemic [11].

For a qualitative study of the listed problems, a number of methods and approaches should be used: systemic, institutional, evolutionary, logical, comparative. The application of a systematic approach involves considering the agri-food system as a set of interrelated and interacting elements. The transition to an inclusive model requires a study of the consistency of interaction between representatives of agribusiness, the public sector, and civil society within the framework of a social contract.

The combination of evolutionary and institutional approaches to the study of the peculiarities of the development of the agri-food system made it possible to carry out a comparative analysis of the level of achievement of social development goals depending on the place of residence of the population, to assess the contribution of state target programs to their implementation, to identify the impact of convergence and divergence of the population's standard of living on the nature of economic growth. The author's methodology made it possible to substantiate the criteria and indicators characterizing the level of social inclusion [6]. By this approach, an empirical research base was formed and a comprehensive assessment of the social development of the village was given in the context of the following aspects:

-unemployment of the urban and rural population;
-resources and final consumption expenditures, on average, per household member;
-physical and economic accessibility of basic food products for the urban and rural population.

RESULTS AND DISCUSSIONS

Rural social development is hampered by a relatively high level of poverty. The study of poverty has always been the focus of attention of economists and sociologists not only in Russia, but throughout the world. In Russia, the category of the poor includes the population with an income level below one living wage. The share of Russians with incomes below the subsistence level in 2020 was 13.5% (19.9 million people). This was facilitated by a decrease in business activity and, as a result, a decrease in income during the pandemic.

The most acute problem is rural poverty, and the level of which is many times higher than poverty in the city and the entire population of the country. As Academician A.V. Petrikov affirmed, «poverty in Russia has a rural face». This is due to the interaction of various and interrelated factors:
- high level of rural unemployment and underemployment, low wages and labor productivity;
- underdevelopment of social infrastructure facilities;
- low level of education and professional training;
- reduction in the size of the middle class as a bulwark of stability in society;
- social and regional differentiation of socio-economic development.

The negative consequences of the transformation of the economic system most strongly affected the rural population; a large number of poor people live in Russian villages. The distribution of the poor population by place of residence is shown in Figure 1.

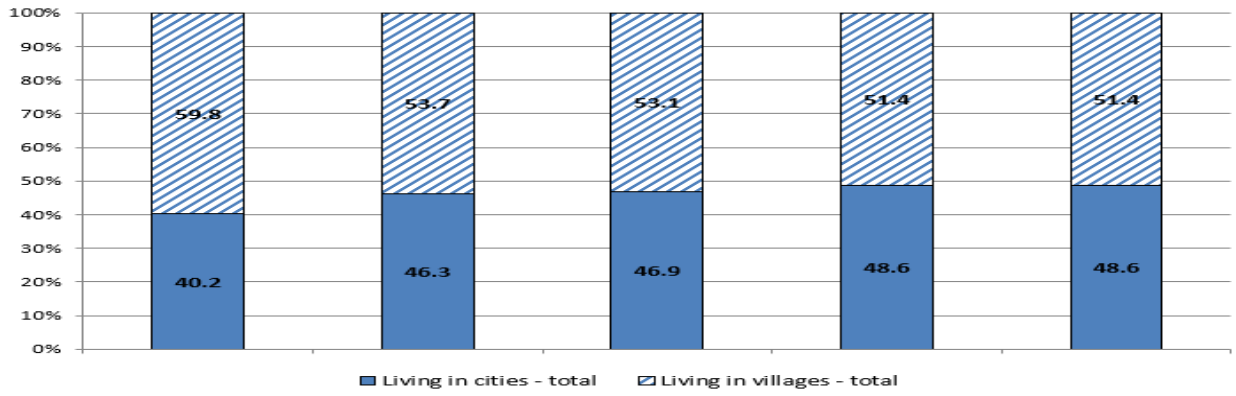

Fig. 1. Distribution of the poor population by place of residence
Source: Own calculation.

Rural settlements are home to 51.4% of the population with an income below the subsistence level. However, given that the share of the rural population of Russia is 25.3%, the share of the poor in the rural population will be much higher than in the city. Thus, the share of the population with monetary incomes below the subsistence level in the countryside exceeded 25%, while in the city - only 8% (Table 1).

The ratio of the poverty level depending on the place of residence can be estimated using the indicator "risk of poverty".
The poverty risk was calculated as the ratio of the share of the population with money incomes below the subsistence level for population groups depending on the place of residence to the average value of this indicator.

Table 1. Indicators of poverty level in urban and rural population

Indicators	2015	2016	2017	2018	2019	*2019/ 2015.%*
Population with cash incomes below the subsistence level. mln.	19.6	19.4	18.9	18.4	18.1	*92.3*
Cost of living, rubles per month	9,701	9,828	10,088	10,287	10,890	*112.3*
The share of the population with cash incomes below the subsistence level. % (total population) incl.	13.40	13.24	12.87	12.53	12.33	*92.03*
Urban population	8.37	8.36	8.41	8.16	8.02	*95.83*
Rural population	27.78	27.35	25.85	25.35	25.06	*90.18*
Share of rural population. %	25.9	25.7	25.6	25.4	25.3	*97.68*

Source: Own calculation.

When analyzing the risk of poverty, it should be borne in mind that the proximity of this indicator to 1 corresponds to the average level of risk. Higher values of the risk of poverty signal the critical distress of this population group. The analysis revealed that the risk of poverty for the rural population is more than three times higher than the risk of poverty for the urban population. An alarming symptom is the re-growth of the poverty risk gap between the urban and rural population, which is narrowed in 2017 (Table 2).

Table 2. Indicators of poverty risk by population groups depending on their place of residence

	2015	2016	2017	2018	2019	*2019/ 2015. %*
Urban population	0.625	0.631	0.653	0.651	0.650	*104.1*
Rural population	2.073	2.066	2.009	2.023	2.032	*98.1*
Ratio of poverty risk for rural and urban population	*3.32*	*3.27*	*3.07*	*3.11*	*3.12*	

Source: Own calculation.

A joint analysis of the indicators of the proportion of the population with money incomes below the subsistence level and the risk of poverty for the population living in cities and villages made it possible to construct poverty fields for the urban and rural population (Fig. 2). This approach makes it possible to more adequately assess the depth of rural poverty, which will make it possible to substantiate the guidelines for the poverty reduction policy.

We consider it necessary to analyze not only the incidence of poverty but also its depth. Even in developed countries, it is not uncommon for a situation where, even with a decrease in the incidence of poverty, its depth increases. It is obvious that, despite the measures taken, the depth of poverty in Russia in general and for the rural population, in particular, is becoming threatening. The conditions created by the COVID-19 pandemic will seriously exacerbate this problem.

Despite several measures taken by the government to bring the Russian agri-food system to the trajectory of sustainable development, most of the villagers (about 60%) consider themselves poor and disadvantaged.

Positive economic results, manifested in the development of grain farming, pig and poultry farming, as well as in increased investment in agriculture, were offset by a large number of unsolved social problems.

One of the significant causes of poverty is the high unemployment rate. According to preliminary data, the number of unemployed in Russia in 2020 was about 4.8 million people, which is 47% more than in 2019.

The proportion of the unemployed among the working-age population in 2020 reached 6.4% against 4.6% in 2019. Rural unemployment looks more critical.

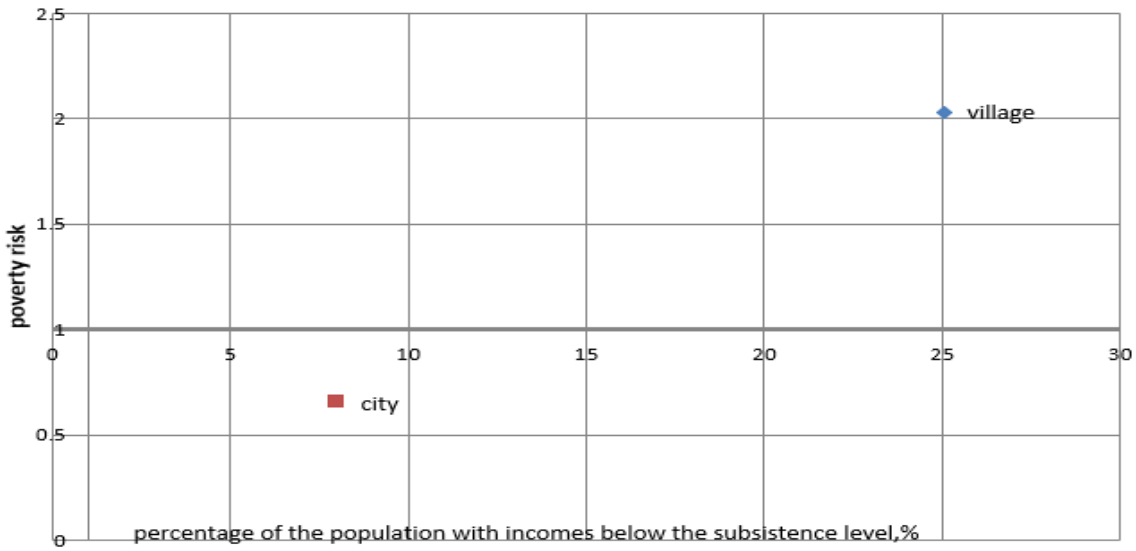

Fig. 2. Poverty fields of the urban and rural population of Russia (according to 2019 data)
Source: Own calculation.

Despite the significantly lower share of agricultural workers in the number of employed in the economy as a whole, rural unemployed makeup more than half of the registered unemployed. The analysis showed that the rural unemployment rate is almost 1.8 times higher than the urban unemployment rate. For a rural dweller, the problem of finding a job is more acute; he spends 17% more time finding a job (Table 3).

Table 3. Indicators of the unemployment rate depending on the place of residence

	Unemployed people aged 15 and over thousand people.		**The unemployment rate of the population. %**			**Average job search time. months**		
	city	village	city	village	*village* / city	city	village	*village* / city
2015	2,825	1,438	4.8	7.9	*1.646*	6.9	8.0	*1.159*
2016	2,805	1,438	4.8	8.0	*1.667*	7.2	8.5	*1.181*
2017	2,543	1,427	4.3	8.0	*1.860*	7.2	8.4	*1.167*
2018	2,367	1,291	4.0	7.3	*1.825*	7.1	7.9	*1.113*
2019	2,284	1,181	3.9	6.9	*1.769*	6.5	7.6	*1.169*

Source: Own calculation.

It should be noted, however, that many villagers are not registered as unemployed. Therefore, the actual unemployment in the village is much higher than the official level. Against the background of hidden unemployment and the single-industry structure of the rural economy, the problem of labor surplus in rural areas is aggravated. The most difficult thing is to solve the problem of employment for young people (Fig. 3).

Studies have shown that with the relatively successful development of the market for material and technical resources, investments and innovations, some positive experience of using digital platforms, a full-fledged labor market in rural areas has not yet been formed.

The modern agrarian economy is not yet capable of absorbing the surplus supply of labor resources. And at the same time, agricultural enterprises are forced to maintain surplus labor, while experiencing a shortage of qualified labor.

The high level of rural poverty and unemployment, the imperfection of the labor market, and the low level of wages do not allow breaking the vicious circle in which the agrarian economy of Russia finds itself.

Thus, insufficient efficiency of agricultural production does not allow increasing the level of profitability and wages.

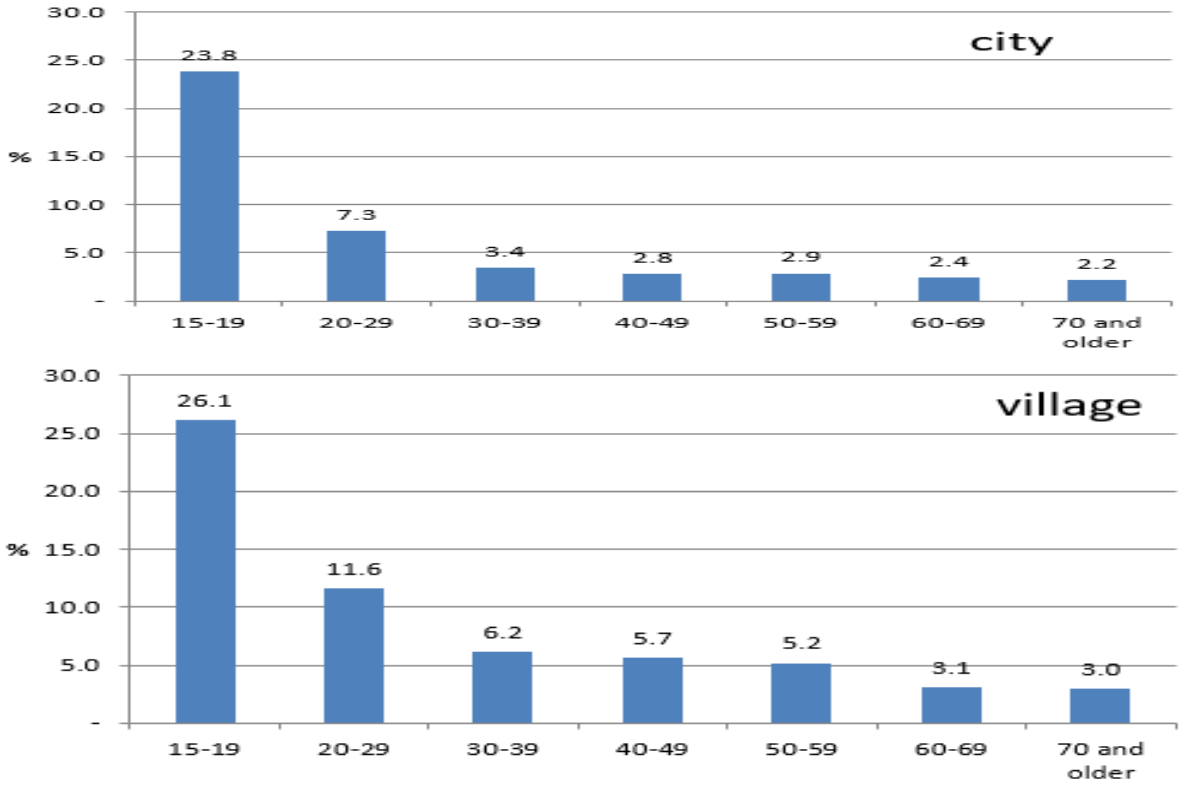

Fig. 3. Unemployment rate of urban and rural population aged 15 and older by age group, %
Source: Own calculation.

This does not induce both demand and supply in the rural labor market, especially qualified personnel. The low level of wages generates a correspondingly low standard of living for the rural population, hinders the social development of the territory, and limits tax revenues from economic activities.

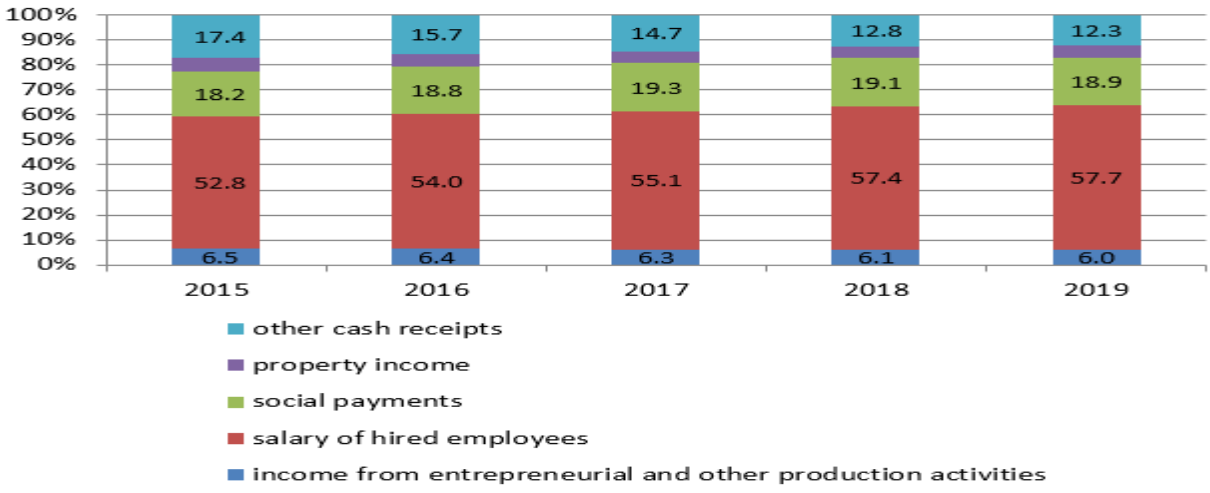

Fig. 4. The structure of cash income of the population of the Russian Federation by sources of income,%
Source: Own calculation.

An analysis of statistics allows us to conclude that the nominal average wage has grown by more than 6% in January-May 2020 compared to the same period in 2019. However, the proportion of Russians, for whom wages are becoming the main source of income, has already grown to 65.3%.

There is a threat of an exacerbation of the economic crisis and an increased risk of an increase in the number of unemployed. The

share of income from entrepreneurial activity in the income of the population decreased to 6%. At the same time,
the contribution to the income of social payments remains quite high (Fig. 4).
The analysis revealed a significant gap in the resources of urban and rural households. Thus, income in rural households does not exceed 2/3 of income in urban households (Table 4).

Thus, the formation of worse living conditions for the rural population activates migration processes: there is an outflow of the economically active rural population to the cities. This repetitive feedback loop aggravates the already dire situation in the Russian countryside, leading to its depopulation.

Table 4. Disposable resources on average per household member per month (rubles)

Indicators		**2015**	**2016**	**2017**	**2018**	**2019**	***2019/2015. %***
Disposable resources. Total	All households	23,084.8	24,209.8	24,926.5	26,917.7	28,995.2	*125.6*
	city	25,466.4	26,719.7	27,206.8	29,556.9	31,931.9	*125.4*
	village	16,639.7	16,971.0	18,309.1	19,188.5	20,360.8	*122.4*
Of them: cash income	All households	20,621.5	21,753	22,359.2	23,628.8	25,792.2	*125.1*
	city	22,848.3	24,114.8	24,589.6	26,063.1	28,566.3	*125.0*
	village	14,595.1	14,941.1	15,886.7	16,499.6	17,635.8	*120.8*
in-kind cost	All households	794.1	766.7	762.2	758.4	812.1	*102.3*
	city	641	602.1	591.1	580.9	637.8	*99.5*
	village	1,208.3	1,241.4	1,258.8	1,278.1	1,324.8	*109.6*
the amount of funds attracted and spent savings	All households	1,669.3	1,690.2	1,805	2,530.5	2,390.9	*143.2*
	city	1,977.1	2,002.8	2,026.1	2,912.8	2,727.8	*138.0*
	village	836.2	788.5	1,163.6	1,410.8	1,400.2	*167.4*

Source: Own calculation.

In disposable resources, the largest share belongs to cash income (86% in the countryside and 89% in the city). Recently, the share of in-kind receipts in the disposable resources of households has been noticeably decreasing (6.5% in the countryside and 2% in the city). The aggravation of rural poverty is evidenced by the growth of both the amount and the share of borrowed funds and spent savings (up to 7% in the countryside and 8.5% in the city). The limited demand of the population associated with a low level of monetary income is compensated by spending savings. As a result, the savings behavior of households is changing.
A significant factor that determines the sustainability of the development of rural areas is the low level of wages in agriculture, which determines the poverty of the rural population. The large-scale concentration of poverty in rural areas contributes to the demotivation of labor, the spread of social deviations, mass migration of young people from the countryside, creating real threats to the country's food security.
Agricultural wages are 66.3% of the average wages in the economy. It should be noted that this gap is not closing. Extrapolation of the current dynamics of wages and the construction of linear trends indicates the impossibility in the near future to solve the problem of rural poverty without a significant increase in the rate of growth of wages in agriculture.

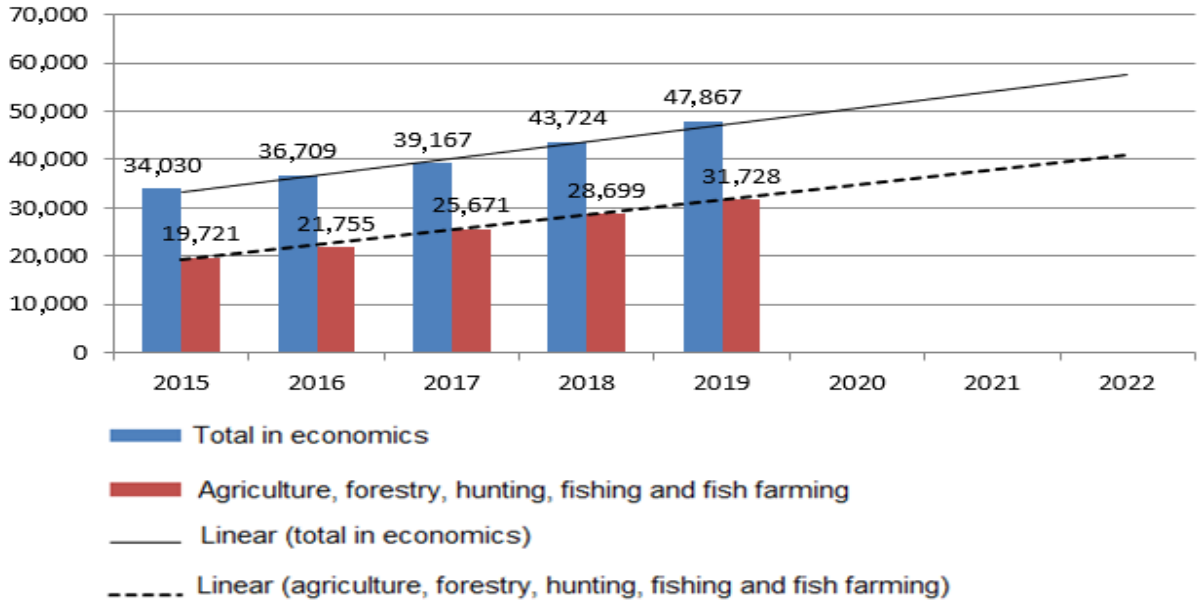

Fig. 5. The ratio of wages in agriculture and the average for the economy
Source: Own calculation.

The reasons for the low level of wages in rural areas include lack of non-agricultural employment, underdeveloped social infrastructure in the countryside, attachment to personal subsidiary farming. A distinctive feature of our time is pendulum migration, which allows you to get a job in the city.

Differentiation of the level of expenditures on the consumption of urban and rural households is also significant (Table 5). Consumption expenditures in rural households are more than half that of urban households. A smaller gap (18%) is observed in the ratio of food spending in urban and rural areas.

Table 5. Expenditures on final consumption on average per household member per month (rubles)

Indicators		2015	2016	2017	2018	2019	*2019/2015 .%*
Consumption expenses, total	All households	14,764.1	16,532.5	17,319.9	18,031.4	19,749.4	*133.8*
	city	16,782.4	18,214.3	18,905.6	19,663.2	21,668.7	*129.1*
	village	11,271.3	12,070.4	12,718.5	13,252.5	14,106.2	*125.2*
Home food expenses	All households	5,221.3	5,698.5	5,730.9	5,776.1	6,213.8	*119.0*
	city	5,338.8	5,841.7	5,879.5	5,914.5	6,396.4	*119.8*
	village	4,903.4	5,285.5	5,299.8	5,370.8	5,677.0	*115.8*
The cost of food in-kind	All households	575.9	588.1	574.5	569.6	593.6	*103.1*
	city	389.2	404.6	385.5	381.2	397.9	*102.2*
	village	108.2	1,117.5	1,122.9	1,121.6	1,168.9	*108.1*
Of which: receipts from personal subsidiary plots	All households	419.7	429.4	415.9	410.7	420.2	*100.1*
	city	241.2	254.9	237.1	231.3	234.2	*97.1*
	village	902.6	932.8	934.7	936.2	966.8	*107.1*
Food expenses from total consumption expenses	All households	5,707.8	6,220.7	6,250	6,352.4	6,824.6	*119.6*
	city	5,932.2	6,475.4	6,505.4	6,621.9	7,149.4	*120.5*
	village	5,100.5	5,486.2	5,509	5,562.9	5,869.6	*115.1*

Source: Own calculation.

This is due to more significant natural income, including from personal subsidiary plots (more than 4 times). For the period 2015-2019 receipts from personal subsidiary plots for urban households decreased by 3%, and for rural households - increased by 7%.

Analysis of the structure of household expenditures depending on the place of the residence revealed significant differences. So, if in 2019 in the city the share of food expenditures in consumer spending of households was 33.1%, in the countryside - 41.7%. The shares of expenses for payment of services also differ noticeably. At the same time, there is practically no differentiation in the share of expenditures on non-food products (Fig. 6).

A high share of food expenditures characterizes a low level of affordability of food, which does not meet the main criteria for food security. An analysis of the economic affordability of food in developed countries revealed that the higher the level of development of the national food system and the more it is better integrated into world economic relations, the smaller the share of food expenditures in the population's expenditures (no more than 15%) [5].

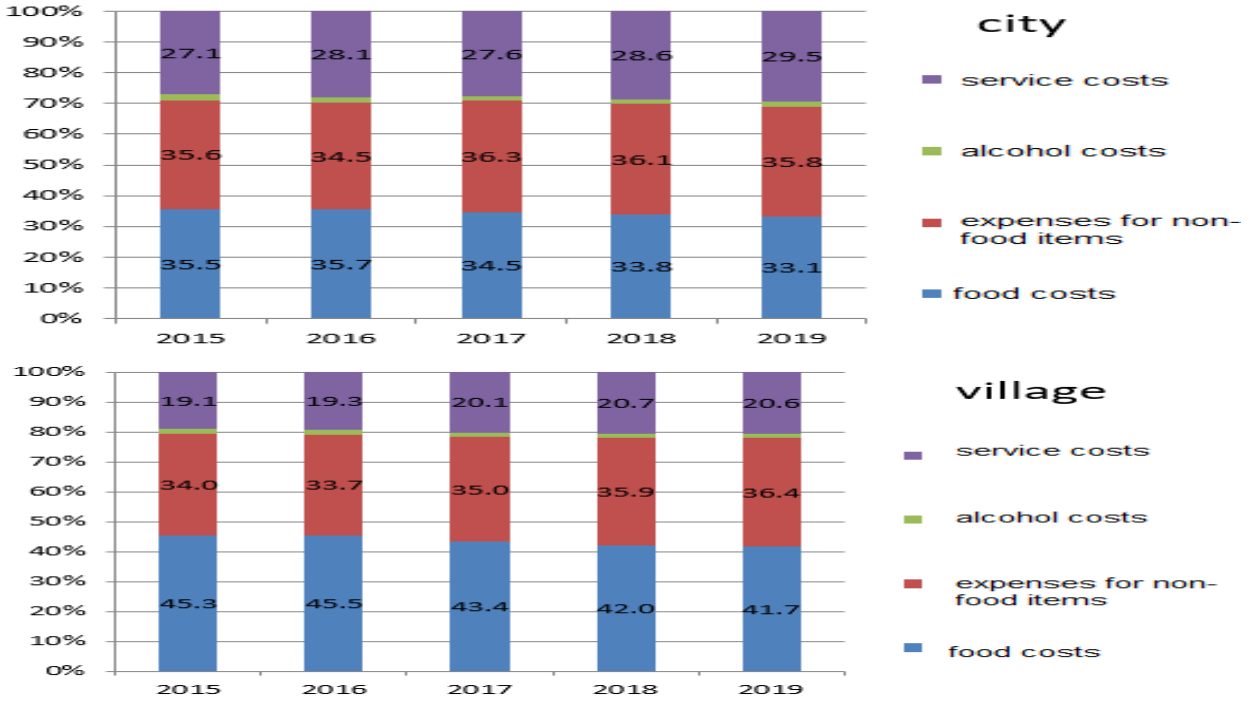

Fig. 6. The structure of household consumption expenditures depending on the place of residence (based on the results of a sample survey of household budgets), as a percentage of the total
Source: Own calculation.

Solving food security problems is still relevant for Russia as a whole, and especially for rural areas [3, 8]. The food structure of the rural population lags significantly behind the requirements of rational norms of food consumption, despite the greater availability of food from their own subsidiary plots. The diet of villagers is much poorer than in cities: the rural population consumes less meat and dairy products, fruits, but more bread and potatoes. This is evidenced by the analysis of food security based on the coefficient of the sufficiency of consumption (Table 6). This coefficient is calculated as the ratio of the actual consumption of food products per capita to the rational norms of food consumption. Poor quality nutrition can exacerbate the health problem of rural residents, negatively affect life expectancy in the countryside, and decrease the birth rate.

Table 6. Indicators of sufficiency of consumption of basic food products for urban and rural population

Food	Terrain	2015	2016	2017	2018	2019
Bread products (96 kg *)	City	0.927	0.958	0.948	0.936	0.943
	Village	1.156	1.219	1.240	1.176	1.144
	Village/ City	*1.247*	*1.272*	*1.308*	*1.256*	*1.213*
Potatoes (90 kg *)	City	0.600	0.633	0.622	0.622	0.619
	Village	0.756	0.778	0.789	0.742	0.733
	Village /City	1.259	1.228	1.268	1.193	1.184
Vegetables and melons (140 kg *)	City	0.714	0.750	0.736	0.740	0.742
	Village	0.707	0.743	0.729	0.756	0.747
	Village/City	*0.990*	*0.990*	*0.990*	*1.022*	*1.006*
Meat and meat products in terms of meat (73 kg *)	City	1.192	1.247	1.247	1.251	1.273
	Village	1.068	1.123	1.178	1.133	1.146
	Village / City	*0.897*	*0.901*	*0.945*	*0.906*	*0.900*
Milk and dairy products in terms of milk (325 kg *)	City	0.834	0.852	0.825	0.823	0.826
	Village	0.769	0.803	0.803	0.800	0.783
	Village / City	*0.923*	*0.942*	*0.974*	*0.972*	*0.947*
Eggs (260 pcs. *)	City	0.850	0.892	0.896	0.891	0.911
	Village	0.808	0.850	0.869	0.883	0.879
	Village / City	*0.950*	*0.953*	*0.970*	*0.991*	*0.965*
Fish and fish products in terms of fish (22 kg *)	City	0.955	1.000	0.955	0.978	0.994
	Village	0.955	1.000	1.045	1.017	1.014
	Village / City	*1.000*	*1.000*	*1.095*	*1.040*	*1.020*

* Recommended rational norms of food consumption / Order of the Ministry of Health of the Russian Federation of August 19, 2016 No. 614 "On the approval of Recommendations for rational norms of food consumption that meet modern requirements for healthy nutrition.

Source: Own calculation.

The solution to the problems of social development of the countryside is impossible without an active state policy. Problems of sustainable development of rural areas for a long period of time are at the center of attention of the state. Several targeted programs and projects aimed at developing rural infrastructure (housing, transport, medical, educational), supporting small businesses, employment of young specialists, etc. have been implemented and accepted for implementation. Since 2013, the Federal Target Program (FTP) "Sustainable Development of Rural Areas" has been implemented. Funding was provided from federal, regional, and extrabudgetary sources. The expenditures on FTP over the past six years from all sources amounted to about 200 billion rubles [31].

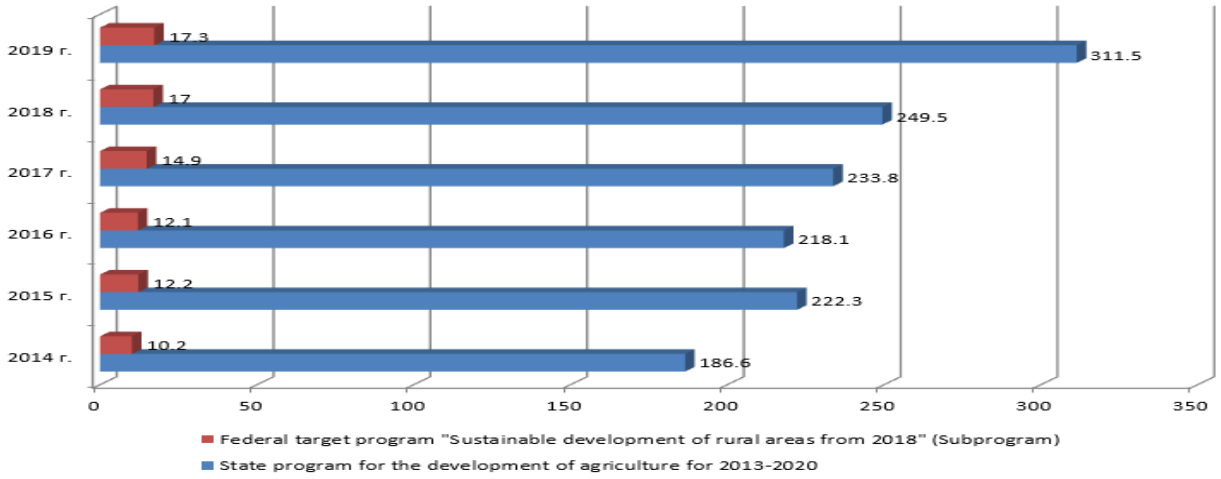

Fig. 7. Financing of the State Program for the Development of Agriculture and Regulation of Markets for Agricultural Products, Raw Materials and Food and the Federal Target Program «Sustainable Development of Rural Areas» from the federal budget in 2014-2019, billion rubles.
Source: Reporting on the execution of budgets [27].

Funding from the federal budget amounted to 83.7 billion rubles. As can be seen from Fig. 7, such volumes of financing in comparison with the total volume of financing of the State Programs amounted to only 5.5-6%. Two-thirds of the total volume of funding were funds from regional budgets (36.2%) and extra-budgetary sources (22.5%).

Resolution of the Government of the Russian Federation No. 696 of May 31, 2019, approved the State Program of the Russian Federation "Comprehensive Development of Rural Areas" for 2020–2025. (the amount of funding is about 2.3 trillion rubles, including from the federal budget - 1 trillion rubles). The main idea of this program is to make the rural area attractive not only for the already living villagers but also for the influx of a new population. The peculiarity of the implementation of this program is the principle of proactive budgeting by citizens, the business community, public and non-profit organizations. A project-based approach to the implementation of activities in the following areas: social infrastructure and housing; engineering and transport infrastructure; culture and sports; living environment; promotion of employment of the population; government services; physical availability of food and household goods, provides for a competitive selection of initiative projects by the Ministry of Agriculture of Russia. The main task is to reduce the level of rural poverty. This program should synchronize the implementation of the entire list of measures to support rural areas aimed at eliminating social degradation in the countryside. The significance of this program is due not only to the importance of solving the “old” social problems of the village, the causes of persistent rural poverty, but also the possible turn of society towards de-urbanization, especially in the context of the Covid-19 pandemic.

However, significant concerns arise from the experience of implementing numerous measures to address sustainable rural development issues. First, the planned conditions and volumes of financing from the federal and regional budgets are not being met. Secondly, the principle of co-financing laid down in the program, provides for priority financing of settlements where there are jobs and more opportunities to attract funds from extra-budgetary sources. Such conditions will put rural areas with a high level of unemployment, poverty, and low budgetary security in an extremely unequal position, as a result of which the “vicious circle” of rural poverty will not be broken. Implementation of the principle of state co-financing of local initiatives, taking into account the interests of rural areas and the competitive advantages of agribusiness is not now a generally accepted practice of allocating budget funds. Public-private partnership in solving social problems of the village has not yet become the norm.

CONCLUSIONS

The study made it possible to conclude that the implementation of the Sustainable Development Goals (SDGs) based on the model of inclusive growth of the Russian agro-food system is impossible without solving the problems of social development of the countryside. However, the social development of the countryside is hampered by a complex of long-standing problems of domestic agriculture: a high level of poverty, a deformed structure of the labor market, an underdeveloped rural infrastructure, and general degradation of the countryside. Taking into account the new risks of the development of the Russian agri-food system, state policy should be aimed at solving the following tasks of inclusive growth:

-development of social rural infrastructure;
-strengthening of state support for the economic activity of small forms of agribusiness;
-raising the level of education and qualifications of rural residents;
-diversification of the rural economy based on support for non-agricultural activities;
-increasing the physical and economic availability of food;
-bridging the income gap between the urban and rural population and increasing social protection in rural areas.

So far, the lack of coordination in government policy has prevented the problem of rural poverty from being resolved. Programs for the development of social and engineering infrastructure are not funded. Therefore, agricultural production, faced with restrictions on the growth of efficiency, in turn, becomes the cause of an increase in social tension. A real opportunity to respond to this challenge is the state policy of rural social development.

An additional opportunity for the development of rural areas is associated with an increase in the attractiveness of the village as a habitat in a pandemic. This actualizes the revision of the existing concept for the development of rural areas and the fight against rural poverty in line with the model of inclusive development.

In our opinion, both increasing the social responsibility of large agribusiness (agricultural holdings) and the revival of peasant entrepreneurship based on the intensification of state support for the economic activity of peasant (farmer) households and households are important for solving the problems of sustainable rural development. Only in such conditions, on the one hand, the positive dynamics in the development of domestic agriculture can be converted into an improvement in the quality of life of rural residents, and on the other hand, the sustainable development of the countryside will become the basis for strengthening Russia's position in the world food market.

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CONDITIONS FOR THE DEVELOPMENT OF THE INSTITUTIONAL STRUCTURE OF THE SCIENTIFIC AND INTELLECTUAL POTENTIAL OF THE AGRICULTURAL FOOD COMPLEX

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Abstract

The scientific and intellectual potential of the agri-food complex is the most important determinant of the process of innovative development of the agri-food complex of the national economy. The aim of the study is to improve the theoretical and methodological provisions for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders. The author's paradigm for the development of the institutional structure of the scientific and intellectual potential of the agri-food complex is described by the concept of the national innovative agrosystem (NIS), and the interaction between its stakeholders is described by the triple helix model. The theory of the triple helix has been developed by including, along with science, agribusiness and the state, such institutional elements as society and the institution of information support; specific features of the formation of an innovation system in the agricultural sector of the economy have been identified. Based on the results of the analysis, disparities in the structure of scientific and intellectual potential and indicators of the effectiveness of its functioning were revealed. The systemic-functional approach to the development of scientific and intellectual potential by linking the identified systemic problems with specific functions of innovative development, taking into account the characteristics of the agri-food complex, has been substantiated. The practical implementation of the proposed approach consists in the possibility of forming strategies for the innovative development of agriculture at the sectoral and regional levels based on the synergistic effect of the complex interaction of the stakeholders of the innovation process based on improving the organizational, economic and legal conditions.

Key words*: scientific and intellectual potential, agri-food complex, institutional structure, interaction of stakeholders, system-functional approach, strategies for innovative development*

INTRODUCTION

Improving the efficiency of agricultural production, ensuring sustainable balanced development of rural areas in the context of the transition to an export-oriented agrarian economy can be achieved only through the large-scale introduction of innovative technologies and high-tech products into production processes. According to the Strategy of Scientific and Technological Development of the Russian Federation, approved by Decree of the President of the Russian Federation of December 1, 2016 N 642, the problems of insufficient coordination of research institutes with sectors of the economy hinder the scientific and technological development of Russia.

Accelerating the diffusion of agro-innovations into production and increasing the efficiency of innovative processes is inextricably linked with the improvement of the institutional structure of the scientific and intellectual potential of the agri-food complex, aimed at increasing the effectiveness of interaction between science and production.

The theoretical basis of the study is a set of theories describing both the process of formation of the institutional structure of the scientific and intellectual potential of innovative agricultural systems and the process of interaction of their constituent stakeholders. The formation of innovative agricultural systems is described by the NIS concept, as well as by systems theory. The interaction between the stakeholders of the

scientific and intellectual potential of innovative agricultural systems is described from the perspective of the theory of the triple helix and its development. Formation of the institutional structure of innovative agrosystems is based on effective interaction between the stakeholders of agrosystems, which is regulated by institutions like norms and rules, customs, ensuring the innovative receptivity of agribusiness [35].

Let us consider the synthesis of these theories about agriculture to form the author's paradigm for creating the institutional structure of the scientific and intellectual potential of the innovative agrosystem. The modern concept of innovation systems is based on the classic works of economic theory [32].

Currently, there are different points of view on the innovative development of territories: the concept of national innovation systems by K. Freeman, J. Clark and L. Soete [11, 20, 21], mechanism and tools for spatial replication of innovations A. Preda, H. Perloff, B. Berry, J. Friedman, G. Richardson [15, 23, 30]. the "diffusion of innovation" model by T. Hägerstrand [16], the concept of technological orders S. Glazieva, V.E. Dementieva [12, 10].

Russian scientists VV Ivanov made a significant contribution to the development of the concepts of innovation systems at the regional level [18, 13, 8].

The internal mechanism of functioning of innovation systems is based on the Triple Helix model, which is the concept of interaction between government, business, and universities. The model was developed in the mid-1990s. famous scientists G. Itskovits and L. Leidesdorff in the form of integration of institutional ideas of economists, sociologists, and biologists [14, 17].

According to N. Smorodinskaya, the concept of the "triple helix" is based on the evolutionary theory. She describes the transformation and structural shifts of economic systems based on the development of technology. In the process of these transformations, the forms of combining science, business and the state have changed. The independent activity of these agents (actors) did not give an effective result at the next stage of technology development [3, 33].

The high relevance of the formation of the institutional structure for the socio-economic development of society is studied in the works of D. North, V.M. Polterovich, J. Hodgson, GB Kleiner [19, 24].

Currently, the following interpretation of Douglas North's institutions is most widespread: "Institutions are rules, mechanisms ensuring their implementation, and norms of behavior that structure repetitive interactions between people" [22, 4].

National innovation systems of different countries have their own specific goals and objectives.

One of the main reasons for the emergence of institutional "traps" of food systems and agrosystems with a complex organization is the divergence of interests of the main stakeholders of innovation systems, a combination of different models of their economic behavior based on these interests [7].

MATERIALS AND METHODS

The study aims to improve the theoretical and methodological provisions for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders.

The object of the research is the institutional structure of the scientific and intellectual potential of the agri-food complex, represented by a set of stakeholders - science, agribusiness, state, society, and informatization, the interaction of which is aimed at increasing the efficiency of agricultural production and increasing its innovative activity.

The subject of the research is complex organizational, economic, and managerial relations that ensure an increase in the efficiency of interaction between stakeholders of scientific and intellectual potential in the process of forming its institutional structure.

The main research methods were abstract-logical, graphic, statistical, comparative, and expert methods.

The development of theoretical provisions for the innovative development of the agrarian sector of the economy, models, and approaches to the interaction of stakeholders of innovative systems, made it possible to represent the scientific and intellectual potential of the agri-food complex as a set of institutional elements, such as science, business, government, society, informatization, the effectiveness of interaction of which contributes to the formation of the stakeholder receptivity.

The author's paradigm for creating the institutional structure of the scientific and intellectual potential of the agri-food complex is based on the development and adaptation of the synthesis of theoretical and methodological provisions for the formation of the institutional structure of the innovative agrosystem. Building an institutional structure based on the NIS concept presupposes the formation of new approaches to explaining the processes of the emergence and diffusion of innovations about the agricultural sector of the economy. At the same time, properties and new trends are analyzed, which are reflected in the interaction of stakeholders of the system-state, science, and business.

When forming the institutional structure of the scientific and intellectual potential of the innovative agrosystem, it is necessary to take into account the general formal norms and rules that determine the behavior and interaction of its stakeholders. Its formation is also influenced by informal institutions - beliefs, culture, customs, practices, norms of behavior, and attitudes. Informal institutions are characterized by specific features at the national, regional, and sectoral levels. Innovation-oriented institutions support entrepreneurship, shape the attitude of the stakeholders of the innovative agrosystem to risk, their orientation towards individual or social education, the development of scientific and intellectual potential competencies in the context of the digital transformation of the economy, as well as to threats and shocks of the external environment. The specificity of building an innovative agricultural system is determined by the characteristics of agriculture, complex climatic and geographical factors, high risks of agricultural production, the uneven spatial distribution of the scientific and innovative potential of agriculture [6].

Successful foreign experience in the study of the most important resources of agricultural systems, such as land, labor, production, technological, informational, are reflected in the works of foreign researchers [25-29].

RESULTS AND DISCUSSIONS

The methodology for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex is represented by a set of approaches, principles, functions, research methods, as well as its specific features. When forming the institutional structure, systemic, marketing, process, and behavioral were taken into account. institutional, program-targeted approaches. The main research methods are abstract logical, expert, statistical, and methods of economic and mathematical modeling. The study developed the author's principles for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex, which has the property of innovative susceptibility:

1.interaction of stakeholders (multi-stakeholder partnerships) on the issues of identifying the needs for agro-innovation, the creation, implementation, and dissemination of science-intensive technologies in agricultural production;

2. rational distribution of competencies and resources in the process of functioning of the stakeholders (actors) of the system;

3. the flow and exchange of knowledge, information, innovative ideas both from scientific institutions and government agencies, as well as from the sphere of production, marketing, and consumption;

4. focus on the needs of end-users - enterprises, industries, regions, national priorities;

5. the integrity of the innovation chain from the stage of identifying the needs for targeted

innovation to implementation to the end consumer and distribution;
6. assistance of the state to stimulate the innovative susceptibility of the system through legal, administrative, economic measures; the state is viewed in the innovative agrosystem as a customer of innovations, it stimulates the introduction of innovations through loans, loans, tax incentives, finances most of the fundamental and most important applied research on agriculture;
7. flexibility of interaction and redistribution of resources between the stakeholders (actors) of the system to achieve the planned goals;
8. determination of the main subsystems and elements of the innovative agrosystem and analysis of the forms of knowledge circulation within it. Based on the developed methodological principles for the formation of innovative agricultural systems, an analysis of the effectiveness of innovative activities in agriculture was carried out, taking into account the contribution of stakeholders included in the innovation system. With its high scientific potential, agriculture is currently showing growth and is the engine of economic growth in the economy as a whole, creating the necessary jobs and gross added value [9]. However, in Russia, there is an insufficiently stable trend of investment inflow into agriculture. Table 1-3, some proposed indicators for assessing the effectiveness of the functioning of the innovative potential of agriculture in dynamics are presented based on existing statistical data.

Table 1. Key indicators of the level of innovative activity in agriculture of the Russian Federation in 2013–2017, %

Indicators	2013	2014	2015	2016	2017
The aggregate level of innovation activity (share of organizations, carrying out technological, marketing, organizational innovations, in the total number of organizations in agriculture)	…	…	…	4.0	3.7
Of them:					
the share of organizations engaged in marketing innovations in the total number of organizations	…	…	…	0.4	0.5
the share of organizations that carried out organizational innovations in the total number of organizations	…	…	…	0.9	0.9
the share of organizations implementing technological innovations in the total number of organizations	…	…	…	3.4	3.1
The share of organizations implementing technological innovations in the total number of organizations in industry	9.7	9.7	9.5	9.2	9.6

Source: Rosstat data [31].

Table 2. Dynamics of indicators of costs for innovative development of agriculture in the Russian Federation, 2013-2017

Indicators	2013	2014	2015	2016	2017
The amount of state support funds under the State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Products, Raw Materials and Food, RUB mln	260,960	262,122	254,982	295,928	257,529
Investments in fixed assets aimed at the development of agriculture, billion rubles	516	510	505	511	434
Expenditures on technological innovations of agricultural enterprises, mln rubles	29,974	25,864	25,023	23,963	23,976
Share of costs for technological innovation in relation to the volume of goods shipped, work performed, services by agricultural enterprises,%	0.57	0.55	0.53	0.54	0.55

Source: Rosstat data [31].

Tables 1 and 2 show that the level of innovative activity in agriculture remains low despite a slight increase in the cost of technological innovation. Agricultural organizations are characterized by a rather low involvement in innovation processes: the development of the latest scientific and technical products was carried out by only 3.1% of organizations. For comparison, Table 1 shows data on industry, where the share of organizations implementing technological innovations is 3 times greater than in agriculture.

Table 3 shows the dynamics of the production of high technology products in the agricultural sector of the economy.

Table 3. Dynamics of production of high-tech products in agriculture, in the Russian Federation, 2013-2018

Indicators	2013	2014	2015	2016	2017	2018
The number of created varieties and hybrids of agricultural crops	298	293	287	266	295	238
The number of breeding forms of animals, birds, fish and insects	4	9	7	4	3	1
Number of new and improved technologies developed	301	295	273	247	224	210
Number of developed vaccines, diagnostics, biological products	59	47	36	36	27	15
Number of new food items developed	364	392	214	192	188	172

Source: Rosstat data [31].

As a result of the analysis, the following trends were revealed: low level of innovative activity in agriculture; low level of demand for domestic developments among agricultural producers of various types, unsatisfactory rates of implementation of modern technologies in small and medium-sized farms; the insufficient level of funding for agricultural science.

The diagnostics of the identified factors and systemic problems based on the results of the analysis made the task of targeted improvement of the institutional structure at the sectoral and regional levels urgent.

The paper proposes a system-functional approach to improving the institutional structure, based on the principles of construction and functions of the scientific and intellectual potential of the agri-food complex. The synergistic effect of the interaction of stakeholders is due to the use of a co-innovative approach in the architecture of the institutional structure of the scientific and intellectual potential of the agri-food complex [34].

The application of a co-innovation approach at the regional and sectoral levels will make it possible to develop a set of incentive instruments and mechanisms for innovation policy. A wide range of innovation policy instruments exists to strengthen support for innovation processes, such as research funding, patent regulation, and industry standards that stimulate innovation.

Targeted tools for stimulating innovation are aimed at overcoming the shortcomings of innovation susceptibility, coordinating the policy of fundamental and applied research. The development of these tools is aimed at countering specific systemic problems by supporting the performance of the functions of agrosystems, joint forecasting and vision building, balancing supply and demand for various types of innovation support, and creating a space for learning and experimentation of stakeholders [5].

The development of innovative processes based on improving the institutional structure of the scientific and intellectual potential of the agri-food complex is proposed to be carried out by linking the identified systemic tasks with the specific functions of the innovation system. The scientific and intellectual potential of the innovative agrosystem is realized through the following functions: entrepreneurial activity, knowledge generation, knowledge dissemination, management, market formation, resource mobilization, counteraction to change [2].

The function of entrepreneurial activity is aimed at transforming the potential of new knowledge, networks, and markets into real actions for the formation and implementation of consumer value. This function determines the level of progress of the innovative agricultural system, is an indicator of the spread of high technology products. It is a central function linking other functions of the agrosystem and stimulating the creation of knowledge.

The knowledge generation function is of fundamental importance, aimed at finding ideas and developing knowledge with the help of scientific institutions and agribusiness.

The function of spreading or diffusing knowledge across technological platforms and networks is of high importance. It provides policy and market support for innovation, increasing the number of users to further facilitate the co-evolution of social, technological, institutional, and market change. Among the forms of knowledge dissemination, we note seminars, conferences, and scientific and technical speeches.

The function of managing the development of an innovative agricultural system includes planning, organization, motivation, coordination, and control. The form of its implementation is the stimulation of entrepreneurial activity and the transition to a new technological level, the establishment of research priorities, the assessment of the necessary resources to achieve the set goals.

The function of market formation is important and completes the process of interaction between stakeholders. It is proposed to enhance its importance by diagnosing the needs of agricultural producers in specific innovations and the production of scientific and technological solutions by the needs of agribusiness.

The function of mobilizing resources in an innovation system includes the accumulation and optimization of financial, intellectual, informational, regulatory, and other resources necessary for the development of technologies and the development of innovative market concepts.

The function of counteracting changes and adapting the stakeholders of the innovative agricultural system to the transforming conditions of the external environment, redistributing resources between stakeholders to achieve the priority tasks of scientific and technological development at the federal, regional and sectoral levels is also of high importance [1].

The development of a management mechanism for the institutional structure of the scientific and intellectual potential of an innovative agricultural system is based on the improvement of legal, economic, and organizational conditions (Fig. 1).

The interaction between science and industry is possible through the development of a research program by representatives of the manufacturing sector, joint research programs, and timely funding of research programs. The development of relations between science and the state is proposed based on the introduction of long-term funding programs, the participation of representatives of scientific organizations in government advisory bodies, the implementation of state tasks, as well as the expansion of informal contacts.

Funding is possible through the use of such forms as venture funds, innovation, and implementation firms and centers, technology parks, technology transfer centers, etc.

The unification of stakeholders in an innovative agricultural system is a driver for obtaining new knowledge and translating it into products and technologies. Networks or systems that can effectively disseminate knowledge, technology, and information are acquiring key importance; science is embedded in the system of production and

diffusion of knowledge. In an innovative agricultural system, science fully contributes to the production of knowledge, transforming it into science-intensive products for agricultural production.

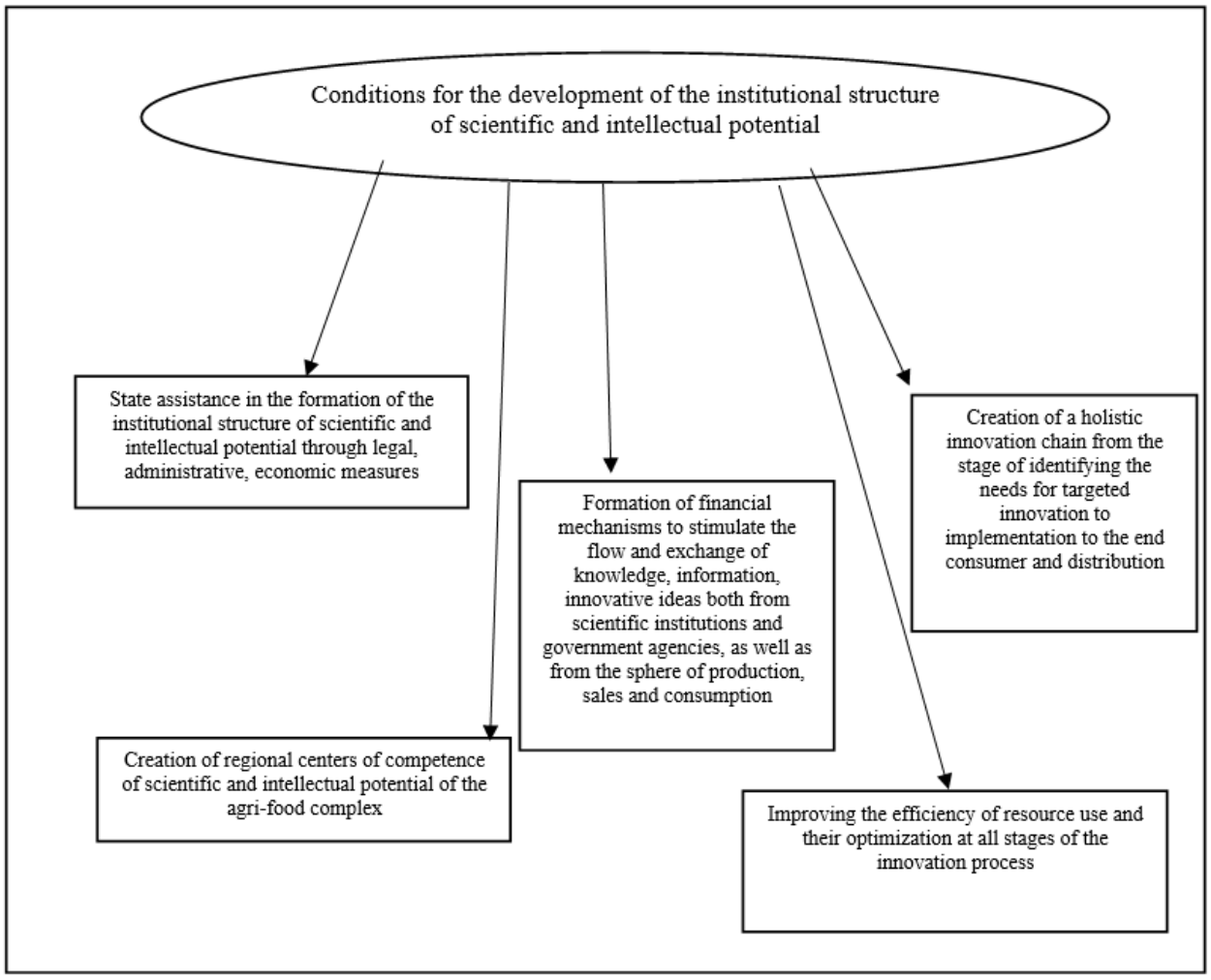

Fig. 1. Organizational and economic conditions for the development of the institutional structure of the scientific and intellectual potential of the agri-food complex
Source: Own calculation.

The dynamic nature of innovative agrosystems manifests itself in the symbiosis of participants in the innovation process in the face of emerging risks and external shocks. This task requires the development of interdisciplinary research, the creation of new technologies based on the partnership between the state and private business, the approval of new rules for international trade, trade, and competition.

CONCLUSIONS

The study developed theoretical and methodological provisions for the formation of the institutional structure of scientific and intellectual potential at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders. The author's paradigm of the innovative agricultural system is described by the NIS concept, and the interaction between its stakeholders corresponds to the triple helix model.

The formation of the institutional structure of innovative agrosystems is based on effective interaction between the stakeholders of agrosystems, which is regulated by institutions like norms and rules, customs that

ensure the innovative susceptibility of agribusiness according to D. North's concept.

The methodology for the formation of an innovative agrosystem is represented by a set of approaches, principles, functions, research methods, as well as its specific features. Based on the developed methodological principles for the formation of innovative agricultural systems, the analysis of the effectiveness of innovative activities in agriculture, taking into account the contribution of the stakeholders included in the innovation system, is carried out. As a result of the analysis, the following trends were identified: an insufficient level of efficiency of innovative activities in agriculture, an insufficient level of funding for agricultural science, as well as a weak connection between research topics and the needs of agribusiness.

The paper proposes a system-functional approach to improving the institutional structure, based on the principles of construction and functions of the scientific and intellectual potential of the agrosystem. The synergistic effect of the interaction of stakeholders that are part of the agrosystem is due to the application of the methodological approach of innovations in the architecture of the agrosystem. Taking this approach into account at the regional and sectoral level will make it possible to develop a set of incentive instruments and mechanisms for innovation policy. The development of innovation processes is presented based on improving the institutional structure of the innovation system by linking the identified systemic problems with specific functions of the innovation system.

The features of the implementation of the seven main functions of the scientific and intellectual potential of the innovative agrosystem are highlighted, revealing the nature of the interaction between its stakeholders, the system with the external environment, and between other innovative systems: entrepreneurial activity, knowledge generation, knowledge dissemination, management, market formation, resource mobilization, counteraction to changes ...

A range of innovation policy instruments aimed at eliminating the identified imbalances by supporting the performance of the functions of the agricultural system is proposed.

The paper proposes directions for the development of a mechanism for managing the institutional structure of scientific and intellectual potential, including the improvement of legal, economic, and organizational conditions.

The practical implementation of the proposed approach consists in the possibility of developing strategies for the innovative development of agriculture at the sectoral and regional levels based on the synergistic effect of the complex interaction of the stakeholders of the innovation process. The significance of the research results lies in increasing the efficiency of scientific and intellectual potential based on improving the organizational, economic, and legal conditions for interaction of stakeholders to accelerate the scientific and technological development of the agri-food complex.

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SUBSTANTIATION OF FACTORS OF STRATEGIC DEVELOPMENT OF SCIENTIFIC AND INTELLECTUAL POTENTIAL OF AGRICULTURAL FOOD COMPLEX

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Abstract

The strategic development of the scientific and intellectual potential of the agri-food complex is a driver for increasing the efficiency of agricultural production. The purpose of the article is to study the constraining and accelerating factors of strengthening the scientific and intellectual potential of the agri-food complex and to develop a methodology for assessing the level of its development. The study clarified the theoretical and methodological aspects of the development of the scientific and intellectual potential of the agri-food complex. The restraining and accelerating factors of the development of the scientific and intellectual potential of the agri-food complex are systematized. According to the results of the analysis, disparities in the efficiency of the functioning of scientific and intellectual potential and its structure were revealed. The assessment of the values of these indicators makes it possible to substantiate proposals aimed at increasing the number of people employed in the scientific field and at attracting additional public and private funding for research and development to the national average level. This will increase the economic, social, technological, and budgetary efficiency of managing the scientific and intellectual potential of the agri-food complex. In the agri-food sector, first of all, an increase in budget financing will be required, taking into account the achieved level of development based on the results of the assessment. As a result of substantiating the conditions and factors for the development of scientific and intellectual potential and the author's methodology for its assessment, strategic directions will be developed to increase the efficiency of the production potential of the country's agri-food complex, taking into account the possible effect of the implementation of national projects.

Key words**:** *scientific and intellectual potential, agri-food complex, factors of strategic development, assessment methodology, government regulation*

INTRODUCTION

In connection with the existing global problem of ensuring the food security of states, the availability of food in most developed countries, research is being carried out on the development of innovative activities in the agro-industrial complex and the growth of agricultural production [6]. Scientific and technological development of the agrarian economy of developed countries is guided by the intensive introduction of advanced scientific achievements into production processes. The economies of developed countries are increasingly relying on knowledge, innovation and new technologies, which are now considered to be the driving force of economic growth. Scientific and intellectual potential is closely related to the production potential of the agricultural economy. The level of the current development of the scientific and intellectual potential of the agri-food complex and the degree of its contribution to the economic growth of national economies depend on the combination of factors of strategic development that the state creates for its development and use.

The conceptual basis for the study of scientific and intellectual capital is the synthesis of the theory of the knowledge economy and innovative development. According to B. Milner, the knowledge economy is being transformed and become a part of the innovation system at the moment when ideas, knowledge and technologies reach the stage of commercialization and turn into a market product [17]. In this case, value

chains are formed from an idea to a final product, which is produced taking into account the needs of the population. An indicator of the dynamics of the rate of innovative development is an indirect spillover effect, expressed in an increase in demand for end products produced on an innovative basis. Government procurement and industry regulation are effective mechanisms to stimulate demand [2].

The evolution of management thought about the role of human and scientific and intellectual capital is reflected in the works of A. Smith, A. Marshall, T. Schultz, G. Becker. In recent years, the related concept of the "knowledge triangle", reflected in the documents of the Bologna Process, has been relevant, the mechanism of which is shown in the works of M. Unger and V. Polt. [33].

These authors demonstrated that the "knowledge triangle" unites other concepts that partially complement each other, such as the "third mission", where the need to modernize higher education as an initial element of human capital reproduction comes to the fore, "triple helix" (triple helix), where institutions such as the University, Business, Power strive for cooperation and, if necessary, partially take over each other's functions, which ultimately forms the innovative component of their interaction, an "entrepreneurial" university, which presupposes the entrepreneurial behavior of a higher educational institution, which in symbiosis with business should lead to the economic development of the region, as well as the "smart specialization" of the regions, developed by the expert group "Knowledge for Growth" of the Directorate for Technology and Innovation of the European Commission, interaction Actions taking into account the existing unique competencies of each region within a single innovation cluster.

L. Mindeli and L. Pipia proposed to highlight such areas of the knowledge economy as resources, knowledge asset creation, productivity, networking, and learning [18].

An integrated approach to measuring the knowledge economy, according to E. Vaisman, involves assessing the relationship between the level of innovative development and the formation of competitive advantages against the background of the development of the knowledge economy in certain regions [35].

The formation of knowledge clusters, the core of which is scientific and educational institutions, is one of the effective tools for the development of the knowledge economy. G.V. Petruk, Yu.V. Baldina, and Lebedinskaya Yu.S. prove that the most successful form of interaction in the knowledge cluster is a public-private partnership [21].

The innovative development of agriculture in foreign countries is most directly related to the farming sector, although research is not the basis of the EU strategy. The Common Agricultural Policy of the European Union includes measures to facilitate the transfer of information, innovation, technology, and knowledge from research and development to farmers. The study of the contribution of labor resources to improving the efficiency of agricultural production is reflected in the works of leading foreign researchers [22-26].

Foreign researchers note the need for wider use of targeted support measures: "knowledge transfer", "cooperation" and "investment in intangible assets" [14]. Increased farmers' access to knowledge can be achieved through the use of appropriate agricultural development programs aimed at integrating research centers [10]. Advisory services (PRO-AKIS) play an essential role in supporting farmers. CAP activities focus on climate change mitigation and adaptation; solving numerous environmental problems; economic development and training. The current concept of agricultural knowledge AKIS is based on the development of information and communication technologies (ICT) [15].

Rajalahti, R ., Willem, J ., Eija, P. highlighted the main purpose of the AKIS system - the transfer of knowledge to rural residents. The main links of the AKIS system are national agricultural research organizations; agricultural universities or agricultural colleges; advisory services, farmers; persons engaged in agricultural activities; non-governmental organizations (NGOs) and

entrepreneurs in rural areas [28]. Leeuwis, C. define an innovation system as "a network of organizations, businesses and individuals that manufactures new products; develops and implements new processes and new forms of organization in the economy ". Thus, within the framework of the Agrarian Innovation System (AIS), the knowledge creation process is complemented by activities for its implementation. AIS aims to create competitive agriculture and maintain the achieved positions in a changing economic and social environment. The main feature of AIS in comparison to AKIS, which unites classical systems of knowledge and innovation (universities and research institutions), lies in a wider range of participants, including both public and private organizations [16].

Thus, the agro-innovation system creates conditions for organizing the innovation process in relation to agro-ecological innovations.

In addition to AKIS and AIS, the National Agricultural Research System (NARS) is distinguished, the purpose of which is the creation and transfer of technologies. The World Bank defines NARS as a system that includes institutional units engaged in organizing, coordinating, or carrying out research aimed at developing agriculture and preserving its natural resource potential [36].

Foreign researchers note the imperfection of the conceptual apparatus for AKIS, AIS, PRO-AKIS and other research systems, including state ones [27]. It should be noted the specifics of the functioning of the AKIS system in different countries [13, 29]. Authors such as Dockès et al. [7] emphasize that a lack of understanding of the role and functions of various innovation systems hinders the effective organization of the innovation process of subsystems, and also hinders effective research and teaching. In particular, AKS/AKIS is often perceived as being overly regulated and not in the interests of consumers of knowledge and innovation. In addition, intense competition for financial resources between AKS/AKIS participants (researchers and institutions) hinders collaboration between researchers and innovators. Thus, all existing innovation systems can be perceived as competing. The development of innovative systems has led to the emergence of the new PRO-AKIS system associated with the development of a register of agricultural advisory services in the EU. Its purpose is to integrate AKIS and consulting services.

The political concept of innovation is itself controversial [31].

The most common two approaches to considering innovation: innovation and macroeconomic approach. According to the latter, innovation is viewed as a research and development process for commercial use. The first approach is considered more complex and focuses on interactions between the various actors in the [11].

Discussing innovation, Edler and Fagerberg [8] argue that innovation is an effective lever for solving important social and economic problems. In addition to generating new ideas, they should be promoted. Organization for Economic Co-operation and Development (OECD) [19, 20] notes that innovation can take different forms: the introduction of a new or significant improvement in a product, service, process, marketing or marketing method and an organizational method, both in the form of commercialization and in the form of the internal organization of the company and/or its relations with the outside world [12] assessed the measurement and definition of innovation in various sectors of the economy, using a systems approach to develop a framework for the statistical measurement of innovation. According to the Green Paper, European Commission. Green Paper on Innovation, Bulletin of the European Union [9], innovation flows within the system and business innovation can be grouped according to the following strategic areas (competencies): long-term analysis; the ability to identify and anticipate market trends; the ability to collect information and process technological and economic data; organizational capacity: risk awareness; internal and external cooperation; involving the entire company in the process of change and investing in human resources.

To solve the problems, the acceleration of the scientific and technological development of the agri-food complex becomes relevant to study the factors of strategic development of scientific and intellectual potential, to improve the methods of its assessment and directions of state regulation.

MATERIALS AND METHODS

The study aims to identify the constraining and accelerating factors in the development of the scientific and intellectual potential of the agri-food complex and to develop a methodology for assessing the level of development of scientific and intellectual potential in the regional agri-food complex.

The author's methodological approach to the study of the factors of development of the scientific and intellectual potential of the agri-food complex is based on the analysis in the field of organizational, financial, legal, and information aspects of scientific and technological development; foreign and Russian approaches to financing innovative activities of the agri-food complex in Russia and abroad. The methodological basis of the study was the regulatory documents, studies of foreign and Russian scientists on the issue under study, monographic, analytical, and economic-statistical research methods.

Information materials are Rosstat data for 2013–2018. according to form No. 2K "Information on the number and level of professional education of workers of organizations of the agro-industrial complex."

International experience in assessing innovative development based on advanced scientific and technological achievements combines a pool of indicators and generally accepted indicators: the knowledge economy index and the knowledge economy index; global innovation index (Global Innovation Index); the Global Competitiveness Index; human development index, etc. These indices were proposed by the UN, UNESCO, the World Bank, the European Commission, etc.

These indicators are calculated for the economy as a whole. Directly to calculate the level of development of scientific and intellectual potential in the agri-food complex, it is necessary to take into account both industry and regional specifics, due to various factors.

In the course of this study, the main indicators were identified and substantiated, which makes it possible to assess these factors. Based on the author's indicators, a method is proposed for assessing the level of scientific and intellectual potential of the regional agri-food complex based on constructing and calculating integral indicators and directions for improving state policy on its regulation.

RESULTS AND DISCUSSIONS

Regions of Russia have significant differentiation in terms of the level of development of the scientific and intellectual potential of the agri-food complex. This is due to the state of natural, humanitarian material capital, the specifics of the policy pursued in the regions. For this reason, the conditions and factors for the formation and development of scientific and intellectual potential also differ significantly [30, 1, 5].

The work presents the factors of the development of the scientific and intellectual potential of the agri-food complex: political and legal, organizational and institutional, innovation and technological, structural, economic and financial, socio-psychological, informational and methodological, environmental. As a result, it was found that under the influence of the above factors, relations between the subjects of the innovation process are transformed [34].

Early studies summarized methodological approaches to assessing the effectiveness of the innovation process in the agri-food complex at the stages of production, promotion, and commercialization of knowledge [3, 4]. In continuation of the research, we will analyze and assess the structure and efficiency of science costs in the context of economic sectors. Government statistics distinguish four sectors in which research and development are carried out: government, business, higher education, and non-profit organizations. The gradation of expenditures on science by sector clearly

illustrates the specifics of the Russian structure of production (Table 1).

Table 1. Structure of internal current expenditures on research and development by types and sectors of economic activity of the agro-industrial complex in 2017 and 2019,%

	Internal operating costs - total		Including by type of economic activity			
			Agriculture		Food production	
	2017	2019	2017**	2019	2017	2019
Total, Russian Federation	100.0	100.0	100.0	100.0	100.0	…
Government sector	29.8	27.9	74.1	78.8	15.2	…
Business sector	60.4	60.6	3.5	3.6	35.6	…
Higher education sector	9.4	11.1	22.4	18.3	49.2	…
Nonprofit sector	0.4	0.4	0.1	1.3	0.0	…

Source: Own calculation.

According to Table 1, less than 30% of work is performed in the public sector, and in 2 years the share of this sector has decreased by 2%; and 60% of the costs are in the business sector. There is an inverse proportion in the structure of agricultural research. The public sector accounts for more than 70% of costs, while the entrepreneurial sector accounts for only 3.6%, which is almost 20 times lower than in the economy as a whole. This provision of low funding for agricultural science from the business sector indicates a lack of interaction between scientific organizations and agricultural production and actualizes the problem of the need to create effective forms and methods for integrating science and production. On a positive note, there has been a significant increase in the contribution of non-profit organizations to research and development for agricultural production.

Also, a favorable trend is an increase in research spending in the higher education sector in 2019 compared to 2017 by 1.7%. This may indicate the growth of state support for the development of talented personnel, the growth of key competencies in the sectors of the economy, the creation of regional centers of competencies.

Table 2 shows the structure of internal current expenditure on research and development by sector in the context of basic and applied science, as well as development.

Table 2. Structure of internal current expenditures on research and development in the Russian Federation, including by sectors of agricultural science in the Russian Federation in 2017 and 2019, %

	Total, Russian Federation	Including agricultural sciences	of which by sector			
			government sector	business sector	higher education sector	nonprofit sector
Internal recurrent research and development costs	100.0	100.0	100.0	100.0	100.0	100.0
including:						
Fundamental research 2017	14.8	58.1	67.1	4.4	10.6	17.1
2019	17.1	60.7	67.8	42.6	37.9	14.9
Applied research 2017	18.1	31.1	24.0	40.0	77.5	62.4
2019	20.1	29.8	24.1	5.5	55.8	63.4
Development 2017	66.9	10.7	9.0	55.7	11.9	20.5
2019	62.8	9.5	8.1	51.9	6.3	21.6

Source: Own calculation.

As a result of the analysis of this table, it can be seen that the dynamics of spending on fundamental, applied research and development differs significantly across

sectors. For example, in the higher education sector, basic research accounted for only 10% of spending in 2017, while applied research accounted for over 70%. In the public sector, applied research accounted for 24% of spending in 2017, and fundamental research for 67%. The business sector is characterized by a high share of development costs, in 2017 almost 56%, but in 2019 the share of this sector decreased to 52%, reflecting the general trend of a reduction in the share of development costs. Agriculture is characterized by a fairly stable dynamics of the structure of costs by sector and by type of research, which creates favorable conditions for the development of scientific and intellectual potential.

Figure 1 shows the relative number of researchers by field of science in general and in the public sector.

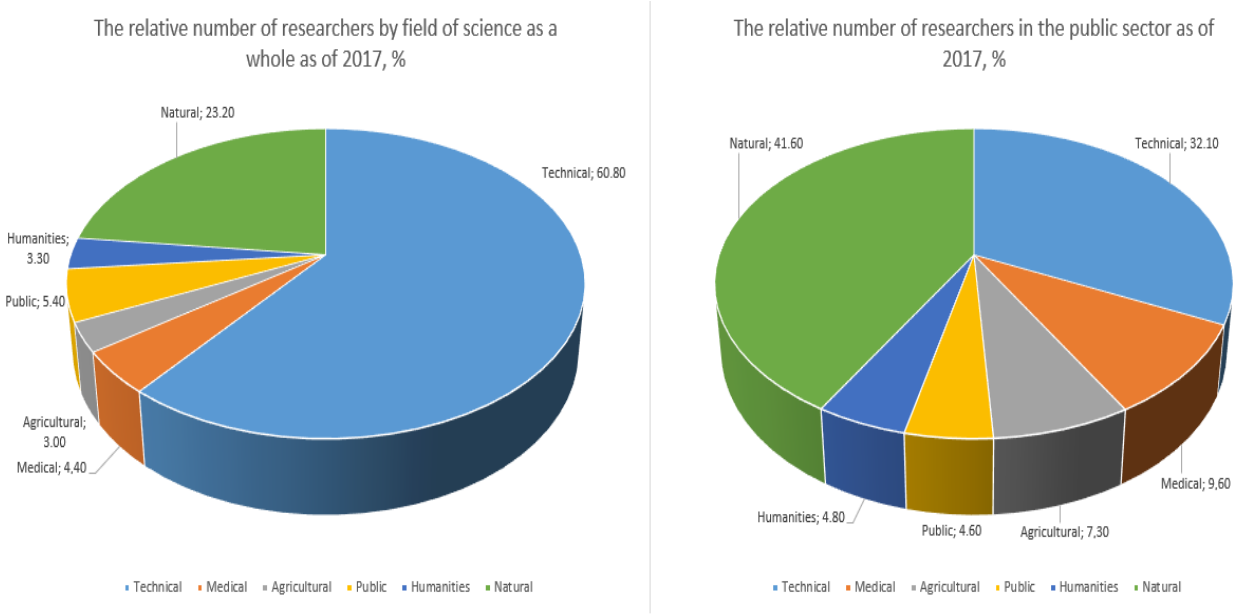

Fig. 1. Relative number of researchers by field of science in general (left) and in the public sector (right) as of 2017
Source: Own calculation.

An analysis of the results suggests that agricultural research is more intensive in the public sector.

V. Spitsyn suggested taking into account the effectiveness of interaction of its institutional elements when assessing the effectiveness of innovation processes [32]. His analysis showed serious disparities in the structure of research funding, the lag of Russian industry behind developed countries in funding science, and, as a result, low efficiency of interaction between research and educational centers and industry.

As a measure to expand the interaction between science and industry, it is proposed to stimulate the demand of industrial organizations for research work. The directions of improving statistics of scientific activity and innovations in the industry are also proposed. The statistical indicator of the cost of innovation should be detailed, it characterizes the industry demand for the development of Russian science. It is shown that in assessing current research, it is necessary to maximize the use of indicators of the volume of costs for innovations in the industry: the acquisition of machinery and equipment, as well as the costs of research and development.

In continuation of research to improve the efficiency of management of scientific and intellectual potential, a search was made for additional relevant indicators for assessing the scientific and intellectual potential of the agri-food complex, taking into account such aspects as resource provision, territorial and sectoral structure, organization of the use of the intellectual potential of the agri-food complex.

Due to serious limitations in Russian statistics of innovation and imperfection of methods for assessing the effectiveness of innovation processes in the agri-food complex, there are only limited statistical data in the context of regions and industries. Based on the existing private indicators, it is proposed to build an integral indicator for assessing the level of development of scientific and intellectual potential. Its construction is proposed to be presented as a set of specific weights of the following indicators: the proportion of organizations that carried out marketing innovations in the total number of organizations surveyed, the proportion of organizations that carried out organizational innovations in the total number of surveyed organizations, the proportion of organizations that carried out technological innovations in the total number of the surveyed organizations, internal expenditures on research and development as a percentage of GRP, internal expenditures on research and development per researcher, the share of people engaged in research and development in the average annual number of people employed in the regional economy. Table 3 shows the indicators for assessing the level of development of scientific and intellectual potential in the agri-food complex in 2018.

Table 3. Integral indicator for assessing the level of development of the scientific and intellectual potential of Russia and the Saratov region and its components in 2019

	Russian Federation	Saratov region	Saratov region in % to Russian Federation
Scientific and intellectual potential			
Share of organizations that carried out marketing innovations in the total number of surveyed organizations,%	0.53	0.42	79.25
Share of organizations implementing organizational innovations in the total number of surveyed organizations,%	0.94	0.68	72.34
Share of organizations implementing technological innovations in the total number of surveyed organizations,%	0.98	0.87	88.78
Internal costs for research and development as a percentage of GRP,%	0.08	0.10	125.0
Share of people employed in research and development in the average annual number of people employed in the regional economy,%	0.27	0.22	81.48
Scientific and intellectual potential index	0.56	0.46	

Source: Own calculation.

In the context of the selected private indicators of the development of the scientific and intellectual potential of the Saratov region, the following conclusions can be drawn. Relatively high values are typical for such indicators as “The proportion of organizations that carried out organizational innovations in the total number of surveyed organizations”, “The proportion of organizations that carried out technological innovations in the total number of surveyed organizations”, “The proportion of organizations that carried out marketing innovations in the total number of surveyed organizations”.

Low and below-average values of indicators are typical for such indicators as "The share of people employed in research and development in the average annual number of people employed in the regional economy", as well as "Internal expenditures on research and development as a percentage of GRP."

The assessment of the values of these indicators makes it possible to substantiate proposals aimed at increasing the number of people employed in the Saratov region in the scientific field and at attracting additional public and private funding for research and development to the average level in Russia.

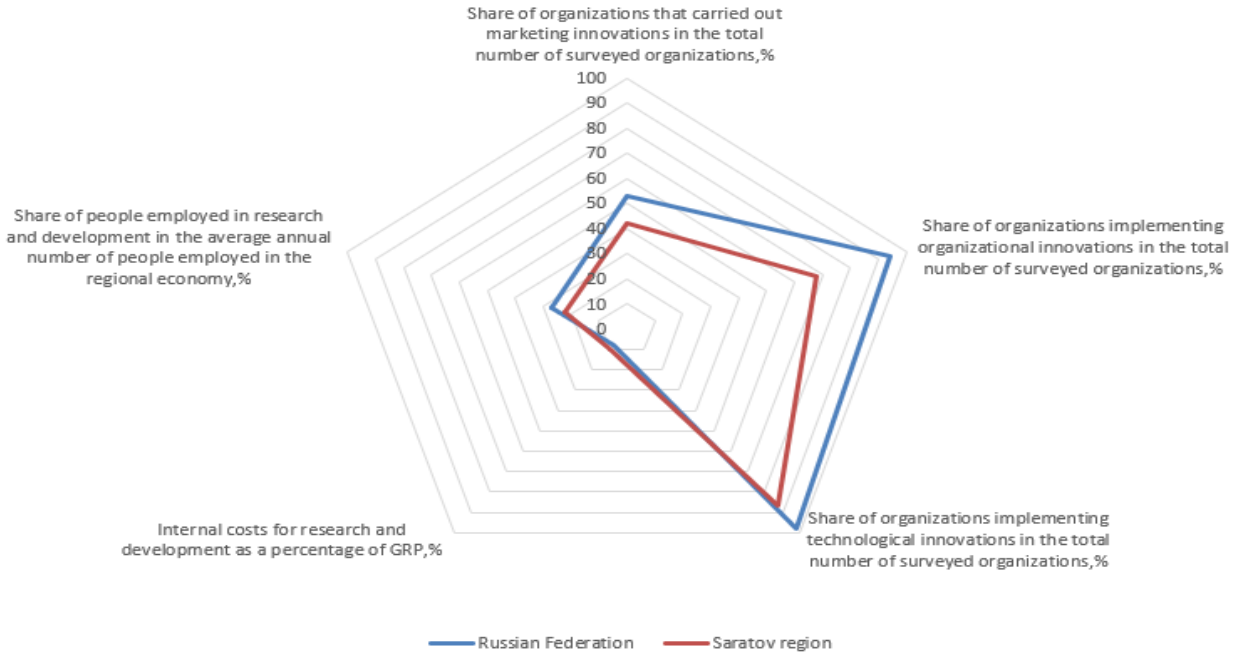

Fig. 2. The ratio of the integral indicator of the level of development of scientific and intellectual potential of Russia and the Saratov region in 2019
Source: Own calculation.

This will make it possible to make fuller use of the capabilities of existing scientific organizations. In the agri-food sector, first of all, an increase in budget financing within the framework of national projects will be required.

The weakness of the state agri-food policy in terms of the development of scientific and intellectual potential is evidenced by the pronounced differentiation of the constituent entities of the Russian Federation by the level of its development. The reasons for such interregional differentiation may be such factors as a low level of resource provision, insufficient funding for research and development, the imperfection of state policy in the allocation of budget funds for innovative activities, which does not take into account the level of development of the scientific and intellectual potential of the agri-food complex.

There are two strategies for innovative development. One of them is the acquisition of copyright for well-known technologies and types of products. This borrowing strategy is characterized by the high costs of acquiring innovative products and depends on the appearance of new products and technologies on the market.

The second strategy for the development of scientific and intellectual potential is an innovative breakthrough, focusing on one's own scientific and intellectual potential. The implementation of this strategy requires overcoming various financial and organizational and managerial barriers.

The strategic development of the scientific and intellectual potential of the agri-food complex causes the transformation of all components of the innovative agrosystem with further transformations of the external environment interacting with it. As a result, the strategy, goals, and priority directions for the development of innovative processes in the agri-food complex are changing.

CONCLUSIONS

The model for the development of the scientific and intellectual potential of the agri-food complex as a modern paradigm for the scientific and technological development of the agri-food system is based on the synthesis of the concepts of innovative development and the knowledge economy. The study clarified the theoretical and methodological provisions for the development of the scientific and intellectual potential of the agri-food complex. The restraining and

accelerating factors of the development of the scientific and intellectual potential of the agri-food complex, political and legal, organizational and institutional, innovative and technological, structural, economic and financial, socio-psychological, informational and methodological, environmental, are systematized. In the course of the study, the main indicators were identified and substantiated, which makes it possible to assess these factors.

Based on the private author's indicators, a methodology for assessing the level of scientific and intellectual potential of the regional agri-food complex and directions for improving state policy on its regulation is proposed. It is proposed to construct an integral indicator for assessing the level of development of scientific and intellectual potential as a set of specific weights of the following indicators: the proportion of organizations that carried out marketing innovations in the total number of organizations surveyed, the proportion of organizations that carried out organizational innovations in the total number of surveyed organizations, the proportion of organizations, carried out technological innovations, in the total number of surveyed organizations, internal expenditures on research and development as a percentage of GRP, internal expenditures on research and development per researcher, the share of people engaged in research and development in the average annual number of people employed in the regional economy.

The practical implementation of the proposed approach consists in the possibility of using the author's system of indicators to assess the level of development of scientific and intellectual development potential. Improving the quality level and objectivity of the assessment will identify opportunities and threats in increasing the economic, social, technological, and budgetary efficiency of managing the knowledge economy in agriculture and the agri-food complex of Russian regions. An approach to the distribution of budgetary funds is proposed, taking into account the achieved level of development of the scientific and intellectual potential of the agri-food complex. The assessment of the values of these indicators makes it possible to substantiate proposals aimed at increasing the number of people employed in the Saratov region in the scientific field and at attracting additional public and private funding for research and development to the average level in Russia. This will make it possible to make fuller use of the capabilities of existing scientific organizations. In the agri-food sector, first of all, an increase in budget financing within the framework of national projects will be required.

As a result of substantiating the conditions and factors for the development of scientific and intellectual potential, strategic directions will be developed to increase the efficiency of the production potential of the country's agri-food complex, taking into account the possible effect of the implementation of national projects.

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ANNUAL CHANGES IN THE PRICES OF TABLE GRAPES AND PRICE MARGINS IN THE SUPPLY CHAIN

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Abstract

Price volatility is one of the main sources of risk in the production of fresh fruit, including table grapes. Sustainable functioning of the supply chain requires a detailed study of price fluctuations in the context of both - stable development of production and security and access to food for consumers. The movement and variation of producer, wholesale and retail prices of table grapes during the period 2000-2019 were studied. The changes in the relative price margins of the production prices in the wholesale and retail prices were identified. The producer prices have risen significantly in the period after Bulgaria accession to the EU until 2012. Variation in the quantity of production in the country explained 24.9% of the change in producer prices by years, as the quantity of imports, the unit price of imported products, the bargaining power of other contractors in the supply chain, changes in consumer demand also have an impact. Declining relative share of producer prices in the wholesale and the retail prices showed the weakening market positions of producers in recent years and the limited market power to negotiate a satisfactory level of purchase prices.

Key words**:** *table grapes, market, supply chain, prices, variability, price margins*

INTRODUCTION

From the point of view of economic theory, the price has been a complex economic category, in the value of which the divergent interests of producers, traders and consumers were refracted [11]. The prices, through the information function they perform, have been an important factor influencing the dynamics of the macroeconomic environment, determining on the one hand to a large extent the investment decisions of producers, and on the other - the decisions for distribution of income from consumers [24]. In the globalized environment of production and trade, price instability was established as one of the most serious problems arising from and largely determining the functioning of the market mechanism [9, 10].

The specificity of the production process in agriculture, based on natural processes, outside the control of producers, causing significant changes in production and supply of agricultural products, along with volatile price levels, often lead to instability of farm incomes and uncertainty for the survival of farms [7, 8]. Price volatility is one of the main sources of risk in the production of fresh fruit, including table grapes [9, 6]. The sustainable functioning of the food chain requires a detailed study of price fluctuations in the context of both the stable development of production and the security and access to food for consumers [4, 7, 24, 6, 10]. The movement of prices in the long and short term, as well as the variation by years and by stages of the supply chain, is an important indicator of the sustainability of fresh fruit production [4, 24, 9, 23, 6].

The aim of the study was to investigate the movement and variability of the prices of table grapes and price margins by stages of the supply chain (production-wholesale-retail) in the long run.

MATERIALS AND METHODS

The object of the research activity were the price fluctuations on the table grapes market. The analytical activity covered three levels of the supply chain: producer price, wholesale price and retail price. Long-term changes in price levels were assessed through a comparative analysis by the stages of the

supply chain. The study of price variability in the long run was based on the construction and processing of time series, which summarized information on average annual price levels. Sources of primary data were Eurostat, the Ministry of Agriculture, Food and Forestry (MAFF), the Agrostatistics Department, the National Statistical Institute (NSI), the Commodity Exchange and Wholesale Markets State Commission (DKSBT) and the Agricultural Market Information System (SAPI Ltd.). The data for the period 2000-2019 were studied. The methods of comparative, index and graphical analysis, descriptive statistics, analysis of variance, correlation analysis and regression analysis were applied [20, 3, 18, 24, 9]. For the purposes of variation analysis, the method of descriptive statistics was used [20, 3]. The following basic values are derived: minimum value, maximum value, arithmetic mean, standard deviation. The estimation of price fluctuations was based on the values of the coefficient of variation (CV, %), calculated as the ratio between the standard deviation of the prices and the average price for the studied period, using the following formula [7, 2, 21, 22, 25]:

$$CV(\%) = \frac{SD}{\bar{p}} * 100 = \frac{\sqrt{\frac{\sum_{i=1}^{n}(P-\bar{P})^2}{n}}}{\bar{p}} * 100,$$

where
SD – standard deviation,
$\bar{P}$- average price for the studied period.

Due to the lack of statistical information, the dynamic time series of wholesale prices did not include the years 2002, 2004 and 2005, and of retail prices - 2004, 2005, 2010, 2017. For the purpose of comparability of the data, the analysis of the variation of producer prices was performed in two variants: for the entire twenty-year period 2000-2019 and for sixteen years - excluding the data for 2000 due to the large deviation from the average price level as well as for 2004 and 2005.
The presence and parameters of price asymmetry between the stages of the supply chain were studied by calculating a relative price margin - the producer price, expressed as a percentage of the wholesale price and of the retail price [4]. Statistical data processing was performed with MS Excel and SPSS 19.0.

RESULTS AND DISCUSSIONS

For the twenty-year period covered in Figure 1, the production of table grapes in Bulgaria registered a significant decrease compared to the level of 2000 and 2001, which amounted to 49.4 thousand tons and 30.4 thousand tons, respectively. In the last three years, the quantity of production was between 10.1 thousand tons and 14.3 thousand tons, which was a decrease of over 75% based on production in 2000. Fluctuations in annual production levels reflected the combined impact of production and market risk in the subsector. It should be noted that during the period 2015-2019 the variation in the volume of production had been weaker compared to the previous five years. The quantity of table grapes produced in the country did not fall below 10 thousand tons per year, which is largely due to the possibility of supporting the income of farmers under the coupled subsidy scheme applied under the first pillar of the CAP 2014-2020.
Considered in the long run (Fig. 1), the level of the producer prices of table grapes showed an increasing trend, which was confirmed by the high value of the coefficient of determination (R^2=0.6162).
The price levels were the lowest in the pre-accession period - between 0.14-0.50 BGN/kg. Since 2007, when Bulgaria ranked among the full EU member states, producer prices have been gradually rising, with the highest average annual prices reported in 2012, corresponding to the extremely small quantity of table grapes produced - only 7.1 thousand tons.
The average level of the annual producer prices of table grapes during the period 2000-2019 was 0.55 BGN/kg, as the difference between the minimum and the maximum price level amounted to 0.85 BGN/kg (Table 1).

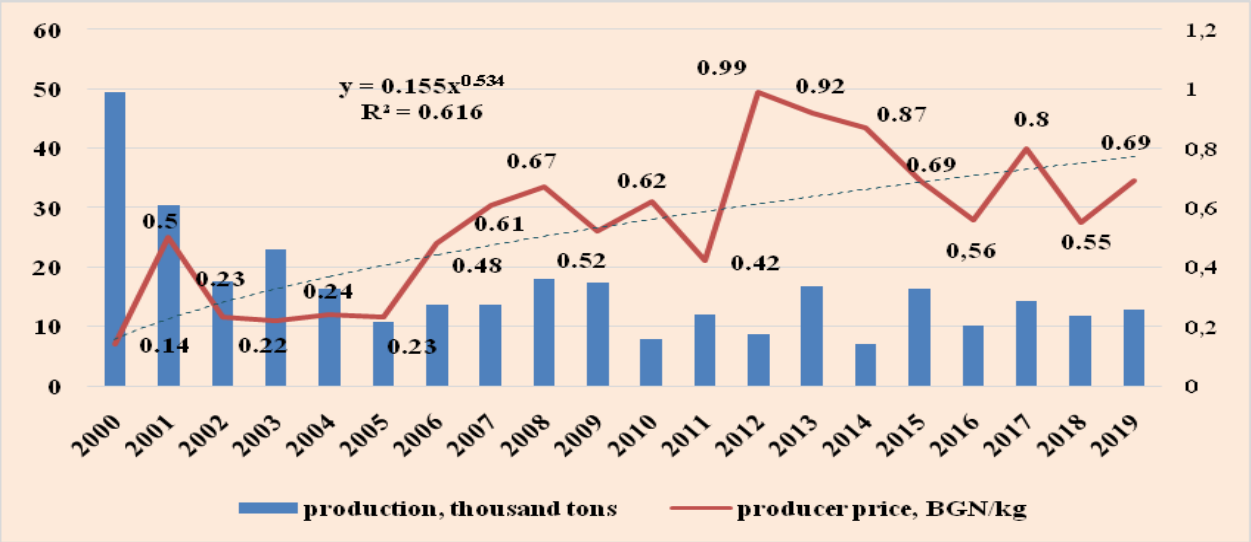


Fig. 1. Dynamics of the level of production and producer prices in Bulgaria during the period 2000-2019
Source: MAFF, Agrostatistics Department (https://www.mzh.government.bg/bg/statistika-i-analizi/izsledvane-rastenievadstvo/danni/) [12] and Eurostat (https://ec.europa.eu/eurostat/web/agriculture/data/database) [5].

Table 1. Analysis of the variation of producer prices of table grapes during the period 2000-2019

Indicator	n	R	Pmin	Pmax	$\bar{P}$	SD	CV (%)
Producer price, BGN/kg	20	0.85	0.14	0.99	0.5475	0.24715	45.14
Producer price, BGN/kg	16	0.77	0.22	0.99	0.6319	0.19739	31.24

Source: own calculations with SPSS.19
R – range of variance, Pmin – minimum price, Pmax – maximum price

The deviations of the prices by years compared to the average value for the period were within ± 0.25 BGN/kg. The value of the coefficient of variation was high and indicated a large annual variation in price levels, which implied a significant market risk in terms of income of producers.
To study the strength of the relationship between the quantity of production and the level of the producer price, the method of correlation analysis was applied (Table 2).

Table 2. Correlation between the quantity of production and the level of producer price

	Production, thousand tons	Producer price, BGN/kg
Production (thousand tons)	1	
Producer price (BGN/kg)	-0.4988	1

Source: own calculations with MS Excel.

The value of the correlation coefficient given in Table 2 showed that there was a significant inverse relationship between the volume of production and the producer price formed by years.
With an increase in the quantity produced, the price decreased and vice versa - with a reduced production volume, the price increased. To measure the specific quantitative ratios, i.e. the quantitative influence of the factor on the result, a one-factor linear regression analysis performed using the SPSS 19.0 program was applied.
The empirical value of the F-criterion was 5.960, which means that the estimate of the explained variance was more than 5 times higher than the estimate of the residual variance at a significance level of 0.025, which defines the model as adequate (Table 3).

Table 3. Assessment of the adequacy of the linear regression model

	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.289	1	0.289	5.960	0.025
Residual	0.872	18	0.048		
Total	1.161	19			

Source: own calculations with SPSS 19.0.

With a risk of error of 5% (Sig = 0.025 <0.05 = α), there was reason to reject the null hypothesis and to assumed that there was a regular relationship between production volume and producer price.
As already mentioned, the correlation coefficient had a value of 0.499 with a negative sign (given the negative value of the

regression coefficient given in Table 5 - 0.013), confirming the significant inverse relationship between production and producer price. The value of the coefficient of determination (0.249) showed that only 24.9% of the variation in the production price can be explained by the change in the quantity of production (Table 4).

Table 4. Values of measures of dependence

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.499	0.249	0.207	0.220

The independent variable is production, thousand tons.
Source: own calculations with SPSS 19.0

The values of the coefficients given in Table 5 were statistically significant at a risk of error of 5%.

Table 5. Values of the coefficients

Indicator	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
Production, thousand tons	-0.013	0.005	-0.499	-2.441	0.025
(Constant)	0.761	0.100		7.570	0.000

Source: own calculations with SPSS 19.0.

The movement of wholesale prices of table grapes in the period 2001-2019 was presented in Fig. 2. The low value of the coefficient of determination (R^2 = 0.3477) did not give grounds for determining a specific trend in the development of the price level under the influence of the studied time period. The lowest price levels were noted in the initial years 2001-2003, before the accession of our country to the EU.

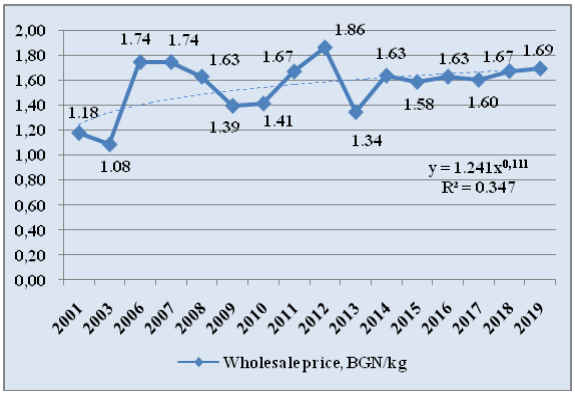


Fig. 2. Dynamics of wholesale prices of table grapes by years during the period 2001-2019, BGN/kg
Source: MAFF, DKSBT and SAPI Ltd. (prices do not include VAT) [13, 14, 15, 16, 17, 26]

In the years of the pre-accession period and beyond, wholesale prices showed some stability, moving in most cases between 1.90 BGN/kg and 2.23 BGN/kg with VAT. Only in 2009 and 2013 there were more significant deviations, as the situation in the last year could be explained by the higher volume of production - 16.7 thousand tons, exceeding by 73.4% the average level of production for the previous three years, as well as with the larger volume of imports.

According to the results of the descriptive statistical analysis (Table 6), the average level of the wholesale price during the period 2001-2019 was 1.55 BGN/kg without VAT. The minimum value - 1.08 BGN/kg was noted in 2003, and the maximum - 1.86 BGN/kg was reached in 2012. The difference between the maximum and the minimum value was 0.78 BGN/kg, and the annual deviations around the average price for the studied period were within ± 0.21 BGN/kg. The coefficient of variation was 13.78 %, which mean that the studied population was characterized by a relatively high degree of homogeneity, i.e. wholesale prices were relatively stable, which was more pronounced during the period 2014-2019.

Table 6. Analysis of the variation of wholesale prices of table grapes during the period 2001-2019

Indicator	n	R	Pmin	Pmax	$\bar{P}$	SD	CV (%)
Wholesale price, BGN/kg	16	0.78	1.08	1.86	1.55	0.21390	13.78

R – range, Pmin – minimum price, Pmax – maximum price
Source: own calculation with SPSS 19.0.

The data from the performed analysis showed a certain stability and a smaller degree of variation in the annual wholesale prices of table grapes compared to the producer prices. Based on the average annual price level, it can be concluded that the variation in the quantity produced, under the influence of the climatic conditions of the year, did not create serious deviations in wholesale prices over the last five years. They remain relatively stable, with more significant deviations observed by months and weeks of sales, when (depending on the period) the impact of the volume of production in the country and imports and the

accordance with consumer demand may affected more significantly.

While producer and wholesale prices were used as an indicator of the sustainability of production, retail prices rather determined the sustainability of the whole supply chain and were more important in the analysis of consumer behavior. The change in their level could be considered as a direct and indirect indicator of market security and consumer access to final products.

The high value of the coefficient of determination (R^2 = 0.8129) confirmed the positive change in the price level, as the upward trend was more pronounced during the period 2012-2019, when prices ranged between 2.26 and 2.97 BGN/kg without VAT (Figure 3). The only exception was observed in 2013, when the average annual price decreased, as one of the influencing factors is the increased amount of production in the country.

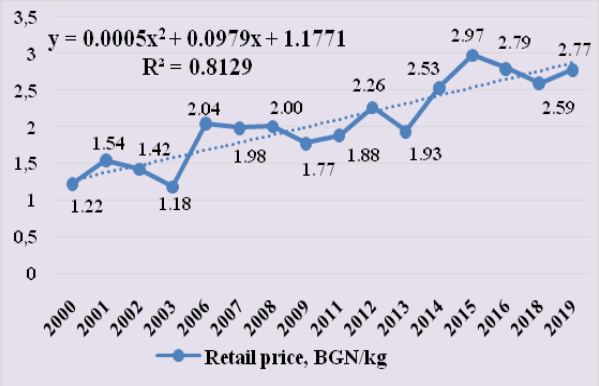


Fig. 3. Dynamics of retail prices of table grapes during the period 2000-2019, BGN/kg

Source: MAFF, SAPI Ltd. (prices do not include VAT) [13, 14, 15, 16, 17, 1].

Noting the upward trend in prices, it should be pointed that the current study did not rule out the impact of inflation, and the quantity of production in the country was significantly less than in the early years of the period.

The average level of the retail price without VAT for the sixteen surveyed years was 2.05 BGN/kg (Table 7). The highest level was noted in 2015 - 2.97 BGN/kg, and the lowest - 1.18 BGN/kg in 2003. The range of variation between the two values was 1.79 BGN/kg. The value of the standard deviation showed that the annual changes were within ± 0.56 BGN/kg.

Table 7. Analysis of the variation of retail prices of table grapes during the period 2000-2019

Indicator	n	R	Pmin	Pmax	$\bar{P}$	SD	CV (%)
Retail price, BGN/kg	16	1.79	1.18	2.97	2.05	0.56037	27.28

Source: own calculation with SPSS 19.0.

R – range, Pmin – minimum price, Pmax – maximum price

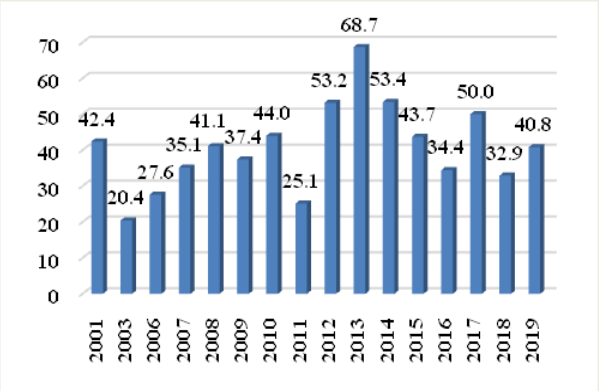
To compare the average levels and the annual variation of producer, wholesale and retail prices of table grapes, an analysis was performed by the method of descriptive statistics with a scope of sixteen years between 2000 and 2019, in accordance with the available information mostly due to the gaps in wholesale and retail price data.

The average level of the producer price for the studied period (excluding the prices for 2000, 2004 and 2005) was 0.63 BGN/kg and was lower by 0.92 BGN/kg (-59.4%) compared to the average value of the wholesale prices and by 1.42 BGN/kg (-69.3%) compared to the average value of the retail prices. The limits of the annual deviations from the average level were the widest at retail prices ± 0.56 BGN/kg. They were narrowest at the producer prices, where the fluctuations of the average annual levels were within ± 0.20 BGN/kg. Wholesale prices deviated on average by ± 0.21 BGN/kg during the years indicated in the study. The coefficient of variation had the highest value at producer prices, which determines the significant impact of market risk on production.

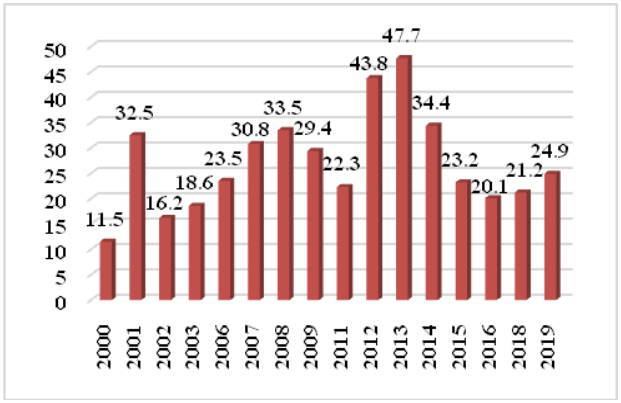
The analysis of the data showed the maintenance of a relatively low average level of producer prices - 0.63 BGN/kg compared to the other two stages of the supply chain. Viewed in the long run through the prism of investor interest, such a price with a constant increase in the average level of direct production costs for growing vineyards for table grapes production, reaching about 7,500 BGN/ha according to Institute of Viticulture and Enology calculations for 2019, could not provide incentives for starting and/or developing the production activity. In this case it was necessary to assess the potential

markets and opportunities for a more rational organization of sales channels in order to achieve a higher price level and limit market risk.

The relative share of the producer price in the wholesale and retail price was an indicator of the market positions and bargaining power of each of the counterparties in the supply chain. From the data shown in Figure 4 a) it was evident that the share of the production price in the wholesale price of table grapes in Bulgaria varied between 20.4% and 68.7% during the sixteen-year study period. Higher levels were reported during the period 2012-2014, after which the relative share of the producer in the wholesale price decreased sharply. In 2018 and 2019, it was 32.9% and 40.8%, respectively. The big difference could be explained by the higher post-harvest costs incurred by wholesalers. The reduced contribution of producer prices showed that the activities of transport, sorting, packaging, storage of products and others were carried out mainly by wholesalers, who in the most cases had the necessary equipment and labor.



Source: NSI, MAFF, DKSBT [19, 13, 14, 15, 16, 17, 26] and own calculations.
a) in the wholesale price, %



Source: NSI, MAFF, SAPI Ltd. [19, 13, 14, 15, 16, 17, 1] and own calculations.
b) in the retail price, %

Fig. 4. Relative share of producer price in the wholesale price and in the retail price during the period 2000-2019, %

The relative share of the producer price in the retail price was even smaller and varied between 11.5% and 47.7% (Fig. 4 b). A significant decrease in the percentage share of the producer was observed after 2014 and with each passing year the share of producer prices in retail prices decreased. Increasingly high requirements of consumers in terms of appearance, cuts, security guarantees and more attributes of the goods displayed in the trade network, required the realization of additional investments in order to increase the added value. These costs should be borne mainly by traders, which, excluding the influence of the speculative element, determined the declining market share of the producer.

These data determined the weakening market positions of producers in recent years, which had a downward effect on producer prices. The weak market power of this stage of the supply chain did not allowed to defend the interests and to achieved a stable return. Improving the situation in this aspect should be a matter not only of intervention and protection of domestic production, but also of the perceived need for cooperation and building groups and organizations of producers that could help increase the added value of the final product and its realization at the more price-attractive markets.

The findings made so far were also confirmed by the long-term dynamics in the movement of the producer, wholesale and retail prices outlined in Figure 5.

The comparison between the three curves, describing the movement of prices in the supply chain, showed that not every change in the producer price affected the level of the wholesale prices and of the retail prices. The increase in the producer price in 2007 did not lead to a higher wholesale price, and the retail

price even decreased very slightly. At the same time, the decrease in producer prices in 2011 did not provoke a similar reaction in the other two stages of the supply chain, as retail prices even marked a slight increase compared to the previous year. Lower producer prices after 2014 did not lead to a decrease in wholesale and retail prices, with a significant increase in retail prices. The gap between producer prices and wholesale and retail prices increased. This could be explained by the higher costs that retailers incur to store and present the product in the form sought by consumers. Another question was to what extent, under these conditions, the producer managed to receive adequate payment for his investments and efforts. The big loser in this case remained the consumer, as high prices, limited production and growing imports did not stimulate the growth of consumption and it stayed extremely low - about 2.6 kg per capita in 2019 according to NSI data.

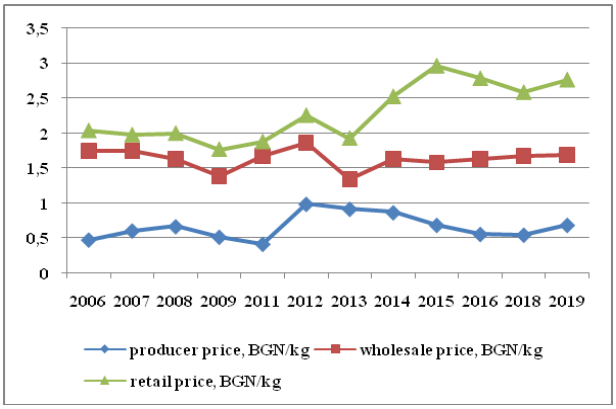


Fig. 5. Dynamics of producer, wholesale and retail prices during the period 2006-2019, BGN/kg
Source: NSI, MAFF, DKSBT and SAPI Ltd. [19, 13, 14, 15, 16, 17, 26, 1]

The results of the analysis showed that producers remained the weakest stage in the supply chain. Stabilizing their market positions and increasing their bargaining power would require both state support, not only to stabilize profitability, but especially to protect Bulgarian production, and awareness of the need to join forces and expand investment in increase the added value of production.

CONCLUSIONS

In the long run, there was an increase in producer prices, given that the current study did not rule out the impact of inflation. The price levels had increased significantly since the accession of our country to the EU, reaching 0.99 BGN/kg in 2012, which is the highest level for the entire surveyed twenty-year period. Since 2013, there had been a gradual decrease in producer prices with significant annual fluctuations, and for the last three years they ranged between 0.55 BGN/kg and 0.80 BGN/kg.

There was a significant inverse relationship between the variation of production in the country and the change in the price level of a producer. The annual changes in the volume of production explained only 24.9% of the change in producer prices. Their dynamics were influenced by a number of other factors, such as the volume of imports, the unit price of imported products, the bargaining power of other counterparties in the supply chain, changes in consumer demand.

The results of the analysis showed some stability and weaker variation in the annual wholesale and retail prices of table grapes compared to producer prices, which is most valid for the period 2014-2018. The largest annual fluctuations were observed in producer prices, which outlined the application of short distribution channels and direct sales as an extremely important option for increasing profitability in the subsector.

The declining relative share of producer prices in the wholesale and the retail prices showed the weakening market positions of producers in recent years. Improving the situation in this aspect is a matter not only of intervention and protection of domestic production, but also of the perceived need for cooperation and building groups and organizations of producers that could provide conditions for increasing the added value of the final product and sales its at a more attractive in price aspect markets.

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COMPARATIVE ANALYSIS OF THE RABBIT MEAT PRODUCTION IN BALKAN COUNTRIES, MEMBERS OF THE EUROPEAN UNION

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Abstract

Data about rabbit meat production are provided from the web site of Food and Agriculture Organization of the United Nations. The mentioned information for the studied three Balkan countries (Bulgaria, Romania and Greece) has been extracted and organized in a created relational database. Different parameter queries have been used for visualization of certain subsets from the indicated database. Subsequently, they have been processed and evaluated. The article presents comparative analysis of the rabbit meat production in these Balkan countries for the period 1984-2018. Hierarchical cluster analysis has also been applied to the considered data. The grouping of the investigated indicator is discussed. The obtained results showed that the rabbit meat production in Romania increased significantly for 1984-1990. The same process was observed in Bulgaria and Greece during 1987-1997 and 1988-1993, respectively. The values of this indicator for Greece and Bulgaria are quite higher in comparison with those ones in Romania for 2006-2018. A decreasing tendency in the rabbit meat production in the listed three countries was established for the last five years of the time interval.

Key words**:** *comparative analysis, clustering, database, queries, rabbit meat production*

INTRODUCTION

Since the 1970s, in some European countries rabbit meat production has progressively become a highly specialized industry, which has made Europe the second (after China) largest rabbit meat producer in the world [2]. However, the industry is currently facing a critical period due to structural weaknesses, progressive and constant reductions in consumption, and raising criticism related to welfare conditions and other ethical issues [2]. Compared to the amount of meats produced from different farm animals, rabbit meat plays a minor role [13]. In many ways, rabbits are more suited for small-scale production than large-scale, industrial production [4].

Recommended by nutritionists over other meats, rabbit meat is valued for its nutritional properties because is lean, rich in proteins of high biological value, low in cholesterol content and high in linolenic acid [10].

The aim of the current article is to present comparative analysis of the rabbit meat production in three Balkan countries (Bulgaria Romania and Greece) for the time interval 1984-2018.

MATERIALS AND METHODS

Data concerning rabbit meat production in the mentioned above countries have been published on the web site of Food and Agriculture Organization of the United Nations [5]. This information has been extracted from the indicated website and structured in a designed relational database containing five table schemes (Fig. 1). They are the following:

- Continents (id_c, continent);
- Countries (id, country, id_c);
- Product (id_product, product, id);
- Product types (id_t, name, id_product);
- Quantities (id_q, quantity, measure, year, id_t).

The relationships between the listed tables are of type one-to-many. The examined time interval includes 35 years period. Searching and finding data from several related tables that meet certain conditions can be quite a difficult task in many cases. In this regard, it is appropriate to create and use parameter queries. Depending on selected criteria, the necessary information is displayed [1], [7]. Subsequently, it can be stored and studied.

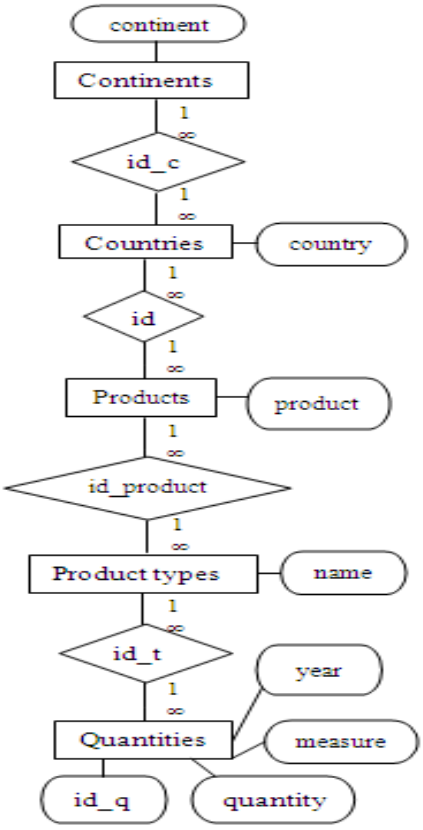


Fig. 1. E/R diagram of the database
Source: Author's conception.

Comparative analysis [12], [6] and hierarchical cluster analysis [14], [3] have been applied in the paper. The share (P_{ji}) of rabbit meat produced for each year in the given country as compared to the total quantity produced during the examined period in that country has also been calculated:

$$P_{ji} = \frac{y_{ji}}{\sum_{i=1}^{n} y_{ji}}.100$$

where y_{ji} - rabbit meat production for i-th year in the considered country; 1<=j<=3; 1<=i<=35; $\sum_{i=1}^{n} y_{ji}$ - rabbit meat production for the whole surveyed period in this country; n=35.

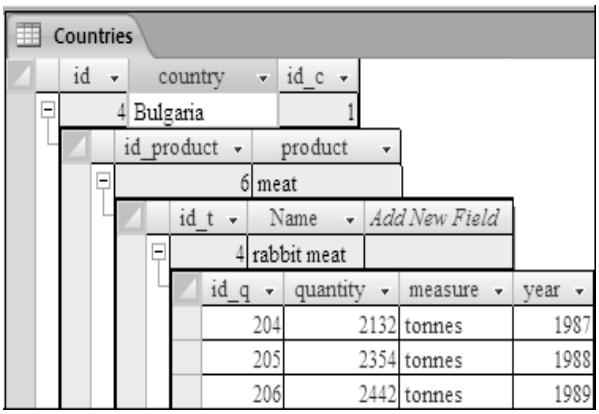
The capabilities of the Microsoft Excel program [8], [9] and software package R Commander [11] have been used for data processing. The obtained results have been summarised and the relevant conclusions have been visualised mainly in graphical form.

RESULTS AND DISCUSSIONS

Data about rabbit meat production have been presented in several fields of different tables in the database (Fig. 2). In order to limit the displayed records, it is necessary to apply a certain set of criteria. It includes the following components:

- Chosen country;
- Selected time period;
- Indicated values of the examined indicator for a given time interval.

As a result, different parameter queries have been created. Practically, the obtained information from them has been processed.


Countries

id	country	id_c
4	Bulgaria	1

id_product	product
6	meat

id_t	Name	Add New Field
4	rabbit meat	

id_q	quantity	measure	year
204	2132	tonnes	1987
205	2354	tonnes	1988
206	2442	tonnes	1989

Fig. 2. Information about the studied indicator structured in tables of the created database
Source: Data from Food and Agriculture Organization of the United Nations, FAOSTAT.

The considered data for these three Balkan countries, members of the European Union have been analyzed and evaluated for the period from 1984 to 2018. The results of the calculations showed the following:

- The rabbit meat production in ***Romania*** increased significantly for the first seven years from the examined time interval. In the case, it was about 4.2 times. During 1986, as compared to 1985, this indicator grew by about 53.85%. Quite naturally, the highest value of the variable was registered in 1990. Over the next two years (1991-1992), the reverse process was observed. A decline of about 42.57% was established. The assessment of the data on rabbit meat production in Romania showed a decreasing tendency during 1993-2004. It should be noted that, the values of the surveyed

indicator marked a certain growth in three non-consecutive years - 1999, 2001 and 2003. A significant decline in the rabbit meat production in Romania was registered for the period 2004-2006, as can be seen from the diagram of Figure 3. The values of this variable remained almost the same in the years between 2010 and 2012. The period from 2006 to 2018 is characterized with a steady decrease of the indicator. The lowest value was registered in the last year of the studied interval. The calculated determination coefficient is 0.63. This means that the time explains 63% of the variations in the quantities of the indicated product;

- The situation is quite different for the examined information concerning rabbit meat production in ***Greece.*** The highest value of the indicator was established in 1985. Compared to the year 1984, the surveyed variable increased by 18.99%. A quite big decline in rabbit meat production was observed in the years between 1986 and 1987. It was about 1.5 times. The period covering next five years is characterized with a continuous growth of the indicator with an exception in 1992. An interesting fact should be noted. A significant increase in rabbit meat production in Greece was observed during 1993 (Fig. 3). The value of this variable for the indicated year is very close to that in 1985. A process of almost continuous reduction of the indicator was established from 1994 to 1999. Over the next 5-years the considered variable increased by about 12.65%. A decreasing tendency in the rabbit meat production in Greece was observed for 2005-2018. The decline of the indicator for the mentioned period was quite large. In this case, it was more than 2.4 times. As can be expected, the lowest value was recorded in 2017. The coefficient of determination is 0.52. Therefore, the time explains 52% of the variations in the quantities of this product;

- The production of rabbit meat in ***Bulgaria*** for the first three consecutive years reduced more than 13.32%. Quite naturally, the lowest indicator value was registered in 1986. The analysis of this studied data showed a clearly-expressed increasing tendency in the period from 1987 to 1997 (Fig. 3). In the first six years of the mentioned subinterval the rabbit meat production grew about 1.8 times. The highest value was recorded in 1997. Compared to the year 1996, the rabbit meat production increased by 93.22%. A quite big decline of the variable was observed in 1998. In this case, it was about 59%. The subintervals 1999-2000 and 2004-2006 are characterized with a growth of the indicator values. This variable remained almost the same during 2007-2009. A significant decrease was calculated in 2012. The production of rabbit meat changed at a relatively slower pace over the next six years, but there has been some reduction for most of this subinterval. The determination coefficient is 0.48. Therefore, the time explains 48% of the variations in the production of the considered product.

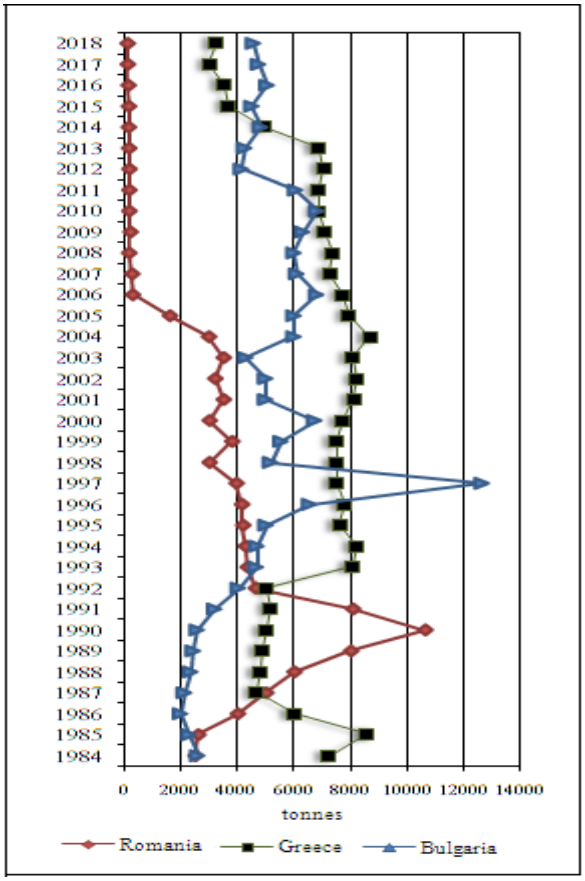


Fig. 3. Data analysis of the rabbit meat production
Source: Data from Food and Agriculture Organization of the United Nations, FAOSTAT.

Analyzing the presented results (Fig. 3), it can be summarized that the values of the studied indicator for two of the considered countries (Greece and Bulgaria) are quite higher in

comparison with those ones in Romania for the period from 2006 to 2018. A decreasing tendency in the rabbit meat production in the listed three countries is observed for the last five years of the time interval.

The relative share (P_{ji}) of rabbit meat produced for each year in the given country as compared to the total quantity produced during the studied period in that country was calculated. Approximately equal percentages are obtained for seven years (2010-2016) for Romania. A similar situation with the variable was established for 2017-2018. Therefore, the production of the indicated product changed insignificantly. For the other years of the period there are certain differences. The indicator (P_{ji}) varies in range between 0.10%-10.72% for Romania, while for Greece and Bulgaria - between 1.33%-3.78% and 1.16%-7.39%, respectively. The obtained percentage values for Bulgaria are almost the same during 1993-1994, as well as in 2001-2002 and 2004-2005. A similar case was observed in Greece for two subintervals. The first contains three consecutive years from 1997 to 1999 and the other includes 2010-2011.

The considered countries were grouped according to the values of rabbit meat produced in them. Hierarchical cluster analysis was applied to these surveyed data.

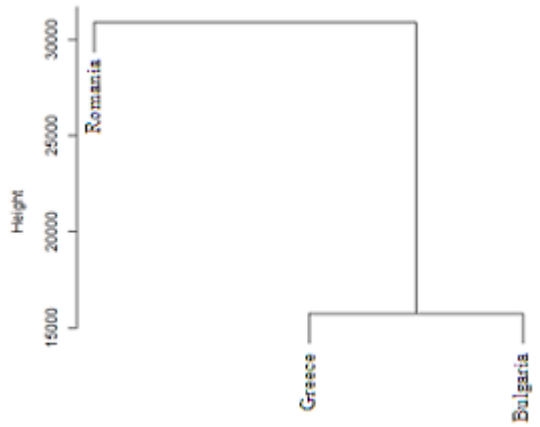


Fig. 4. Clustering the countries according to the values of rabbit meat produced in them
Source: Own calculation on the basis of data from FAOSTAT.

As can be seen from the dendrogram in Figure 4, the obtained results showed the following:

- Romania forms a separate cluster;
- Greece and Bulgaria are presented in one cluster. They are characterized by relatively similar values of the quantities of rabbit meat produced in them.

The current study also visualizes grouping the years according to the values of this indicator (produced quantities of rabbit meat) in each country. The results of the data processing for Romania displayed four clusters (Fig. 5). The first contains the years from 2006 to 2018. The second includes 2000-2005, 1984-1985, as well as 1998. The years 1989 and 1991 formed the next cluster. Subsequently, 1990 joined to it on relatively small distance. In this interval the values of the produced quantities of rabbit meat are the highest. The fourth cluster includes 1986-1988, 1992-1997 and 1999.

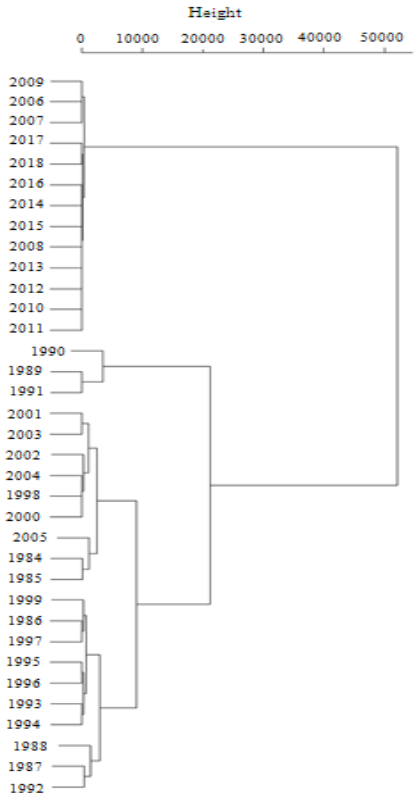


Fig. 5. Presentation of the results for Romania
Source: Own calculation on the basis of data from FAOSTAT.

The evaluation of the data about Greece presented the following three clusters (Fig. 6). The years 2001-2005, 1993-1994 as well as 1985 formed a separate cluster. The largest production of the indicated product was realized during this period. The next cluster

contains two sub-clusters. The first of them includes the years 1995-2000, 2006 and 2008, while the second contains 1984, 1986, 2007 and 2009-2013. The third cluster is formed by two sub-clusters. The years between 1987-1992, as well as 2014-2018 are presented in it.

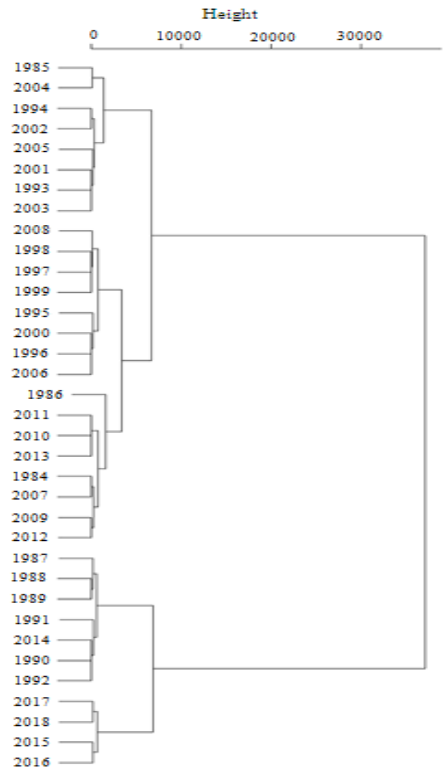


Fig. 6. Grouping the years according to the values of the studied indicator for Greece
Source: Own calculation on the basis of data from FAOSTAT.

The results of the indicated analysis for Bulgaria showed also four clusters (Fig. 7). The years 1984-1991 formed one cluster. The period is characterized by the lowest values of the produced quantities of rabbit meat. The second cluster contains two sub-clusters, which joined on relatively small distance. The years 1992-1995, 1998-1999, 2001-2003 and the interval from 2012 to 2018 are included in it. 1997 is presented in a separate cluster. The last cluster consists of two sub-clusters, which include 2004-2008, 2011, as well as 1996, 2000, 2009-2010.

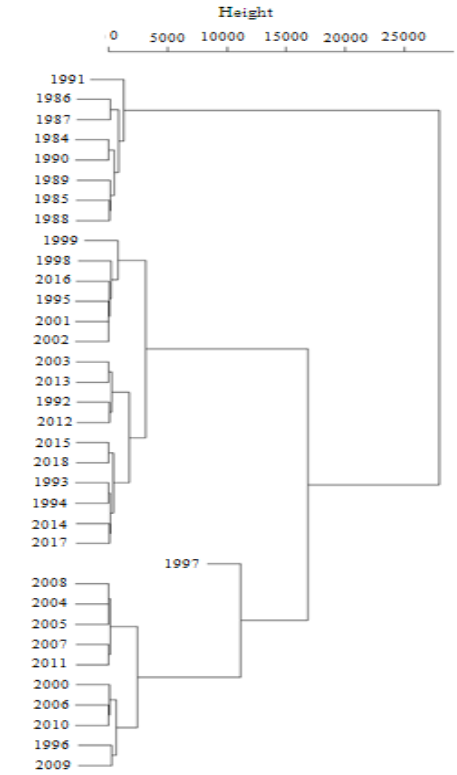


Fig. 7. Results of the cluster analysis for Bulgaria
Source: Own calculation on the basis of data from FAOSTAT.

CONCLUSIONS

The information about rabbit meat production has been published on the web site of Food and Agriculture Organization of the United Nations. These data concerning three Balkan countries (Bulgaria, Romania and Greece) have been extracted and presented in a built relational database. The parameter queries have been used for visualization of the deferent subsets from the database. The obtained information has been processed and accessed. The share of rabbit meat produced for each year in the given country as compared to the total quantity produced during the examined period in that country has also been calculated. Comparative analysis and hierarchical cluster analysis have been applied in the article. As a result of this study the following conclusions can be drawn:
- The rabbit meat production in Romania increased significantly in 1984-1990. The same process was observed in Bulgaria and Greece during 1987-1997 and 1988-1993, respectively. The values of the indicator for two of the considered countries (Greece and

Bulgaria) are quite higher in comparison with those ones in Romania for 2006-2018. A decreasing tendency in the rabbit meat production for the indicated three countries was established for the last five years of the studied period;

- The grouping of the countries according to the values of rabbit meat produced in them led to the formation of two clusters. The current article also visualizes grouping the years according to the values of this indicator (produced quantities of rabbit meat) in each country. The evaluation of the data about Romania and Bulgaria showed four clusters, while for Greece the presented clusters were three.

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SURVEY OF THE PURCHASING POWER OF HOUSEHOLDS CONCERNING CERTAIN MILK PRODUCTS

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Abstract

The information about the food products has been organized in a created relational database. It has been extracted from the web site of the Bulgarian National Statistical Institute. The paper surveys the purchasing power of households concerning certain milk products (milk, yoghurt, white cheese and yellow cheese) in Bulgaria for the period 2005-2019. These data are searched from the database tables. Subsequently, they have been processed and analyzed. The percentage change in the purchasing power of households concerning each product for current year in comparison with the previous year has also been calculated. The results showed that a process of almost continuous decrease of the purchasing power of households concerning milk was observed for 2007-2011. A gradual growth of this indicator is obtained during 2012-2019. Approximately the same dependences were established for the purchasing power of households concerning yoghurt in the considered period. An increasing tendency of the studied indicator for the white cheese was observed in the interval 2015-2019. A similar situation is obtained for the purchasing power of households concerning yellow cheese for 2012-2019.

Key words**:** *analysis, database, milk products, Bulgaria*

INTRODUCTION

In the past few decades there has been a revolution in computing and communications, and all indications are that technological progress and use of information technology will continue. The revolution in information and communication technology has changed not only our lives but also the way how people do business [3].

The World Wide Web is a vast and rapidly growing source of information [2]. There are many repositories on the Web that provide statistical data [1]. Organizations gather increasingly large and complex data sets each year [5]. Some of them can be structured in relational databases. A database is an organised collection of related data [9]. Data are processed to get information. Information is used for making decisions which lead to actions [9]. The current work considers some of these exposed problems.

The aim of the article is to survey the purchasing power of households concerning four milk products (milk, yoghurt, white cheese and yellow cheese) in Bulgaria. The considered period includes 15 years time interval from 2005 to 2019.

MATERIALS AND METHODS

Data related to food products have been published on the web site of the National Statistical Institute [7], [8]. They have been extracted and organized in a created relational database [4]. This database has been expanded. As a result, it contains the following table schemes:

- Categories (id_category, category);
- Food products (id, id_category, food product);
- Type of foods (id_ foods, type, id_product);
- Quantities_Prices (id, year, average price, measure, quantity, id_ foods);
- Household purchasing power (id, year, measure, quantity, id_foods)
- Non-food products (id, non-food product, id_ category);
- Kinds_non-food products (id, kinds, id_non-food products);
- Distribution_households (id, year, measure, average price, quantities average per 100 households, id_ kinds).

Updating the database is done each year, and the respective new records are entered into the listed tables. The relationships between the tables are of type one-to-many.

The object of study in the paper is the information about purchasing power of households concerning the indicated milk products. These data have been searched from several fields located in different database tables (Fig. 1). Subsequently, they have been stored in a separate Excel file and have been analyzed. In this connection the following variables have been calculated:

- Differences - D_i and $D_{i\,j+1}$

$$D_i = d_{i\,max} - d_{i\,min}$$

where: $d_{i\,max}$ and $d_{i\,min}$ - the highest and the lowest value of the examined indicator for each product, 1<=i<=4;

$$D_{i\,j+1} = v_{i\,j+1} - v_{ij}$$

where: $v_{i\,j+1}$ and v_{ij} - the value of the indicator for current and previous year, 1<=j<=14;

- Variable - $$L_{i\,j+1} = \frac{v_{i\,j+1} * 100}{v_{i\,j}} - 100$$

where: $L_{i\,j+1}$ - percentage change in the purchasing power of households concerning each product for current year in comparison with the previous year.

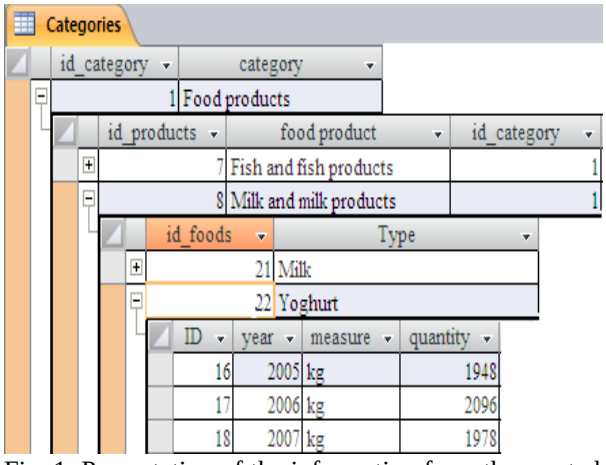

Fig. 1. Presentation of the information from the created database
Source: Data from National statistical Institute [7, 8].

The Microsoft Excel program [6] has been used for the data processing. The obtained results have been presented in tabular or graphical form and the relevant conclusions have been drawn.

RESULTS AND DISCUSSIONS

Information about purchasing power of households (average per capita) concerning four milk products (milk, yoghurt, white cheese and yellow cheese) in Bulgaria has been extracted from several database tables. In the case, they are the following: Categories; Food products; Type of foods; Household purchasing power.

The results of the calculations showed that a process of almost continuous decrease of the studied indicator for milk was observed in the interval from 2007 to 2011 with one exception in 2009. The situation with the purchasing power of households concerning the indicated product was quite different over the next eight years. A gradual growth of this considered indicator is obtained during the mentioned period. The calculated difference D_1 is 1,227 litres. The columns in figure 2 present the data on purchasing power of households about milk (shown on the primary vertical axis), whereas the line represents the data for the mentioned indicator concerning yoghurt (shown on the secondary vertical axis).

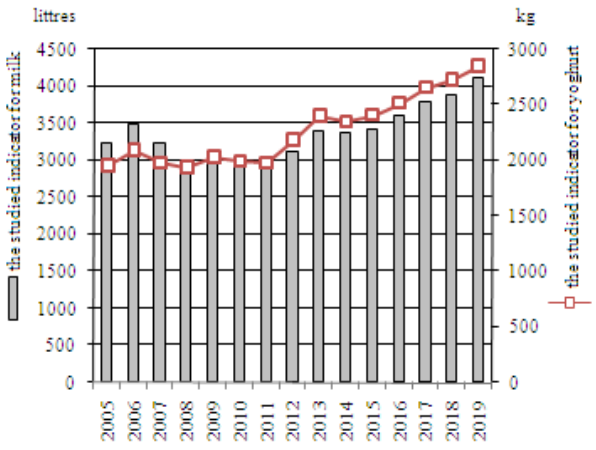

Fig. 2. Analysis of the data for 15 years period
Source: Data from the National Statistical Institute [7, 8].

Approximately the same dependence was established for purchasing power of households concerning yoghurt in the years

between 2005 and 2019. Conditionally, this interval could be divided on two subintervals. The first of them includes 2005-2011. The indicator marked a certain decline in this period. It is about 120 kg. The second subinterval contains the years 2012-2019, where the increase of the studied indicator is 665 kg. In this case, the calculated variable D2 is 916 kg.

This study showed that the purchasing power of households concerning white cheese changed continuously in the period 2005-2014. A reduction was established in four nonconsecutive years 2007, 2010-2011 and 2014, while a growth was registered in 2006, 2008-2009 and 2012-2013 (Fig. 3). The increase pace is significantly slower over the last 5 years of the investigated time interval. An interesting fact should be noted: the purchasing power of households concerning white cheese for 2013 and 2019 remained almost the same. The obtained variable D_3 for the considered data is 167 kg.

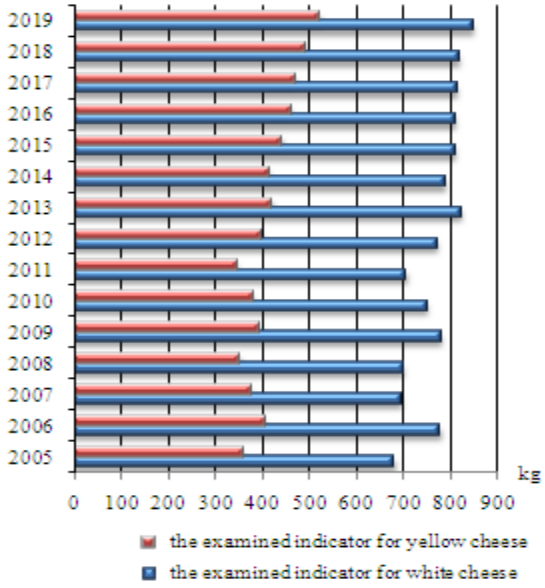

Fig. 3. The change of the indicator for the time interval 2005-2019
Source: Data from the National Statistical Institute [7, 8].

The situation is quite different for this surveyed indicator about yellow cheese. A reduction of the purchasing power of households for the indicated product was observed in the time interval 2007-2008, as well as 2010-2011. In the case, it was 52 kg during the first two listed years and 45 kg for the second presented two years. The period from 2012 to 2019 is characterized with a steady growth of the considered indicator (Fig. 3). At the end of the mentioned interval the increase was about 126 kg. The purchasing power of households concerning yellow cheese is the highest during 2019 and the lowest in 2011. The calculated value of the variable D_4 is 175 kg.

This work also analyzes the percentage change in the purchasing power of households concerning each product for current year in comparison with the previous year. As can be seen from table 1, the highest value of the indicator L_{ij+1} (i=1, j=12) for the studied data about milk is 8.38%. The obtained difference D_{ij+1} (i=1, j=12) is 261 liters (Table 2).

Table 1. Percentage change (L_{ij+1}) of the purchasing power of households about each examined product during the indicated time interval

Year	Milk	Yoghurt	White cheese	Yellow cheese
2006	7.98	7.60	14.31	13.20
2007	-6.99	-5.63	-10.71	-7.44
2008	-8.23	-2.17	0.87	-5.90
2009	3.71	4.86	11.60	11.11
2010	-5.76	-1.76	-4.18	-2.78
2011	-0.75	-0.87	-5.82	-9.01
2012	8.30	10.63	9.53	14.20
2013	8.38	9.86	6.48	6.36
2014	-0.52	-2.29	-3.97	-1.64
2015	1.64	2.57	2.57	6.79
2016	5,22	4.48	-0.14	4.01
2017	5.28	5.64	0.47	2.28
2018	2.59	2.57	0.83	4.42
2019	5.75	4.63	3.38	6.30

Source: Own calculations on the basis of data from the National Statistical Institute [7, 8].

During 2012, as compared to 2011, the purchasing power of households concerning yoghurt was significant. The obtained value of the variable L_{ij+1} (i=2, j=11) is 10.63%. The calculated variable D_{ij+1} (i=2, j=11) is 210 kg. The highest value of the mentioned difference was established in 2013. It was 216 kg. The percentage change of the variable L_{ij+1} (i=3, j=1) for surveyed data concerning white cheese was relatively higher during 2006. In the case, it was 14.31%. At the same time the difference D_{ij+1} (i=3, j=1) is 97 kg (table 2). A similar situation was observed for the

examined indicators about yellow cheese in 2012. The calculated values of the variable L_{ij+1} (i=4, j=11) is 14.20%, and the obtained difference D_{ij+1} (i=4, j=11) is 49 kg.

Table 2. The obtained results for the variable D_{ij+1}

year	indicator D_{1j+1} for milk /litres/	indicator D_{2j+1} for yoghurt /kg/	indicator D_{3j+1} for white cheese /kg/	indicator D_{4j+1} for yellow cheese /kg/
2006	257	148	97	47
2007	-243	-118	-83	-30
2008	-266	-43	6	-22
2009	110	94	81	39
2010	-177	-36	-33	-11
2011	-22	-17	-43	-34
2012	239	210	67	49
2013	261	216	50	25
2014	-18	-55	-33	-7
2015	55	60	20	28
2016	178	108	-1	18
2017	190	142	4	10
2018	98	68	7	21
2019	223	126	28	31

Source: Own calculations on the basis of data from the National Statistical Institute [7, 8].

CONCLUSIONS

The information related to food products has been organized in a created relational database. It has been extracted from the web site of the Bulgarian National Statistical Institute.

The current paper surveys the purchasing power of households (average per capita) concerning four milk products (milk, yoghurt, white cheese and yellow cheese) in Bulgaria. These data have been searched from several fields located in different tables of the presented database. Subsequently, they have been processed and analyzed. The percentage change in the purchasing power of households concerning each product for current year in comparison with the previous year has also been calculated and discussed. The considered time interval includes the period 2005-2019. As a result of this study, the following conclusions can be drawn:

- A process of almost continuous decrease of the purchasing power of households concerning milk was observed from 2007 to 2011. The situation is quite different for 2012-2019. A gradual growth of this indicator is obtained during the indicated period. Approximately the same dependences were established for the purchasing power of households concerning yoghurt in the years between 2005 and 2019;
- The calculations showed that this examined indicator for white cheese is changed continuously during 2005-2014. An increasing tendency of the indicator was observed for the last 5 years of the time interval;
- A reduction of the purchasing power of households for the yellow cheese was established in 2007-2008 and 2010-2011. The period 2012-2019 is characterized with a steady growth of the considered indicator.

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EVALUATION OF MATHEMATICAL MODELS WHICH DESCRIBE THE PROCESS OF DRYING GOAT MEAT

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Abstract

Drying is a step in the processing of goat meat. This paper presented the influence of salt and pH on moisture ratio over time, when the goat meat dries at 103℃, at thermobalance. From the obtained data it was observed that the water-holding capacity of goat meat was influenced only by lowering the pH by one unit. In the case of goat meat containing 3% salt, moisture ratio varied over time as in the case of the control sample. The mathematical models which describe the process of drying goat meat was investigated under each experiment conditions. An exponential variation of moisture ratio over time was obtained and this was best described by the exponential model named "Wang & Singh".

Key words**:** *goat meat, drying, moisture ratio, mathematical models*

INTRODUCTION

In Romania, goat breeding is done in the traditional system (domestic system), in the modernized traditional system (semi-intensive) or in the industrial system (intensive). Goat rearing is mainly done for milk production, while meat is appreciated mainly due to its lower fat content compared to meat from other animal species [5]. Goat meat is processed in the form of minced meat or specialties such as pastrami. In most cases the maturation-drying stage is encountered.

In goat meat, after slaughter, a significant decrease in pH values can be observed due to rigor mortis phenomena. Subsequently, the pH decreases under the action of bacteria, and can reach, depending on the time and storage conditions, to values lower than 6 [11]. In addition to the low pH value, the shelf life of goat meat products is also ensured by the salting and drying processes, which cause a decrease in water activity [16]. The way in which water is removed is important both economically and microbiologically [6]. The mass transfer takes place in two stages. Initially, water migrates from the inside of the meat to the surface, then from the surface to the environment. The diffusion of water inside the meat depends on the physicochemical characteristics and is of great importance to produce salted-and-dried goat meat [2]. Several researchers have investigated the drying kinetics of meat to evaluate different mathematical models for improving existing drying systems or even for process control [15].

The purpose of this article is to compare the mathematical models for drying of salted and acidified goat meat in relation to unpreserved meat.

MATERIALS AND METHODS

Goat was purchased from a domestic system and after slaughter and until the analysis was kept to a maximum of 4°C. Prior to the analysis, the connective tissue and superficial fat were removed from the leg and the muscle tissue was chopped to a size of 3 mm. After that, the meat was mixed, for the three samples, with equal volumes of distilled water (sample M), brine (sample SM) and lactic acid (sample AM), so that the sample SM contains 3% salt and the sample AM has a pH = 5.2 (The pH of samples M and SM was 6.2). Drying at 103°C, were preferred to obtain accurate results, in the shortest possible time, to reduce the influence of other factors or errors.

The first equation for mathematical modeling of the food drying process was proposed by Lewis [9].

$$\frac{dM}{dt} = -k(M - M_e) \quad (1)$$

where: M represents the bulk moisture content depends only on time t and M_e the equilibrium moisture content. After integrating equation 1, considering M_t is the moisture content of samples at time t and M_0 is the initial moisture content, results the moisture ratio (MR) [1].

$$MR = \frac{M_t - M_e}{M_0 - M_e} = \exp(-k \cdot t) \quad (2)$$

Where M_e is the equilibrium moisture content and is relatively smaller than M_t or M_0 [19]. For this reason, equation 2 was simplified to:

$$MR = \frac{M_t}{M_0} \quad (3)$$

Over time, several mathematical models of drying have been proposed, nine of different moisture ratio equations which are given in Table 1.

Table 1. Mathematical meat drying models used for the approximation given by various authors

Eq. no.	Model name	Model equation	References
1	Lewis; O'Callaghan et al.	MR = exp (-k · t)	[9], [12]
2	Henderson & Pabis; Chhinan	MR = a · exp (-k · t)	[7], [4]
3	Yagcioglu	MR = a · exp (-k · t) + b	[20]
4	Midilli & Kucuk	MR = a · exp(-k · t^n)+b · t	[10]
5	Page; Zhang & Litchfield	MR = exp (-k · t^n)	[14], [21]
6	Modified Page	MR = a · exp [- (k · t^n)]	[14]
7	Overhults	MR = exp [- (k · t) ^{n}]	[13]
9	Wang & Singh	MR = b - a · exp [- (k · t^n)]	[18]
9	Karathanos	MR = a·exp(-kt) + a_1·exp(-k_1t) +a_2·exp(-k_2t)	[8]

Author's synthesis based on [4, 7, 8, 9, 10, 12, 13, 14, 18, 20, 21].

The reduced chi-square (χ^2) and root mean square error ($RMSE$) can be calculated as follows [3]:

$$\chi^2 = \frac{\sum_{i=1}^{N}\left(MR_{pre\,i} - MR_{\exp\,i}\right)^2}{N} \quad (4)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}\left(MR_{pre\,i} - MR_{\exp\,i}\right)^2}{N}} \quad (5)$$

where $MR_{pre\,i}$ and $MR_{exp\,i}$ represent predictive moisture ratio and experimental moisture ratio; N is the number of observations

RESULTS AND DISCUSSIONS

In Figure 1 it can be observed that, for all samples, MR values decrease in two stages. The decrease is accentuated up to a value of about 0.1, after which it tends slowly towards the value zero. However, in the case of dried meat products, these do not dry completely. Depending on sensory preferences, local traditions or shelf life, meat products dry until the MR reaches values around 0.45. As seen in Figure 1, especially in the final drying period of meat products, there are significant differences between the control and meat with higher acidity (lower pH)

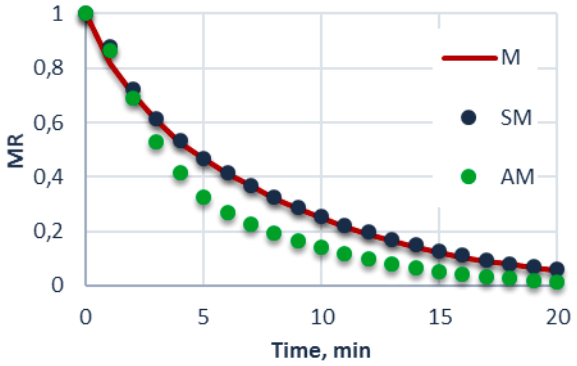

Fig. 1. The effect of salting and acidification on the moisture ratio (MR) values of IR-dried minced goat meat
Source: own processing.

By changing the parameters of the environment, such as varying the speed of air circulation, the amount of evaporated water changes. So, the limiting factor is the water transfer to the surface of the meat, and this depends on water-holding capacity of meat. In the case of salted meat, there is no difference from the control (unsalted meat), while the decrease in pH, as expected, favors the elimination of water. While in salted meat, the

water retention capacity of the meat increases due to the presence of dissociating salt, the salt also favors the extraction of myosin which has a hydrophobic and a hydrophilic part. Thus, it is reduced the repulsion between water and fat. This may explain why the results obtained for the control and for the salted meat are very close. Previously, other authors have observed that the presence of salt insignificantly influences cooking losses, while large differences were obtained depending on the post-slaughter stage in which the meat was because pre-rigor muscle had a higher pH value than post-rigor muscle [17].

Fitting of experimental drying data to model

The experimental drying data observed were fitted to the nine models listed in Table 1.

The coefficients: k, k_1, k_2, a, a_1, a_2, b, n, the regression coefficients (R^2), the reduced chi-square (χ^2) and root mean square error (*RMSE*) values results of the different models are listed in Table 2.

Table 2. The coefficients (k, $k1$, k_2, a, a_1, a_2, b, n), the regression coefficients (R^2), the reduced chi-square (χ^2) and root mean square error (*RMSE*) values obtained by application of nine equations to the experimental drying data for dried goat meat.

Eq.	Model	Sample	Coefficients								Model precision		
no.	name		k	k_1	k_2	a	a_1	a_2	b	n	R^2	χ^2	*RMSE*
1	Lewis;	M	0.1620								0.9969	0.7418	0.8613
	O'Callaghan	SM	0.1433								0.9979	0.7386	0.8594
	et al.	AM	0.2062								0.9973	0.8154	0.9030
2	Henderson	M	0.1401			0.9586					0.9984	0.6791	0.8241
	& Pabis	SM	0.1405			0.9807					0.9983	0.71054	0.8429
	Chhinan	AM	0.1669			1.0013					0.9976	0.81702	0.9039
3	Yagcioglu	M	0.1396			0.9588			-0.000881		0.9984	$0.8921*10^{-4}$	0.0094
		SM	0.1404			0.9807			-0.000219		0.9983	$1.0191*10^{-4}$	0.0101
		AM	0.2112			1.0172			0.001777		0.9969	$1.2430*10^{-4}$	0.0111
4	Midilli &	M	0.1719			0.9873			$-2.1057*10^{-4}$	0.9150	**0.9993**	$\mathbf{0.0351*10^{-4}}$	**0.0019**
	Kucuk	SM	0.1686			1.0064			$-1.8469*10^{-4}$	0.9242	**0.9990**	$\mathbf{0.0089*10^{-4}}$	**0.0009**
		AM	0.2159			1.0219			$0.1185*10^{-4}$	0.9865	**0.9976**	$\mathbf{0.1048*10^{-4}}$	**0.0032**
5	Page	M	0.1745							0.9191	0.9988	$0.6557*10^{-4}$	0.0081
	Zhang &	SM	0.1612							0.9463	0.9988	$0.7230*10^{-4}$	0.0085
	Litchfield	AM	0.2029							1.009	0.9973	$1.3717*10^{-4}$	0.0117
6	Modified	M	0.1644			0.9824				0.9385	0.999	$0.8091*10^{-4}$	0.0090
	Page	SM	0.1626			1.0026				0.9435	0.9988	$0.7335*10^{-4}$	0.0086
		AM	0.2161			1.0221				0.9856	0.9976	$1.6211*10^{-4}$	0.0127
7	Overhults	M	0.1471							0.5240	0.8602	$79.3769*10^{-4}$	0.0891
		SM	0.1464							0.5465	0.8792	$71.4773*10^{-4}$	0.0845
		AM	0.1734							0.5698	0.8380	$83.9961*10^{-4}$	0.0916
8	Wang &	M	0.1734			-0.9992			-0.0102	0.9037	**0.9994**	$\mathbf{0.0262*10^{-4}}$	**0.0016**
	Singh	SM	0.1693			-1.0158			-0.0084	0.9162	**0.9990**	$\mathbf{0.0121*10^{-4}}$	**0.0011**
		AM	0.2150			-1.0202			-0.0013	0.9904	**0.9976**	$\mathbf{0.0778*10^{-4}}$	**0.0028**
9	Karathanos	M	1.0770	0.1000	0.1008	0.1160	-26.746	27.6301			0.9999	$0.0688*10^{-4}$	0.0026
		SM	2.1908	2.1908	0.1324	52182	-52181	0.9170			0.9995	$7.9663*10^{-4}$	0.0282
		AM	0.9531	0.1785	0.9532	31640	0.78216	-31640			0.9996	$0.2776*10^{-4}$	0.0053

Source: Own calculation on the basis Desmos Graphing Calculator and Scientific Calculator.

Models analysis were based on the values that the regression coefficient of determination (R^2) should be close to 1. At the same time, *RMSE* and χ^2 should be very low [1].

These requirements have been met by the models "Midilli & Kucuk" and "Wang & Singh".

0.9994 was the highest value of R^2 and was obtained for the control sample (M), using the model proposed by "Wang & Singh". The lowest values of *RMSE* and χ^2 were obtained for sample SM, using "Midilli & Kucuk" equation. However, the model that best describes the drying process for all three samples is the model "Wang & Singh". For all samples, the decrease of *MR* is exponential and the values of R^2 have values very close to 1. Also χ^2 and *RMSE* have values less than $0.0778 \cdot 10^{-4}$ and 0.0028, respectively.

CONCLUSIONS

The drying time of meat products and the choice of drying conditions depends on water-holding capacity of samples. As expected, *MR* had the largest variation in the unit of time for the AM sample. The mathematical model noted "Wang & Singh" best describes the exponential variation of *MR* over time for all samples.

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SOCIO-ECONOMIC DEVELOPMENT OF THE UNITED TERRITORIAL COMMUNITY WITHIN THE CONDITIONS OF FINANCIAL DECENTRALIZATION

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Abstract

This article researches scientific and applied aspects of decentralization and outlines methodical approaches to the analysis of socio-economic development of communities. The work looks into the peculiarities of the united territorial community formation based on the example of Truskavets UTC. It proves that reforming of the territorial organization of power proves to be the effective mechanism for stimulating economic activity as well as developing of effective strategies for regional and local development. The changes in the budgetary policy in accordance with the new approaches in the management of administrative-territorial entities are illustrated. The article identifies the results of activities in the current and perspective plans of Truskavets united territorial community based on such indicators as the average amount of own revenues, local taxes and levies, the percentage of administrative office costs in own resources. It also substantiates the main priorities of Truskavets UTC in the context of current conditions and establishes the principles of financial support of the united territorial communities' activity, which is an integral part of their financial capacity.

Key words**:** *socio-economic development, resources, financial decentralization, perspective plan, united territorial community (UTC)*

INTRODUCTION

The significance of rural areas is further enhanced by their exceptional contribution to the formation of food security and building the country's export potential. These factors alone make the development of rural areas one of the main priorities of Ukraine's state policy which is aimed at raising the living standards of the rural population as well as boosting agricultural performance. The new organizational structure between the central authorities, regions and the territorial community based on the principles of effective distribution of powers, resources and comprehensive responsibility is directed at providing citizens with all public goods and increasing the efficient use of budget funds at all levels government.

Activities of state and local government bodies within the context of financial decentralization, territorial organization of power and the new ideology of public administration in Ukraine create opportunities for functioning and self-development of a prosperous community, introduction of sustainable socio-economic development principles, and use of modern infrastructure, obtaining necessary high quality services and promoting high level welfare of all citizens.

The existing administrative barriers and gaps in the current legislation hinder the implementation of decentralization reform that targets the issues of socio-economic development of territories.

Ukrainian and foreign scientists, such as O. Padalka, V. Kulishov, E. Kuzkin, O. Shishko, S. Davydenko, and others researched the development of theoretical bases and principles of practical realization of local self-government in the context of making financial, economic and social decisions. O. Bobrovska, O. Vasylieva, N. Vasylieva, T. Kravchenko [3, 5, 9] dwelled on sustainable

development of territorial communities while the economic aspects of territorial communities development were addressed by I. Kolomiets, O. Nezdoimynoha, A. Pavliuk, A. Pelekhtyi, I. Yaroshenko [4, 7, 8, 11, 14].

The importance of this process has been noted by a number of academic economists. According to O. Padalko and V. Kulishov, along with budgetary process reforming conditions are created for solving the most complex tasks of state influence on the social sphere and economic development. "Socio-economic processes within the conditions of regionalization and decentralization play an important role in the course of drafting a set of reforms, making adjustments to their implementation during analysis and evaluation of the region's performance and identifying the performance of the economic system" [1]. Management of public finances is an integral part of UTC's socio-economic development. Analysing administrative decentralization in European countries, S. Davydenko [5] notes that European practice in the field of financial security confirms the fact that there are no universal models and algorithms for decentralization of powers, property and sources of local government funding. However, we believe that consolidation of grassroots territorial structures will be an important component and expanding the financial base for the local budgets will be a mandatory priority.

Scientists Ye. Kuzmin and O. Shyshko grounded their researches on the principle of subsidiarity, when most of the powers delegated to local government bodies are financed by sectoral grants. Such opinion is worth accepting, as it will allow accumulating a significant part of funds at the local levels.

It is advisable to conduct thorough calculations based on scientific and practical researches and to develop economically sound capacity indicators (criteria) of the territorial community. All this lay the ground for further scientific and practical study.

The purpose of the study is to monitor and analyze the current results of the financial decentralization implementation, to assess its importance for socio-economic development and effective functioning of the united territorial community, on the example of Truskavets sub-region.

MATERIALS AND METHODS

In the study, we used general and specific economic methods, and a basic research approach, which allowed us to determine the economic nature of UTCs development as well as their social component.

All materials in this article are processed by means of a complex of scientific research methods, in particular the direct description of the investigated phenomenon, processing of the statistical information by means of economic research methods, and representation of the obtained results by means of tabular and graphic forms. In particular, computational and analytical method - to assess UTC's revenues; comparative method - to compare revenue growth trends of a particular village council, logical generalization and extrapolation method - to justify on the qualitative level new approaches and develop proposals for effective socio-economic development of the UTC; graphical and tabular method - to provide the calculation part of the study and ensure visual presentation of its results in the course of statistical data processing.

RESULTS AND DISCUSSIONS

The potential of Community Resources could be analyzed from the following points of view:

-*Institutions* regarding: local economic agencies, organizations, business associations, clusters;

-*Intangible assets* regarding: image, reputation, knowledge, experience, skills, social capital, information;

-*Human resources* regarding: local government officials, employees of social institutions, employees of pedagogical, and medical, cultural fields, individuals;

Physical resources, including: manufacturing facilities, equipment and processes, logistics, infrastructure;

-*Natural resources*: primary natural resources, ecosystems;

-*Material objects*: administrative premises, social infrastructure facilities, social institutions, establishments, other infrastructure facilities;
-*Financial resources* consisting of: budget funds (common funds), charitable contributions (special fund), borrowings, loans (special fund), donor funds etc.
All these resources must be integrated at the level of the United Territorial Community as presented in Fig. 1.

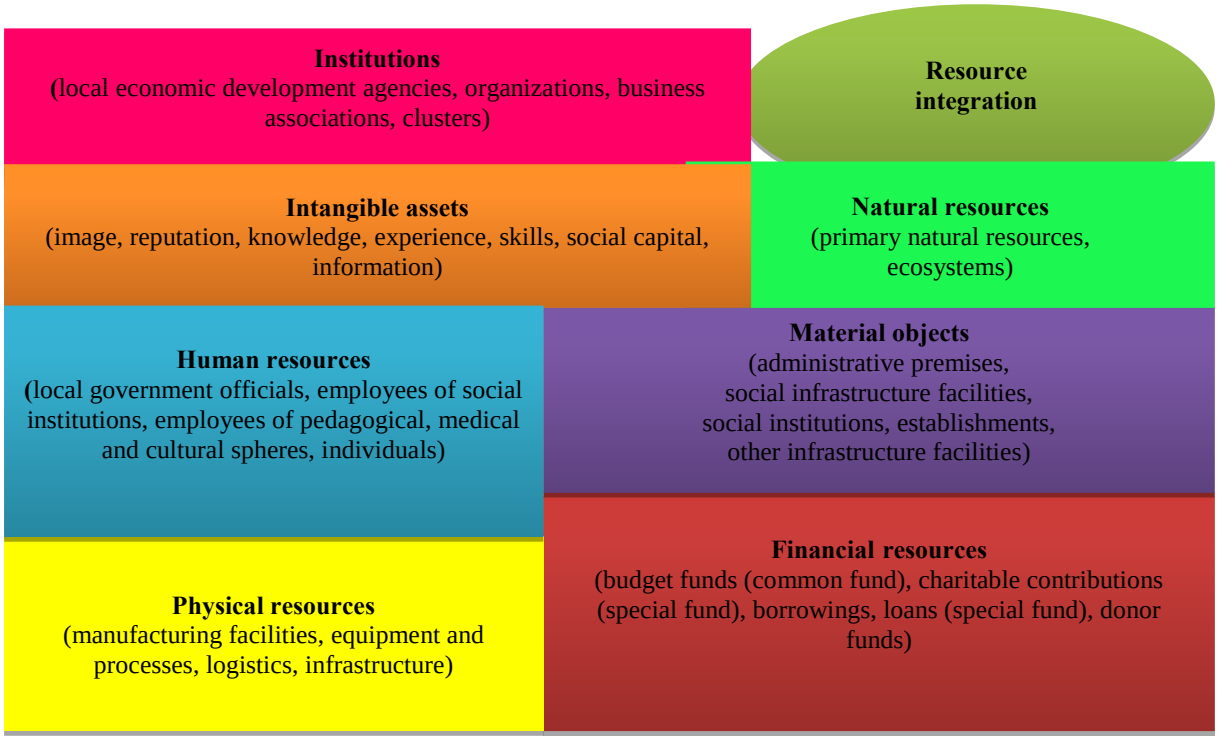

Fig.1. Community Resource Potential
Source: own research.

The ability of community members to make - through their knowledge, skills and interaction - a qualitative and quantitative contribution to the sustainable development of the community on a daily basis is the key internal resource.
The main expenditures of village councils, comprising almost 90% of income were intended for keeping a separate village council. Figure 2 shows the income of separate village councils: Dobrohostiv, Ulychne, Oriv, Stanylia, and Modrychi as compared to the income of the separate city council of Truskavets.
Unfortunately, most material resources are depleted and nonrecoverable. Therefore, it is important to ensure their integration as well as to assess and identify the resource potential of important to ensure their integration as well as to assess and identify the resource potential of the community. In the process of comparing the pair of indicators “community budget – percentage of administrative office costs”, it should be noted that maximal expenditures for maintaining an administrative office are typical for most UTC’s village councils.
This indicates inefficient use of costs intended for maintaining an administrative office. Own revenues of village councils comprise rent, consolidated tax, property tax, tourist fee.

Fig. 2. Own revenues of the village councils and the local council of Truskavets city
Source: Own calculations.

UTC's budget is formed in accordance with the Budget Code of Ukraine and is included in the Consolidated state budget of Ukraine.

The budget of income and expenses of Truskavets UTC is shown in Fig.3.

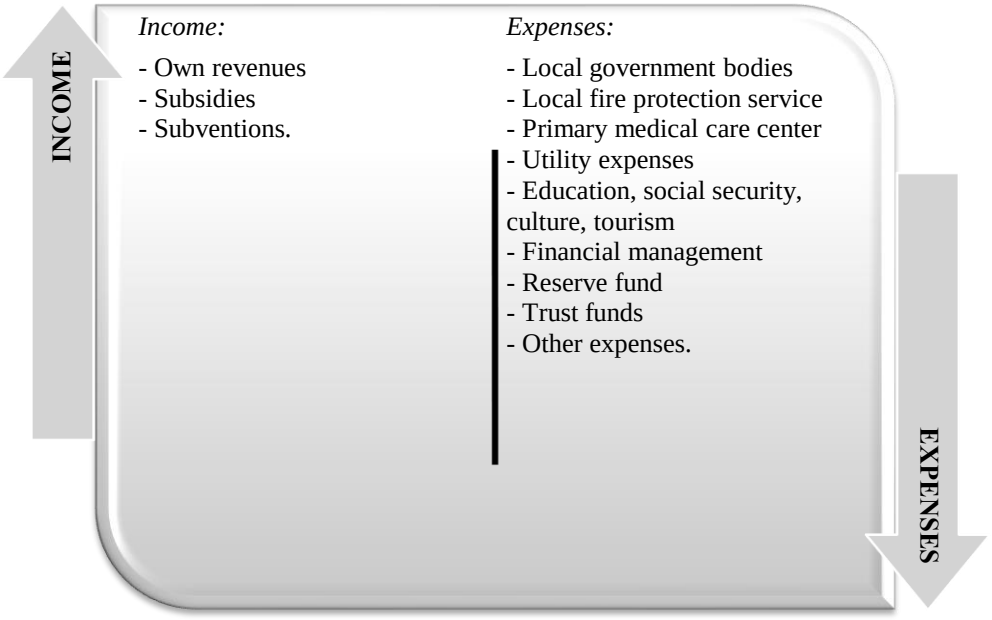

Fig. 3 Income and expenses of Truskavets UTC
Source: [6, 2].

As we can see from Fig.3, the income sources of the UTC are represented by own revenues, subsidies and subventions.

The main fields of activity where the UTC budget is spent are the following ones: local government bodies, protection service at the local level, the centre for health care, utilities, education, social security, culture and tourism, financial management, trust funds and also a reserve fund.

The structure of own tax revenues for 2021 is expected in the following amounts: personal income tax - 55.1% of the total amount of own revenues, property tax - 27.4%, consolidated tax - 13.4% and other own revenues - 19.1% [10].

Filling up the main part of the UTC's budget, about 80%, at the expense of Truskavets taxpayers. The tax capacity index of Truskavets UTC is 0.9, which is the highest indicator in the Lviv region, therefore the UTC's budget does not fall under equalization and can be considered self-sufficient or non-subsidized. If the value of the tax capacity index is below 0.9, the amount of subsidy will be 80% of the insufficient sum to reach the indicator. If the value of the tax capacity index is higher than 1.1, then a reverse subsidy is applied, i.e. 50% of the excess sum is withdrawn.

As far as the financial component is concerned, further we analyse the estimated revenues of Truskavets UTC for the end of 2020, in UAH (Fig. 4).

While comparing all of the estimated tax revenues of the Truskavets united territorial community, it should be noted that 53% will come from income tax and profit tax, 39% - local taxes, 0.05% - other taxes and levies, 0.03% - rent, 6% - domestic taxes on goods and services. In addition, a significant part of the estimated revenues includes capital transactions - UAH 1.4 million, official transfers - UAH 42.4 million, nontax income - UAH 8.5 million.

Monitoring of strategic milestones of the united territorial community's efficient development will provide for the increase of annual revenues as well as ensure sustainable economic development of the territory and its socio-economic component.

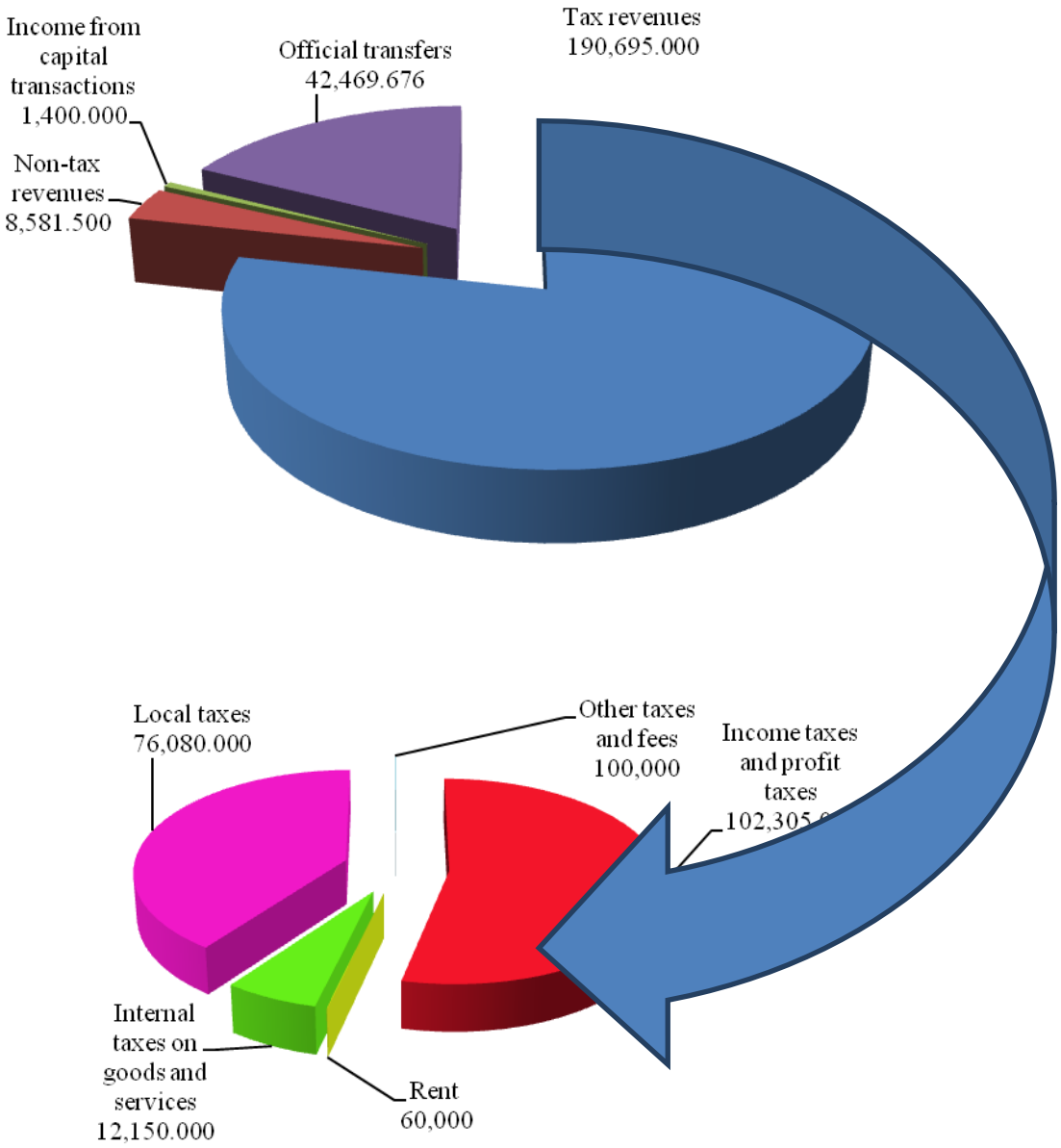

Fig. 4. Estimated revenues of Truskavets UTC as of the end of 2020, UAH
Source: Own calculations.

The largest part of estimated tax revenues comes from income taxes and profit taxes – amounting to UAH 102.30 million, local taxes comprise UAH 76.08 million.

Subvention funds intended for the formation of the united territorial community's infrastructure are granted for:

- Developing of design and town planning documentation,
- Improving the quality of administrative services provision, particularly for the modernization of Centers for provision of administrative services,
- Installing of up-to-date communications,
- Equipment purchasing (firefighting and rescue),
- Reconstructions, re-equipment works with the use of energy efficient technologies,
- Reconstructing and repairing of streets and roads directly leading to institutions that provide social and administrative services,
- Purchasing of vehicles to transport children to educational institutions as well as for the needs of health care facilities.
- State support of Ukraine's territories development is shown in Figure 5.

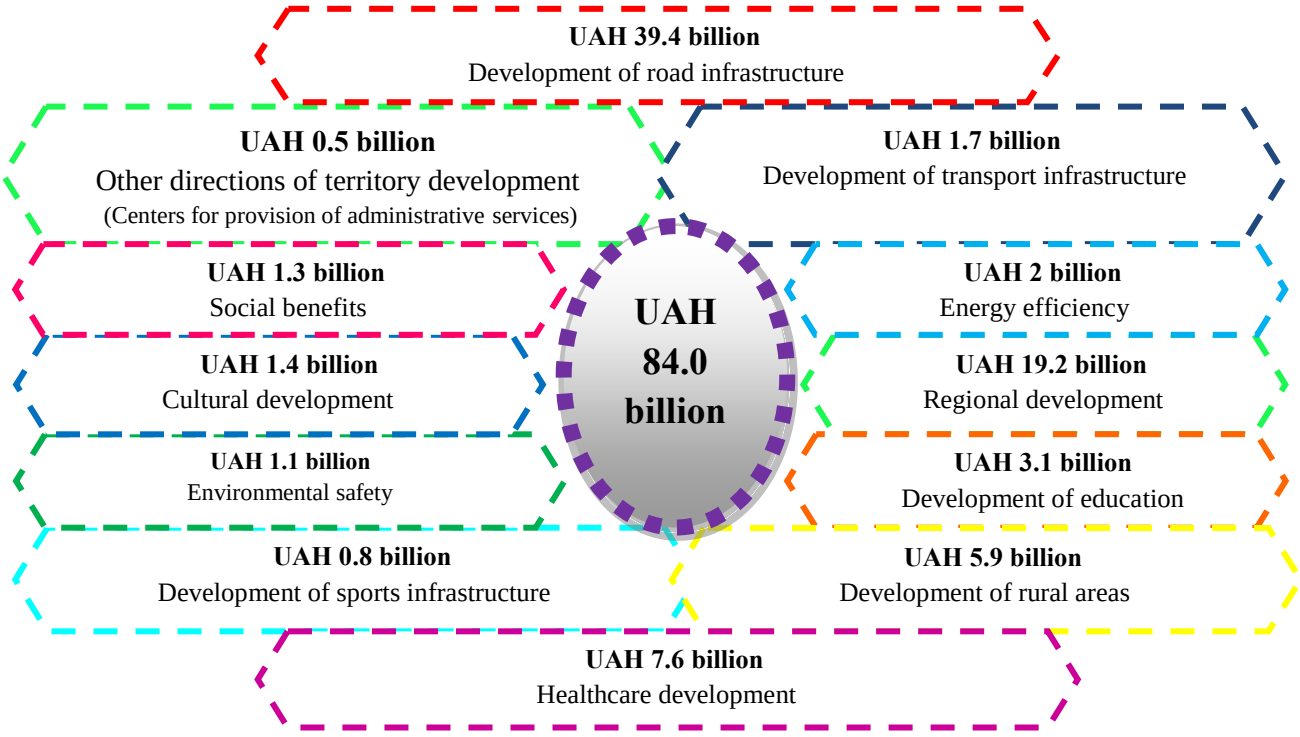

Fig. 5. State support of Ukraine's territories development in 2020
Source: Own calculations.

Countries with different systems of territorial organization use targeted transfers: France – 10.6% out of the interbudgetary transfers; United Kingdom – 27%; Norway and Switzerland – 14%; Poland – 22%; Italy – 24% [9, p. 230], [13].

With the aim to assess socio-economic indicators of the territorial communities based on the reports of financial (budgetary) activity of the united communities in 2020 an indicator of socio-economic budget execution of the territorial communities and indicators of taxpaying capacity of the Lviv communities were calculated [12, 4, 5].

The overall consolidated indicator of socio-economic budget execution of the territorial communities can be calculated using the following formula:

$$P = \frac{\sum_{j=1}^{k} P_j}{k}, \qquad (1)$$

Having made corresponding calculations, we obtained the following values showed in Figure 6.

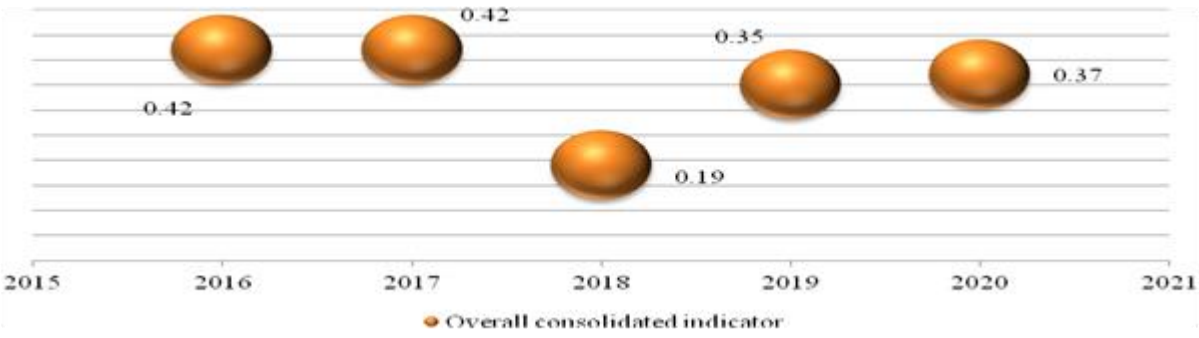

Fig. 6. Overall consolidated indicator of socio-economic budget execution of the territorial communities in Lviv region throughout 2016-2020
Source: Own calculations.

After analyzing Figure 4, we can conclude that in 2018 it was difficult for the territorial communities of the Lviv region in terms of executing socio-economic budgets.

The consolidated indicators were at the same level in 2016-2017. An increase is observed in 2019 and 2020 which is a positive trend.

To determine the financial capacity and self-sufficiency of the community, it is not enough to take into consideration only the general income growth indicator under conditions of budgetary and tax changes. We recommend taking a comprehensive approach and make calculations of necessary expenses and disposable income per 1 community resident, based not only on providing the urgent needs of the community (maintenance of educational institutions, health care facilities, infrastructure, salary financing, social benefits, etc.), but also the financing of perspective socio-economic development projects aimed at improving the living environment and well-being of citizens as well as planning the future territorial development, etc.

Economic development is associated with the rational use of land resources, development of agricultural activity and attracting investments. Expanding economic opportunities for the development of the social sphere in rural areas, in particular, through the development of industry in rural areas, and the organization of agricultural products processing.

Social development is associated with adequate social infrastructure, appropriate conditions for the provision of administrative services and high quality primary medical care as well as significant improvement of its financial support, which will provide for the formation of confidence and social balance. Socio-economic development scheme is presented in Figure 7.

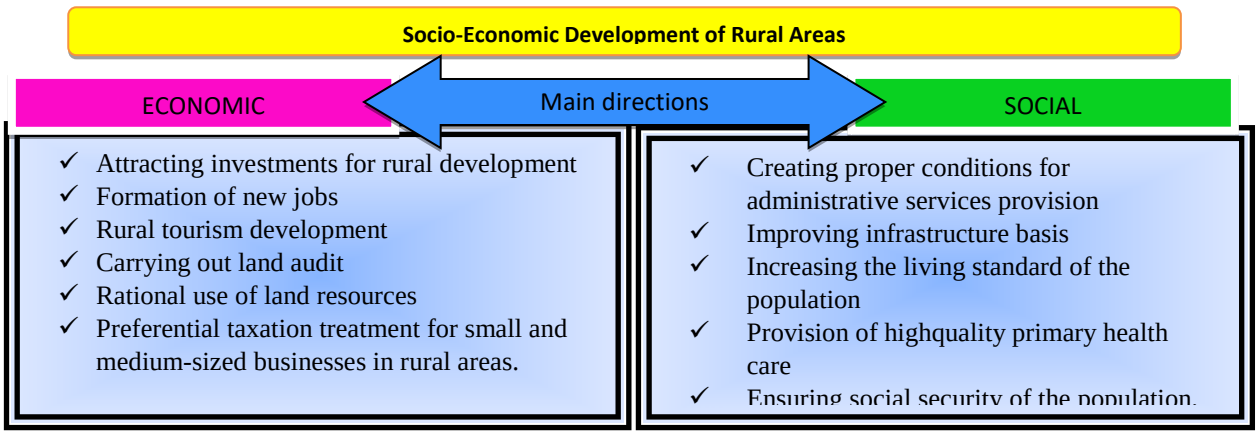

Fig. 7. Scheme of the Socio-economic Development of Rural Areas
Source: own research.

Due to the decentralization reform, the UTC will have a real opportunity to use the available financial resources in order to solve urgent community problems.

To monitor the assessment of the social and economic development implementation, we identified performance indicators – the number of existing and newly established enterprises; the rate of unemployment; the amount of energy saved; the number of created and operating tourism infrastructure sites; the number of operating and newly established agricultural enterprises; the number of social services recipients; the number of administrative services users; the number of sports and recreational activities; the number of cultural and arts events; the length of repaired roads.

Success can be achieved by a united territorial community, which is ready to eliminate its weaknesses while consolidating its strengths, and on the other hand - to promote the use of opportunities that may arise due to external powers. SWOT analysis which is based on long-term and short-term operational goals proves to be an effective method to research

the opportunities and threats related to the community activities. Researching the UTC's perspectives is aimed at revealing the strengths and weaknesses of the community, provided that either the external and internal factors are stable, or if economic and political instability in the country worsens. The SWOT analysis assessment is presented in Figure 8.

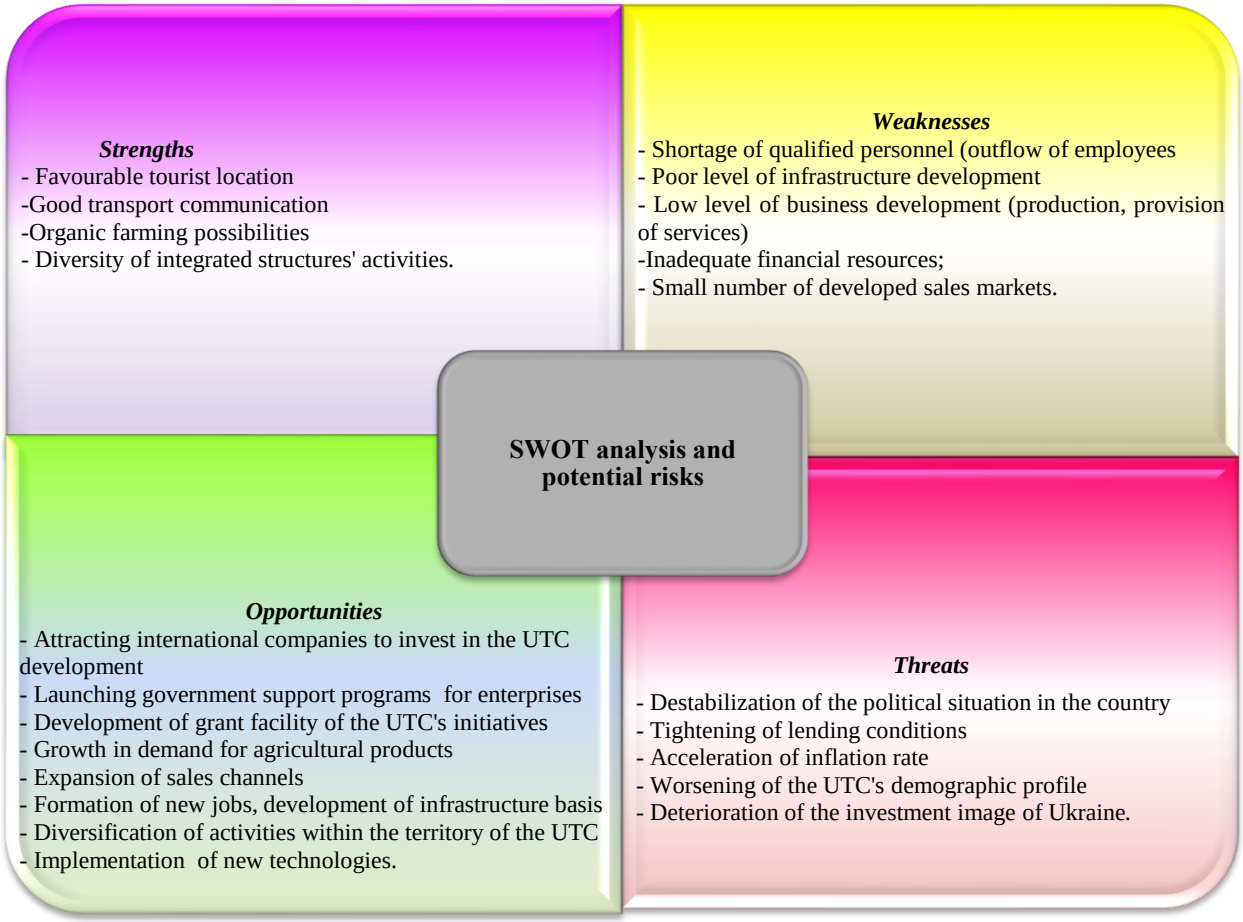

Fig. 8. SWOT Analysis- Assessment of UTC's Strengths and Weaknesses
Source: own research.

The competitive potential of Truskavets UTC is ensured through a system of financial and organizational opportunities aimed at effective community development. Considerable attention is paid to weaknesses, since the identification of problems and ways to solve them lays the basis for the implementation of specific proposals.

Priority development of rural areas should be ensured through the implementation of a number of important tasks, among which are:

– Motivating the development of agriculture and the agricultural market through stimulating the increase of the population's purchasing power by means of increasing salaries and pensions of citizens, substitution of all social benefits with targeted monetary subsidies.

– Providing state aid to improve the level of rural development as a sphere of life, the activity and life standard of rural citizens, delimitation of policies to support agriculture and rural areas development.

– Creating favorable and stable conditions for investment in the state's agriculture sector based on mutually beneficial conditions for the investor country.

– Creating conditions for the social development of the village, strong motivation for corporate social responsibility of businesses operating in the agricultural sector as well as in the related sectors of production and the sphere of services provision.

– Diversification of agricultural production, development of alternative economic activities in rural areas.
– Stimulating employment of rural areas citizens outside the field of agricultural production.

CONCLUSIONS

Strategizing and planning, quality management, development and implementation of effective municipal services system, transition to e-government, minimization of corruption and creation of investment platforms, use of resource and tourism potential form the main advantages of Truskavets UTC.
Let's outline the main priorities of Truskavets UTC:
- Rational use of human, financial and natural resources and prioritizing primarily the interests of all community citizens.
- Consideration of online appeals and petitions in the shortest possible time frame.
- Attracting investors by providing tax benefits, for instance those related to the development of social facilities near investment sites (public parking lots, parks, playgrounds).
- Implementation of investment projects.
- Development of UTC's intellectual capital and innovativeness.
- Creation of a tourist route passing through the UTC's villages which will provide for additional financial resources and create new job openings.
By 2022, the UTC's management and local enterprises will be formed by 70% of the territory residents, who were selected in the course of competition and meet the qualification requirements.
For the progressive development of the UTC, it is important to set short-term and long-term goals. An important priority is the sustainable and perspective economic growth of the UTC, diversification of energy sources as well as increasing energy efficiency through government programs aimed at the development of alternative renewable energy sources. It is also reasonable to develop pilot projects with regard to formation of more jobs in organic farming sector, creative industries and tourism. Most importantly it is necessary to ensure the effective operation of all Starostyn districts of the community, namely: management and purchase of special equipment for removal and disposal of household waste, landscaping, current road repairs, maintenance of water drainage and water supply systems, street lighting etc.
Achieving these goals will create appropriate conditions for socio-economic development of the community as a whole as well as all of its components, while using the diversification mechanisms to address potential risks in rural areas.

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MANAGEMENT OF SOIL RESOURCES IN GIARMATA, TIMIŞ COUNTY, ROMANIA

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Abstract

The aim of this paper is to present the qualitative assessment with a view to the sustainable development of the land presented (land that occupies the largest share) of the studied area. The methods used to carry out this work were: the characterization of the area studied in terms of natural conditions; the assessment of the productive capacity of the soil with a view to the most accurate sustainable use. The study material used for the elaboration of this paper is the land belonging to the Giarmata territorial administrative unit (6,119 ha) and the Pedological study of the Giarmata City Hall. As regards the agricultural land of the commune, it consists of the following uses: arable 4,859 ha (77.2%), pastures 834 ha (13.3%), meadows 121 ha (1.9%), and orchards 305 ha (4.8%). With regard to the classification of the area studied in quality classes (fertility), for the category of use "arable", the situation is as follows: 1st class – 128 ha (2.6%), 2nd class – 913 ha (18.8%), 3rd class – 2852 ha (58.7%), 4th class – 850 ha (17.5%), and 5th class – 116 ha (2.4%). For the proper development of the agricultural land under study, action will be taken as appropriate by carrying out the work of deep watering or subsoiling, the introduction of long-term crop rotation, the introduction of breeding crops, and the establishment of an adequate load of grazing livestock.

Key words**:** *sustainable development, agricultural land, fertility, crops, Giarmata*

INTRODUCTION

Maintaining and improving soil fertility is a major concern of all countries, primarily to ensure the food needs of the ever-growing population. [5], [17], [18].

The conservation and maintenance of soil natural fertility have been and are supported and promoted by researchers and specialists, in view of the current requirements for the development of sustainable agriculture.[1], [16].

In the context of sustainable agriculture, soil protection, conservation, the achievement of an environment conducive to the development of crops should also be based on the knowledge of the physical condition of the soil, in addition to chemical and biological ones. [2], [13], [14].

In modern and efficient agriculture, soil is the main means of production which, if used rationally, ensures the production of quality and economically cost-effective agricultural produce. [4], [11], [15].

Soil still is the indispensable element on whose knowledge is based the assessment of the management opportunities provided by agricultural land, but for any applied interpretation regarding the use or exploitation of soil resources one needs to know the other environmental factors in their interaction and conditioning. [7], [9], [12].

This is achieved through the concept of "terrain" that integrates four distinct aspects, namely: -the ecological aspect related to the conditions of plant development; -the technological aspect related to the possibilities and way of working the soil; -the economic aspect related to the soil's production capacity and resistance to use; -the geographical aspect related to the agricultural landscape.[8],[10]. Agricultural

science and practice have proven that soil fertility can be continuously enhanced by agrotechnical, agrochemical, and land improvement measures, thereby fighting the theory of soil depletion taken into cultivation or the so-called law of soil decreasing fertility. [5], [6], [9]. Actual (economic) productivity will depend on the level of soil cultural fertility, the suitability of the climate and the level of technicality and investments. [1], [4], [10]. There are numerous and extensive cases of strong growth of soil fertility through organic fertilization and improvement works, as there are also numerous and widely extensive cases of decreased natural fertility through the degradation of the physical, chemical, and biological properties of the soil as a result of a wrong system of agriculture. [2], [3], [7].
In the intensive farming system, there is lasting and fleeting cultural fertility depending on the level of fertilization, irrigation, and rationally-made agrotechnical work [3], [1]. This means that, once the additional investments are interrupted, the level of productivity will decrease, thus depending on the complex of technical, economic, and social factors [8].

MATERIALS AND METHODS

Located in the central-northern area of Timiș County (45°83' north latitude and 21°32' east longitude), on DJ 691, Giarmata, the seat of the commune of the same name, is located 11 km from the municipality of Timisoara and, through DC 58, 1.3 km from Timișoara International Airport. The municipality of Giarmata covers an area of 7,150 ha, of which 6,292 ha represent agricultural land and 43.5 ha represent forest land. Giarmata is located on the south-eastern margin of the Vinga Plain, with a general north-easterly orientation to south-west. The Vinga Plain has average altitudes between 100 and 150 m, very wide interfluves sprinkled with depressive areas, poor fragmentation, and less relief energy. The study on the sustainable development of agricultural land in Giarmata were carried out in 2019 on different types of soil and agricultural crops. Based on the study and the information collected, the area studied comprises a number of 10 types and 38 subtypes of soils, namely: -*Aluviosols*: molic (mo), gleic (gc), gleic-salinic (gc-sc) – UT 1-4, 88.66 ha, 1.41%; -*Chernozems*: cambic-gleic (cb-gc), gleic-salinic (gc-sc), vertic-gleic (vs-gc) – UT 5-8, 146.45 ha, 2.33%; -*Faeozioms*: clinogleic (cl) – UT 9-10, 18.89 ha, 0.30%; -*Eutricambosols*: typical (ti), molic (mo), alluvial (al), molic-gleic (mo-gc), aluvic-gleic (al-gc), aluvic-stagnic (al-st), aluvic-salinic (al-sc), molic-gleic-salinic (mo-gc-sc), aluvic-gleic-salinic (al-gc-sc)– UT 11-25, 795.43 ha, 12.64%; -*Preluvosols*: typical (ti), molic (mo), vertic (vs), stagnic (st), reddish-molic (mo-rs), molic-stagnic (mo-st), vertic-stagnic (vs-st), gleic-stagnic (gc-st) – UT 26-71, 3,578.16 ha, 56.86%; -*Pelosols*: gleic (gc), stagnic (st), stagnic-gleic (st-gc), gleic-salinic (gc-sc), gleic-salsodic (gc-ss) – UT 72-85, 454.64 ha, 7.23%; -*Vertosols*: gleic (gc), gleic-salinic (gc-sc), gleic-salsodic (gc-ss) – UT 86-93, 827.88 ha, 13.16%; *Gleisols*: molic (mo), pelic (pe) – UT 94-96, 242.88 ha, 3.86%; -*Stagnosols*: typical (ti), vertic (vs), vertic-gleic (vs-gc) – UT 97-100, 96.45 ha, 1.53%; -*Erodosols*: pelic-calcic (pe-ka) UT 101-103, 42.97 ha, 0.68%. For the analysis of sustainable development, the soils with the highest weight were studied, namely Preluvosol, Vertosol and Eutricambosol for different agricultural crops. The process of evolution of *preluvosols* was carried out with an intensity dictated by the bioclimatic zone, the age of the relief form, its appearance, and the nature and origin of the soil genesis materials. This soil covers an area of 3,578.16 ha, 56.86%. Subtypes of Preluvosol from Giarmata: typical preluvosol, vertic preluvosol, batigleic preluvosol, stagnic preluvosol, molic-batigleic preluvosol, vertic-stagnic preluvosol. *Vertosols*. Soils in this class cover an area of 454.64 ha in Giarmata, 7.23 % of the area under investigation. They are divided into several subtypes depending on the excess water and on the water shape that affects excess soils. The subtypes of vertosol from Giarmata: typical vertosol, batigleic vertosol, stagnic vertosol. *Eutricambosols* are, generally, relatively young or rejuvenated soils in different stages

of debasification (but their degree of saturation in bases falls below 53%). They are conditioned by the nature of the soil genesis rock or by the conjuncture of bioclimatic conditions. There are soils that have evolved only on rocks rich in bases (clays, marls). They cover an area of 795.43 ha, 12.64%. Subtypes of eutricambosol in Giarmata: typical eutricambosol, batigleic eutricambosol, stagnic eutricambosol, stagnogleic eutricambosol.

RESULTS AND DISCUSSIONS

Soil suitability for different agricultural crops

Table 1. Soil suitability for wheat, maize and sunflower

Soil type	Wheat		Maize		Sunflower	
	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class
Preluvosol	73	III	65	IV	65	IV
Vertosol	33	VII	22	VIII	23	VIII
Eutricambosol	58	V	45	VI	43	VI

Source: Calculated by author.

Table 2. Soil suitability for sugar beet and potato

Soil type	Sugar beet		Potato	
	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class
Preluvosol	58	V	52	V
Vertosol	19	IX	11	IX
Eutricambosol	32	VII	28	VIII

Source: Calculated by author, 2020.

Table 3. Soil suitability for plum and apple

Soil type	Plum		Apple	
	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class
Preluvosol	64	IV	45	VI
Vertosol	20	IX	15	IX
Eutricambosol	52	V	59	V

Source: Calculated by author, 2020.

Table 4. Soil suitability for cherry, sour cherry and apricot

Soil type	Cherry		Sour cherry		Apricot	
	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class	Soil assessment grade	Fertility class
Preluvosol	64	IV	64	IV	64	IV
Vertosol	15	IX	15	IX	11	IX
Eutricambosol	47	VI	47	VI	41	VI

Source: Calculated by author, 2020.

1.Suitability of soils for wheat, grain maize and sunflower Preluvosol for wheat is grade 73, 3rd fertility class; for grain maize and sunflower, its grade is 65, 4th fertility class, compared to vertosol whose grade is 33 and 7th fertility class in wheat and 8th fertility class for grain maize and sunflower. *Eutricambosol* values are specific to the 6th fertility class.

The reduced values are due to the following limitations: *Preluvosol* has: -reduced limitations due to the humus reserve; -moderate limitations due to acidity; -severe limitations due to soil compaction. *Vertosol* has: -reduced limitations due to alkalisation; -reduced limitations due to the content of $CaCO_3$; -reduced limitations due to the physical property of the soil-texture; -severe soil due to compaction limitations.

2. Suitability of soils for sugar beet and potato

Preluvosol has values for the 9th fertility class. These values are due to the following limitations: -moderate limitations due to soil acidity; -reduced limitations due to the humus reserve. Humus is mostly made up of a complex of organic compounds with a complex molecular structure. -severe limitations due to soil compaction. *Vertosol* for sugar beet and potato has 9th fertility class values. These values are due to the following limitations: -moderate limitations due to humus reserve; -reduced limitations due to $CaCO_3$ content; -reduced limitations due to the physical characteristic of the soil-texture; -reduced limitations due to alkalisation; -severe limitations due to soil compaction.

3.Suitability of soils for fruit (plum, apple, cherry, sour cherry and apricot). As for plum and apple, preluvosol has the grade 64 and the 4th fertility class for plum and the grade 45 and the 6th fertility class for apple, respectively. This soil has the following limitations: -reduced limitations due to soil salinisation; -reduced limitations due to the humus reserve; -severe limitations due to soil compaction. These values are penalized for the following limitations: -moderate limitations due to humus reserve; -reduced limitations due to $CaCO_3$ content; -reduced limitations due to physical properties of the soil-texture; -severe limitations due to soil

compaction. For cherry and apricot, preluvosol has a grade of 64 and a 4th fertility class. This soil has the following limitations: - moderate limitations due to soil acidity; - reduced limitations to the humus reserve; - severe limitations due to soil compaction.

As regards eutricambosol, for all the crops studied the characteristics and limitations are as follows: -the total cationic exchange capacity varies greatly, depending on the nature of the clay, but it is generally lower (less than 10 me/100g soil); -the degree of saturation in the bases is high in horizon A (50-85%), after which the depth gradually decreases, meaning that the pH decreases, from 6.8-6.0 to 5.8-5.1; -the higher values of the chemical characteristics in horizon A reflect an intense bioaccumulation with all the lack of bases and nutrients of the initial rock. Along with the active aeration process, under the impulse of specific climatic conditions, alteration is much more active than in other similar altimetric areas of the country, with clay formation at the expense of rock silicates. Rock disaggregation and alteration products are frequently moved on the slopes, towards their basis, gravitationally or by the sill waters, which explains the polystratification of the bedspreads.

CONCLUSIONS

Following the analysis of limiting factors and the calculation of the bonus notes, the determination of fertility classes, the following can be highlighted:

-to reduce the soil reaction within optimum limits, periodic calcium amendment shall be carried out;

-the amendment dose will be determined according to the recommendations in the agrochemical mapping;

-among the fundamental properties of the soil having a relatively more determinable function, the content of $CaCO_3$ influences the growth and fruiting of plants in direct relation to the intensity of phenomena;

-texture plays an important role in ensuring the necessary conditions for growing and bearing plants (it achieves rooting depending on texture) as other soil properties widening or limiting their production capacity;-since texture is hard-to-change itself over time, the optimal time to carry out the work needs to be taken into account;

-soil compaction is linked to the granulometric composition reaching maximum values within the clay soils lacking structure, being influenced by the content of water, of humus, and by the nature of cations. For the sustainable development of agricultural land in Giarmata, Timiș County, Romania, action will be taken as appropriate by carrying out deep-ground or subsoiling works, introducing long-term crop rotation, introducing breeding crops, and establishing an adequate load of grazing livestock.

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ANALYSIS AND ECONOMIC-MATHEMATICAL MODELING IN THE PROCESS OF FORECASTING THE FINANCIAL CAPACITY OF MILK PROCESSING ENTERPRISES OF THE AGRICULTURE SECTOR: A CASE STUDY OF VOLYN REGION, UKRAINE

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Abstract

In the article we substantiate that the process of analysis of the financial potential of dairy enterprises in the agricultural sector of Volyn region of Ukraine should be preceded by an in-depth financial analysis of these enterprises, including analysis of financial condition and financial capabilities of dairy enterprises. We substantiate that the forecast value of the indicator of financial potential of dairy enterprises includes the implementation of the development of a factor model that reflects the relationship of the result with the factors that influenced it. The forecast values of the financial potential of dairy enterprises, the dynamics of which is described by regression dependence, were calculated by us using the functional service capabilities of the electronic software product Excel. Based on the analysis of the financial potential of the dairy industry of the agro-industrial sector of Volyn region of Ukraine, we determined its interdependence on such indicators as the coefficient of autonomy, the ratio of current assets, own liquidity ratio, profitability, total return on assets. In the article we substantiate that the results of economic and mathematical modeling of the financial potential of dairy enterprises in the agricultural sector of Volyn region of Ukraine, identified on its basis of interdependence and constructed forecast values, can be used by investors in making management investment decisions.

Key words**:** *dairy industry, agricultural sector, financial capacity of milk processing enterprises, economic and mathematical modeling, forecasting*

INTRODUCTION

The main task of the process of managing the financial potential of economic entities is to optimize their financial flows in order to ensure a positive financial result. Thus, companies must form a financial plan for their activities, which is based on the results of forecast research.

Problems of effective formation of the financial potential of dairy enterprises of the agro-industrial sector in the system of production relations are widely covered in the works of such researchers as O. Apostolyuk [2], M. Demianenko [4], T. O. Kriuchkovska [11], B. Y. Paskhaver [13], N. V. Petrunia [14], A. M. Podderyogin [15], A. Popescu [16-24], T. O. Shmatkovska [25-27], O. M. Shubalyi [28], Ya. Yanyshyn [34-35], O. M. Zgurska [37]. In addition, it is necessary to pay tribute to the study of the peculiarities of the control system over the dynamics of changes in the financial potential of dairy enterprises, as a key element in ensuring the efficiency of their operation, disclosed in the works of O. Agres [1], A., O. Boiar [3], M. I. Dziamulych [5-7], S. V. Kharchenko [9], A. Khomenko [10], I. O. Kriukova [12], P. A. Stetsiuk [29], I. O. Tsymbaliuk [31], V. Yakubiv [32-33],

I. V, Zhurakovska [38]. However, the new problems facing the dairy enterprises of the agro-industrial sector in the national economy of Ukraine, in particular - under the influence of globalization, require a more in-depth study of specific aspects of ensuring the effectiveness of their financial potential in the long run.

Characterizing the process of forecasting financial potential, it should be noted that the first volumes of production and sales are forecast, and then financial indicators and cash flow indicators are forecast. Note that forecasting the volume of production and sales is the first step and a necessary tool in establishing the relationship between the prospects of enterprise development and the need to attract investment and financial resources.

MATERIALS AND METHODS

Research and analysis of scientific sources and program documents on both the theory and methodology of forecasting and the peculiarities of managing the financial potential of the enterprise, allowed us to conclude the need to adapt existing methods and tools for forecasting socio-economic phenomena to the specifics of the forecast area. The financial potential of the enterprise is determined.

The process of forecasting the financial potential of the enterprise is characterized by the formation of a system of financial opportunities and the choice of the most effective ways to optimize them. Within the limits of financial forecasting the general concept of financial development and financial policy of the enterprise which considers all directions of its activity is formed.

It is worth noting that there are many factors in the forecast period that can cause inconsistencies, and therefore financial forecasting may not always be carried out with great accuracy. However, the possibility of error should not be the reason that can lead to the refusal to use forecasting [30].

The process of forecasting the financial potential of the enterprise can be carried out in the following areas:

– forecasting the resource base of the enterprise (labor, financial, material);
– forecasting the financial condition (assessment of financial balance);
– forecasting financial policy [30].

In terms of building market relations in the analysis of financial potential should be preceded by an in-depth financial analysis of the enterprise, in particular the analysis of financial condition and determination of financial capabilities of the enterprise.

The specifics of forecasting financial potential is that the company is characterized by interdependence and a certain degree of inertia. The latter characterizes the dependence of the value of any indicator at the moment on the state of the same indicator for the previous period but at the same time inadmissible abstraction from the influence of various factors. Thus, the forecast value of the indicator of financial potential includes the implementation of a factor model that links the result with the factor that influenced it.

Forecasting of financial potential indicators can be carried out in the following periods:

- short-term forecasting – 1-4 years;
- medium-term forecasting – 5-10 years;
- long-term forecasting – 11-15 years.

In short-term forecasting, a quantitative and qualitative assessment of changes in indicators comes to the fore. Medium-term and long-term forecasting is based on a system of forecasts [30].

It should be noted that the activity of any enterprise largely depends on the availability and use of its own potential. Liquidity, profitability, financial stability - these are the indicators that determine the overall financial potential of the enterprise.

The study of different methods of analysis allows you to choose the best way to conduct and, based on the results, to determine the financial potential of the enterprise, as well as to forecast indicators for the short, medium, or long term.

To determine the level of significance and dependence of the indicators of the financial potential of the enterprises of the dairy industry of the agro-industrial sector of the Volyn region of Ukraine, we used the method of correlation and regression analysis.

To analyse the calculated indicators, we used the average annual growth rate and the coefficient of variation of the indicator. The average annual growth rate ($\overline{T}$) is calculated by the formula [36]:

$$\overline{T} = \sqrt[5-1]{T_1 \cdot T_2 \cdot T_3 \cdot T_4} \ ,$$

where T_1, T_2, T_3, T_3 – chain growth rates.

The coefficient of variation is used when it is necessary to compare the variability of the characteristics of the object. The variability is considered weak if ν < 10%; if ν from 11-25% – average and significant for ν > 25%.

Coefficient of variation:

$$K_{VAR} = \frac{\sigma(x)}{\bar{x}} \cdot 100\%,$$

where $\sigma(x)$ – standard deviation, $\vec{x}$ – average value.

We used the moving average method to find the forecast values of the indicators of the financial potential of the enterprises of the dairy industry of the agro-industrial sector of the Volyn region of Ukraine.

The moving average method is one of the empirical methods for smoothing and predicting time series. The essence of this method is that the absolute values of a series of dynamics change to the arithmetic mean value at certain intervals. The choice of intervals is made by sliding: the first levels are gradually removed, the next – are included. The result is a smoothed time series of values, which allows you to clearly trace the trend of changes in the studied parameter and make a forecast.

With the help of a variable average, you can detect the nature of changes in the value of Y over time and predict this parameter in the future. The method works when the trend in the dynamics is clearly traced to the values.

RESULTS AND DISCUSSIONS

In the process of analysis of the financial potential of enterprises (FPE) of the dairy industry of the agro-industrial sector of the Volyn region of Ukraine according to the existing method its interdependence on such indicators as autonomy ratio (Ra), current assets ratio (R_{ca}), current liquidity ratio (CLR) product profitability (PP), total asset turnover ratio (R_{ta}).

We analysed the dynamics of the main financial indicators of the studied basic enterprises of the dairy industry of the agro-industrial sector of the Volyn region of Ukraine for the period 2015-2019, which have a direct impact on the formation of their financial potential (Fig. 1).

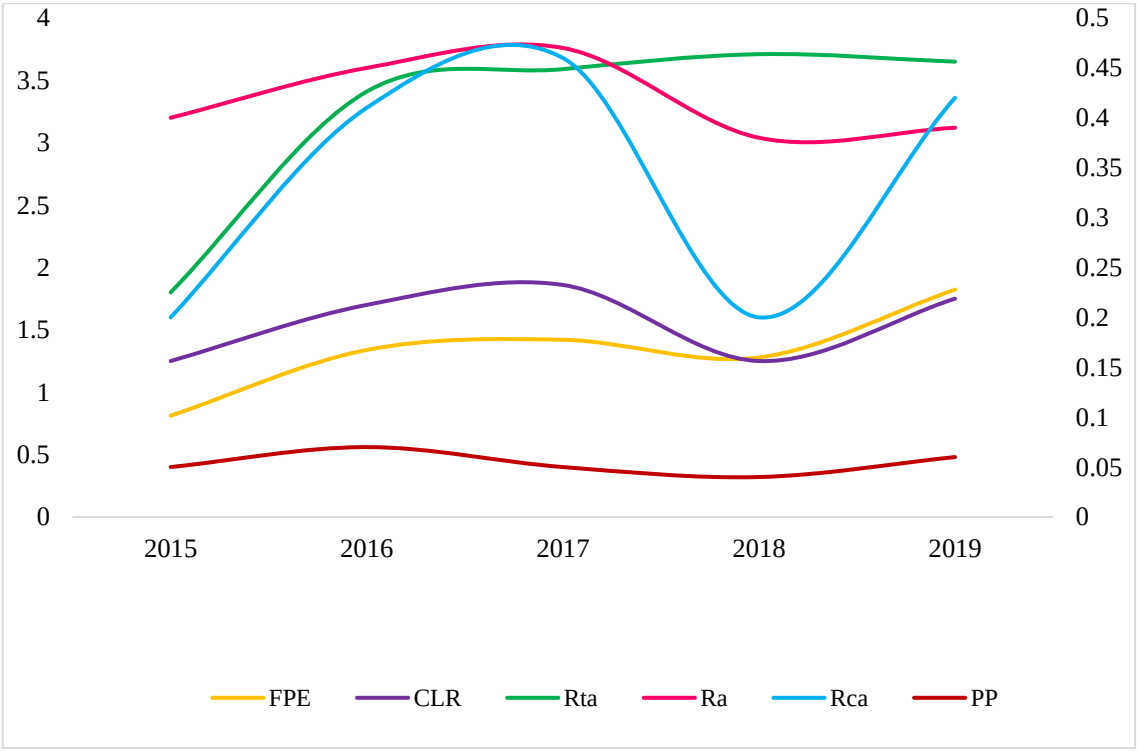

Fig. 1. Dynamics of the main financial and economic indicators of PJSC "Kovelmoloko", which belongs to the dairy industry of the agro-industrial sector of Ukraine, for 2015-2019

Source: developed by the authors on the basis of reporting data of the enterprise.

Thus, the economic and mathematical model of the dynamics of the financial potential of the enterprise has the form:

$$y = 0.85664 + 0.4991\ln(t), R = 0.8774,$$

where: y – financial potential, t – period of time, year.

The indicator of the financial potential of PJSC "Kovelmoloko" has positive dynamics. However, the growth rate of FPE is slow (the model is described by a logarithmic dependence).

The study and evaluation of the relationships between the studied indicators were carried out using a matrix of correlation effects (Table 1). Based on the study of the matrix of correlation coefficients, we can conclude that the value of FPE, according to the theory, is not affected by the coefficient of autonomy, and the other above-mentioned indicators have a positive effect, i.e. increasing these indicators increases the value of FPE.

Table 1. Interdependence of financial indicators of PJSC "Kovelmoloko", which belongs to the dairy industry of the agro-industrial sector of Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	0.0429	1	–	–	–	–
R_{ca}	0.7099	0.6975	1	–	–	–
CLR	0.7106	0.6973	0.9984	1	–	–
PP	0.3356	0.4095	0.6267	0.5854	1	–
R_{ta}	0.8196	0.1578	0.5401	0.5400	0.0803	1

Source: own development .

To mathematically substantiate the determination of the effect of these indicators on the resulting, we check the significance of the obtained correlation coefficients.

According to [8], the significance of the correlation coefficients is checked using Fisher-Snekedor F-statistics. The critical value of this statistic for (k_1 = 2-1 = 1, k_2 = 5-1 = 4) is 7.71.

According to the calculations, we can conclude that only for the correlation coefficients between the indicators FPE and R_{ta} and R_{ca} and CLR we have the value $F > F_{kp}$. Therefore, we can say that there is an interdependence between these indicators. Increasing the ratio of asset turnover to own funds contributes to the growth of the current liquidity ratio.

The economic and mathematical model of the dependence of financial potential on the ratio of total asset turnover has the form:

$$y = 0.14991 + 0.3665x, R = 0.8196,$$

where: y – financial potential, x – C_{ta} indicator.

An increase in the value of the total turnover ratio of assets by 1% leads to an increase in FPE by 0.367%. The percentage increase in the value of the FPE indicator is insignificant, but is promising.

We will analyze the growth rate of financial indicators, namely: the coefficient of autonomy (R_a), the ratio of current assets to own funds (R_{ca}), the current liquidity ratio (CLR), product profitability (PP), the total turnover ratio (R_{ta}) of the Shevchenko PRAE (Fig. 2).

It is worth noting that all our indicators tend to increase since 2016. The period 2015-2016 had a negative impact on the company's activities. This situation can be traced to the activities of many food industry enterprises, as it was during this period that external factors had a significant impact.

The values of the average growth rate and the coefficient of variation of the indicators of the PRAE named after Shevchenko are given in the Table 2.

Table 2. Indicators of average growth rate and coefficients of variation PRAE named after Shevchenko, which belongs to the dairy industry of the agro-industrial sector of Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
T	106.2	92.26	91.93	106.35	87.34	116.05
K_{VAR}	18.16	19.22	96.73	18.94	233.94	24.57

Source: own development.

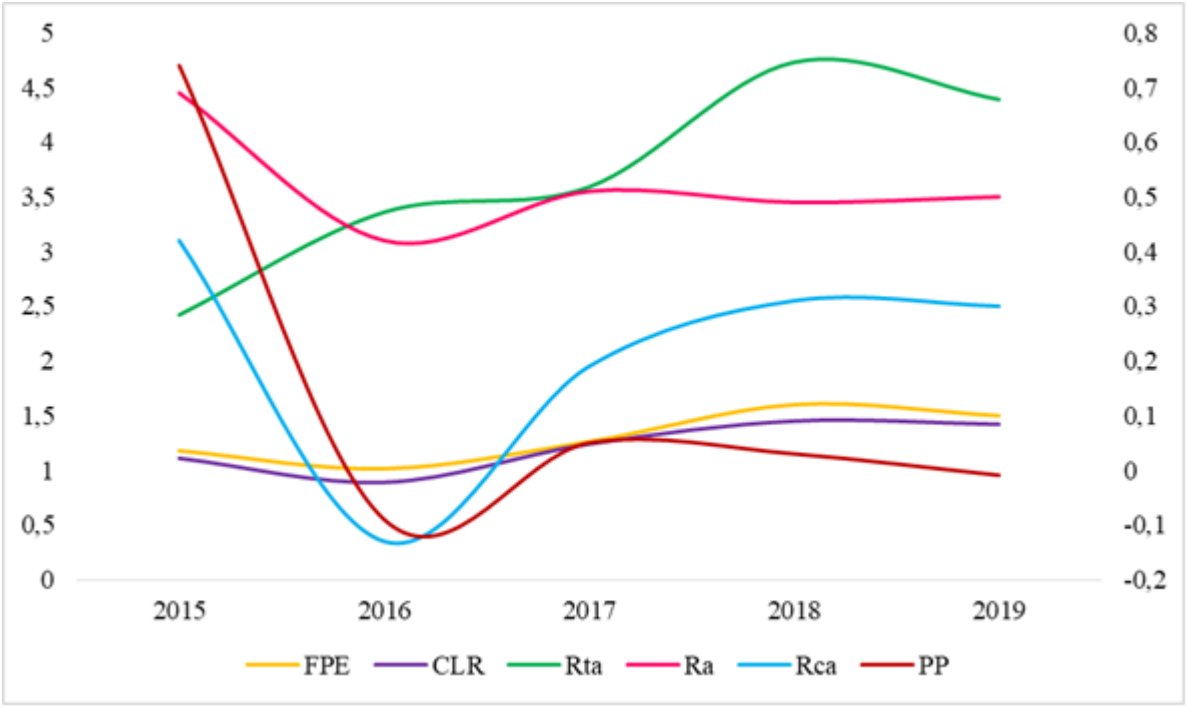

Fig. 2. Dynamics of the main financial indicators of the PRAE named after Shevchenko, which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine, for 2015-2019
Source: developed by the authors on the basis of reporting data of the enterprise.

An analysis of the relationships between the studied indicators using a matrix of correlations (Table 3).

Table 3. The interdependence of financial indicators of PRAE named after Shevchenko, which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	-0.0503	1	–	–	–	–
R_{ca}	0.5967	0.7681	1	–	–	–
CLR	0.9781	0.0342	0.6639	1	–	–
PP	-0.2078	0.9758	0.6376	-0.1506	1	–
R_{ta}	0.8125	-0.6228	0.0185	0.7438	-0.7307	1

Source: own development

Based on the study of the matrix of correlation coefficients, we can conclude that the FPE has almost no effect on R_a. It should be noted that the profitability of products has a negative impact on the value of the FPE indicator, as during 2015-2019. product profitability is almost negative. All other indicators have a positive effect on the value of the FPE indicator.

It should be noted that only the correlation coefficients between FPE and R_{ta} and between PP and R_a are significant. Economic and mathematical model of dependence of FPE *(y)* on R_{ta} *(x)* has the form:

$$y = 0.5236 + 0.2129x, R = 0.8125$$

An increase in the total turnover ratio of assets by 1% leads to an increase in FPE by 0.2129%.

Economic and mathematical model of R_{ta} (y) dependence on FPE (x) is described as follows:

$$y = -0.3666 + 3.004x, R = 0.8125$$

An increase in the value of the indicator of the financial potential of the PRAE named after Shevchenko by 1% increases the value of R_{ta} by 3.004%.

As a result of research, the indicators obtained the following functional relationship between the coefficient of autonomy and product profitability. The economic-mathematical model of the dependence of R_a (y) on PP (x) has the form:

$$y = 0.4801 + 0.2903x, R = 0.9758$$

According to [8] and the study of the interdependence of the indicators of the PRAE named after Shevchenko, it can be noted that the growth of product profitability contributes to the growth of the coefficient of autonomy.

Analysing the activities of LLC "Shatsk Dairy", we can conclude that the financial indicators are within the normative values, but it is necessary to further increase the value of the indicator of financial potential. The situation has improved somewhat since 2017 and there is an increase in the value of FPE, but there is a decrease in the values of the coefficients PP and R_{ta} (Fig. 3).

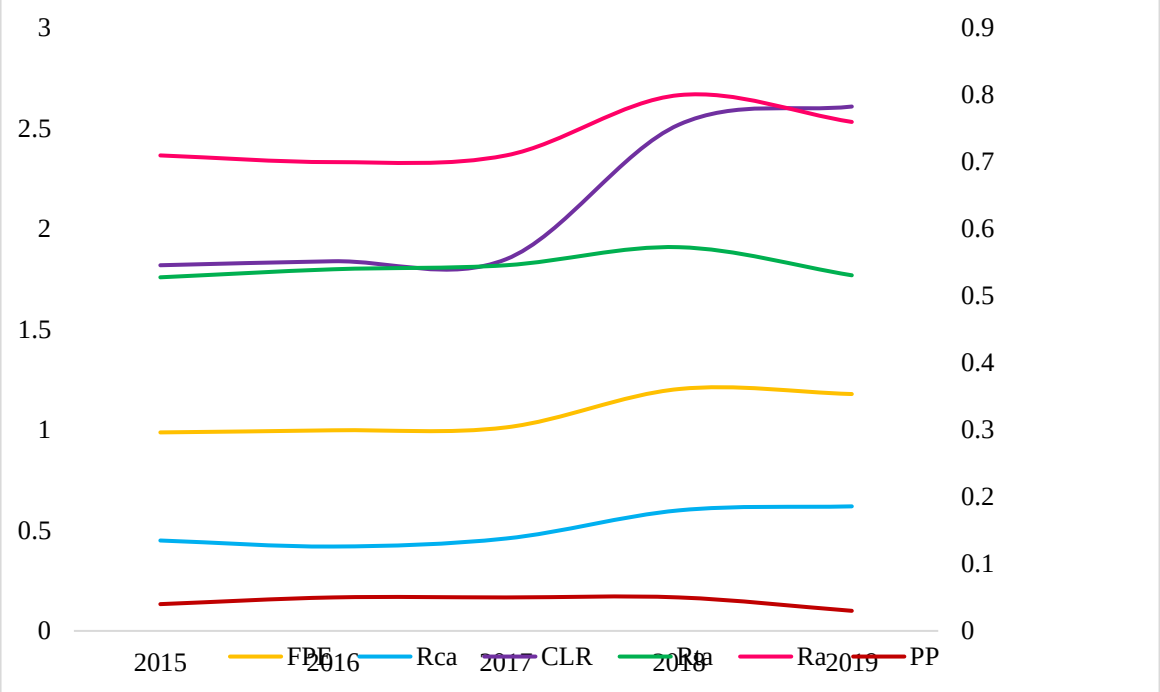

Fig. 3. Dynamics of financial indicators of LLC "Shatsk Dairy", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine, for 2015-2019
Source: developed by the authors on the basis of reporting data of the enterprise.

The values of the average growth rate and the coefficient of variation of financial indicators of LLC "Shatsk Dairy" are given in Table 4.

Table 4. Indicators of the average growth rate and coefficients of variation of LLC "Shatsk Dairy", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
T	104.52	101.72	108.34	109.43	93.06	100.14
K_{VAR}	9.82	5.81	18.18	18.81	20.33	3.30

Source: own development.

The economic and mathematical model of the dynamics of the financial potential of the enterprise is presented in the form:

$$y = 0.9003 + 0.05875t, R = 0.8786,$$

where y – financial potential, x – C_{ta} indicator.

Based on the study, it can be argued that the value of the Fpp LLC "Shatsk Dairy" is growing annually by an average of 0.05875%. The analysis of the relationship between the studied indicators will be performed using a matrix of correlations (Table 5).

Table 5. Interdependence of financial indicators of LLC "Shatsk Dairy", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	0.9607	1	–	–	–	–
R_{ca}	0.9754	0.9138	1	–	–	–
CLR	0.9850	0.9089	0.9872	1	–	–
PP	-0.3080	-0.1437	-0.4822	-0.4580	1	–
R_{ta}	0.5232	0.6690	0.3609	0.3702	0.6362	1

Source: developed by the authors on the basis of reporting data of the enterprise.

Based on the matrix of correlation coefficients, we can conclude that the value of FPE has a slight negative impact on profitability. Other indicators have a positive effect, the increasing the value of these indicators increases the value of the FPE indicator.

It should be noted that the dependencies between the correlation coefficients are significant, namely FPE and R_a, FPE and R_{ca}, FPE and CLR. Since the indicators R_a and R_{ca} are multicollinear with the indicator CLR, the indicator CLR will be chosen as an independent variable to build an economic-mathematical model.

The economic and mathematical model of the dependence of the indicator of financial potential *(y)* on CLR *(x)* has the form:

$$y = 0.5229 + 0.2601x, R = 0.9849$$

An increase in CLR by 1% leads to an increase in FPE by 0.2601%.

Economic and mathematical model of the dependence of CLR *(y)* on FPE *(x)* can be presented as:

$$y = -1.8871 + 3.2797x, R = 0.9849$$

It should be noted that in this case there is a functional dependence. Increasing the value of FPE by 1% leads to an increase in the value of CLR by 3.2797%.

Analysing the performance of LLC "Terra-Food", it should be noted that the value of the FPE indicator is variable. The values of profitability and total turnover tend to decrease (Fig. 4).

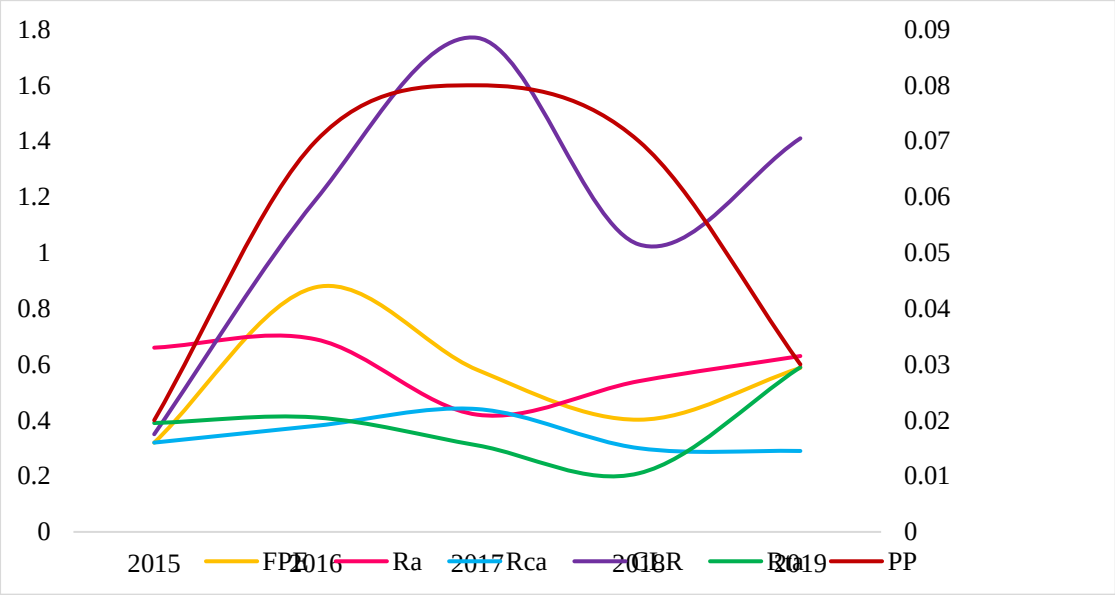

Fig. 4. Dynamics of financial indicators of LLC "Terra-Food", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine, for 2015-2019
Source: developed by the authors on the basis of reporting data of the enterprise.

The calculated values of the average growth rate and the coefficient of variation of indicators of LLC "Terra-Food" are given in the Table 6.

Table 6. Indicators of the average growth rate and coefficients of variation of LLC "Terra-Food", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
T	116.45	98.84	97.57	141.67	110.67	116.45
K_{VAR}	38.76	18.61	18.23	45.77	50.03	38.76

Source: developed by the authors on the basis of reporting data of the enterprise.

Based on the study of the average growth rate, we can conclude that the values of the coefficients R_a and R_{ca} are less than one. The normative value of the coefficient $R_a > 0.5$, i.e. the company can fulfil external obligations from its own assets.

The relationship between the studied indicators was assessed using a matrix of correlation effects (Table 7).

Table 7. The interdependence of financial indicators of LLC "Terra-Food", which belongs to the dairy industry of the agro-industrial sector of Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	0.2159	1	–	–	–	–
R_{ca}	0.4559	-0.5194	1	–	–	–
CLR	0.5402	-0.6122	0.5376	1	–	–
PP	0.4568	-0.5886	0.6571	0.6294	1	–
R_{ta}	0.3185	0.5292	-0.2754	0.0839	-0.6220	1

Source: own development.

Analysing the results of the study of financial indicators (Table 7), we can conclude that all ratios have a positive impact on the value of the financial potential of LLC "Terra-Food". The increase in the coefficient of autonomy negatively affects the values of R_{ca}, CLR, and PP. However, the correlation coefficients are insignificant, so it is not possible to establish functional relationships.

Analysing the financial performance of PE "Volyn Ecoproduct" for 2017-2019, we can conclude that i.e. company is not working efficiently, i.e. unprofitable. Indicators of financial potential. are negative. The dynamics of financial indicators are presented in Fig. 5.

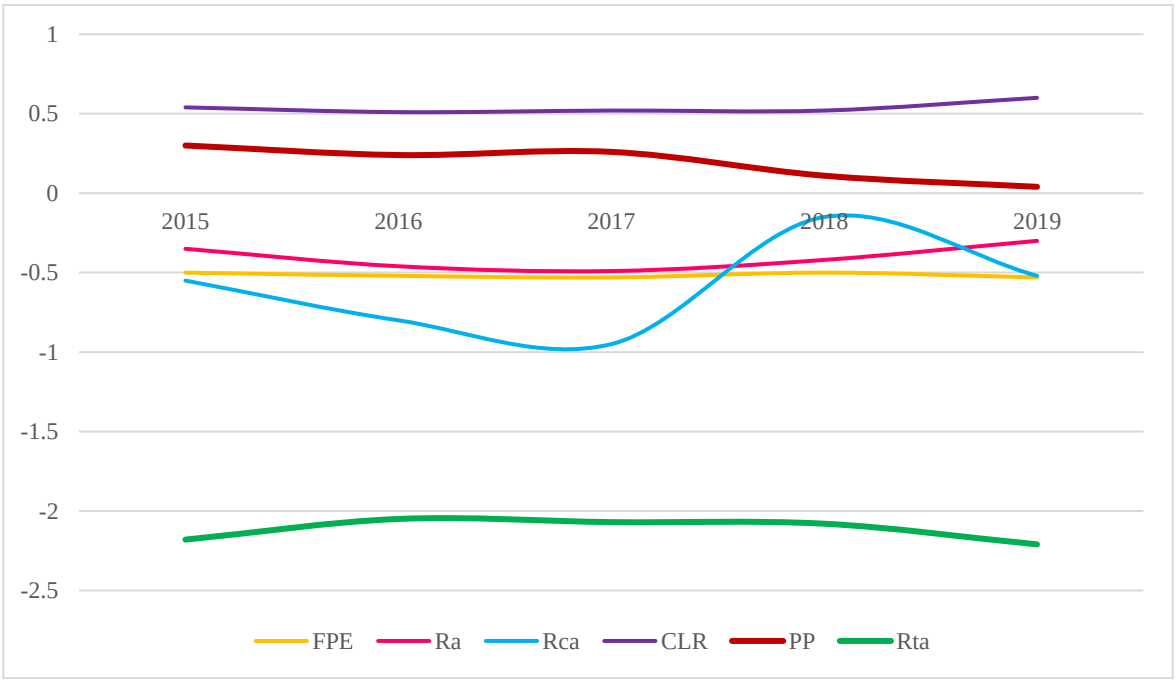

Fig. 5. Dynamics of the main indicators of PE "Volyn Ecoproduct", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine
Source: developed by the authors on the basis of reporting data of the enterprise.

The values of the average growth rate and the coefficient of variation of the indicators of PE "Volyn Ecoproduct" are given in the Table 8.

Table 8. Indicators of the average growth rate and coefficients of variation of PE "Volyn Ecoproduct", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
T	103.59	100.82	98.68	105.33	55.78	100.90
K_{VAR}	10.18	22.28	57.00	10.56	61.67	4.56

Source: own development.

It should be noted that the values of FPE, CLR, and R_{ta} indicators of the studied enterprise for 2015-2019. practically remain unchanged. The average is the variability of R_a. Significantly variable are the values of R_{ca} and PP.

We will evaluate the relationships between the studied indicators using a matrix of correlation effects (Table 9).

Table 9. The interdependence of financial indicators of PE "Volyn Ecoproduct", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	0.3123	1	–	–	–	–
R_{ca}	0.8572	0.3212	1	–	–	–
CLR	-0.1512	0.5328	0.2841	1	–	–
PP	0.0835	-0.1162	-0.4319	-0.7758	1	–
R_{ta}	0.1040	-0.7981	-00781	-0.8180	0.2842	1

Source: own development.

It should be noted that only the correlation coefficient between FPE and R_{ca} is significant. Economic and mathematical model of dependence of FPE *(y)* on R_{ca} *(x)* is presented in the form:

$$y = -0.4501 + 0.1313x, R = 0.8572$$

An increase in R_{ca} by 1% leads to an increase in FPE by 0.1313%.

Economic and mathematical model of the dependence of R_{ca} *(y)* on FPE, *(x)* has the form:

$$y = 2.3536 + 5.595x, R = 0.8572$$

Increasing the value of FPE by 1% leads to an increase in R_{ca} by 5.595%.

The activity of PE "TH Tyberia" is effective because the value of financial indicators is above the norm. The current liquidity ratio is quite high, which characterizes the adequacy of working capital of the company and the ability to repay liabilities during the year. It is worth noting that for 2018-2019 the company has no long-term liabilities and the amount of short-term liabilities is insignificant compared to the value of current assets. The dynamics of financial indicators are mostly stable, except for the indicators CLR, PP, and R_{ta} (Fig. 6).

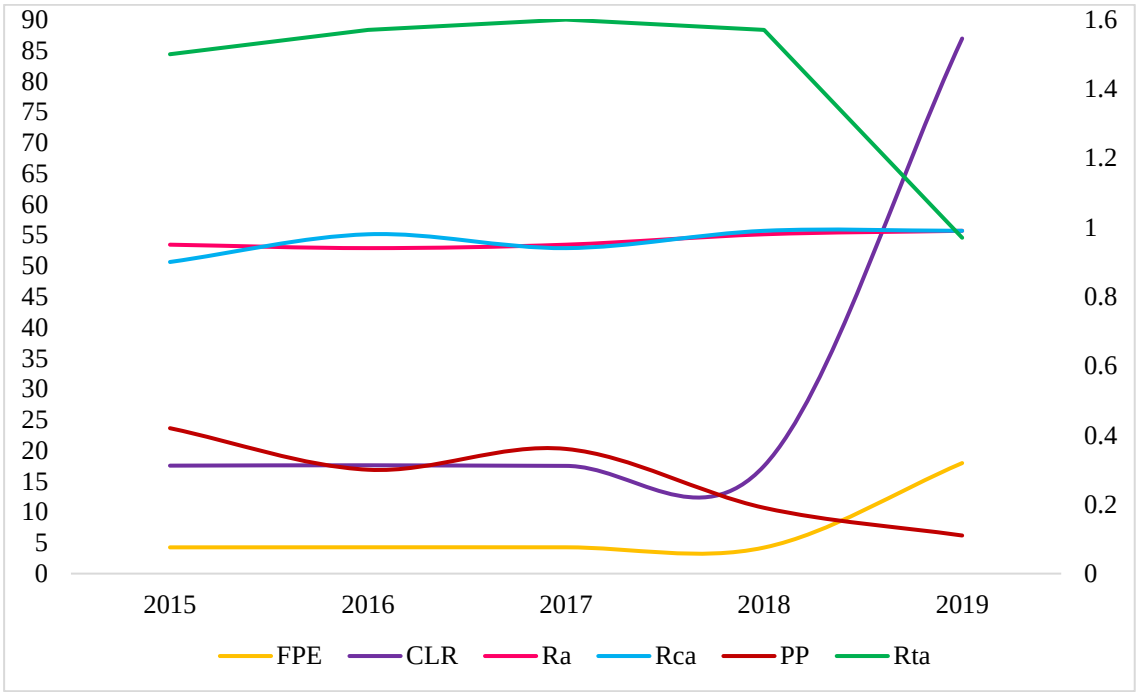

Fig. 6. Dynamics of financial indicators of PE "TH Tyberia", which belongs to the dairy industry of the agro-industrial sector of Ukraine

Source: own development on the basis of reporting data of the enterprise.

The calculated values of the average growth rate and the coefficient of the indicators variation for PE "TH Tyberia" are given in Table 10.

The values of R_a and R_{ca} are practically unchanged. All other indicators of PE "TH Tyberia" are characterized by medium and high variability.

Table 10. Indicators of the average growth rate and coefficients of variation of PE "TD Tyveria", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
T	143.23	101.04	102.41	149.21	71.54	89.67
K_{VAR}	87.46	2.25	4.10	98.79	45.59	18.47

Source: own development.

The assessment of the relationships between the financial indicators of PE "TH Tyveria" was carried out using the matrix of correlations (Table 11).

Table 11. The interdependence of financial indicators of PE "TD Tyveria", which belongs to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine

Indexes, %	FPE	R_a	R_{ca}	CLR	PP	R_{ta}
FPE	1	–	–	–	–	–
R_a	0.7202	1	–	–	–	–
R_{ca}	0.4250	0.5565	1	–	–	–
CLR	0.9999	0.7214	0.4261	1	–	–
PP	-0.7363	-0.8670	-0.8782	-0.7374	1	–
R_{ta}	-0.9904	-0.7064	-0.3432	-0.9905	0.6865	1

Source: own development.

Significant is only the correlation coefficient between FPE and CLR. Economic and mathematical model of the dependence of the value of FPE *(y)* on the coefficient CLR *(x)* is as follows:

$$y = 0.7377 + 0.1997x, R = 0.9998$$

Increasing the value of the current liquidity ratio by 1% leads to an increase in the value of the financial potential of PE "TH Tyverias" by 0.1997%.

Based on the analysis of financial indicators of the surveyed enterprises, a diagram is formed that characterizes the dynamics of financial potential for 2015-2019 and may be used by investors to make specific investment decisions (Fig. 7).

However, in order to make investment decisions, it is necessary to have forecast values of financial potential indicators. Therefore, it is advisable to use the regression equation to predict the expected values of the results.

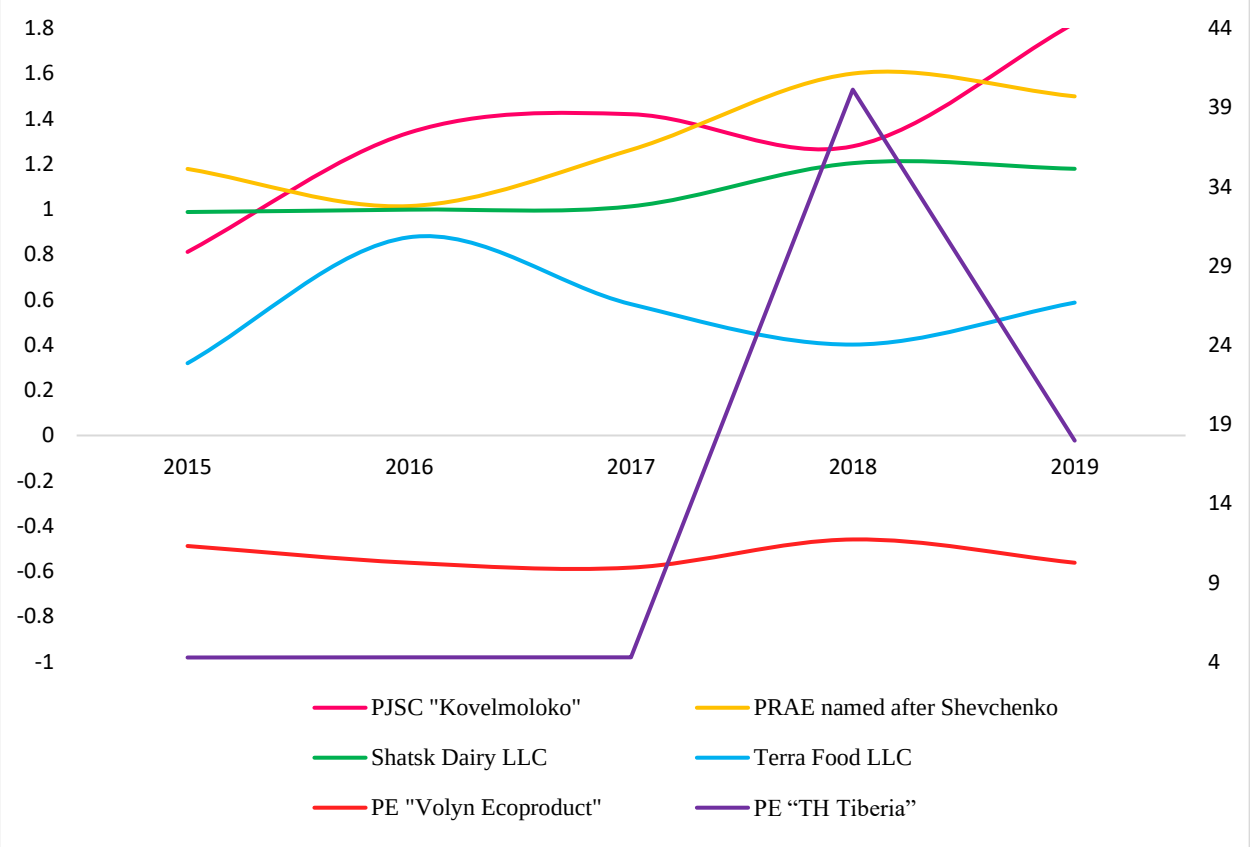

Fig. 7. Dynamics of indicators of the financial potential of enterprises of the dairy industry of the agro-industrial sector of Volyn region of Ukraine for 2015-2019

Source: developed based on the results of our own research.

It should be borne in mind that there is no transfer of the regularity of communication, which is measured in a variable set in statics to the dynamics. That is, in our opinion, such a study is not reliable and requires verification of the conditions of admissibility of such a transfer, which goes beyond statistics.

Estimated values for PJSC "Kovelmoloko" and LLC "Shatsk Dairy", the dynamics of which is described by regression and which is adequate to the experimental data, calculated using the functional service capabilities of the electronic software product EXCEL. Forecast indicators of the financial potential of the studied enterprises of the dairy industry of the agro-industrial sector of Ukraine are given in Table 13.

To find the forecast values of financial potential for basic enterprises of the dairy industry of the agro-industrial sector of Volyn region of Ukraine, namely: PRAE named after Shevchenko, LLC "Terra-Food", PE "Volyn Ecoproduct", PE "TH Tyveria" we used the moving average method (Table 12).

According to the results of the analysis of Table 13, we found that all enterprises, except PE "Volyn Ecoproduct" and LLC "Terra-Food" have a positive outlook. Such enterprises are profitable and financially stable. However, it should be borne in mind that such indicators are predictable, and other things being equal, the situation in enterprises may change significantly, which may lead to a decline or a significant increase in the level of financial potential.

Table 12. Forecast indicators of the financial potential of the enterprises of the dairy industry of the agro-industrial sector of the Volyn region of Ukraine for 2020-2021

Basic enterprises	Forecast period, years	Forecast values of the financial potential of enterprises
PJSC "Kovelmoloko"	2021	2.120
	2020	2.316
PRAE named after Shevchenko	2021	1.299
	2020	1.349
Shatsk Dairy LLC	2021	1.312
	2020	1.370
Terra Food LLC	2021	0.578
	2020	0.574
PE "Volyn Ecoproduct"	2021	-0.539
	2020	-0.536
PE "TH Tyveria"	2021	13.761
	2020	16.924

Source: own development.

It should be noted that the analysis of indicators in the short term is the simplest and most accurate, taking into account the largest share of factors that lead to an increase or decrease in the financial potential of enterprises. The forecast of financial indicators for the medium and long term is more complex, as it cannot always predict the action of all factors that affect the financial potential of enterprises.

CONCLUSIONS

Thus, the process of forecasting financial potential begins with forecasting the volume of production and sales, and further predict the financial results, cash flows, and reporting. Determining the future volume of production and sales is an entry point and a necessary element in establishing the relationship between the opportunities for enterprise development, investment needs, and financial resources.

The specifics of forecasting financial potential is that the company is characterized by interdependence and a certain degree of inertia. The latter characterizes the dependence of the value of any indicator at the moment on the state of the same indicator for the previous period but at the same time inadmissible abstraction from the influence of various factors. Therefore, the predicted value requires the use of a deterministic factor model that combines the result with the factor that affects it.

We analysed the dynamics of the main financial indicators of the studied enterprises of the dairy industry of the agro-industrial complex of Ukraine for the period 2015-2019, which have a direct impact on the formation of the level of their financial potential. In order to make investment decisions, it is also necessary to have forecast values of financial potential indicators. We used pre-developed regression equations in order to predict the possible expected values of the performance trait for basic enterprises belonging to the dairy industry of the agro-industrial sector of the Volyn region of Ukraine.

According to the results of the study, it is revealed that for enterprises with a low level

of the financial potential it is advisable to implement modern methods and tools of financial management, improve the skills of financial management staff, implement software products to automate financial management processes. For enterprises in the agricultural sector of Ukraine with a high level of financial potential, it is necessary to invest free cash in projects or financial assets, providing additional income, continuously monitor the financial condition of enterprises and environmental factors, benchmarking, constantly monitor changes and environmental impact and improve business management. processes.

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INVESTIGATING THE EFFICIENCY OF EXTENSION SERVICES IN PROMOTING DAIRY FARMING IN PAKISTAN

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Abstract

The provision of effective extension services to smallholder farmers is still a major challenge. The study explores the impacts of extension services on the understanding, knowledge, and adoption rates of smallholder dairy farmers in Pakistan. The dairy farming industry provides livelihoods and home expenses to rural people. The data was collected through a pre-tested well-structured questionnaire by 140 regionally-spread dairy farmers within a district Dera Ghazi Khan (Punjab). It results that there is a positive impact of education on skill improvement. The study found that a huge number of farmers (62.86-74.29%) produced milk for sale purposes, and obtained information through fellow farmers and extension field staff. As ICT has a vital role in disseminating knowledge in village areas, however, half of the participants reported mobile as their major source of information. The various services are provided to dairy farmers, in which artificial insemination, vaccination, etc. were stated satisfactorily. About one-fourth (22.86-25.71%) of the dairy developer had excellent awareness level and participation in vaccination and free medicine. The education, awareness, and experience affect dairy production, skills enhancement, and economical level by adopting these services. It was conveyed that by ICT's, smart extension services, and the involvement of educated individuals, It is easier to improve skills as well as the economic level of dairy farmers, so there is a need to train farmers to use ICT's especially to promote dairy business and overcome the hurdles.

Key words**:** *extension services, dairy farming, livestock production*

INTRODUCTION

Pakistan has a rural economy focused on agriculture and livestock production is one of the best fields that intrigued people. At present, it accounts for 60.6% of agriculture and 11.7% of GDP in 2019-20. The added gross value of livestock rose from Rs 1,430 billion (2018-19) to Rs 1,466 billion (2019-20), with a 2.5% rise over the same period last year [9, 10]. In general, livestock is a crucial asset for the rural population and provides important opportunities to increase household income [28, 27, 26, 35]. In Asian countries, animals had formed an essential role in the family farming system and rural women had been involved in livestock farming since time immemorial [3].

Extension services play a vital role in the improvement of the dairy sector in developing countries. The goal of the extension is to provide research-based knowledge to rural communities to improve their farm productivity, leading to poverty reduction, rural development, and more sustainable rural livelihoods [36, 16, 12]. The role, function and structure of extension services in any country depend on farmer education level, availability, and use of technologies, level of commercialization and value of the product [23].

Dairying is the mixed farming system and it is a strong tool to develop the micro-economy in

villages [17, 7, 34, 32] to improve rural livelihoods and to alleviate rural poverty. About 40-45 million of Pakistan's population lived in rural areas is engaged in this sector [24]. Small household farming of 2 to 3 cattle/buffalo and 5 to 6 sheep and goats served by 2 to 3 workers that are obtaining 30 to 40% of income from it [8].

Generally, small farmers are traditionally dealing with livestock while commercialization is only limited around urban areas and approximately 5 million families in Punjab are dependent on the livestock sector for the economic viability of their livelihood [2]. Milk production is labor-intensive. There is a large number of biological, technical, and socio-economic constraints like shortage of feed, high mortality rate, poor genetic potentials, high input cost, scarcity of resources and inadequate marketing system are a few constraints in high milk production [14]. The small farmer fulfilled their needs of milk, food, and income on daily basis by rearing livestock. Mostly in rural areas, the people are landless and holding livestock for fulfilling their needs. Some of them had their livestock and some poor people are doing the job of caring for livestock and got paid for this work. Livestock is a subsistence sector dominated by smallholders. It is suggested that the policies towards the livestock and dairy sector have not always been beneficial because the farm small farmer is not always taken into consideration during the making of these policies. Improving livestock production is only possible by improving the conditions in rural communities by improving extension services, management, and effective disease control programs. The improvement of the rural areas also improves livestock farming. Extension workers could play a vital role in disseminating technologies to improve livestock and dairy production at a small level by engaging with the farming community in rural areas. That's why it is necessary to be familiar with scientific knowledge and updated technologies [22]. According to a study [16], the extension wing plays a key role in the dissemination of scientific knowledge to the farming community and also provides the basic facilities according to their needs and services about animal health and breed improvement. But some of the areas need special attention from the extension department.

In the dairy business, there are many issues in which lack of infrastructure facilities is the major issue. Animals are still sold in the local areas (known as Mandi). However, there are no best facilities as watering, feeding, and shelter, and health facilities in those areas [31]. Some of the other issues included improper vaccination, medicines, shortage of vegetation, insufficient marketing facilities, and improper services. In this regard, [2] argued that the Pakistan Dairy Development Company (PDDC) has improved the socio-economic conditions of the dairy farmers, especially small and medium dairy farmers by implementing new services. The calf losses are reduced by introducing and adopting new techniques of dairy management e.g. on-time colostrum feeding, hutch housing, feeding, and nutrition [30]. There was seldom use of synthetic and chemical substances for the wellbeing of livestock and agriculture. In Pakistan, there is an increasing trend toward organic farming. The majority has produced milk for sale purposes and no concern about the quality of milk due to their low income. Another issue of dairy marketing is that prices of milk are fixed by municipal authorities without keeping in view the production cost and quality [31].

Pakistan needs to make different strategies to improve dairy production also improvement in the livestock extension services such as vaccination, breeding, feeding, AI, and first aid services [29, 18]. The technical inefficacy of the dairy farmer is reduced when they participate in milk production. Milk production increased in the past years but this increase was not due to the productivity per animal this is because of an increase in the number of animals. There are many reasons for a decrease in productivity like lack of genetic resources and lack of good management system and shortage of food etc [2, 11, 15]. The reorientation of dairy extension services and research may not be a complete solution for sustainability in Asia as

the majority increase in livestock production originates from the industrialized orientation of the production system [25, 19].

MATERIALS AND METHODS

The present study was conducted in district Dera Ghazi Khan. There are 4 tehsils, 7 Markaz district (an Arabic term meaning "center", and also being used for subdivision of area like "country" and "district" etc.) and 48 union councils in the district. All of the Markaz was served for study. However, one union council was selected from each Markaz by using a simple random sampling technique and then two villages were selected from the selected union council by simple random sampling. From each selected village, ten farmer's respondents were selected conveniently. Therefore, the total size of the study was 140 respondents. The data was collected through a well-designed, structured, validated, and pre-tested interview schedule. Both open and close-ended questions were asked through face to face interviews. The interview schedule was prepared in English but asked in local languages. The data was analyzed through Microsoft excel and Statistical Package for Social Science (SPSS). Descriptive statistics were used to draw findings and conclusions.

RESULTS AND DISCUSSIONS

Sources of income

Dairying is a strong tool to improve the economy of people in rural areas and to alleviate rural poverty [16]. There were various sources of income but most (41.22%) of the respondents had livestock as the major source of income. One-fifth (26.35%) of the respondents have agriculture crops and a small number (11.82-16.89%) of the respondents reported government jobs and business as their sources of income. However, a negligible number (3.72%) of the respondents have a private job as the source of income (Table 1).

Tenancy Status

About three-quarter (74.29%) of the respondents reported ownership of the land and a small (14.29%) number of the respondents were tenant (Table 1) and a few (11.43%) number of the respondents appeared as owner-cum tenant which is almost similar to results of Raza (2015).

Table 1. Distribution of respondents according to their sources of income (n = 140)

Source of income	**%**
Govt. Job	11.82
Private Job	3.72
Business	16.89
Crops	26.35
Livestock	41.22
Tenancy Status	
Owner	74.29
Owner-cum-tenant	11.43
Tenant	14.29

Source: Field Survey Result.

Size of land for dairy farm

The recorded data show that a fair majority (69.28%) of the respondents have up to 1.5 Kanal (which is a unit of area used in subcontinent and considered equal to 4,500 square feet) land for a dairy farm and about one-fifth (23.57%) of the respondents have 1.5-3 Kanal and a few numbers (7.14%) of respondents have their dairy farm larger than 3 Kanal (Table 2). It is also mentioned that the minimum land area of the respondent was half Kanal and the maximum size of the land was 4 Kanal. However, the average size of the land throughout the respondents is 1.37 Kanal**.**

No. of the workers in the dairy farm

Almost all (96.3%) of the respondents have up to 3 workers on their dairy farm (Table 2).

Table 2. Landholding and number of the worker in the dairy farms (n = 140)

Landholding (Kanal*)	**%**	**Min.**	**Max.**	**Mean**
Up to 1.5	69.28			
>1.5 to 3	23.57	0.5	4	1.37
>3	7.14			
Number of workers				
Up to 3	96.43			
>3 to 5	3.57	1.0	4	1.65

Note: *Unit of area, In Pakistan and India, it is generally considered equivalent to 4,500 square feet
Source: Field Survey Result.

Only a negligible number (3.57%) of the respondents has 3 to 5 workers on their dairy farm. The maximum number of the worker was 4 and the minimum was 1. However, the average number of the worker was 1.65. Almost similar results [8].

Types of animals

Animals have various classes in the examination zone calf, milking, and non-milking. One-fifth (25.71%) of the respondents had calves and a reasonable number (62.86%) of the respondents had animals for milking and half (50%) of the respondents detailed just non-milking animals. Buffaloes animal had found a large number in the study area while calves of the buffaloes were only one-fifth (20.71%) but a large number (60%) has reported about non-milking (Table 3).

Table 3. Types of animals in the dairy farm (n = 140)

Animals	Calf	Milking	Non-Milking
	%	%	%
Cows	25.71	62.86	50.00
Buffaloes	20.71	74.29	60.00
Goats	0.00	19.29	25.71
Sheep	0.00	2.14	5.00
Camels	0.00	2.86	3.57

Source: Field Survey Result.

Goats were just milking (19.29) and non-milking (25.71%) It also depicts that the minimum number of the animals were sheep and camel**.** Further, the estimated livestock population-based on inter census growth rate of Livestock Census 1996 & 2006 is shown (Figure 1).

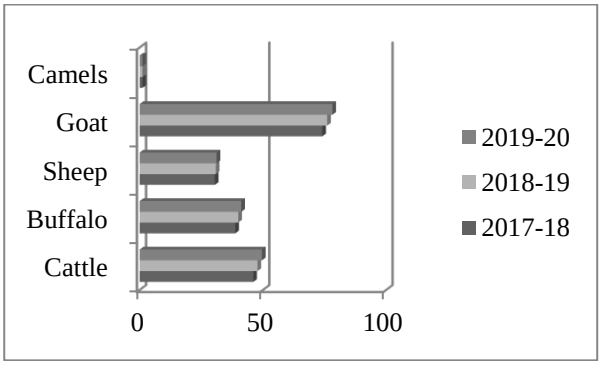

Fig. 1. Estimated livestock population (Million Nos.)
Source: Ministry of National Food Security & Research.

Sources of information

There are now many aids used by dairy farmers as sources of information. The vast majority (85.71%) of the respondents obtained information from the extension officers as well as the veterinary officers was and appeared to be the best source of the information about the livestock. A greater number (75.71%) of the respondents received information from their fellow farmers (Figure 2). Mobile and television were the sources that were reported by more than half (53.57-58.57%) of the respondents. In past studies, mobile was reported as the best source of information used by farmers [30, 4]. There were a few (14.29%) respondents who collected information through the agriculture helpline. In Pakistan, the Punjab agriculture helpline was reported by the literate farmers [5].

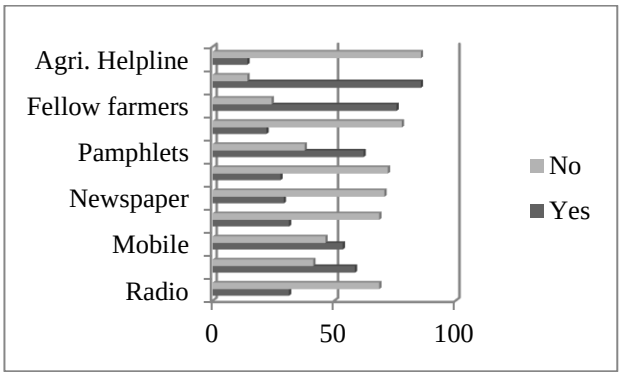

Fig. 2. Sources of information used by dairy farmers (%)
Source: Field Survey Result.

Awareness level of dairy farmers about extension services

The awareness level of the dairy farmers about the extension services varies from area to area. The vast majority (90.71%) of the respondents knew about the vaccination service as It is the service performed by the provincial government [1] and more than half (54.29-57.86%) of the respondents reported about first aid service and artificial insemination services (Figure 3). A large number (61.43%) of the respondents reported the awareness about the diseases and almost one-third (30.00-37.53%) of the respondents reported the awareness of fodder growing and cutting, new breeds, fencing, etc. It can also

be improved by seminars, training, and demonstrations [20, 21]. A few (14.29%) of the farmers know about the milking service provided by extension staff.

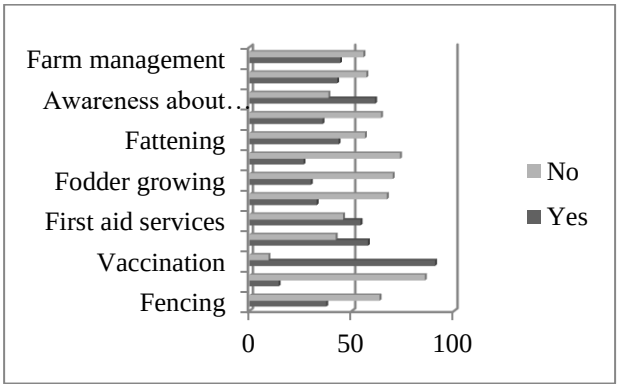

Fig. 3. Awareness' response of dairy farmers about livestock extension services (%)
Source: Field Survey Result.

Awareness level of farmer according to various extension services

The study revealed that more than one-fifth (22.86-25.71%) of the respondents had an excellent awareness level about the vaccination and free medicine service which were provided by the extension field staff to them. Furthermore, only 9.29 to 13.57% of the respondents reported a good awareness level of fencing, farm management, fattening, diseases, latest technologies, and artificial insemination. Vaccination services were reported as satisfactory by one-fourth (25.00%) of the respondent. Fodder growing (14.29%) and cutting (11.43%) were the services that fell in the poor category (Table 4).

Table 4. Awareness level of dairy farmers about extension services provided by EFS (n = 140)

Services	P	F	S	G	E	M*	R
	%						
Fencing	0.71	3.57	10.71	9.29	5.71	1.06	10
Milking	1.43	3.57	6.43	0.71	1.43	1.38	8
Vaccination	9.29	7.86	25.00	27.86	22.86	3.26	1
Artificial insemination	7.14	16.43	11.43	13.57	9.29	1.75	4
First aid services	10.00	5.71	6.43	20.71	11.43	1.81	3
New breeds	5.71	10.00	2.86	6.43	4.29	1.01	11
Fodder growing	14.29	5.00	5.00	2.86	2.86	1.20	13
Fodder cutting	11.43	3.57	5.00	2.86	3.57	1.13	12
Fattening	8.57	4.29	11.43	12.14	6.43	1.32	7
Free medicines	5.00	12.14	17.86	23.57	25.71	3.06	2
Awareness about diseases	4.29	12.86	16.43	13.57	14.29	2.05	5
Latest Technologies	3.57	9.29	8.57	13.57	9.29	1.19	9
Farm management	4.29	12.86	12.40	11.20	9.30	1.49	6

Note: P = Poor, F = Fair, S = Satisfactory, G = Good, E = Excellent, M* = Mean, R = Rank
Source: Field Survey Result.

Effectiveness of extension services provided by the EFS to dairy farmers

Various extension services were provided by extension field staff to dairy farmers in which vaccination (22.86%) and free medicine (18.57%) fell in the very high category.

About one-fourth (21.43-25.71%) of the respondents reported artificial insemination, vaccination, free medicine, and first aid services as a high level of effectiveness (Table 5).

Furthermore, a small number (9.29-12.86%) of the respondents had reported awareness about the disease, the latest technology, fodder growing services, etc.

However, the latest technology had the highest (2.88) mean value in these services.

Table 5. Effectiveness of extension services provided by EFS to dairy farmers (n = 140)

Services	V. L	L	M	H	V.H	M*	R
	%						
Vaccination	2.14	7.14	33.57	23.57	22.86	1.15	1
Free Medicines	9.29	13.57	18.57	25.71	18.57	0.34	2
Awareness about diseases	10.00	10.71	12.14	17.86	14.29	3.26	3
First Aid Service		7.14	10.00	25.00	9.29	1.86	4
AI	1.43	14.29	9.29	21.43	8.57	1.91	5
Mobile hospital	7.86	8.57	17.14	9.29	7.14	0.69	6
Farm management	9.29	9.29	7.14	10.00	7.14	0.72	7
Fattening	5.71	2.86	16.43	5.00	7.86	0.70	8
Milking	5.71	2.86	16.43	5.00	7.86	1.20	9
Latest Technology	12.14	6.43	2.86	7.86	6.43	2.88	10
Fodder growing	12.86	7.86	4.29	1.43	5.00	2.11	11
Fodder cutting	12.86	6.43	6.43	5.00	0	0.97	12
New breeds	2.14	10.00	5.00	3.57	3.57	1.25	13
Fencing	0.71	4.29	13.57	10.00	5.00	1.49	14

Note: V.L = Very Low, L = Low, M = Medium, H = High, V.H = Very High M* = Mean, R = Rank
Source: Field Survey Result.

Frequency of visit of the dairy farm by EFS

The data shows that more than one-third (36.43%) of the respondents had not visited by extension field staff and about one-fourth (25-25.71%) of the respondents visited by extension field staff (veterinary officers) on a monthly and occasionally base respectively (Table 6). Visit extension office and participation in training etc. will help to improve the dairy business for this purpose [13, 33, 6]. A small number (9.29%) of the respondents had visited the EFS fortnightly while a few (2.14%) of the respondents had paid visits on weekly basis.

Table 6. Frequency of visit of their dairy farm by EFS (n = 140)

Frequency of visit	%
Weekly	2.14
Fortnightly	9.29
Monthly	25.71
Half yearly	0.71
Yearly	0.71
Occasionally	25.00
Never	36.43

Source: Field Survey Result.

CONCLUSIONS

It was inferred from the survey results that that most of the respondents engaged with livestock and various services were provided to the dairy farmers by extension field staff. In which, vaccination, veterinary medicine, artificial insemination, and first aid services were very effective. The participants visit the extension office occasionally and fellow farmers and extension officers were the effective sources of information. Extension workers played a significant role in reducing the constraints faced and disseminating knowledge in dairy production. Most interviewees are aware of vaccination and free veterinary services. However, literate farmers were also satisfied with mobile hospitals, the latest technology and farm management services because they had improved their skills, production and economic level due to the adoption of these extension services.

Based on the this study results, the following recommendations should be made:

-The Extension Department should conduct field tours on weekly basis in the rural areas.
-The Government should organize training programs for dairy farmers to maximize their technical skills in farm management.
-There should be conducted a live question session on television according to the basic needs of farmers and a question portal for the literate farmers.

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COMPREHENSIVE MODELING OF AFFECTING FACTORS ON THE ADOPTION OF CONSERVATION PRACTICES AMONG PADDY FARMERS IN NORTH OF IRAN

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Abstract

Iran, and especially its northern provinces, lose a large amount of agricultural soil annually due to erosion, and this is one of the reasons why productivity in Iranian agriculture is low. Hence, there is a great need for measures to protect water and soil resources and prevent their pollution, which are called "water and soil conservation measures" (WSCM). The main purpose of this study was to investigate the factors that were effective in determining the adoption of WSCM by farmers in Lasht-e-Nesha district (northern Iran). Binary logistic regression was used to analyze the data. The results showed that the variables of the total amount of rice production, cooperation with other farmers and participation in development-extension and training courses, which all are quantitative, had a positive and significant relationship with the adoption of WSCM. Other quantitative variables used in this study (e.g. number of household members, farmer's experience in rice cultivation, farm size, number of paddy plots, dealing with other agricultural activities) showed a negative and significant relationship with the adoption of WSCM. Also, all the attitudinal variables used in this study, including behavioral intention, facilitating conditions and initial trust, had a strong, positive and significant effect on the adoption of WSCM by Lasht-e-Nesha farmers. The strong suggestion of the authors of this article is that by holding various meetings in rural areas and the presence of experts in all branches of agriculture, especially water and soil, farmers should be more familiar with the benefits and efficiency of WSCM.

Key words**:** *Binary logistic regression, conservation agriculture, soil erosion, water*

INTRODUCTION

Soil is one of the natural resources necessary for human survival [4], [65]. It is considered a scarce and non-renewable resource [91]; it takes a long time (between 600 and 700 years) to form 2.5 cm of soil, which is suitable for agriculture. Soil erosion is one of the causes of the degradation of agricultural lands around the world [11], [56], [67], [90]. When a nation's agricultural lands are degraded, the agricultural sector faces problems and crises, and sustainable development slows down, especially in developing countries [122].

Nearly 80 percent of the world's farm lands are involved in various levels of soil erosion each year [76]. Indeed, the amount of soil that is out of reach each year due to soil erosion is estimated at 75 billion tons, causing the loss of $ 400 billion [29]. How a farmer uses arable lands, as well as knowledge of managers, are critical and determining factors to occurring soil erosion [60], [99], [46].

Soil erosion can have many reasons. From the point of view of Muchena et al. [81], erosion can be the result of climate change (e.g. heavy rainfall, drought), farm land characteristics (e.g. slope, type of soil) or even personal characteristics of farmers (e.g. level of education, experience in farming, access to credit resources, access to promotional and extension courses). In addition to the factors mentioned earlier, the slope gradient of agricultural land [71] and the use of old and inefficient methods in cultivation can be added to the factors involved in soil erosion [104]. Unfortunately, there are still farmers who use old and inefficient methods and are reluctant to adopt techniques and measures designed to conserve the soil [9].

In addition to soil, water is another natural and scarce resource that plays a vital role in agriculture activities. The growing population of the world, industrialization of countries, frequent droughts, increasing agricultural land to provide food for the hungry population and, most importantly, climate change have led to water resources depletion and scarcity [44], [58], [119], [53]. With the current trend of population growth and over-exploitation of water resources, it is expected that by 2025, more than half of the world's population will face water shortage [13], [113]. Similarly, by the end of 2040, a large number of countries in the Middle East, often in arid and semi-arid regions, will experience severe water shortages [72]. It is also projected that by the end of 2030, global demand for water will be 40 percent higher than supply [116]. In addition, the Middle East is expected to experience a very serious water crisis due to overpopulation and climate change [115], [18]. Iran, is one of the arid and semi-arid countries, and drought and water scarcity are observed in most of its regions [31], [120], [123], [19].

Water shortages and declining groundwater aquifers over recent decades have increased soil salinity and desertification. The Iranian Soil Science Association has also issued a statement that water shortages in Iran have caused 31.5 million hectares of agricultural land to be abandoned [117].

In 2013, the Forests, Rangelands and Watershed Management Organization of Iran released statistics showing that more than 80 percent of the country's arable lands were out of reach and have lost their fertility due to a sharp increase in population, followed by rising water demand, successive droughts and climate change. This has had detrimental effects on Iran's economy, such as a 4.4 percent drop in the Gross Domestic Product (GDP), a significant drop in exports of non-oil products, and an increase in food imports and inflation [98].

The agricultural sector is one of the most important sectors in the world in terms of water consumption, and Iran is no exception [51]. Therefore, designing and introducing water resources conservation methods should be a priority for all countries.

In Iran, rice is considered a very important, strategic and basic commodity, and one of the most widely consumed agricultural products [100]. The importance of this product is such that its per capita consumption per person and per year increased from 28 kg in 1972 to 41 kg in 2014 [78]. One of the most vital steps in planting rice is the irrigation stage, because in all stages of rice cultivation and growth, this crop must be completely submerged in water. Water has many benefits for the rice plant, and it is responsible for transporting nutrients from the roots to the stems, leaves, and seeds, and ultimately providing the dry matter. Also, another requirement for planting rice is soil free of any contamination [39].

Guilan province, located in the northern Iran, is one of the main suppliers of Iranian rice. The area under rice cultivation in Guilan province is 238,403 hectares, which produces 11,065,331 tons of rice [80]. Due to incorrect and unscientific exploitation of natural resources in this province, natural resources such as water and soil are wasted or polluted considerably every year. Therefore, in Guilan province, the need for water and soil conservation measures (WSCM) is one of the main priorities for sustainable agriculture [1].

Given the reasons discussed in the previous paragraphs about the importance and scarcity of two sources of water and soil, the use of WSCM seems necessary. Factors that directly or indirectly affect a farmer in adopting WSCM can play an important role in WSCM adoption. When policymakers are aware of these factors, they gain a broader and more in-depth view of issues and act in more detail on policy-making [43].

There have been many studies around the world on the factors that affect the adoption of WSCM.

Moges and Taye [79] examined farmers' attitudes toward investing in water and soil conservation technologies using a logistic regression model. The variables of education level and access to training and practice courses had a positive effect and the variables of age and farm-house distance had a negative

effect on the adoption of water and soil conservation measures.

Darkwah et al [36] evaluated the determinants of the adoption of water and soil conservation practices (WSCP) in Ghana. They used the Poisson regression model and considered variables such as the number of household members, access to facilities, the distance from the farmer's house to the farm, and etc. Variables such as number of household members, farm size and access to credit had a positive effect and variables such as distance to the nearest product market, access to extension services and risk of using pesticides had a negative effect on WSCM adoption.

Sileshi et al. [102] also analyzed the factors influencing the adoption of physical and conservation measures of water and soil resources by Ethiopian farmers using a multiple probit regression model. Numerous demographic variables were used in the study, including age, gender, level of education, livestock maintenance, off-farm employment, and farm size. The results of the study showed that socioeconomic factors and characteristics of institutions were the main and determining factors in the adoption of WSCM by Ethiopian farmers.

Many other studies dealing with WSCM can be mentioned [10], [103], [27], [61], [9], [14], [15], [47], [2], [87].

However, it is safe to say that in most of the studies mentioned above, the researchers focused on the effect of demographic and quantitative variables on WSCM adoption, and only in small number of studies addressed the simultaneous effect of quantitative, demographic, dummy and attitudinal variables [15], [28], [93].

A person's attitudes and beliefs are directly related to his actions and behavior, and if these attitudes are not properly formed and oriented, we will see harmful results because human beings with these wrong attitudes cause the destruction of the environment and natural resources [57], [22], [7]. However, the determinant effect of attitude variables on WSCM adoption cannot be denied.

Based on the above review of literature, it was found that there is a gap in the study of variables affecting WSCM adoption, and that is the vacuum of attitude variables. Therefore, this paper tries to examine the factors influencing the adoption of water and soil conservation measures by considering both demographic and quantitative variables, and attitudinal and behavioral variables, as well as using an econometric regression model.

The measures that this study refers to as water and soil conservation measures (WSCM) and are carried out by farmers on agricultural lands are: equipping and renovating lands, second crop after paddy cultivation, maintenance of tertiary and quaternary irrigation canals, use of organic and green manure, weeding of irrigation canals, regular dredging of irrigation canals, use of plastic mulch on land boundaries, and water drainage from paddy fields.

MATERIALS AND METHODS

Study area description

This study was conducted in Lasht-e-Nasha district, which is geographically located 51'34.03"N longitude and 21'41.634"E latitude in Guilan province, located in the northernmost point of Iran (Fig. 1). Lasht-e-Nasha is located in the northeast of the center of Guilan province, i.e. the city of Rasht, and its distance to the center of the province is 31 km. The total area of Lasht-e-Nasha district is 162 square kilometers. Lasht-e-Nasha cosists of 47 rural areas and three urban areas, of which only 38 villages have taken conservation measures (most of which relate to equipping and renovating paddy farms). The land area equipped and renovated in Lasht-e-Nasha district until 2018 is estimated at 3,531 hectares. The reason for choosing Lasht-e-Nasha district among all the districts of Guilan province was that the highest WSCM adoption rate was recorded in this section. Most of the heads of households living in the Lasht-e-Nasha district are engaged in agricultural work and make a living out of it. The total number of active farmers in Lasht-e-Nesha district is reported to be 11,614, who cultivate annually 8,350 hectares of paddy farms. The amount of rice that is produced and supplied annually in

Lasht-e-Nesha district is estimated at 20,000 tons in 2019 [6].

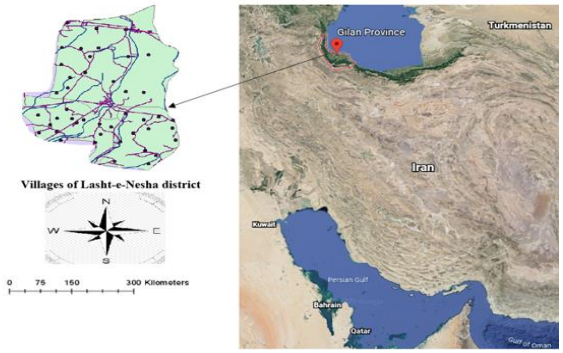

Fig. 1. GIS map of the Lasht-e-Nesha district in Northern Iran
Source: Google Earth and ArcMap.

Sample selection and size

Farmers engaged in rice cultivation in the Lasht-e-Nesha region have been targeted in this study. According to the statistics obtained from the Jihad Agricultural Organization of Guilan Province, the number of these farmers was 6,841. Using a table provided by Bartlett et al. [23], it is observed that the required sample size at a significance level of 5% was 367 but we choose 538 paddy farmers. Data from this study were collected between November and December 2019. Data collection tool was a questionnaire. Farmers in this study were divided into two categories: 1- WSCM adopters and 2- Ordinary or non-adopter farmers.

Table 1. Demographic variables and characteristics of survey respondents (n=538).

Distribution	Class	Frequency	%
Age (years)	20-29 30-39 40-59 > 60	5 40 261 232	9 7.4 48.5 43.1
Education	Lower than BSc BSc or higher	528 10	98.14 1.85
Use of family labour	Yes No	411 127	76.4 23.6
Type of land tenure	Ownership Rent Sharing	439 14 85	81.6 2.6 15.8
Sloppy Paddy farm	Yes No	116 422	21.6 78.4
Access to development and extension services	Yes No	77 469	14.3 85.7

Source: Field survey data, 2019.

The number of adopters was 432 and the number of non-adopters was 106. Descriptive statistics of demographic variables of farmers located in Lasht-e-Nesha are shown in Table 1.

Research design and variables

As mentioned in the introduction, one of the goals of this study is to fill the gap that exists in terms of factors affecting WSCM adoption. Therefore, in addition to involving quantitative and demographic variables, we also included behavioral and attitudinal variables in this study to gain a deeper and more comprehensive understanding of the factors influencing the adoption of WSCM. Quantitative, demographic and dummy variables, which were thought to affect WSCM adoption, analyzed in this study were: farmer's level of education, number of household members, farmer's experience in rice cultivation, farm size, number of paddy plots, use of family labor in rice cultivation, doing other agricultural activities, off-farm employment, total amount of rice production, cooperation with other farmers, participation in development-extension and training courses. In addition, attitudinal variables affecting WSCM adoption such as behavioral intent (BI), facilitating conditions (FC), and initial trust (IT) were included in the analysis. Few studies are available on the attitudinal factors influencing WSCM adoption. The most recent study in this field is the study of Faridi et al. [43], which by merging two conceptual models of initial trust model (ITM) and unified theory of acceptance and use of technology (UTAUT), examined the attitudinal factors affecting the adoption of WSCM. Using the conceptual model used in this study and using variables that directly and indirectly affect the adoption variable, we examined the attitudinal factors affecting adopting WSCM with the logit regression approach. To examine the attitudinal and behavioral variables more accurately, the items used for these variables in different studies were also examined. These items are shown in Table 2.

Table 2. Introduction of attitudinal variables and items used in them

Constructs	Items	Contents	Sources
Behavioral intention (BI)	BI1 BI2 BI3 BI4 BI5	(1)I intend to implement WSCM in my paddy field next year. (2)I predict to apply WSCM on my paddy field next year. (3)I plan to have WSCM on my paddy field next year. (4)If I have access to WSCM next year, I intend to apply them to my paddy field. (5)If WSCM are financially viable, I will use them in my paddy field next year.	[111], [112], [97], [68], [70], [118], [121], [74]
Facilitating conditions (FS)	FS1 FS2 FS3	(1)I have the necessary resources (land, labor, capital) to implement WSCM. (2)I have the necessary knowledge to implement WSCM. (3)Experts are available in the area to address the problems and deficiencies of WSCM.	[63], [105], [95], [111], [108]
Initial trust (IT)	IT1 IT2 IT3	(1)WSCM lead to sustainable production in my paddy field. (2)WSCM are reliable. (3)WSCM are designed to help paddy farmers.	[64], [86]

Source: Own synthesis based on literature.

Data analysis

The binary logistics regression model is commonly used to investigate the relationship and correlation of a dual dependent variable and several independent variables [88]. Using this approach makes it possible to examine the simultaneous effect of several explanatory variables on a dependent variable. Through this measure, the explanatory variables can be graded according to the degree of effect on the dependent variable [59].

In this study, binary logistic regression model was used to investigate the effect of quantitative, demographic and attitude variables on WSCM adoption. In the section of interpretation and analysis of the results of the Logit model, the two concepts of weighted aggregate elasticity and the marginal effect were used. Elasticity can be thought of as a measure of how sensitive a variable is to another variable. In economics, the interpretation of elasticity is that if the first variable increases by 1%, the second variable will increase by what percentage [35].

The marginal effect tells the researcher on how changing a particular explanatory variable, changes the dependent variable. In other words, if the independent variable is increased by 1 unit, by how many units will the dependent variable increase [114].

Based on the results obtained from the Logit model estimate, the model used in this study is statistically significant [Likelihood Ratio (LR) = 685.452, P-value < 0.000, df = 14] and can be considered as a suitable model for analyzing research data. The percentage of right prediction of the model was 98.5%, which means that 98.5% of the changes in the dependent variable are explained by the explanatory variables.

RESULTS AND DISCUSSIONS

In this study, we examined the factors influencing the adoption of WSCM by paddy farmers in Lasht-e-Nesha district, located in northern Iran. Using logistics binary regression model, the effectiveness of 14 different variables - including quantitative, demographic and behavioral attitudinal - was tested. Table 3 shows the descriptive statistics of the variables used in the study.

The results of estimating the Logit regression model are shown in Table 4.

The variable level of education of the paddy farmer had a negative effect on the adoption of WSCM, which was also statistically

insignificant (β= -0.3, and t-value= -1.14). Similar results can be found in the studies of Eleni [40], Anim [10], Chomba [34], Foltz [45], Jara-Rojas et al. [52], Nkegbe et al. [84], Mutuku et al. [82] and Abdul-Hanan [2]. It also contradicts the results of studies by Moges and Taye [79], Tenge et al. [107], Sinore et al. [103], Sileshi et al. [102], Nurie et al. [85], Asfaw and Neka [14], Ashoori et al. [15], Anley et al. [11], Illukpitiya and Gopalakrishnan [50], Mengstie [77], Kessler [62], Lapar and Pandey [66], Pender and Kerr [89], Rezvanfar et al. [94], Kerse [61] and Long [69].

The next variable that had a negative effect on WSCM adoption was the number of household members and it was significant at 10% level (β= -0.5, and t-value= -1.69). This finding is in line with the studies of Ouedraogo and Tiganadaba [87], Sileshi et al. [102], Bekele and Drake [25], Ashoori et al. [15], Bakhsh et al. [20], Mengstie [77], Gebremichael [48] and Abdul-Hanan [2]. On the other hand, there are a number of studies that show that the more the members of a family are, the higher is the rate of adoption of WSCM by the head of the household [40], [42], [106], [79], [103], [36], [3], [52], [84], [61], [12], [16].

Farmer's experience in rice cultivation (which was based on the number of years) was another variable that negatively affected WSCM adoption. This variable was statistically significant at 10% (β= -0.05, and t-value= -1.64). Darkwah et al. [36] and Ashoori et al. [15] also found the effect of the variable experience as negative.

Farm size was another variable whose effect on WSCM adoption was negative and it was statistically significant at 5% (β= -0.0001, and t-value= -2.46). The results obtained in the studies of Shortle and Miranowski [101], Ouedraogo and Tiganadaba [87], Sileshi et al. [102], Ashoori et al. [15], Gebremedhin and Swinton [47], Mutuku et al. [82] and Asfaw and Neka [14] confirm the finding of our study about the negative effect of farm size. However, there were studies whose results differed from this study in the case of farm size variable [9], [79], [103], [36], [8], [3], [106], [40], [37], [26], [61], [2]. No significant relationship between field size and WSCM adoption was found in the studies of Agbamu [5] and Uri [110].

The number of plots of land available to the farmer was another variable that had a negative effect on WSCM adoption, which was also significant at the statistical level of 5% (β= -0.4498, and t-value= -2.50). Also Ashoori et al. [15] and Beshir [26] concluded that the number of agricultural land plots and the adoption of WSCM have a negative relationship and correlation. On the other hand, Ashoori et al. [16] found a positive relationship between the number of agricultural plots and the adoption of WSCM.

Doing other agricultural activities, along with rice cultivation, is another dummy variable that had a negative effect on WSCM adoption, which is significant at 5% level (β= -2.5249, and t-value= -2.33).

Employment in off-farm activities was another examined variable whose effect on the adoption of WSCM was positive but statistically insignificant (β= 1.4209, and t-value= 1.31). Demelash and Stahr [38] found that the farmer's employment outside the farm generated additional income and encouraged him/her to adopt and implement WSCM on farm. Tiwari et al. [109] also concluded that income from off-farm activities is a reliable source for investing in conservation measures and considered it an influential and decisive factor. Darkwah et al. [36] found that off-farm activity variable was positive but insignificant. Meanwhile, Abdul-Hanan [2] considered the off-farm income variable to be negative and insignificant. Eneyew et al. [41] also concluded that household access to off-farm income is more likely to have an effect on water and soil conservation measures implemented by farmers. On the other hand, other studies have concluded that off-farm activities and income from them have a negative effect on WSCM adoption [14], [9], [61], [32], [107], [40], [89], [75], [47], [102].

When the variable of employment in off-farm activities increases by 1%, the probability of WSCM being adopted by farmers also increases by 0.014%. Also, with an increase of 1 unit in this variable, it can be said with

certainty that WSCM adoption by farmers will increase by 0.293 units.

Another quantitative variable used in this study was the total amount of rice production, which was calculated in kilograms. According to the results obtained by the Logit regression model, the effect of this variable on the adoption of WSCM is positive and statistically significant at the level of 5% (β= 0.00105, and t-value= 2.29). In the studies of Ouedraogo and Tiganadaba [87] and Ashoori et al. [16], the effect of the variable "total amount of production" was positive but statistically insignificant. When total rice production increases by one percent, we will see a 0.057 percent increase in WSCM adoption rates in the Lasht-e-Nesha district. Also, if this variable increases by 1 unit, the adoption rate increases by 0.0002 units.

The cooperation and participation of farmers with each other and membership in producer organizations was considered in the regression model of this article and its effect was considered positive, which should be noted that it was also significant at the statistical level of 10% (β= 0.77688, and t-value= 1.88). These results are consistent with studies conducted by Mango et al. [73], Abdul-Hanan et al. [3], Mutuku et al. [82] and Nkegbe et al. [84]. It also contradicts the results of the studies by Bayard et al. [24] and Abdul-Hanan [2].

If the variable of cooperation among farmers increases by one percent, there is a 0.036 increase in the likelihood of WSCM adoption. Also, if this variable increases by one unit, the probability will increase by 0.192 units.

The last dummy variable to be included in the regression model of this paper was the farmer's participation and access in development-extension and training courses whose relationship with and effect on WSCM adoption were positive and statistically significant at 5% (β= 1.2574, and t-value= 2.08). This variable has been analyzed in many studies and its effect on WSCM has been recognized as positive [79], [83], [103], [21], [102], [82], [61], [55], [2], [14], [109], [40], [16], [17], [25]. There are also other studies that have assessed negatively the effect of this variable on WSCM adoption [36], [5], [47], [9].

If the variable of farmer participation and access to development-extension and training courses increases by one percent, the variable of WSCM adoption increases by 0.13 percent, and if this variable of increases by1 unit, the adoption of increase by 0.311 units.

However, in addition to quantitative, demographic and dummy variables, attitudinal and behavioral variables have been included in this study, which is a kind of innovation in the study of factors affecting WSCM adoption.

The first attitudinal variable introduced in the Logit regression model of this paper was the behavioral intention variable (BI) in WSCM adoption. According to the results (Table 3), the relationship between BI and the adoption was positive and statistically significant at the level of 1% (β= 0.70252, and t-value= 3.88). In the study of Faridi et al. [43], the BI coefficient was 0.353 and was statistically significant at the level of 1%. Various articles such as Chauhan and Jaiswal [33], Suki and Suki [105]), Brom et al. [30], Hoque and Sorwar [49], Venkatesh et al. [112] and Oliveira et al. [85], highlighted a positive effect of BI on the adoption variable. If the BI variable increases by one percent, the WSCM adoption variable increase 0.32 percent, and if it increases by 1 unit, the adoption rate increases by 0.173 units.

The second attitudinal variable influencing WSCM adoption is facilitating conditions (FC). According to the results of the Logit regression model, FC has a positive and significant correlation at the level of 5% with WSCM adoption (β= 1.1207, and t-value= 2.44). Faridi et al. [43] obtained similar results in their study (path coefficient equal to 0.185 and statistically significant at the level of 1%). Numerous studies have concluded that FC has a positive and significant effect on the adoption [54], [85], [92], [96]. With a 1% increase in FC, the probability of adopting WSCM increases by 0.18%, and with an increase of 1 unit of this variable, 0.277 units will be added to the probability of adopting WSCM.

However, the latest attitude variable introduced in this regression model is the initial confidence (IT) variable, which according to the results (Table 3) has a clearly positive and significant effect at the statistical level of 1% (β= 2.3313, and t-value= 4.74). The study by Faridi et al. [43] confirms the positive and significant effect of IT on adoption. With a 1% increase in IT, there is a 0.63% increase in WSCM adoption, and with an increase of 1 unit in this variable, the adoption rate increases by 0.577 units.

Table 3. Descriptive statistics of variables (N=538)

Variable	Mean	ST. DEV.	Min	Max
Farmer's level of education	3.550	1.762	1	8
Number of household members	3.403	1.363	1	10
Farmer's experience in rice cultivation (in years)	35.1	15.579	3	70
Farm size (m^2)	10,207	11,456	400	0.15
Number of paddy plots	2.977	2.513	1	30
Use of family labour in rice cultivation	0.763	0.425	0	1
Doing other agricultural activities (besides rice)	0.589	0.492	0	1
Off-farm employment	0.472	0.499	0	1
Total amount of rice production (Kg)	1,883.9	1,728.6	100	1,200
Cooperation with other farmers	2.284	1.321	1	5
Participation in development-extension and training courses	4.753	0.760	1	5
Behavioural intention	18.359	6.563	5	25
Facilitating conditions	7.152	2.474	3	15
Initial trust	11.820	2.445	5	15
Adoption	0.571	0.495	0	1

Sources: Field survey data, 2019.

Table 4. Binary logistic regression model results for factors affecting the adoption of WSCM by farmers

Variable	Coefficient	t-ratio	Elasticity	Marginal Effect
Farmer's level of education	-0.303	-1.14	-0.027	-0.075
Number of household members	-0.524	-1.69	-0.047	-0.129
Farmer's experience in rice cultivation	-0.054	-1.64	-0.042	-0.013
Farm size	-0.0001	-2.46	-0.039	-0.000
Number of paddy plots	-0.449	-2.50	-0.037	-0.111
Use of family labour in rice cultivation	1.469	1.16	0.028	0.128
Doing other agricultural activities	-2.524	-2.33	-0.039	-0.551
Off-farm employment	1.420	1.31	0.014	0.293
Total amount of rice production	0.001	2.29	0.057	0.0002
Cooperation with other farmers	0.776	1.88	0.036	0.192
Participation in development-extension and training courses	1.257	2.08	0.13	0.311
Behavioural intention	0.702	3.88	0.32	0.173
Facilitating conditions	1.120	2.44	0.18	0.277
Initial trust	2.331	4.74	0.63	0.577
Adoption	-51.282	-4.56	-1.17	-

Sources: Field survey data, 2019.

CONCLUSIONS

In this study, we evaluated various quantitative, demographic and attitudinal variables that were thought to be effective on WSCM adoption by Lasht-e-Nesha farmers. In the following paragraphs, we discuss policy proposals commensurate with the results of this study.

In this study, the effect of the number of household members on WSCM adoption was negative. This means that families with fewer members in Lasht-e-Nesha were more likely to adopt WSCM. It can be interpreted that households living in rural areas have low financial means and the more are the family members, the more financial problems they have and practically no budget will be

allocated to WSCM. Therefore, governments should take more measures to solve the economic problems of rural households, and also rural development specialists should redouble their efforts to develop rural areas. The Ministry of Agriculture can also encourage low-income households to adopt WSCMs by providing low-interest loans and facilities.

The number of years of experience in agriculture was another variable that had a negative effect on WSCM adoption. In other words, inexperienced farmers living in Lasht-e-Nesha district were more inclined to adopt WSCM. Unfortunately, more experienced farmers are distrustful of modern methods of conserving natural resources and still use traditional and inefficient methods. Social groups as well as influential individuals in rural areas should gain this trust and develop and promote WSCM in rural areas. For example, rural development specialists can rent a small farm to demonstrate WSCM. By doing so, experienced farmers will see the end result more closely and it will be more believable for them.

The effect of farm size variable was also negative. That is, farmers with smaller plots were more likely to adopt WSCM. The prices of agricultural inputs as well as WSCM are high, especially in developing countries such as Iran. So, of course, farmers with large plots of land are less interested in implementing WSCM due to financial problems as well as the large area of land at their disposal. It is proposed to make it easier for large-scale farmers to adopt WSCM by supporting their investments in this field.

Carrying out agricultural activities along with rice cultivation is another variable with a negative effect on WSCM adoption. Due to low incomes, rural farmers are forced to do more agricultural activities for a living. This means that the farmer's small capital is distributed among several agricultural activities and a small share remains for conservation measures. Therefore, if a farmer is engaged in several agricultural activities, then these activities must be done optimally and efficiently so that both his/her resources are not wasted and his/her income increases, which paves the way for the adoption of WSCM. It is suggested that experts in all fields of agriculture (e.g. animal and poultry, gardening, soil, water, agronomy and plant breeding, botany, etc.) come together in rural areas and monitor the activities of farmers to guide activities in the right direction and optimize them. The total amount of farmer's rice crop had a positive and significant relationship with the adoption of WSCM. That is, by implementing conservation measures on agricultural land, in addition to protecting water and soil resources from the risk of contamination or loss, they also maximize the crop yield. In this case, it is again recommended that the Ministry of Agriculture and the government facilitate the adoption of WSCM by farmers so that they can increase their rice production and, consequently, improve the level of economic development of rural areas.

Cooperation and interaction with other farmers also had a positive effect on WSCM adoption. Rural communities, because they have a smaller population, interact more with each other and farmers influence more each other. Therefore, if a farmer achieves a favorable result from the implementation of a protection measure, he/she shares this result with others and promotes it in some way. Therefore, meetings can be held inside the rural areas and WSCM adopters can be invited to share their experience with others, while explaining in detail the benefits of WSCM. This action will surely bring positive results.

Participation in development-extension and training courses also positively increases WSCM adoption. As expected, these training courses have a significant impact on the development and promotion of conservation measures. Therefore, these courses should be held regularly by the ministry of agriculture in all rural areas of the country and be free of charge for farmers to increase their participation. Also, these training sessions should be properly advertised in the rural areas so that the farmers know the exact time and place of the events.

But the part that distinguished this study from previous studies on the factors affecting

WSCM adoption by using the logit regression approach was the inclusion of attitudinal variables in the model. Of course, it should be noted that the strongest identified effect in this model was for attitude variables.

Our first attitude variable was behavioral intention in adopting WSCM, which showed a positive and significant effect. When the farmer has in mind a great desire to implement conservation measures on his/her land in next year or in the near future, they will surely do so. The Ministry of Agriculture, as well as rural development experts, should change the farmer's attitude towards conservation measures by demonstrating the benefits of these conservation measures.

The second attitude variable was the facilitating conditions, which had a positive and significant effect on the adoption of WSCM. Thus, the easier are the conditions for adopting and implementing WSCM, the more inclined are the farmers to adopt them. Therefore, the conditions for the implementation of the WSCM should be made more favorable by the relevant bodies, such as the Ministry of Agriculture, the rural cooperatives, the local agricultural service centers. For example, credits with low-interest for adopters should be considered. Long-term and low-interest loans from banks, especially agricultural banks, can also be useful.

Finally, the strongest variable used in this study is initial trust, which proved to have a positive and significant effect on WSCM adoption. It can be concluded that until an initial trust in the efficiency and effectiveness of WSCM is formed in the farmer's mind, practically no adoption is possible. It is highly recommended that agricultural professionals, especially agricultural promoters and rural development experts, meet with farmers in person and provide them with WSCM information honestly and in full transparency so that they can gain their trust. Also, as mentioned earlier, the demonstration farms in villages can result instrumental in building trust and encouraging farmers to adopt WSCM.

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PRODUCING VINEGAR FROM UNMARKETABLE DATES OF THREE LIBYAN CULTIVARS USING DOUBLE STAGE FERMENTATION METHOD

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Abstract

This work investigated producing vinegar from unmarketable 'Taleese', 'Athwi' and 'Hellawi' Libyan date cultivars. Sugar was extracted from 'Athwi' and 'Talees' dates by soaking in distilled water at 1:3 (w/w) for 10 hours and pressing while 'Hellawi' dates were mixed with distilled water at the similar ratio, heated at 80°C and agitated for 2 hours and pressed. Total soluble solids (TSS) of solutions obtained from the three cultivars were 16.5, 17.4 and 25.0 °Brix, respectively. Solutions were adjusted to 15.5°Brix and 8 litre of solution of each cultivar were fermented in 15L setup equipped with an airlock. Baker's yeast was added and solutions were incubated at room temperature averaging 22°C. The process lasted 9 days, afterward aerobic acetification was carried out by adding virgin date vinegar at 10% (v/v) and solutions were kept under same conditions. Weekly measurements of titratable acidity (TA) and alcohol percentage were made until alcohol content dropped below 1%. The process lasted 60 days for 'Taleese' and 'Athwi', while 'Hellawi' took additional 11 days. Both fermentations were described by linear relations (R^2>0.97). In the anaerobic reaction, cultivars were significantly different in their alcohol percentages and TSS but were similar in acidity and pH. In the aerobic fermentation, no significant differences in TA, pH but significant different in alcohol residues and TSS were recorded. Moreover, sensory evaluation of the three kinds of vinegar was made on acidity, taste, and acceptance; again no significant differences were recorded. Color analysis in Hue angle, Chroma and L were also made, vinegar of the three cultivars were significantly different; 'Hellawi' vinegar was much darker than 'Athwi' and 'Talees'. Quantification of acetic acid showed its contents above 5% (v/v), representing nearly 85% of total acids. The study demonstrated the potential of producing good quality vinegar from unmarketable Libyan dates.*

Key words**:** *vinegar, unmarketable dates, fermentation, alcohol, acetic acid*

INTRODUCTION

Vinegar is one of the most ancient beverages produced by fermentation. It is a food additive and preservative, also a medical and dietetic remedy [5]. It is primarily produced from carbohydrate and sugar based agriculture products, while seed carbohydrates are normally hydrolyzed for yeast fermentation, sugars of most fruits are directly fermented. In general, vinegar is produced by two means; traditional (surface), known in France as Orleans method, and the industrial submerged methods [7]. The first is a slow process but requires less investment and vinegar quality is believed to be high in quality and value [16], [11].

Economy-wise, vinegar is not a major industry comparing with other commodities produced by fermentations. Yet, there are several companies specialized in vinegar production under several varieties and brands. In Europe alone, vinegar market value in 2002 was estimated at nearly €268.7 million [24]. Unlike distilled (white vinegar) which is produced by acetic oxidation of ethanol, natural vinegar is produced by single and double stage fermentation of wide range of agricultural products such as apples, berries, guava, banana, kiwi, apricot, figs, dates, cereals, cashew fruit and many others [23]. In the first stage, sugars are converted anaerobically to ethanol by yeast, while in the second an aerobic acetous fermentation of ethanol into acetic acid is made by acetic acid bacteria belonging to the Acetobacteriaceae

family [12].

Dates are rich in sugars and with great advantages over other fresh commodities; they can be handled dry; giving benefits in transportation and storage until fermentation process is initiated. Despite that, date vinegar is not a wide spread commodity. Most production operations are limited to traditional and family small businesses, in addition to weakness in marketing and technical assistance to vinegar producers. In Mediterranean and Middle East countries, low-quality dates are generally used in vinegar production [4]. Typically, it is a spontaneous single stage fermentation process in which alcohol and acetification processes take place simultaneously within the same enclosure. However, the process is believed to be time-consuming, susceptible to reaction rendering and vinegar may contain high alcohol residues due to several uncontrollable factors [11].

Libya is an important date producing country; in fact, it attains the tenth place among the world top producers [13]. Moreover, it has a climatic advantage over many other date producers, varying from the Mediterranean in the northern part to hyper-arid Saharan proper far south, offering suitable conditions for producing soft dates in the coastal area, semidry in the middle and dry dates in far south oases [8]. Nearly 400 cultivars are reported nationwide, yet about 95 are commercially important [21]. Although most date production takes in the south, dates are transported to the northern populated region, however insignificant quantities are exported. Unfortunately, postharvest infrastructures are rather weak and therefore losses are high, mostly due to over-drying, insect and disease infestation [9]. Utilization of low-quality dates is almost absent, nevertheless, small quantities are used in date syrup (Debbis), date paste, while large volumes are abandoned or used as animal feed.

In Libyan, date vinegar is produced in small operations carried out by farmers and homemade hobbyist; mainly for their own uses, and date vinegar is not a commonly sold commodity. However, people of Wahat, Jufra, Fezzan and Ghadames oases describe their traditional method as mixing dates with water in a clay made enclosure called ('Tass') at ratios between 1:1 and 1:3 (w/w), some table salt is added, 'Tass' mouth is closed with fabric, and kept in a warm place for about 45 days. The process is generally carried out in autumn when warm conditions prevail. In fact, it is an inherited process through generations, and the product is known as the traditional date vinegar. However, prior to carrying out this work, samples were collected from Gadames and Jufra, and analyzed for titratable acidity and alcohol residues at the postharvest laboratory (PL), Faculty of Agriculture, Tripoli University, results showed low titratable acidity (<2.5%) and alcohol residues as high as 4.41% (unpublished data). It is apparent that local traditional date vinegar is very much doubtful, especially in alcohol residue content. It is quite evident that using single stage spontaneous fermentation process and local methods were mostly responsible for high alcohol residues and low acidity observed in the samples.

Studies on date vinegar in Libya are scarce, the only investigation reported producing vinegar from local dates was published [9], the work was carried out at our laboratory and dealt with producing vinegar from low-quality dry date cultivar 'Tasfer'. The study recommended extracting sugars and using other cultivars. Therefore, the current work investigated the potential of using double stage fermentation method for producing vinegar from low-quality dates of three Libyan date cultivars, 'Talees', 'Athwi' and 'Hellawi'. Extraction of sugar solution its efficiency and its properties were targeted, fermentation performance and reactions behavior are also investigated. Also, quality evaluation of vinegar produced from the three cultivars was made.

MATERIALS AND METHODS

Data

'Talees' and 'Athwi' dates were collected from a public market located at about 150km south west of Tripoli. Apparently, they were transported from Fezzan region in an unrefrigerated pickup, fairly dry, handled in

jute bags and sold in bulk. Moreover, they were unsorted, unclean mixed with debris, soil, damaged fruits, and pits. In such state, they are considered as cull; commonly sold for making date syrup (Debbis) and date paste. Samples were transported to the PL, they were sorted, infested and damaged units were eliminated, washed with water, dried and kept in a walk-in cold room at 0˚C (±0.5) until experimental procedures were carried out. Moisture content of the two dry cultivars was determined using the standard oven method. Samples were dried in an oven at 105 ˚C for 24 hours and water contents were determined on the wet basis at 13.6% and 14.3% for 'Talees' and 'Athwi' dates, respectively. On the other hand, 'Hellawi' dates at 'Rutab' stage previously had been collected from an orchard near Tripoli and were kept in a freezer at -18 ˚C.

Sugar Extraction

'Talees' and 'Athwi' dates were taken from the cold room, given time to warm up, weighed 3kg of each cultivar, mixed with 9 liters of distilled water and kept at room temperature for 10 hours. Afterwards, were mechanically blended until a thick solution was formed, then press filtered and clear solutions were collected. Volumes of solution were determined and their total soluble solids (TSS) were also measured using handheld digital refractometer (Model PAL-α, ATAGO Co, Ltd, Tokyo, Japan). TSS of 'Talees' and 'Athwi' solutions were 18 and 15.5˚Brix, respectively. For 'Hellawi' dates, since it is a soft cultivar, dates were removed from the freezer, thawed and mixed with distilled water at the similar ratio, heated at 80˚C with continuous agitation for 2 hours, then pressed, TSS was determined at 25 ˚Brix.

Anaerobic Fermentation

For obtaining comparable results, solutions of the three cultivars were adjusted to similar TSS (15.5 ˚Brix ±0.5). A setup consisted of a 15-liter plastic bottle equipped with an airtight lid was used as a fermenter. For securing airtightness, a brass tire valve was installed on the lid. A plastic pipe was mounted between the valve from one end and a vessel filled with water from the other, serving as an airlock. Moreover, for assuring anaerobic conditions headspace air constituents of oxygen and carbon dioxide were measured using portable CO_2-O_2 gas analyzer (Model CANAL120 O_2 & CO_2 Gas Analyzer, EMCO Packaging Systems Ltd, Kent, CT14 0BD, UK). 8 liter of solution of each cultivar were filled in the fermenter, an inoculum of commercial baker's yeast was prepared by adding 200mg/L of dry yeast to 200 ml of warm solutions from each cultivar, stirred well, incubated at 27˚C for 20 minutes and added. The three fermenters were periodically checked until CO_2 bubbling stopped; giving a clear sign of the anaerobic reaction end. Afterwards, the three fermenters were opened and aerated; samples were taken for analyzing alcohol content, titratable acidity (TA), pH and TSS. Measurements were made in triplicates.

Acetification Process

Virgin date vinegar (unsterilized) was added to the fermented content at 10%, fermenter opening was covered with a fabric and kept at previous stage conditions. Samples were weekly withdrawn and analyzed for titratable acidity, alcohol content and pH using procedures reported in our previous investigation [9].

Acetic acid content

Acetic acid percentages in vinegar samples were determined using high-performance liquid chromatography HPLC system (PerkinElmer, 200). The HPLC is equipped with Supelco C18 column, 5µm, 250m, 4.6 mm. Also, it is equipped with a Diode Array Detector (DAD), an auto sampler, and Total Chroma Software. Analysis conditions used were similar to conditions reported by [22]. Settings used in the analysis were mobile phase A: 10mM KH_2PO_4, pH 2.4 achieved with Phosphoric acid and mobile phase B: Acetonitrile (CAN), both phases resulted into solvent isocratic 80:20 percentage. Flow rate was sat at 1.5 ml.min-1, oven temperature was kept at 30˚C, maximum λ = 210 nm, samples were fed at 20µL, and analysis time was sat at 15minutes. Prior to feeding the three vinegar samples, a high purity acetic acid (99.9%) supplied by Food and Drug Control Center (FDCC) was used as a standard. A 0.1% solution was prepared and injected under the

analysis conditions, its peak area and eluting time were used subsequently in identifying acetic acid peaks of vinegar samples.

Color analysis

Color was analyzed using handheld Tristimulus reflectance colorimeter (Minolta CR 400, Minolta Corp., New Jersey, USA). (Lab color spaces), with (L*) indicates lightness, (a*) for chromaticity from green (-) to red (+), while (b*) represents chromaticity from blue (-) to yellow (+). Measurements were made in triplicates.

Sensory Evaluation

Qualitative descriptive sensory analysis (QDSA) was conducted using 7 untrained taste panel randomly selected from employees and staff of the Department of Agricultural Engineering, Faculty of Agriculture, Tripoli University. Samples were put in coded cups and introduced independently to panelist, he/she was asked to take a teaspoon of each type, taste it and mark down his/her assessment to sample acidity, taste, and acceptability on a 100mm scale line representing 0-100% in each category. Freshwater was provided for rinsing between samples, and panelist marked down their assessment in the three categories. For acidity, the line ranged from weak to very strong, taste from unpleasant to pleasant, and acceptability from unacceptable to acceptable. The evaluation form is widely used in QDSA analysis, and similarly used by [12], [19].

Statistical Analysis

Data analysis was performed using analysis of variance (one way ANOVA), the significance level was selected at (0.05) and analyses were made using Microsoft Excel 2010. Tukey Kramer HSD post hoc test was carried for pairwise comparison by programming formulas on an Excel data sheet.

RESULTS AND DISCUSSIONS

Sugar Extraction

TSS of extracted sugary solution (juice) from 'Talees', 'Athwi', and 'Hellawi' dates were 15.5, 18, and 25 ˚Brix, respectively. Juice volume obtained from the two dry cultivars, 'Talees' and 'Athwi' were 8,320 and 8,460ml, respectively. For 'Hellawi' cultivar, however, collected juice was 10,100ml and its TSS was 25 ˚Brix. Fruits were in the 'Rutab' stage, at high moisture content 84% (w.b) and rich in sugar (TSS > 50%). Extraction for 'Hellawi' was made by heating and agitation, leading to extracting most sugars. Fruit high moisture content and extraction method used may explain juice volume increase and high sugar content obtained. On the other hand, the two dry cultivars 'Talees' and 'Athwi' had low moisture content 13.6% and 14.3% and accordingly collected juice was lower in volume. Certainly, some sugar remained in date tissue after pressing; however, it was measured at 8 ˚Brix in fruit residues of the two cultivars. Taking into consideration that some moisture remained in fruits after pressing, thus efficiencies of recovering moisture added to dates were, 92 and 94% for the 'Talees' and 'Athwi', respectively. Nonetheless, using fruit juice is more efficient than fermenting fruits, easier to handle and faster in the anaerobic fermentation [9]. Though, mixing ratio 1:3 gave TSS around 15 ˚Brix was quite convincing, giving good agreement with literature [6], in their extraction of sugars of some date cultivars. Moreover, TSS content near 15 % (w/v) was used in producing vinegar from Iraqi 'Zahdi' dates [14]. Additionally, TSS content between 10 and 22 ˚Brix was investigated [7], which indicated that TSS was very much inversely related to the anaerobic fermentation time; higher TSS content extended fermentation time. Furthermore, it has been suggested that for achieving good ethanol yield and subsequently vinegar yield in traditional vinegar-making methods, TSS content must be not less than 14 ˚Brix [10].

Performance of Anaerobic Fermentation

The anaerobic fermentation process lasted for 9 days at 22˚C average room temperature, the reaction was considered completed once CO_2 bubbling in the airlocks stopped. Samples were withdrawn and analyzed for TSS expressed as ˚Brix, TA, ethanol percentage and pH. Table 1 shows ANOVA results for alcohol content, TSS, and pH. As can be observed, there were no significant differences among the three cultivars in pH and accordingly the acidity at ($p < 0.05$) level.

Table 1. ANOVA for anaerobic fermentation yield properties

Source	SS	d.f	MS	F	P
Alcohol					
Between groups	2.31	2	1.07	8.22	0.019
Within groups	0.78	6	0.13		
Total	2.91	8			
TSS					
Between groups	2.94	2	0.147	441.3	0.00
Within groups	0.02	6	0.00		
Total	2.96	8			
pH					
Between groups	0.03	2	0.01	1.76	0.251
Within groups	0.05	6	0.01		
Total	0.08	8			

Source: Results of the own experiments.

However, alcohol content (percentage v/v) showed significant difference among the three cultivars, therefore, post hoc Tukey Kramer HSD test was carried out. As it can be observed in Figure 1, 'Hellawi' produced the highest alcohol content (5.94±0.61) followed by 'Athwi' (5.56±0.066), though the two were not significantly different at ($p < 0.05$). However, 'Athwi' was not different from 'Talees' (4.80±0.13). This meant that 'Hellawi' was the highest in sugar conversion to alcohol and 'Talees' was lowest.

TSS measured as ˚Brix also showed significantly different among the three cultivars (Figure 1), 'Hellawi' (8.03±0.058), 'Talees' (6.77±0.058) and 'Athwi' (6.53±0.058). Despite using similar TSS, variations in remaining TSS were recorded at the end of the anaerobic fermentation. Thus, sugar conversion to alcohol percentages was calculated at 52, 44 and 42% for 'Hellawi', 'Talees', and 'Athwi', respectively. Such results showed variations among the three cultivars. Indeed, it is related to cultivar properties, that may affected yeast ability in converting sugar to ethanol. However, efficiencies reported here are in a fair agreement with values reported in the literature, [12], [14]. Factors such as nutrient availability, enzymes, and substrate pH are very much cultivar related.

The anaerobic fermentation lasted for 9 days for the three cultivars, while in our previous study on 'Tasfert' dates; it lasted for two weeks due to using whole fruit [9].

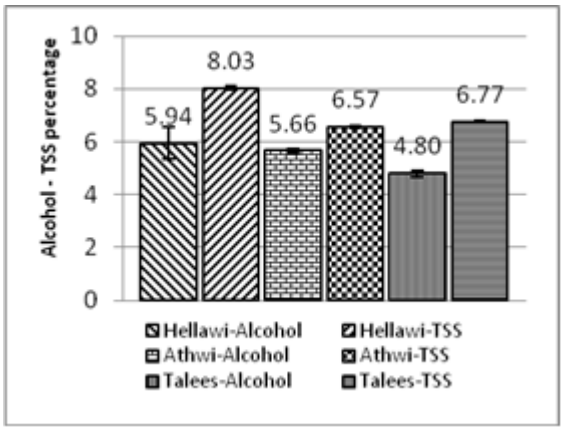

Fig. 1. Alcohol and TTS content after anaerobic fermentation
Source: Results of the own experiments.

Nonetheless, length of the anaerobic fermentation of vinegar in traditional and spontaneous methods is always a matter of contradiction; while some references reported an extended period for up to three weeks [12], others reported 15 days [15], and with substrate adjustments and controlled conditions, it can be as fast as 96 hours [14]. In general, TSS, pH, temperature, and yeast nutrient are the key factors in the anaerobic fermentation lasted for 9 days for the three cultivars, while in our previous study on 'Tasfert' dates; it lasted for two weeks due to using whole fruit [9].

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Performance of aerobic fermentation

TA and ethanol content (AC) are generally considered very important in the aerobic reaction, therefore they were measured weekly until AC dropped below 1%, the

upper limit for alcohol content sat be the Libyan Vinegar Specification (LNS 823: 2015). However, Table 2 shows ANOVA results for properties of the vinegar produced after natural acetification process that lasted 8 weeks for 'Athwi' and 'Talees' an additional 11 days for 'Hellawi'. Mean TA for the three cultivars were (6.72±0.15), (6.15±0.115) and (6.61±0.56) for 'Hellawi', 'Athwi' and 'Talees', respectively. As can be observed, cultivars were insignificantly different in their TA at ($p < 0.05$) level. However, for alcohol content (residues), significant differences among the three cultivars were noted, similar to the anaerobic stage. Post hoc Tukey Kramer HSD test showed that 'Hellawi' cultivar (0.87±0.105) was similar to 'Talees' (0.673±0.11), while 'Athwi' (0.442±0.128) was different from 'Hellawi' while similar to 'Talees'. Additionally, TSS content after acetification exhibited differences among the three cultivars, results showed 'Hellawi' cultivar (7.53±0.58) was significantly higher than 'Talees' (6.87±0.58) and 'Athwi' came lower at (6.13±0.058). Nevertheless, studies on comparing date cultivars in vinegar making are very scarce. In fact, virtually all reviewed literature had used one cultivar [11], [15], [14], [1].

Table 2. ANOVA Table for final vinegar properties

Source	SS	d.f	MS	F	P
Titratable acidity					
Between groups	0.36	2	0.18	1.65	0.27
Within groups	0.65	6	0.11		
Total	1.01	8			
Alcohol residues					
Between groups	0.28	2	0.14	10.4	0.011
Within groups	0.08	6	0.01		
Total	0.35	8			
TSS					
Between groups	2.94	2	0.147	441.3	0.000
Within groups	0.02	6	0.00		
Total	2.96	8			

Source: Results of the own experiments.

However, regardless of alcohol content as the primary middle stage between sugar and acetic acid, TSS around 15 ˚Brix produced acetic acid above 6% (v/v) with efficiency range 40–50%. It is important to mention that 'Talees' cultivar gave alcohol content lower than 'Athwi', but gave higher TA. This gives quite clear evidence that cultivar properties may be affected conversion efficiency of alcohol to vinegar.

Theoretically, ethanol conversion to acetic acid is at 1:1.304 ratio [14], thus final acetic acid yield for the three cultivars was in quite realistic range. In fact, the actual conversion efficiency of ethanol to vinegar of 'Athwi' was 100%, for 'Talees' was 83% and 'Hellawi' conversion efficiency was above that. Conversion efficiencies of 'Athwi' and 'Talees' were in good agreement with the finding of [14], for 'Hellawi' however; this may be linked to either conversion of sugar to alcohol that might occur during the acetification process. It could happen similar to reactions of one stage spontaneous fermentation processes [11]. Nonetheless, taking into account the uncontrolled fermentation conditions in addition to cultivar variations, results obtained from the current study were quite realistic.

Figure 2 shows the performance of the acetification process as accumulative titratable acidity (TA) (% v/v) and alcohol depletion (alcohol concentration) (% v/v), respectively. Acidity linearly increased throughout the acetification process. Acidity and acetification time were in quite good agreement with ref. [20] in their investigation of producing vinegar from coconut sap. Moreover, acetic acid accumulation was fairly linear for the three cultivars; it may be due to fermentation conditions, such as low temperature and natural aeration of the acetified material. Comparing such reaction behavior with acetification curve for Iraqi 'Khastawi' cultivar [15], similarities were observed between the starting point and the 32nd day of their aerobic reaction. Furthermore, a similar linear trend was presented [2] in their study on producing mango vinegar; both acetic acid accumulation and alcohol depletion were fairly linear but sharper than that recorded in the current study.

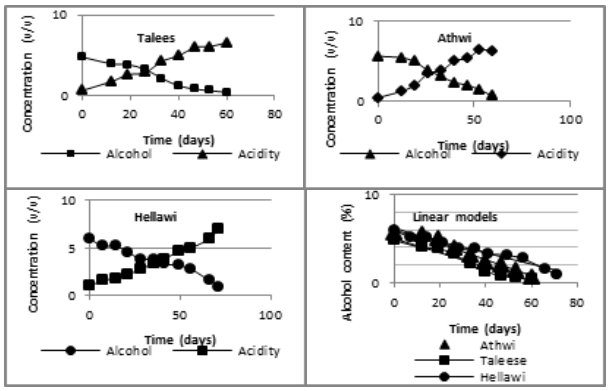

Fig. 2. Acetic acid accumulation and ethanol depletion
Source: Results of the own experiments.

Titratable acidity and alcohol depletion were fitted to linear models, as can be seen in Figure 2 (bottom right), yet linear relations and their R^2 are presented in Table 3. As can be observed, both acetic acid and alcohol depletion followed linear relations with R^2 values above 0.96. Acidity increase and ethanol depletion followed fairly linear in flatten relations for the three cultivars, flattening were mainly due to the slow ethanol conversion. Nonetheless, small variations among the three cultivars were noticed, such as the extra time taken for 'Hellawi' to drop alcohol content below 1%, once again it may be related to cultivar properties.

Table 3. Linear models of the acetic acid accumulation and alcohol depletion versus time (t)

Cultivar	Model	R^2
Alcohol content (AC) (%)		
'Talees'	AC = 5.001 - 0.081t	0.960
'Athwi'	AC = 6.211 - 0.090t	0.971
'Hellawi'	AC = 5.932 - 0.064t	0.967
Titratable acidity (TA) (%)		
'Talees'	TA = 0.592 + 0.105t	0.98
'Athwi'	TA = 0.317 + 0.108t	0.97
'Hellawi'	TA = 0.715 + 0.080t	0.98

Source: Results of the own experiments.

Vinegar quality assessment

Quantification of acetic acid

Figure 3 shows the acetic acid peak of 'Hellawi' vinegar sample analyzed by the HPLC system. Peak appeared at 2.17 minutes, yet peaks of other vinegar samples and standard are similar in time and shape. Peak area of the acetic acid standard injected at 0.1mM was used for converting areas acetic acid peaks eluted from injected vinegar samples to percentages. Acetic acid percentages for 'Hellawi', 'Athwi' and 'Talees' were calculated at 5.70, 5.36 and 5.70, respectively. On the other hand, titratable acidities were 6.71, 6.25 and 6.61 for 'Hellawi', 'Athwi' and 'Talees', respectively. This gives percentages of acetic acid from the total titratable acidity at 85%, 86, and 86% for the three cultivars vinegar, respectively, indicating other organic acids (undetermined) in the sample at nearly 1.5% (v/v). Nonetheless, it is quite anticipated that other organic acids exist in the fermentation [17] the presence of several organic acids other than acetic acid in wide range of vinegar produced from agricultural products was reported. Organic acids such as succinic acid, malic acid, tartaric acid, lactic acid, and citric acid were reported in a small percentage of less than 2% in several types of vinegars including grapes and apples.

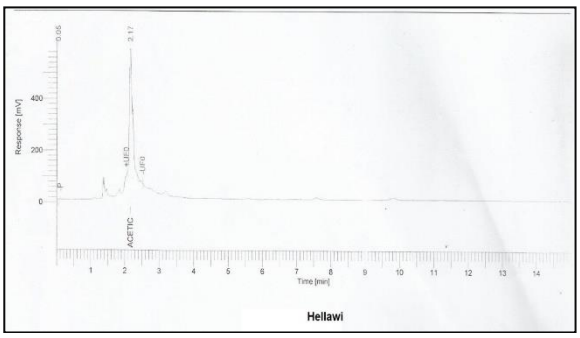

Fig. 3. Acetic acid peak in HAPLC analysis in Hellawi sample
Source: Results of the own experiments.

Thus, a good agreement of our work with the literature can be clearly observed. However, the scope of this work was to investigate the potential of the process and to perceive whether differences in reaction performance and quality attributes among investigated cultivars do exist. Thus quantifying acetic acid in vinegar of the three cultivars was mainly intended to confirm the acetic acid is dominant acid in the three types of vinegar.

Sensory evaluation

Figure 4 shows the graphical representation of the sensory results in acidity, taste, and acceptance. ANOVA results showed no significant differences among vinegar of the three cultivars in the three tested attributes.

Substantial variations were observed, this may be linked to the untrained panel. However, similar to analytical results, differences in mean acidity among the three cultivar kinds of vinegar can be clearly observed (first three columns in Figure 4).

Nonetheless, wide variations can be observed in the judgment of the panel to the tasted samples (error bars = standard deviations), it is rather normally occurring phenomena due to variations related to differences in human likeness and acceptance, and accordingly judgment to food items.

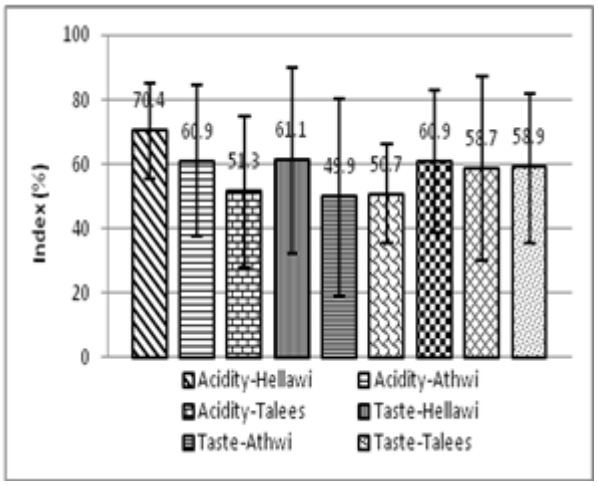

Fig. 4. Sensory analysis results
Source: Results of the own experiments.

However, quite similar observations were reported [12], in his sensory analysis to apple vinegar produced from several cultivars. Despite that, sensory evaluation gave a good indication of similarities between vinegar of the three cultivars, most important in acidity and acceptance, as it can be observed means were in quite close range.

Color analysis

Measured color attributes (L*, a*, and b*) were used in calculating two important color qualities, Hue angle and Chroma. Hue angle was calculated as Hu = tan-1 (b*/a*), while Chroma was calculated as $Cr = [(a^{*2}+b^{*2})^{1/2}]$, while L* presented the degree of lightness or darkness similar to the method was applied [18]. Nonetheless, Hue is an angle on the color circle (360˚). Generally, the circle is divided into four portions; 0-90˚ embodies red-purple Hues, 90-180˚ for yellow Hue, 180-270˚ for bluish-green, and 270-360˚ for blue Hue. Chroma, however, is the intensity of the Hue itself, while L* is the color lightness-darkness. Every three particular combinations give specific three-dimensional point within HunterLab color ball. Table 3 shows Tukey results for the three color qualities of vinegar, clearly, significantly different among the three cultivars exist. 'Hellawi' with lower Hue angle, Chroma, and L* had the darkest color, 'Athwi' and 'Talees', were significantly different among each other but much lighter than 'Hellawi'. Nonetheless, Hue of the three cultivars fell in the first quarter of the color circle, 'Hellawi' had relatively dark reddish color, while the other two were quite lighter towards yellowish. Generally, color is very much related to fruit pigments, indeed cultivars are quite different in this regard.

Table 4. Color attributes means (means with the same letter raw-wise are insignificant at ($p<0.05$)

Color attribute	'Hellawi'	'Athwi'	'Talees'
Hue Angle	26.9^{a}	39.55^{b}	42.04^{c}
Chroma	3.57^{a}	13.32^{b}	13.20^{b}
L*	15.88^{a}	21.05^{b}	19.23^{c}

Means with the same letter are no significantly different at 0.05 level
Source: Results of the own experiments.

CONCLUSIONS

Double stage fermentation method was applied for making vinegar from three Libyan date cultivars, 'Hellawi', 'Athwi' and 'Talees'. Sugars were extracted from dates and similar TSSs were used in the process. The anaerobic process lasted for 9 days, 'Hellawi' produced the highest alcohol percentage and the highest TSS remained after fermentation, followed by 'Athwi', while 'Talees' came last. The aerobic process lasted 8 weeks for 'Athwi and 'Talees' an extra 11 days for 'Hellawi', alcohol contents were converted to acetic acid with high efficiencies. No significant difference in acidity among the three cultivars, however, they exhibited differences in residual alcohol and TSS. Also, acetic acid accumulation and alcohol depletion followed linear models with R^2 above 96. HPLC analysis showed that

acetic acid is dominant in the three types of vinegar at about 85%. Color and sensory analyses were also carried out on kinds of vinegar. The difference in color among vinegar of the three cultivars were recorded, 'Hellawi' vinegar has the darkest color, while 'Athwi' and 'Talees' kinds of vinegar were rather lighter. Sensory evaluation in acidity, taste, and acceptance showed insignificant difference among kinds of vinegar of the three cultivars. The study demonstrated the potential of producing vinegar from the three investigated cultivars at acceptable quality.

ACKNOWLEDGEMENTS

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A STUDY ON THRESHING DEVICE WEARING BEHAVIOR FOR RICE HARVESTING COMBINE

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Abstract

The auxiliary roll of the rice combine harvester were developed and manufactured from local material to reduce wearing rate for threshing device also minimize fuel consumption and energy requirements. Replacing auxiliary roll knives arranged in a spiral instead by forks separating on length were 90 cm with seven rows and each row has four blades to increase the efficiency of separating the seed. The measurement indices of the auxiliary roll before and after development were threshing efficiency, threshing capacity, fuel consumption, power required, energy requirements, device mass losses percent, wearing rate, wearing resistance, critical wearing value, specific wear and expected life. during the harvesting operation of rice crop the rustles showed It is recommended to use the knife as a threshing device because auxiliary roll threshing efficiency increased by 0.2% threshing capacity increased by 16.83 %, fuel consumption decreased by 0.16 %, power required decreased by 0.15 %, energy requirements decreased by 0.33 % device mass losses percent decreased by 1.4 %, wearing rate decreased by 0.11 % wearing resistance decreased by 0.12%. critical wearing value increased by 34 %, specific wear decreased by 25 % and expected life increased by 78.60% all this result tested after 500h operating time.

Key words**:** *rice, threshing, capacity ,wearing, ,fuel, power and energy*

INTRODUCTION

The paddy is threshed by the pull force from threshing components. With bow tooth threshing, the grain is not easy to be damaged. Containing small power consumption, it can be adapted to thresh paddy. Wear cause from material rubbing between parts have the same or different materials. The rice threshing processing the use of certain materials that provide greater wear resistance. In these applications, specific alloys have been developed to eliminate certain types of wear.

Varenberg, (2013) [9] Classified of wear according to part moving wear occur in isolation or complex interaction. wear classified to surface fatigue, adhesive, abrasive wear, erosive and corrosion wear and oxidation wear other, less common types of wear are impact, cavitation and diffusive wear.

Rabinowicz, (1995) [7] The effect of volume percentage of reinforcement, applied load and sliding velocity on abrasive wear behavior was analyzed in detail. To judge the efficiency and ability of the model, the comparison of predicted and experimental response values outside the design conditions was carried out. The result shows, good correspondence, implying that, empirical models derived from response surface approach can be used to describe the tribological behavior of the above composite.

ASM Committee (2002) [1] stated that the kind of contact regulates the type of abrasive wear. The two styles of abrasive wear are known as two-body and three-body abrasive wear. Two-body wear occurs when the hard particles remove material from the opposite surface. The material being removed and displaced by a cutting operation. Three-body wear occurs when the particles are not constrained, and are free to roll and slide down a surface. The contact environment controls whether the wear is categorized as open and closed.

Fouda, T. and M. El-Tarhuny (2007) [3] test the wearing performance at different

shares tillage and measure the wearing indictors for tillage share with sandy loam soil**.**

Helmy et al. (2010) [5] developed the cutting blade crank of the combine for harvesting rice crop and selecting the combine optimum conditions. Also estimate the expected life for the cutting blade crank before and after development. Results indicated that by increasing operating time from 250 to 1,000 h. the wearing rate in combine cutting device increased from 0.044 to 0.062 g/h and from 0.03 to 0.04 g/h before and after development respectively. While the wearing resistance decreased from 79.5 to 56.45 km.g-1 and from 116.7 to 87.5 km.g-1 at the same condition.

Fu et al (2018) [4] said that Harvesting operations are related to grain loss because they touch the processes of rubbing, combing and grinding. Different contact patterns were established between the grain components and the contact points in all the previous processes. The results showed that the grain damage is a function of the peripheral velocity and the contact pattern of the effect. The grain loss can be considered as a function of the contact pattern

L. Xu, et al (2014) [10] Explain that threshing efficiency is of most importance when using a feed rate of 5 kg/s. The combinational threshing and separating unit with a transverse tangential cylinder and axial rotor was designed.

The design focused on the designing process of structural and operational parameters of transverse tangential cylinder tangential concave, transition section between transverse tangential concave and rotor concave, axial rotor and concave. Field test showed that the total loss was 1.47% and the damage rate was 0.2%, when the feed rate was 4.86 kg/s, which met the demands of the design.

The research problem appeared during the harvesting process when using the rice combine harvesting machine noticed increase in the accumulation of straw inside the auxiliary roll, which leads to Increase the spikes wearing rate , Increasing losses during the separation process, Low separation efficiency, Increase the harvest time addition to increase in wearing rate in spike. Thus, the spikes were replaced by cutting knife and fixed on a spiral bar made of iron. This knife cut the straw and have not accumulate and have a extended expected life.

The main objectives of this work to test the modifying of the auxiliary roll by estimate the expected life for spikes and knife under the experimental conditions.

MATERIALS AND METHODS

This experiment was carried out in Beheira Governorate, Dilangat Center, Abu Saifa district, during the two seasons of rice harvest 2018-2019.

Experimental design

Experiments were carried out to study the effect of device development on threshing drum. The wearing behavior tested under working time (from 1-500 hours) before and after development. Measuring indicators were threshing efficiency, threshing capacity, fuel consumption, power required, energy requirements, device mass losses percent, wearing rate, wearing resistance, critical wearing value, specific wear and expected life.

Rice characteristics:

Rice (Sakha 101) variety was used mean values of some rice characteristics are shown in Table 1.

Table 1. Rice variety (Sakha 101) specifications

Characteristic	Value
Plant height, cm	90
No. of grain per panicle.	115
No. of panicles/m^2	520
No of panicles/hill	22
Mass of mature grain/10 panicle, g	34
Mass of 1,000 grain, g	29
Yield, ton/fed	4.5

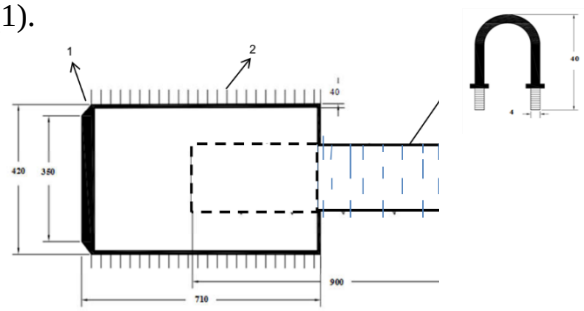
Source: Authors' determination.

The rice combines harvester adjustment

Combine harvester yanmar CA-385 Diesel, 3 cylinder, 4 strokes, water cooled were used. The optimum and constant operating conditions of 3.5 km/h forward speed, 23% grain moisture content.

Threshing drum before development

The threshing drum unit was made of hard steel metal, the unit consists of forks are installed in the threshing cylinder and randomly distributed, which reduces the efficiency of grain extraction as shown in Fig (1).

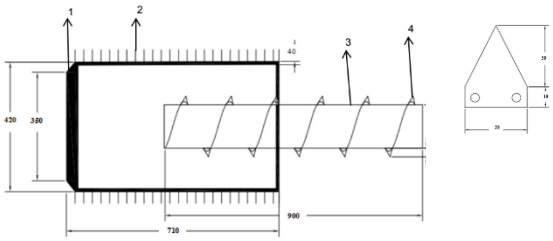


No	1	2	3	4
Part	Drum	Fork	cylinder	Fork

Fig. 1. Threshing drum device before development and fork shape
Source: Authors' drawing.

Threshing drum after development.

The threshing unit consists of 28 sharp knife blades instead of forks and made of hard steel with 30 mm in width and 40 in height. It was installed in a steel strip wrapped around the threshing cylinder in a spiral shape for easy exit of hay residues and it was fixed to the threshing cylinder by a solid tape shown in Fig. 2.



No	1	2	3	4
Part	Drum	Knife	cylinder	Knife

Fig. 2. Threshing drum device before development and Knife blades shape
Source: Author drawing.

The rice combine harvester and wearing measurements:

1-Threshing efficiency

The threshing efficiency was calculated from the following expression in Equation

$$\text{Threshing efficiency} = 100 - \frac{\text{Unthreshed grain}}{\text{threshed grain}} * 100,\%$$

2-Threshing capacity

The capacity was calculated using the following Equation

$$\text{Threshing capacity} = \frac{\text{Weight of total grain output main outlet}}{\text{Time recorded (min)}} * 60$$

3-Fuel consumption

Fuel consumption calculated by this equation:

$Fc = Ci - Cc$

Fc = Fuel consumption Ci = Full tank capacity Cc = Amount of remaining fuel in the tank after a specific period of time

Fc is used to calculate the fuel consumption per hour and the fuel consumption per kg of crop.

4-Power required

The following formula was used to estimate power

$$\text{Power required (EP)} = \frac{\mathbf{fc \times \rho \times l.c.v \times 427 \times \eta_{th} \times \eta_m}}{\mathbf{3600 \times 75 \times 1.36}}$$

where:

EP = engine power, Kw,

f.c = the fuel consumption in l/h.

PE = the density of fuel in kg/l(for gas oil = 0.85)

L.C.V = the lower calorific value of fuel in 11 k.cal/kg,

η_{th} = thermal efficiency of the engine (35 % for diesel),

η_m = mechanical efficiency of the engine (80% for diesel and 85% for Otto).

5- Energy requirements

Specific energy = 3.163 Fc/Ap , kW.h/ ton

where: Fc = the required power, kW

Fc = fuel consumption, L/h.

Ap = Actual system productivity = Wg * Pr , ton/h

6-Device mass losses percent

Device mass losses percent was calculated as follows:

$$\text{Device mass losses percent} = \frac{W_0 - W}{W_0},\%$$

where: W_0 = mass of device before using and W = mass of device after using

7-Wearing rate

Wearing rate was calculated as a removal weight g., or removal area from device surface divided by operating time h., as follows:

$$\text{Wearing rate} = \frac{\text{The removal of materials from device surfaces, g.}}{\text{time h.,}}$$

8-Wearing resistance

Wearing resistance was calculated as inverted wearing rate (Kantarc 1982) [6].

$$\text{Wearing resistance, km/g.} = \frac{1}{\text{Wearing rate, g/km}}$$

9-Critical wearing value

Critical wearing value was calculated as hardness device surface, St divided by hardness of abrasion At = 1,060 quartz hardness, (Eyre 1976) [2].

$$\text{Critical wearing value} = \frac{S_T}{A_T}$$

10-Specific wear

Specific wear was calculated as follows:

$$\text{Specific waer} = \frac{\text{The removal of materials from device surfaces, g.}}{\text{volume of rice m}^3}$$

11- Expected life

Expected life was calculated as follows:

$$\text{EL, h.} = \frac{\text{weight of new device, g - weight of worn device after the expected wear, g.}}{\text{wearing rate, g/h.}}$$

weight of worn device after the expected wear =1/3*weight of new device (Ulusoy, 1977) [8].

RESULTS AND DISCUSSIONS

The obtained results will be discussed under the following items:

Threshing efficiency

The threshing efficiency were tested under two device fork and knife as a threshing device before and after development (Fig. 3).

It clearly revealed that, the average of threshing efficiency increased after development to reach at maximum value with 98.80 % at 50 h. from operating time.

The relationship of operating time and threshing efficiency when used knife be expressed using regression equation as:

$y = -0.1097x + 99.033$ $R^2 = 0.9918$.

Also Linear relationship was obtained. when used fork $y = -0.1145 x + 98.82$ $R^2 = 0.994$

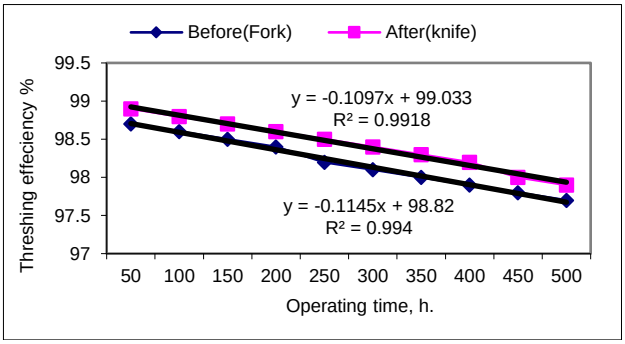


Fig. 3. Effect of operating time on threshing efficiency before and after development (used fork and knife)
Source: Authors' determination.

Threshing capacity

Increasing of operating time from 50 to 500 h the threshing capacity decreased from 3,547 to 2,198 kg/h. before development at a constant grain moisture content of 23% and forward speed of 3.5 km/h Also, by increasing of operating time from 50 to 500 h the threshing capacity decreased from 4,000 to 2,643 kg/h. after development at the same condition. The relationship of operating time and threshing capacity when used knife be expressed using regression equation as:

$y = -166.73x + 4305.5$ and $R^2 = 0.9877$. Also, Linear relationship was obtained. when used fork $y = -177.89x + 3939.2$ and $R^2 = 0.9632$ as showing in Fig.4

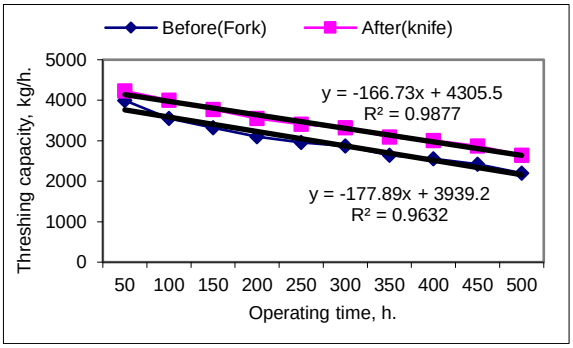


Fig. 4. Effect of operating time on threshing capacity before and after development (used fork and knife) at constant rice moisture content 23%
Source: Authors' determination.

The fuel consumption

The effect of operating time on fuel consumption using Yanmar combine before and after development. is shown in Fig. 5 the results revealed that increasing of operating time from 50 to 500 h the fuel consumption increased from 4.7 to 8.4 l/fed. before

development at a constant grain moisture content of 23% and forward speed of 3.5km/h. Also, by increasing of operating time from 50 to 500 h the fuel consumption increased from 4.4 to 7 l/fed at the same conditions. Also, the results show the lower fuel consumption decreased of the developed drum than the original drum. Where the lowest value for fuel consumption was 4.7 L/fed, 4.4 L/fed in the original drum, the developed drum respectively.

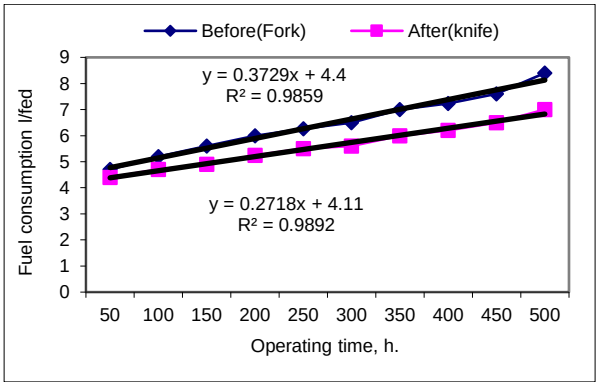


Fig. 5. Effect of operating time on fuel consumption before and after development (used fork and knife) at constant rice moisture content 23%
Source: Authors' determination.

The power required.

Fig. 6 illustrate the effect of operating time on required power before and after development. The results evident that increasing of operating time from 50 to 500 h the required power increased from 14.9 to 26.54 kW before development at a constant grain moisture content of 23% and forward speed of 3.5 km/h.

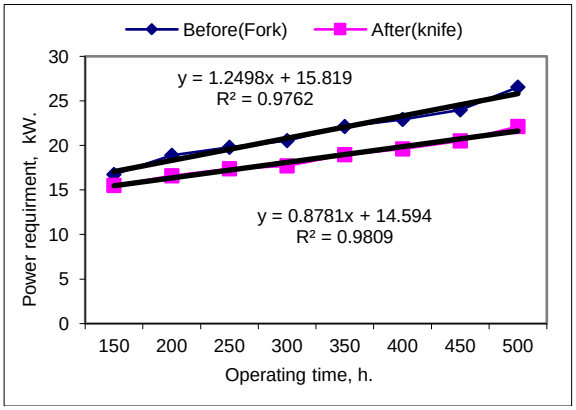


Fig. 6. Effect of operating time on power requirement before and after development (used fork and knife)
Source: Authors' determination.

Also, by increasing of operating time from 50 to 500 h the required power increased from 13.9 to 22.12 kw after development at the same condition. The results show the lower required power decreased of the developed drum than the original drum. Where the lowest value for required power was 14.9%, 13.9% in the original drum, the developed drum respectively.

The energy requirements

Fig. 7. reflects the results which point out that increasing of operating time from 50 to 500 h the energy requirement increased from 3.73 to 12.07 kw.h/ton before development at a constant grain moisture content of 23% and forward speed of 3.5 km/h. Also, by increasing of operating time from 50 to 500 h the energy requirement increased from 3.28 to 8.37 kw.h/ton after development at the same condition. The relationship of operating time and threshing capacity when used knife be expressed using regression equation as:

$y = 0.494x + 2.6173$ and $R^2 = 0.9155$. Also, Linear relationship was obtained. when used fork: $y = 0.838x + 2.6613$ and $R^2 = 0.969$.

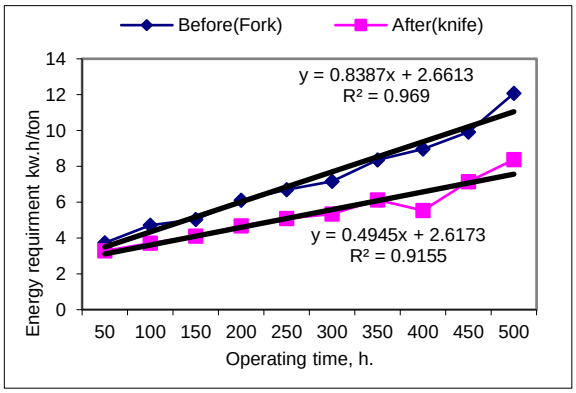


Fig. 7. Effect of operating time on power requirement before and after development (used fork and knife)
Source: Authors' determination.

The device mass losses percent

Fig. 8 showed the effect of operating time on device mass losses present. Data obtained show that increasing operating time from 50 to 500 decreases device mass losses present from 1.2 to 17.3% and from 0.6 to 11.4 % at constant forward speed 3.5 km/h and grain moisture content 23% before and after development respectively. Also and the results show that the highest device mass losses present which decreases from17.3to

11.4% in the original drum, the developed drum respectively, and the lowest device mass losses present which increases from 1.2 to 0.6 in the original drum, the developed drum respectively.

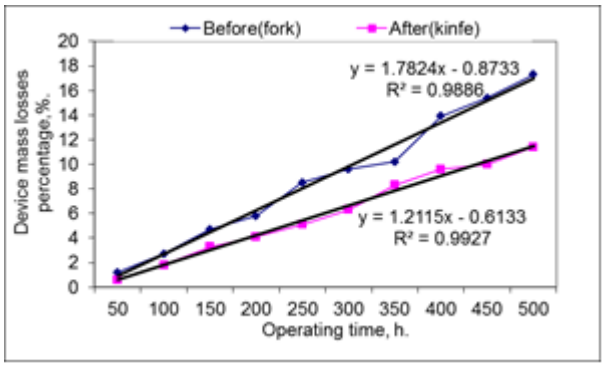


Fig. 8. Effect of operating time on device mass losses present before and after development (used fork and knife)
Source: Authors' determination.

The wearing rate

The effect of operating time and device shape before and after development in auxiliary roll on device wearing rate in threshing combine harvest shown in Fig. 9. The results showed that the increase of operating time resulted in increased in wearing rate in both original and modified drum under all operating periods. In all cases original drum showed higher wearing rates under operating periods than modified drum.

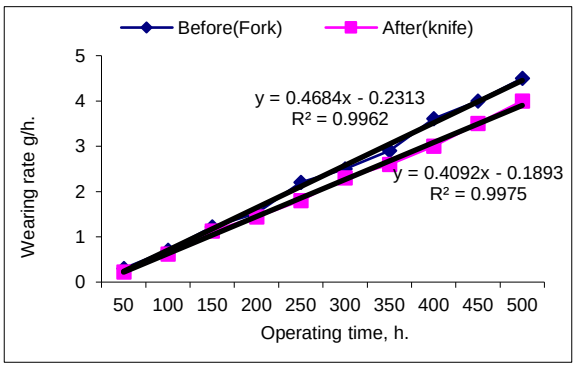


Fig. 9. Effect of operating time on wearing rate before and after development (used fork and knife)
Source: Authors' determination.

Results indicated that by increasing operating time from 50 to 500 h. the wearing rate in threshing combine harvest device increased from 0.3 to 4.5 g/h. and from 0.22 to 4.0 g/h before and after development respectively. The results showed that, the lowest wearing rate was 0.3 and 0.22 g/h. presented at 50 h. before and after development respectively, while the highest wearing rate was presented at 500 hrs. 4.5 and 4 g/h. in both original and modified drums, respectively. Due to the increase of friction with the increase in the operating periods.

The wearing resistance

The relationship between operating time and wearing resistance in threshing combine harvest device before and after development shown in Fig. 10. Results indicated that by increasing operating time from 50 to 500 h. the wearing resistance decreased from 3.33 to 0.22 h/g. and from 4.54 to 0.25 h/g. before and after development the relationship of operating time and wearing resistance when used knife be expressed using regression equation as: $y = 3.9473x^{-1.212}$ and $R^2 = 0.9919$. Also, Linear relationship was obtained when used fork: $y = 3.23x^{-1.158}$ and $R^2 = 0.9966$.

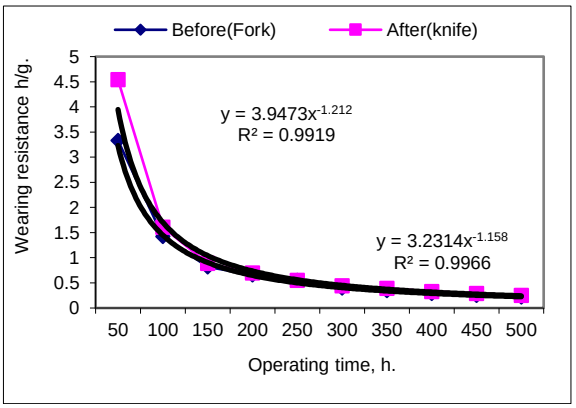


Fig. 10. Effect of operating time on wearing resistance before and after development (used fork and knife)
Source: Author determination.

The critical wearing value

Fig. 11 showed that, the effect of operating time and device shape before and after development in auxiliary roll on critical wear value. Data obtained show that increasing operating time from 50 to 500 decreases critical wear value from 1.92 to 1.6 and from 8.43 to 7.5 at constant forward speed 3.5km/h and grain moisture content 23% before and after development respectively .Also and the results show that the highest critical wear value which increases from 1.92 to 8.43 in the

original drum, the developed drum respectively, and the lowest critical wear value which increases from1.6 to 7.5in the original drum, the developed drum respectively, The obtained results prove that the knife can resist the wear by increasing its critical wear value.

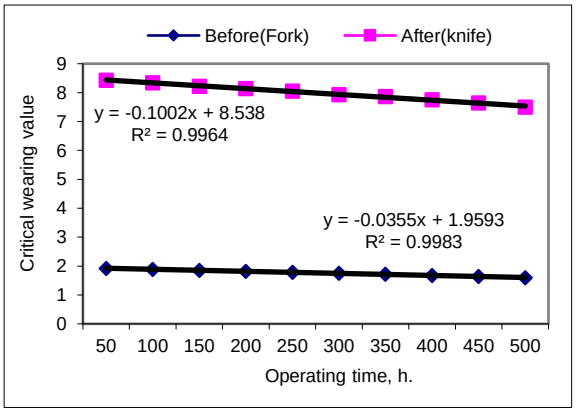


Fig. 11. Effect of operating time on critical wear value before and after development (used fork and knife)
Source: Authors' determination

The specific wear

The relationship between operating time and specific wear in threshing combine harvest device before and after development shown in Fig. 12. Results indicated that by increasing operating time from 50 to 500 h. the specific wear decreased from 0.60 to 1.60 g/m^3. and from 0.4 to 1.20 g/m^3. before and after development The relationship of operating time and specific wear when used knife be expressed using regression equation as:

$y = 0.1669 x - 0.212$ and $R^2 = 0.9778$. Also, Linear relationship was obtained. when used fork: $y = 0.1221x - 0.1293$ and $R^2 = 0.9783$.

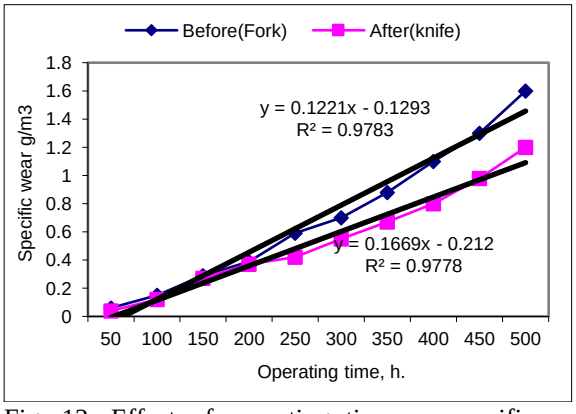


Fig. 12. Effect of operating time on specific wear before and after development (used fork and knife)
Source: Authors' determination.

The device expected life

Fig. 13 shows the effect of operating time on device expected life Data obtained show that increasing operating time from 50 to 500 decreases device Expected Life from 57.7 h to 3.8 h and from 105.9 h to 5.8 h before and after development respectively. Also, the results show that the highest device Expected Life which increases from 57.7 h to 105.9 h before and after development, and the lowest device Expected Life which increases from 3.8to 5.8 in the original drum, the developed drum respectively, The obtained results prove that the knife can resist the wear by increasing its Share Expected Life.

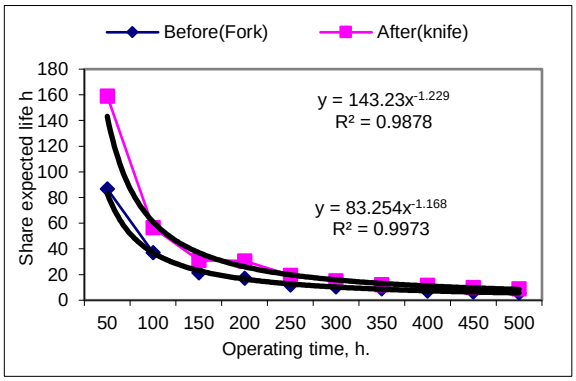


Fig. 13. Effect of operating time on device expected life before and after development (used fork and knife)
Source: Authors' determination.

CONCLUSIONS

The development of the combine threshing device during harvesting rice crop gave to maximum threshing efficiency, threshing capacity, wearing resistance and share expected life minimum required power, energy, wearing rate, fuel consumption and device mass losses percent. With the optimum conditions for operating the combine during harvesting rice crop.

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HEAT CONDITIONING AND OIL STABILIZATION OF FLAXSEEDS UNDER TWO DEFERENT HEATING METHODS

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Abstract

The present work aims tot Study the effect of using two different heating methods on stabilization of flaxseeds using a rotating cylindrical dryer with conduction & infrared heating systems. The study also tested and evaluated two different mathematical models to describe the drying behavior of flaxseed, with linking the constants in the Mathematical examined equations to the experimental variables. The most appropriate mathematical model to describe the behavior of flaxseed moisture loss was also determined. The samples used for experimental work were fresh flax seed at moisture content 11±1 % wb. Four different temperatures of the surface of the cylinder (90, 105, 120 and 135ºC at 3, 6. 9, 12, 15 and 18 minutes were examined for the conduction heating dryer. At Infrared treatments fixed feeding rate of 2 kg was used at radiation intensity of 53.01, 331.6, 477.5, 848.89 and 1,326.39 w/m^2 and exposure times of 3, 6. 9, 12 and 15 minutes. The results showed that, for conduction heating process using heat treatment at 105 ^{0}C for min gives the best result in terms of lower free fatty acids and peroxide value, But in Infra-red treatment the best result was obtained at 331.59 w/m^2 for 15 min.

Key words**:** *flax, heat treatment, Infrared, time, temperature, free fatty acid, peroxide value*

INTRODUCTION

Flax (Linum usitatissimum) is a plant, which belongs to the family of linaceae with seeds commonly known as flaxseed or linseed. Brown flax and golden flax (sometimes called yellow flax) are the two basic varieties of flax with similar nutritional composition. However, golden flaxseed has a nutty-buttery flavor and an eye-appealing golden color, which makes it an attractive and tasty addition to our diet.

Flax knew in Mesopotamia five thousand years ago and was cultivated in Egypt by more than three thousand years. It has been known since ancient medical abilities, but his fame has recently discovered a lot of medical benefits such as: source of omega three necessary for the safety of the heart, protection against breast cancer, reduction of the symptoms of menopause and facilitated digestion and relieved symptoms of constipation (Rajju et al., 2016) [10].

Soni *et al.* (2016) [11] reported that flaxseed cultivated in many parts of world for fiber, oil as well as for medicinal purposes and also as nutritional product. Flax was valued in Ancient and Early Modern times as both a food and medicine. In this review, nutrients, anti-nutrients, functional properties and health benefits of bioactive molecules viz, essential fatty acids, lignans and dietary fiber of flaxseed are discussed. Flaxseed contains good amount of Alpha-Linolenic Acid (ALA), omega-3 fatty acid, protein, dietary fiber, lignan specifically Secoisolariciresinol diglucoside (SDG).

Coskuner and Karababa (2007) [3] studied the length, width, thickness and geometric mean diameter of flaxseeds.

El-Kholy and Tharwat (2008) [4] carried out a study to test and evaluate the effect of accelerated drying of canola on seeds moisture content, fungal load on seeds surface and stabilization of the extracted oil using a conduction heating rotary dryer. The results showed that all the drying process occurred at

the falling rate period in which the rate of evaporation tends to fall as the moisture content decreases and the drying curve decays exponentially towards the equilibrium moisture content. Rapid moisture removal from seeds was obvious in all experiments particularly at higher heating surface temperature and longer exposure time.

Matouk *et al.* (2012) [8] tested and evaluated the effect of accelerated drying of sunflower seeds on seeds moisture content, fungal load on seeds surface and stabilization of the extracted oil using a conduction heating rotary dryer. The drying temperatures were set at approximately 75, 85, 95, 105, 115, 125, 135 and 145^{o}C and the drying times were set at 3, 6, 9, 12 and 15 min. The results showed that all the drying process occurred at the falling rate period in which the rate of evaporation tends to fall as the moisture content decreases and the drying curve decays exponentially towards the final moisture content .Rapid moisture removal from seeds was obvious in all experiments particularly at higher heating surface temperature and longer exposure time. The results also showed that the simple equation was satisfactorily described the drying behavior of sunflower seeds and predicted the change in seeds moisture content as indicated by the higher coefficient of determination (R^2). Meanwhile, high temperature conduction heating reduced the fungal load in sunflower seeds in an effective manner. Also, the extracted sunflower oil was stabilized at certain combinations of heating surface temperature and exposure time as indicated from the lower values of free fatty acids of the these samples. It can be said that, the accelerated drying and heat stabilization of sunflower seeds using the conduction heating rotary dryer may be considered as an effective procedure for moisture reduction, fungal inactivation and oil stabilization. In general , heating surface temperature of 145^{o}C and the exposure time of 15 min are recommended to decrease the moisture content of sunflower seeds to the safe level of 5.8% (w.b), the fungal load to 102 colonies/g. and the percentages of free fatty acids to1.97% .

Grompone *et al.* (2013) [5] mentioned that the fatty acid composition as well as the antioxidant composition and content of two commercially available chia oils of different origins were studied. The purpose of this work was the study of the oxidative stability from different methods and the antioxidant content of the chia oils compared with other commercial oils. The oxidative stability of the oils was determined based on the oxidative stability index test (OSI test) conducted at 110 °C and isothermal as well as non-isothermal differential scanning calorimeter (non-isothermal DSC) for the chia oil and the linseed oil. The OSI induction time of chia oil was compared with that of commercially available linseed, canola, sunflower and high-oleic sunflower oils, chia oil being the least stable oil among those studied. The inherent stability value and oxidazibility for linseed oil was lower than the chia oil A may be ascribed to a lower linolenic acid content of the former. The induction time (It) quotient at 110°C calculated for chia oil A and linseed oil were similar, suggesting a high degree of consistency between the results obtained by the two methods. The activation energy and specific reaction rate constant of chia and linseed oils were compared based on the results of isothermal and non-isothermal DSC. An apparent inconsistency in the experimental data results from the temperature-dependence of the activation energy of each fatty acid which can explain because the methods conditions were different.

Turner *et al.* (2013) [12] reported that flaxseed pasteurization at 148°C for 16.25 minutes was found to be detrimental to the oxidative stability of flaxseed once milled. Significant ($P \leq 0.05$) elevation of peroxide values in the pasteurized samples was found after two weeks of storage at room temperature compared to the raw flaxseed treatments. The progression of oxidation was observed through the elevation of peroxide values and propanal content over the course of the storage study. The application of heat to pasteurize flaxseed likely resulted in damage to the seed, resulting in flaxseed instability and an increased predisposition to lipid oxidation. Milling pasteurized flaxseed under refrigerated conditions did not significantly ($P > 0.05$) increase the oxidative stability

compared to pasteurized flaxseed milled under ambient temperatures over the 20 week storage period. Pasteurization of flaxseed at 148°C for 16.25 minutes using a dry heat with minimal packaging is not recommended, as it can significantly reduce the shelf life of milled flaxseed.

The main objective of this research to test two different heating methods on stabilization of flaxseeds using conduction and infrared heating systems. The study also evaluated two different mathematical models to describe the drying behavior of flaxseed.

MATERIALS AND METHODS

The present study aims at testing and evaluating two different methods of heating (conduction and infrared) in moisture reduction, heat stabilization, microbial load reduction and oil quality of the flaxseeds. An accelerated rotary dryer with two different sources of heat (conduction heating and Infrared heating) was developed to be suitable to heat the seeds of flax for moisture reduction, surface sterilization and oil stabilization. The experimental work was conducted at the Rice Mechanization Center, Agric. Eng. Res. Institute, Kefir El-Sheikh Governorate.

Sampling

Flaxseeds variety (Evona) was used for the experemintal work. Physical and mechanical charactarities of tested seeds are presents in Table (1).

Table (1) Physical and Mechanical Properties of flax seeds Var. (Evona)

Properties	Whole seed	Properties	Whole seed
Length (mm)*	5.50±0.23	Moisture (%)	5.08±0.45
Width (mm)*	2.68±0.18	Fat (%)	39.51±1.05
Thickness (mm)*	1.17±0.24	Protein (%N×6.25)	21.38±0.38
Geometric mean diameter (mm)	2.58±0.18	Ash (%)	2.83±0.20
Sphericity (%)**	42.31±0.49	Crude fiber (%)	3.57±0.48
True density (kg/m^{-3})	1025.33±2.89	Carbohydrate (%) **	28.04±0.36**
Bulk density (kg/m^{-3})	696.67±1.15	Trypsin inhibitors (TIU/g)	29.33±0.23
Angle of repose (°)	26.29±0.46	Flavonoid compounds(mg/100g)	39.99±1.41
Rupture force (N)	41.97±0.38	Total phenolics as gallic acid (mg/100g)	230.0±1.04
Deformation (mm)	0.37±0.13	Phytic acid (mg/100 g)	770.0±0.5
1,000 seed mass (g)	7.38±0.14		

Source: Ministry of Agriculture and Reclamation, Agricultural Research Center laboratory [9].

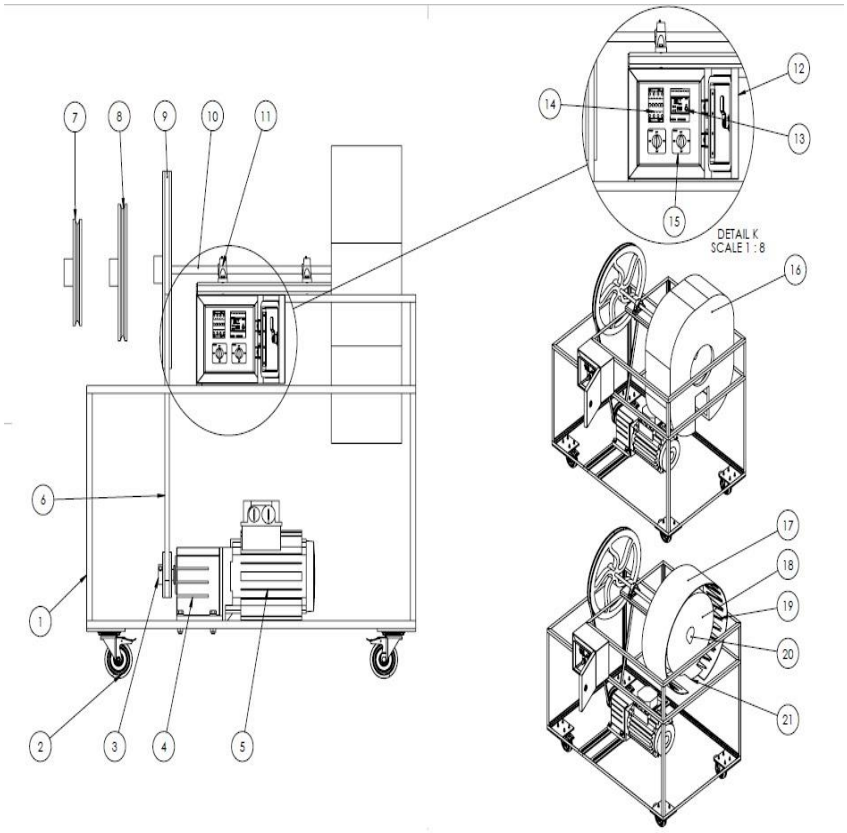
The harvesting and threshing operations of the tested flaxseeds were executed at initial moisture content of (11 ± 1 %) (w.b). Unfilled seeds and other impurities were discarded from the harvested seeds. The flax seeds were sealed in separate polyethylene bags. The bags were stored in a freezer adjusted at temperature of - 5 ± 1^{o}C to prevent moisture loss and fungal growth throughout the storage period. Before each test, the required quantities of seeds were taken out from the freezer and allowed to reach the normal room temperature. The moisture content of the samples was measured just before each test.

The accelerated rotary dryers (Conduction and Infrared heating):

The heat treatment units for conduction and infrared processes are presented in Figures 1 and 2.

The two heating units were fabricated at the workshop of Rice Mechanization Center, Agric. Eng. Res. Institute, Kafr El-Sheikh Governorate. Each units consists of a rotary cylinder (0.6 m in diameter and a 0.2 m long) made of 1 mm galvanized iron steel sheet enclosed by a fixed insulated cylinder (0.8 m in diameter and 0.3 m long).

One side of the rotary cylinder connected to a driving mechanism consists of 0.15 m diameter steel flange fixed to the side cover of the rotary cylinder and welded to a steel bar riding into a heavy-duty ball bearing.



No.	Part Name
1	Chassis
2	Wheel
3	Motor Pulley
4	Gearbox
5	Motor
6	V-belt
7	35 cm Pulley
8	45 cm Pulley
9	60 cm Pulley
10	25 mm Shaft
11	Earing with housing
12	Control unit
13	Differential thermostat
14	Magnetic conductor
15	On/Of switch
16	Fiberglass insulation
17	Outer Cylinder
18	Inner Cylinder
19	Heater
20	Inlet gate
21	Outlet gate

Fig. 1. Schematic diagram of the accelerated drying unit
Source: Authors' drawing.
Note: The surface temperature of the conduction heating rotary cylinder could be raised up to 175ºC and maintained within ± 1ºC using a precise thermostat controlled by an electric contactor.

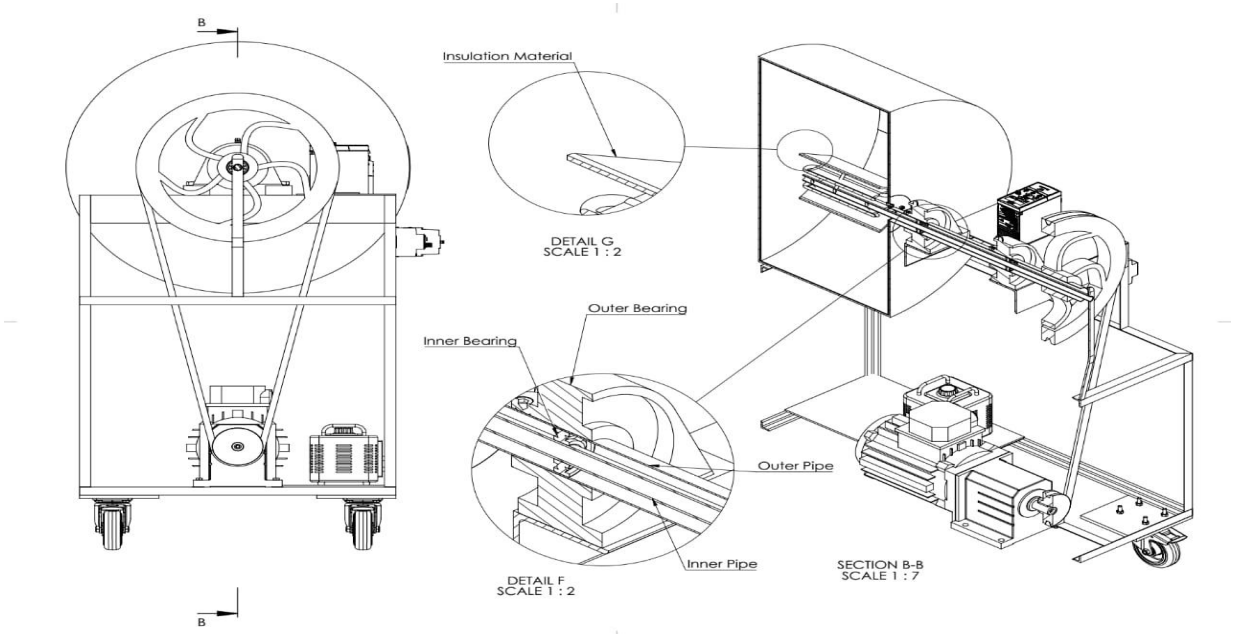


Fig. 2. Diagram of the infra red drying unit
Source: Authors' drawing.

A 0.5 kW low speed motor with different sizes of pulleys was used for power supply and speed control of the rotary cylinder.

The other side of the rotary cylinder serves as an inlet for flax seeds samples through a 0.1 m diameter center hole. The heat-treated flax

seeds discharged through a perforated removable sector of the cylinder bottom. For heating and temperature control of the rotary cylinder units, the conduction heating unit was provided with 2 kW electric resistance heater placed at the inner surface of the fixed insulated cylinder (between the rotary cylinder and the insulated exterior cylinder) while the infrared heating unit was provided with 2 kW infrared heaters and dimmer for controlling the radiation intensity.

The seeds temperature of the conduction heating rotary dryer was depended upon the heating surface temperature of the rotated cylinder and the exposure time, while, the temperature of seeds treated by infrared heating surface was depended upon radiation intensity of the heat source and the exposure time.

Experimental Treatments

Flax seeds was tested under initial moisture content of (11±1 % w.b). The conduction heat treatments were proceeded at five levels of heating surface temperature (90, 105, 120, 135 and 150^{o}C) and six levels of exposure time (3, 6, 9, 12, 15 and 18 minutes) and feeding rate of 2 kg. While, the tests of infrared unit was conducted at five different intensity levels (53.01, 331.6, 477.5, 848.89 and 1,326.39 W/m^2) at exposure times of 3, 6. 9, 12 and 15 minutes with fixed feeding rate of 2 kg. Two different mathematical models were examined to describe the moisture loss behavior of flaxseed, with linking the constants of the examined models with the experimental variables. Beside that the most appropriate mathematical model to describe the behavior of flaxseed moisture loss was assessed and evaluated.

Test procedure and Measurements

Test procedure

For the conduction heating unit, prior to each experiment, a dummy sample was used. The temperature of the cylinder surface was adjusted at the required level. When the surface temperature of the rotary cylinder became stable, the dummy sample was discharged and replaced by the testing sample; similar procedure was also used for the infrared experimental work. After heating, the seeds were feed into the rotating cylinder and the dryer was operated to the required heating time for both heating methods. The heat treated samples were cooled to room temperature in wooden box covered with a perforated aluminium foil to allow gradual escape of steamer during the cooling process. After cooling process, the heat treated seeds were taken out from the cooling wooden box, and then divided into two sub samples, the first one was used to determine seeds final moisture content, while the second was used for oil extraction and determination of Free Fatty Acid (FFA %) and Peroxide value.

Experimental Measurements and Instrumentation

Surface temperature of the rotary cylinder

The remote–type infra red spot thermometer model (HT-11) was used to measure the rotary cylinder surface temperature of the conduction heating unit. The emissive of the thermometer was adjusted at 0.85 for iron sheet surfaces and the temperature was measured at different points. The heating surface temperature was considered as the average of the obtained readings.

Moisture content of flax seeds

The standard A.O.A.C (1991) [1] moisture measuring method was used for determining the seeds moisture content after each drying run. 100 grams of flax seeds were placed at 105^{o}C for 4 h, and then kept in a desiccators at room temperature. The dried samples were weighed again using an electronic digital balance and the moisture content of flaxseeds was calculated on wet and dry basis.

$$M_{wb} = \frac{w_o - w_d}{w_o} 100\%$$

While the moisture content on dry basis is the weight of moisture present in the product per unit weight of dry mater in the product and represented as

$$M_{db} = \frac{w_o - w_d}{w_d} 100\%$$

Mathematical models applied to the drying process

The simple drying equation Lewis's (1921) [7] and the modified simple drying equations Henderson and Pabis's (1961) [6] were

examined for describing the drying behavior and predicting the change in flax seeds moisture content during the heat treating process. The examined drying equation written as follows:

$$MR = \frac{M - M_e}{M_o - M_e} = \exp(-k_s t)$$

$$MR = \frac{M - M_e}{M_o - M_e} = Ae^{-kt}$$

where:
MR: Moisture ratio, dimensionless
M: Instantaneous seeds moisture content at time t, (%, w.b)
Me: Equilibrium moisture content. (%, w.b)
Mo: Initial moisture content, % (w.b.).
t: Time, min
ks: Drying constant, min^{-1}
K, A: Drying constants.

There is no information available about the equilibrium moisture content of flax seeds in a temperature range of 90 to 135°C when the air relative humidity is very low.

However the flax seeds will be bone dried after prolonged heating under such condition. So the moisture ratio was approximated simply by dropping the equilibrium moisture content term and thus the ratio of instantaneous seeds moisture content to its initial moisture content was used for representing seeds moisture ratio.

The drying constant (ks) of the simple exponential model was obtained by applying linear regression analysis to the logarithmic value of (M/Mo) and the drying time (t). The slope of the best fit straight line represents the value of the drying constant (ks).

The simple exponential model (3-4) has been converted to the following from:

$$MIR = \frac{M}{M} = \exp(-k_s t)$$

While, The modified Simple Exponential model was Converted to the following form:

$$MR = \frac{M}{M_o} = A\exp(-k_h t)$$

The drying constant (k_h & A) of the modified simple drying model were obtained by applying linear regression analysis of the value Log (M/Mo) and the drying time (t). The slope of the best fit straight line represent the drying constant (k_h) and the intercept represents the Constant(A).

Quality evaluation tests of heat treated seeds

Oil extraction

Experiments were undertaken to extract flax seed oil and detremine the oil extractions percntage. The amount and the characteristics of the extracted oil in terms of FFA % and Peroxide value.

Acid value (A.V) of flaxseed oil

Acid value was determined according to the method descried by A.O.A.C (2005) [2]. A Known whight of the melted sample (ca 2.5 g) was dissolved in 25 ml of petroleum ether alcohol mixture (1:1, v/v). The contents of the flask were heated on a steam bath for 2 min. then titrated with alcoholic potassium hydroxide (0.1 n) in the presence of phenolphthalein as an indicator. The acid value was caculated according to the following equation:

$$AcidValue = \frac{V \times N \times 56.1}{W}$$

where:
V: Volume of alkali required to naturalize the free fatty acids.
N: Nomality of KOH.
W: Weight of sample.

Peroxide value (P.V) of flaxseed oil

Peroxide value was measured according to the method describe by A.O.A.C (2005) [2]. Five grams of melted lipid samples were dissolved by 50 ml of acetic acid chloroform mixture (2:1, v/v). One ml of saturated potassium iodide solution was added, then the mixture allowed to stand with occasional shaking for exactly 1 min and 30 ml of distilled water were added. The contents of flask were titrated with 0.1 N sodium thiosulphated solution until the yellow color had almost disappeared. Starch solution indicator (0.5 ml) was added and titration was continued until the blue color had just disappeared. The following equation was used to calculated the peroxide value of lipid samples under study.

Peroxide value= $\frac{S \times N \times 1000}{W}$

where:
S: Titration of sample, ml.
N: Normality of sodium thiosulphate.
W: Weight of lipid sample, g.

Free fatty acid (FFA%) of flaxseed oil

Oil samples were extracted from flaxseeds by cold mechanical extract machine. The FFA % of oil samples were calculated as oleic acid using the corresponding acid value of each sample according to the A.O.A.C. (2005) [2] as follows:

$$\text{FFA \%} = \frac{282 \times 100 \times Acidvalue}{56.1 \times 1000}$$

$$\text{FFA \%} = \frac{A.V}{1.99}$$

where: A.V: Acid value.

RESULTS AND DISCUSSIONS

A typical plot showing the change in seeds moisture contents as related to drying temperature during the conduction and infrared heating of high moisture flaxseeds is illustrated in Figs. 3, 4 and 5, respectively. As shown in the Figures rapid moisture removal from flaxseeds was obvious particularly at higher levels of heating surface temperature and infra red intensity.

Change in seeds bulk temperature

A typical plot showing the change in grain bulk temperature as related to heating temperature for both conduction and infrared heating methods are illustrated in Fig. 5.

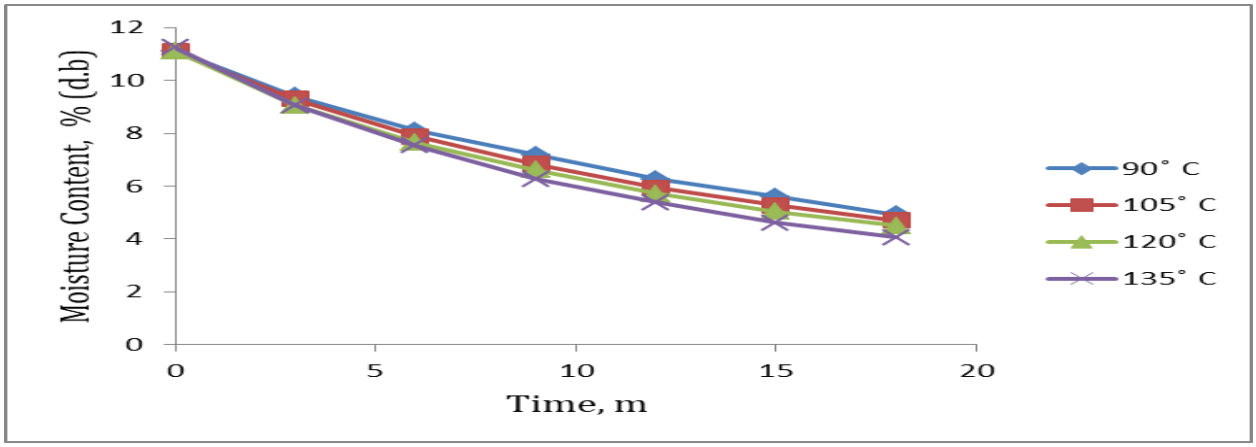


Fig. 3. Change in grain moisture content as related to heating time, at different surface temperature and rotation speed 15 r.p.m.
Source: Authors' determination.

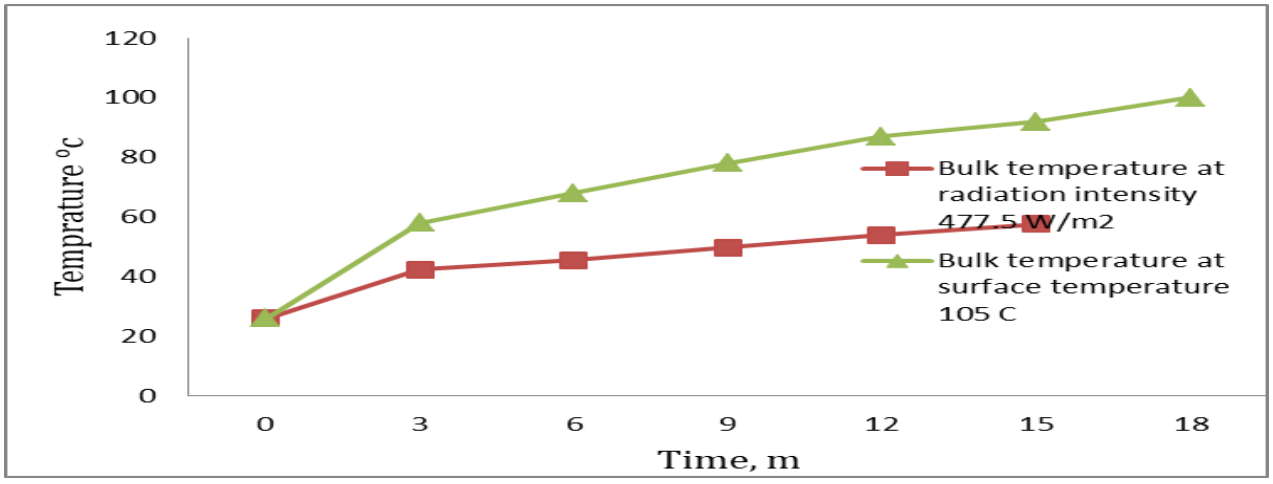


Fig. 4. Change in grain moisture content as related to heating time, at different radiation intenisity and rotation speed 15 r.p.m.
Source: Author determination.

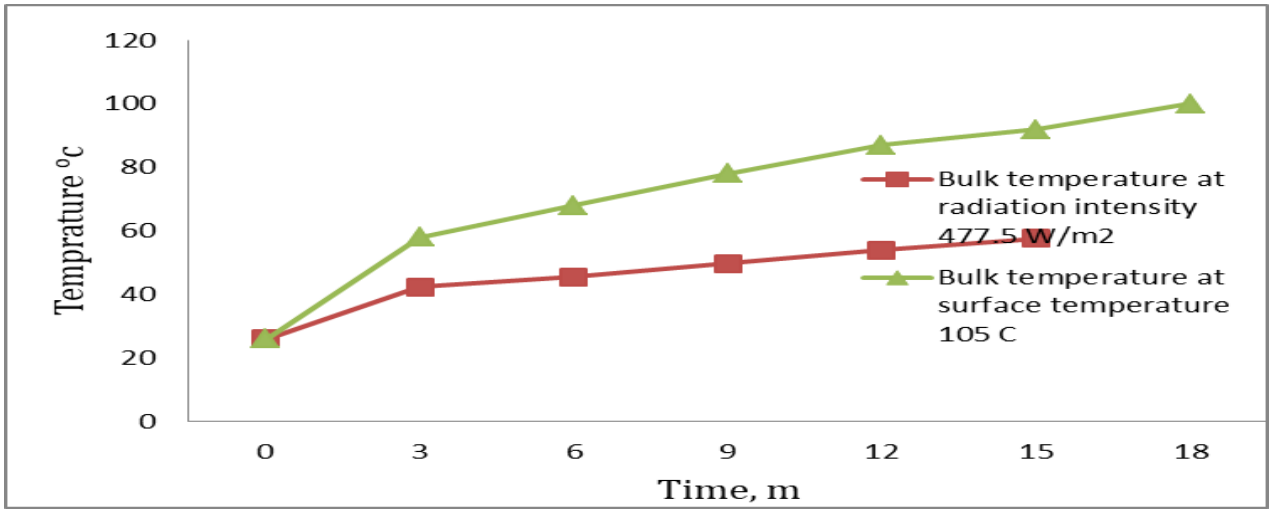


Fig. 5. A typical plot of the change in seeds bulk temperature as related to drying time at 105 °C heating source.
Source: Authors' determination.

As shown in Fig. 5, the grain bulk temperature was lower during the early stage of heating process and it was increased with longer exposure duration. In general, for all levels of heating surface temperature and radiation intensity, as the exposure time increased, the difference between the seeds bulk temperature and the heating sources decreased and the heat transfer rate also decreased.

Simulation of flax seeds Moisture reduction Behavior

In this section of study, analysis of moisture reduction of flax seeds was proceeded under different combination of cylinder surface temperature (90, 105, 120 and 135°C) and exposure time for the conduction heating process and different levels of radiation intensity and exposure time for the infrared heating process.

Analysis of flax seeds drying using Lewis's model [7]

Figures 6 and 7 present the linear relationship at surface cylinder temperatures of 105°C at rotation speed of 15 r.p.m and 2 kg feeding rate for conduction heating and radiation intensity of 477 W/m^2 at rotation speed of 15 r.p.m and 2 kg feeding rate for infrared heating.

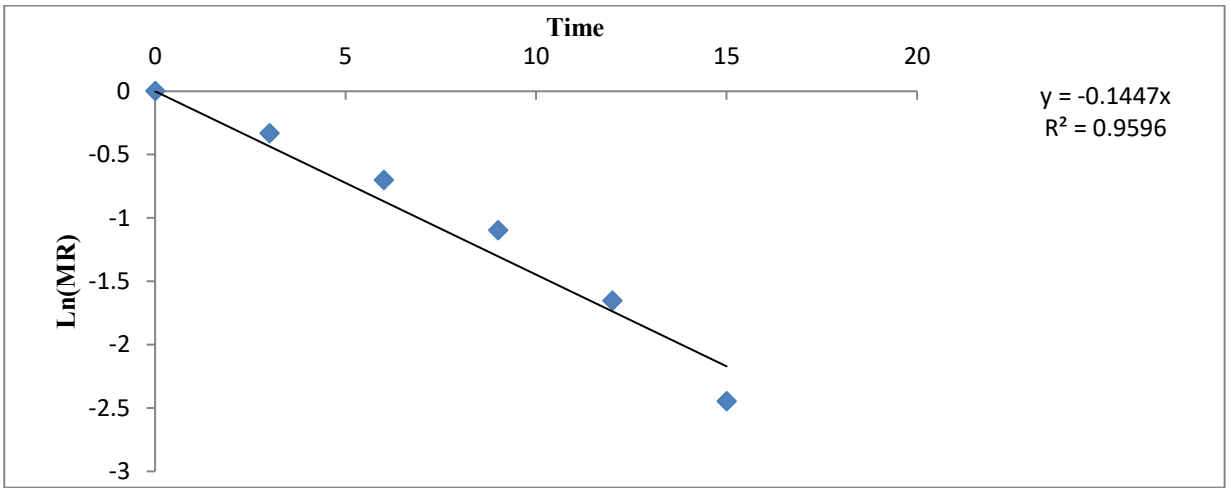


Fig. 6. Drying constant (k_L) of Lewis's model at rotation speed of 15 r.p.m, surface cylinder temperature of 105 °C and 2 kg feeding rate.
Source: Authors' determination.

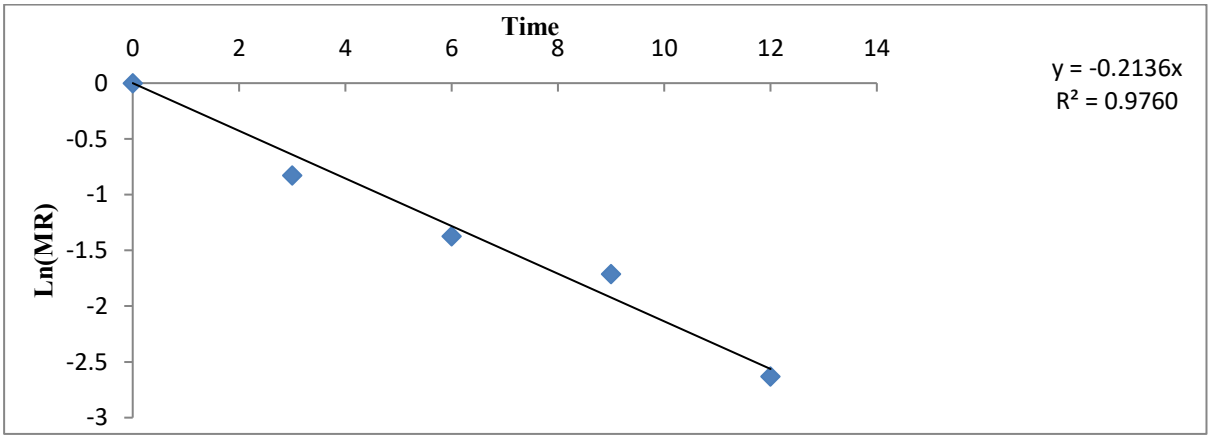


Fig. 7. Drying constant (k_L) of Lewis's model at rotation speed of 15 r.p.m, infrared intensity 477 W/m^2 and 2 kg feeding rate.
Source: Authors' determination.

The values of heating constants k_L for both conduction and infrared heating are listed in Table 2. As shown in Table 2, drying constant (K_L) increased with the increase of surface cylinder surface temperature and also increased with the increase of infrared intensity.

Table 2. The values of heating constants k_L for both conduction and infrared heating methods

Temperature, °C	**Feed rate, kg**	**Rotational speed, 15 r.p.m**
90	2	0.1330
105		0.1447
120		0.1485
135		0.1517
Infrared intensity, W/m2		
53.1		0.1917
331.6		0.2056
477.5		0.2136
848.9		0.2152
1,326.4		0.2297

Source: Authors' determination.

The applicability of Lewis's model in simulating the drying data

Figures 8 and 9 show the observed and the calculated values of flaxseeds moisture ratio at 105°C, rotation speed 15 r.p.m. and feeding rate 2 kg/patch for conduction heating and radiation intensity of 477.5 W/m^2, rotation speed 15 r.p.m. and feeding rate 2 kg/patch for infrared heating.

The results indicated that, Lewis's model can satisfactorily describe the moisture behaviour of the flaxseeds during conduction and infrared heating processes.

Analysis of flax seeds drying using Henderson and Pabis's model

Figures 10 and 11 present the linear relationship between Ln MR and exposure time at cylinder surface temperatures of 105°C at rotation speed of 15 r.p.m and 2 kg feeding rate for conduction heating and radiation intensity of 477 W/m^2 at rotation speed of 15 r.p.m and 2 kg feeding rate for infrared heating.

The values of heating constants (K_H) and A for both conduction and infrared heating are listed in Table 3.

As shown in Table 3, drying constant (K_H) increased with the increase of cylinder surface temperature and also increased with the increase of infrared intensity.

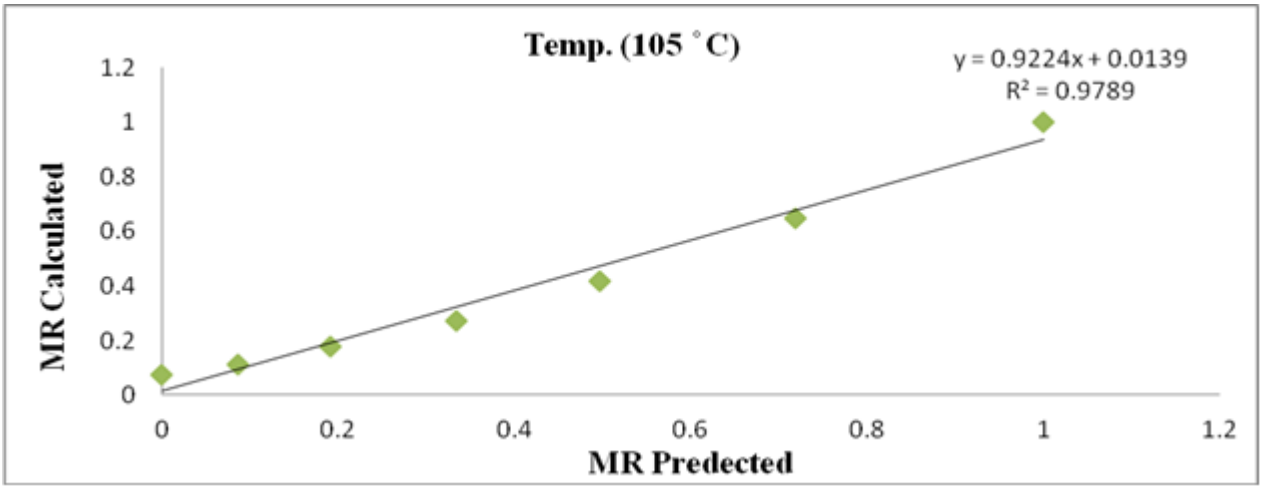


Fig. 8. The observed and the calculated values of flaxseeds moisture ratio at 105 ºC , rotation speed 15 r.p.m. and feeding rate 2 kg/patch.
Source: Authors' determination.

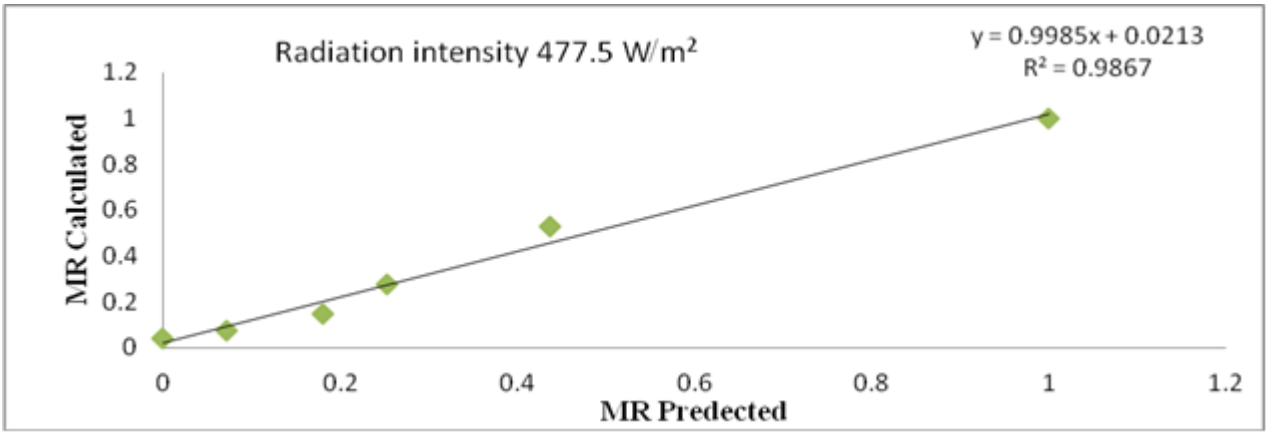


Fig. 9. The observed and the calculated values of flaxseeds moisture ratio at radiation intensity 477.5 W/m^2, rotation speed 15 r.p.m. and feeding rate 2 kg/patch.
Source: Authors' determination.

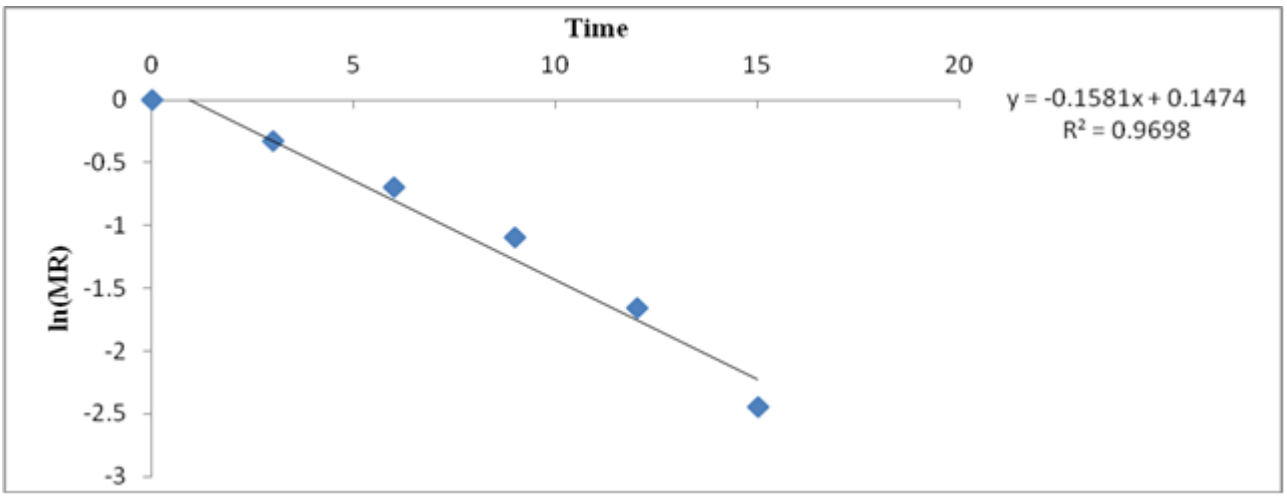


Fig. 10. Drying constant ((K_H)) of Henderson and Pabis's model at rotation speed of 15 r.p.m, surface cylinder temperature of 105^{0}C and 2kg feeding rate.
Source: Authors' determination.

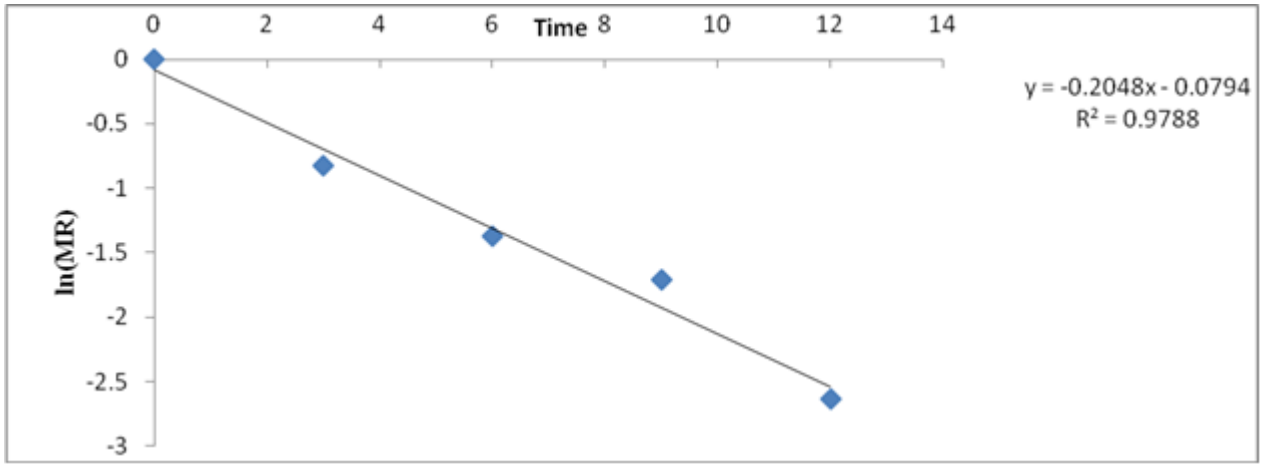


Fig. 11. Drying constant (K_H) of Henderson and Pabis's model at rotation speed of 15 r.p.m, infrared intensity 477.5 W/m^2 and 2 kg feeding rate.
Source: Authors' determination.

Table 3. The values of heating constants K_H for both conduction and infrared heating methods

Temperature, °C	Feed rate, kg	Rotational speed, 15 r.p.m
90	2	0.1440
105		0.1581
120		0.1601
135		0.1652
Infrared intensity, W/m2		
53.1		0.1779
331.6		0.2013
477.5		0.2048
848.9		0.2196
1,326.4		0.2517

Source: Authors' determination.

Analysis of flax seeds drying using Henderson and Pabis's model [6] **to calculated constant (A_H)**

Figures 12 and 13 present the exponential relationship at surface cylinder temperatures of 105°C at rotation speed of 15 r.p.m and 2 kg feeding rate for conduction heating method and radiation intensity 477.5 W/m^2 at rotation speed of 15 r.p.m and 2 kg feeding rate for infrared heating.

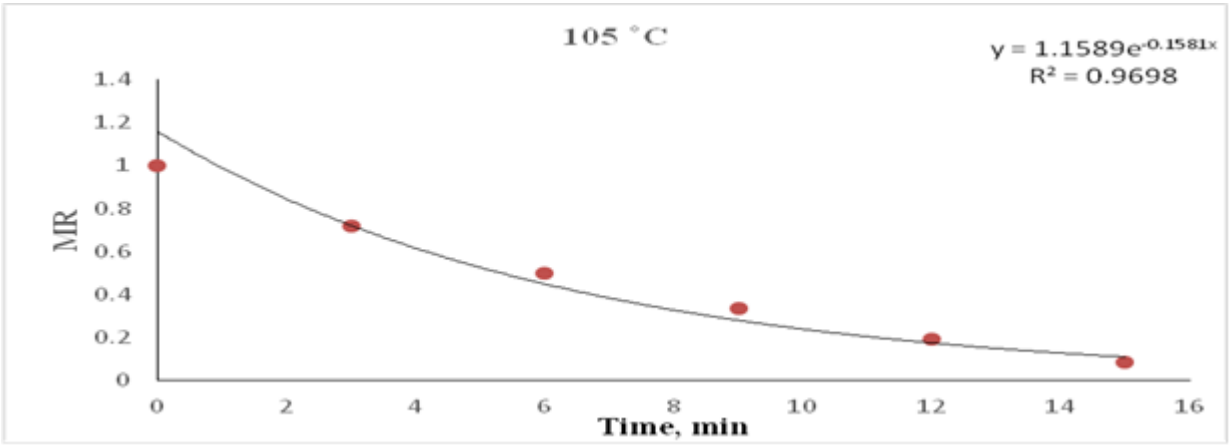


Fig. 12. The exponential relationship between MR and time at cylinder surface temperatures of 105 °C at rotation speed of 15 r.p.m and feed rate 2 kg.
Source: Authors' determinations.

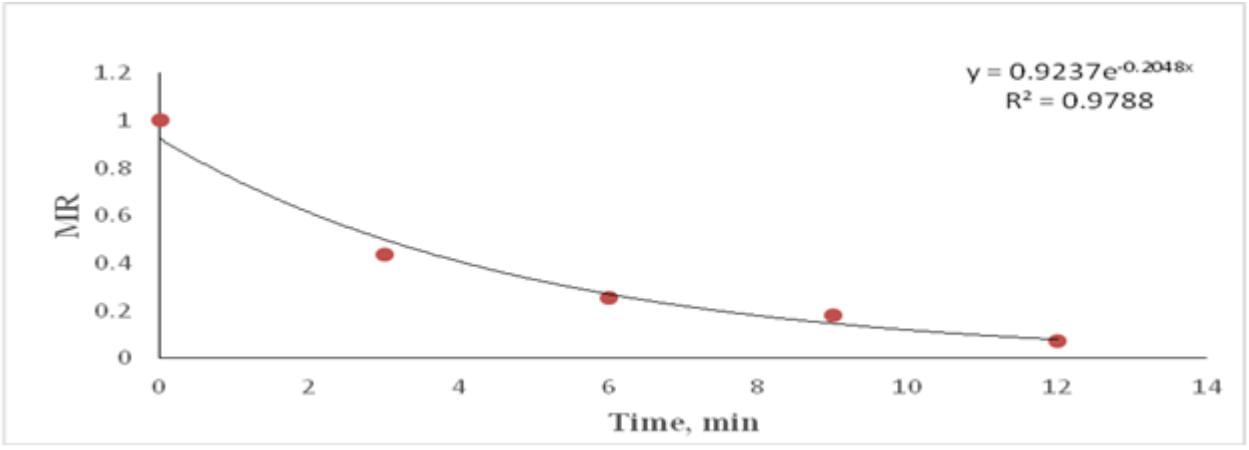


Fig. 13. The exponential relationship between MR and time at infrared intenisity of 477.5 W/m^2 at rotation speed of 15 r.p.m and feed rate 2 kg.
Source: Authors' determination.

The values of constant (A_H) for both conduction and infrared heating methods are listed in Table 4.

Table 4. The values of constant A for both conduction and infrared heating methods

Temperature, °C	Feed rate, kg	Rotational speed, 15 r.p.m
90	2	1.1276
105		1.1589
120		1.1360
135		1.1603
Infrared intensity, W/m2		
53.1		0.8837
331.6		0.9615
477.5		0.9237
848.9		1.0405
1,326.4		1.2190

Source: Authors' determination.

The applicability of Henderson and Pabis's model in simulating the drying data

Figures 14 and 15 show the observed and the calculated values of flaxseeds moisture ratio at at 105°C , rotation speed 15 r.p.m. and feeding rate 2 kg/patch for conduction heating and radiation intensity of 477.5 W/m^2, rotation speed 15 r.p.m. and feeding rate 2 kg/patch for infrared heating.

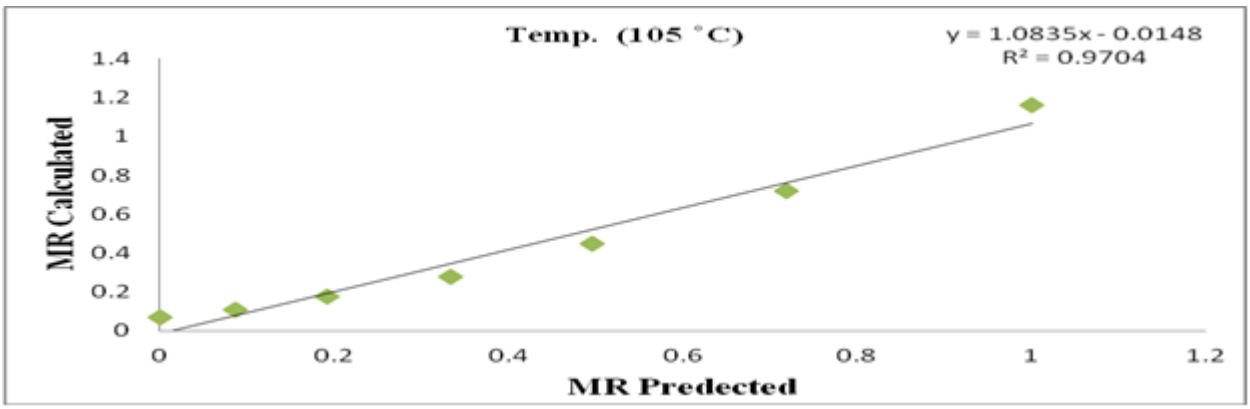


Fig. 14. The observed and the calculated values of flaxseeds moisture ratio at 105 °C , rotation speed 15 r.p.m. and feeding rate 2 kg/patch.
Source: Authors' determination.

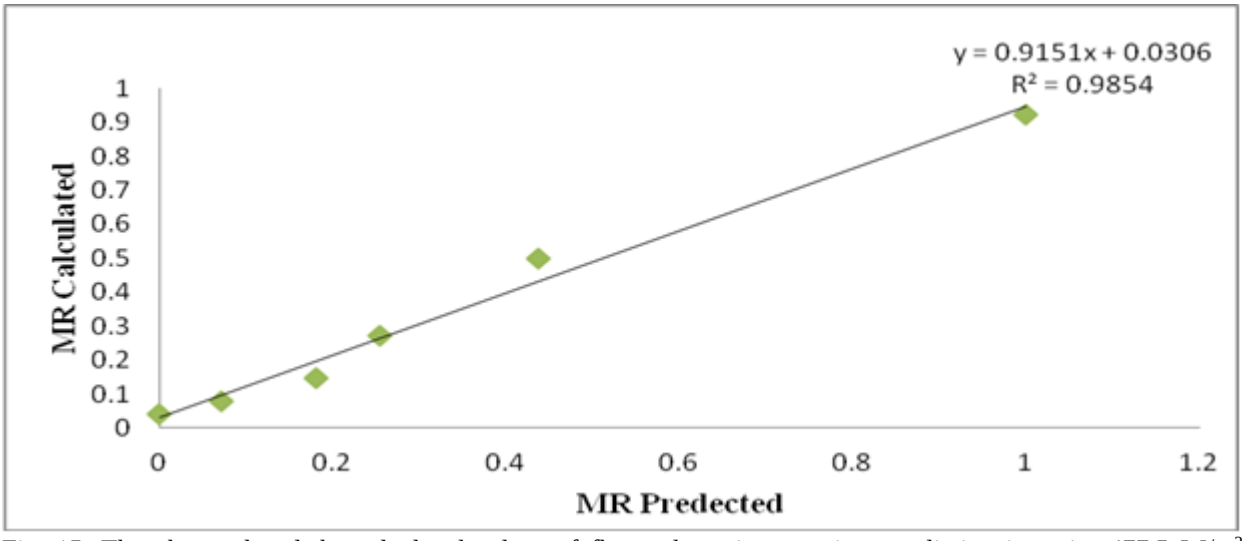


Fig. 15. The observed and the calculated values of flaxseeds moisture ratio at radiation intensity 477.5 W/m^2, rotation speed 15 r.p.m. and feeding rate 2 kg/patch.
Source: Authors' determination.

The results indicated that, Henderson and Pabis's model [6] can satisfactorily describe the moisture behaviour of the flaxseeds conduction heating and infrared heating processes.

Fungi inactivation during conduction and infrared heating

Table 5 presents the change in fungal mortality levels as related to the exposure time and the heating surface temperature for the conduction heating method and the radiation intensity for the infrared heating method. The results showed that, the high values of temperature in conduction heating and the high values of radiation intensity in infrared heating reduced the fungal load in an effective manner. Also, longer exposure time in both conduction and infrared heating methods resulted in more fungal load reduction. As shown in the table, the initial fungal count for flaxseeds was 2013 colonies/g, and they were decreased to a variedlevels depending upon the heating surface temperature, infrared intensity and the exposure time.

Table 5. The exposure time and the heating surface temperature for the conduction heating method and the radiation intensity for the infrared heating method

Heating temperature, ºC	**Exposure time, min**						
	0	3	6	9	12	15	18
90	2,013	1,230	1,099	978	845	701	557
105	2,013	1,081	980	858	708	584	431
120	2,013	1,015	845	734	589	468	304
135	2,013	900	712	620	464	337	178
Radiation intensity, W/m2							
331.6	2,013	1,105	987	906	765	612	
477.5	2,013	980	773	694	548	391	
848.9	2,013	720	591	476	312	170	
1,326.4	2,013	576	407	245	91	13	

Source: Authors' determination.

In general, it can be said that, the accelerated heating using the conduction heating and infrared heating techniques could be considered as an effective procedure for fungal inactivation, however the infrared heating method was more effective in comparison with the conduction heating method. This would be very beneficial for flaxseeds which deteriorate in a short time

after harvesting due to actions of both higher moisture content and higher fungal load.

Free Fatty Acids (FFA%) in the extracted oil

The percentage of lipase enzyme in flaxseeds oil hydrolysis it into free fatty acids. Also oxidation for free fatty acids leads to produce various off odor compounds such as aldehydes and kentons. The free fatty acids tests were conducted after seeds storage in traditional storage system (burlap bags under ambient condition) only for the samples which approached the safe storage moisture content of flaxseeds in the range of (5-7% w.b). Table 6 illustrates the change in percent free fatty acids in relation to heating surface temperature and exposure time.

Table 6. Free fatty acids, oil, acid value and peroxide value as related to heating surface temperature and exposure time

Heating surface temperature, ^oC	**Heating time, min**	**Seeds bulk temperature, ^oC**	**Moisture content (w.b. %)**	**F.F.A., %**	**Acidity (as oleic acid) %**	**Peroxide value ($MeqO^2$/kg oil)**
Ambient	0	26	10.1	0.4	0.79	3.31
90	18	85	4.7	0.29	0.58	4.94
105	12	87	5.6	0.3	0.60	2.82
105	18	100	4.5	0.32	0.63	2.76
120	9	89	6.2	0.32	0.63	3.16
120	15	105	4.8	0.37	0.73	3.25
135	9	96	5.9	0.34	0.68	5.68
135	15	112	4.4	0.42	0.83	11.62
Radiation denisity, w/m^2	**Heating time, min**	**Seeds bulk temperature, ^oC**	**Moisture content (w.b. %)**	**F.F.A., %**	**Acidity (as oleic acid) %**	**Peroxide value ($MeqO^2$/kg oil)**
331.6	15	39.1	8.7	0.56±0.02	1.11	1±0.02
477.5	12	53.9	8.7	0.53±0.03	1.05	1±0.01
848.9	6	48.9	9.1	0.64±0.04	1.27	3±0.05
1,326.4	9	77.8	8.3	0.84±0.02	1.67	5±0.03

Source: Authors' determination.

As shown in Table 6, both studied methods of conduction and infrared heating could keep lower levels free fatty acids of the extracted oil. This was clear in which free fatty acid of all samples were less than 5 % which indicate no rancidity after 3 months of storage on burlap bags under traditional storage condition.

CONCLUSIONS

Seeds bulk temperature increased with the increase of exposure time and approached levels lower than that of the heating surface temperature.

Rapid moisture removal from seeds was clear in all experiments particularly at higher heating surface temperature and radiation intensity and longer exposure duration.

Both the simple and modified exponential drying equations satisfactorily described the heating behavior of flax seeds. However, for more simplified application, the simple exponential equation may be used with clear accuracy.

The accelerated heating using the conduction and infrared heating technique considerably decreased the percentage of free fatty acids and the peroxide value.

Heating surface temperature of 105^oC and the exposure time of 12 min for conduction heating and radiation density 331.6 W/m^2 and the exposure time of 15 min for infrared heating are recommended to decrease the moisture content of flaxseeds to the safe level and the percentage of free fatty acids at the range of 0.3 and 0.56±0.02 respectively, and peroxide value at the range of 2.82 and 1±0.02 respectively.

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USING COLD PRESSING AND LOW TEMPERATURE TECHNIQUE TO PRESERVE OF FLAX SEED OIL QUALITY AND CAKE PRODUCT

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Abstract

The aim of this research was to investigate the efficiency of cold pressing and low temperature techniques to produce oil and cakeform flax seeds. Also, to evaluate the performance of the oil press machine and discuss cold press extraction is one of the methods of mechanical extraction as well as required less energy than other oil extraction techniques and also environmentally friendly. The samples were used from fresh flax seed weighted as a amount of feeding at 1, 2, 3, 4 and 5 kg at 12% db moisture content. The results with cold pressing showed according feeding ratio increased from 20, 40, 60, 80 and 100 %. operation time increased to 8, 16, 23, 32- and 38-min. addition to the temperature start at 29 ^{0}C. and increase by 31, 34, 35, 36 and 37^{0}C. Also, the oil product increased by 184, 402, 576, 775 and 981g. Cake product increased by 786, 1,576, 2,351, 3,196 and 3,991g. While with low temperature techniques using heater start temperature at 47^{0}C for all the samples the feeding ratio increased from 20, 40, 60, 80 and 100 %. the extraction time increased from 6, 12, 18, 24 and 30 min. The oil product increased by 187, 388, 581, 783 and 991 g., cake product increased by 800, 1,591, 2,394, 3,191 and 3,900 g. according feeding ratio increased from 20, 40, 60, 80 and 100 %. but the temperature decreased from 43, 42, 41, 40 and 39^{0}C after using cold pressing and low temperature techniques the oil quality have high contents of functional EPA (20:5 ω 3) and DHA (22:6 ω 3) for oil flax cake. Also, oxidizability index was 1.318.

Key words: *flax, extract, cake, time, temperature, cold pressing, and oil*

INTRODUCTION

Flaxseed is among the most important seeds in foodstuff, as it contains energy, carbohydrates, dietary fibres, proteins, monounsaturated fats, saturated diets, and many vitamins such as riboflavin, thiamine, vitamin B5, vitamin B6, folic acid, and vitamin C they also have many mineral salts, such as calcium, iron, magnesium, phosphorus, potassium, zinc, and omega-3 acid. Extracting flaxseed oil has a variety of health benefits and is used for several purposes in various industries.

Cold press extraction required less energy and also environmental friendly. High-quality oils can be obtained by enhanced production processes.

Physical properties if flax seeds was reviewed by Coskuner and Karaaba (2007) [4] reported that physical properties of flaxseed is a function of seed moisture content. The seed moisture content varied from 6.09% to 16.81% (db). In this moisture range, seed length, width, thickness, arithmetic mean diameter and geometric mean diameter increased linearly from 4.27 to 4.64 mm, 2.22 to 2.38 mm, 0.85 to 0.88 mm, 2.45 to 2.63 mm and 2.00 to 2.12 mm respectively with increasing moisture content. One thousand seed weight increased linearly from 4.79 to 5.32 g. The true density increased with moisture content from 1,000 to 1,111 kg/m^3 while bulk density decreased from 726.6 to 555.6 kg/m^3. Also, porosity values of flaxseeds increased from 27.34 to 57.44%. The highest static coefficient of friction was found on the plywood surface.

Bhatt and Prasad (2018) [3] reported that length, width, thickness and geometric mean diameter for whole seed were found to be 5.50±0.23, 2.68±0.18, 1.17±0.24 and

2.58±0.18 mm, respectively. For dehulled seed the length, width, thickness and geometric mean diameter were found to be 3.64±0.37, 2.58±0.2, 0.77±0.03 and 1.93±0.13 mm, respectively. The values of whole flaxseed were higher than the dehulled flaxseed and which may be due to removal of hull. Similar results for whole seed where the dimensions of the seed vary from 3.0 to 6.4 mm in length, from 1.8 to 3.4 mm in width and from 0.5 to 1.6 mm in thickness. At 6.09% moisture length, width, thickness and geometric mean diameter values were 4.27, 2.22, 0.85 and 2.0 mm, respectively

The importance of flax seeds was reviewed by Jhala and Hall (2010) [10]. Cultivar development of flax is currently focused on enhancing the oil content. Flax seeds are also rich in soluble and insoluble fibers and lignans, makes it useful as a dietary supplement. The residues remaining after the oil extraction from linseed contains about 35-40% protein and 3-4% oil, a rich source of feed to livestock like cattle and buffalo.

Based on the information, Singh (2012) [18] affirmed that it is evident that flaxseed is the richest source of α-linolenic acid oil and lignin. It is a considerable potential source of high quality protein, soluble fibers, and phenolic compounds. The flaxseed has tremendous potential to be used as human food, animal feed, and good quality fibers.

Goyal et al. (2014) [7] were focused on the evidences of the potential health benefits of flaxseed through human and animals' recent studies and commercial use in various food products.

Kaur et al. (2018) [11] concluded that flax seeds oil (*Linum usitatissimum*) is an important oilseed crop which has gained importance over the last few decades due to its unique nutrient profile. It is evident from several studies conducted that flaxseed carries functional ingredients and provide health benefits. Omega-3 fatty acid, and dietary fibers are major bioactive components of flaxseed which can be delivered through value added products. Flax seed consumption in the diet prevents serious diseases like coronary diseases, cancer, diabetes, obesity, gastrointestinal, renal and bone disorders.

Shafie et al. (2019) [16] revealed that linseed is a dietary source of plant. Their results show that the individual components of linseed produce greater potential therapeutic responses in rats with metabolic syndrome than whole linseed. They suggested that the reduced responses indicate reduced oral bioavailability of the whole seeds compared to the components.

Chemical Properties of Flax seeds was reviewed by Gutiérrez et al. (2010) [8] pointed out that oil extracted from flaxseed contained 51.86% linolenic, 16.34% linoleic and 20.98% oleic acid. Fractioning of defatted flaxseed cake produced a polyphenol content of 0.73 mg GAE g-1 extract and a protein isolate of considerable purity, 53.15% yield with 0.78 g of albumin equivalent g^{-1} protein isolate. Additionally, a polysaccharide was isolated with low protein content as impurity, 10.71% yield with 1.37 mg of glucose equivalent per gram of polysaccharide.

Ali and Watson (2014) [1] studied the effect of moisture content on oil yield making a comparison between a mechanical oil expeller, organic solvent extraction, organic solvent and microwave assisted, organic solvent and ultrasonic assisted, and combined microwave and ultrasonic with organic solvent. The maximum oil yield % wt/wt from these techniques was 22.6%, 36.3%, 10.0%, 42.0% and 27.8%, respectively.

Yilmaz and Gűneşer (2017) [20] compared the cold press with hexane-extracted lemon seed oils and determined their physicochemical and thermal properties. Cold pressing yielded significantly lower oil (36.84%) than hexane extraction (71.29%). In addition, the concentrations of free fatty acids, peroxides, and p-anisidine were lower in the cold pressed oil.

Al Juhaimi et al. (2018) [2] reported that the highest total phenol contents (2.36 mg gallic acid equivalent/100 g) were observed in pistachio oils obtained by cold press. The oleic acid contents of cold pressed and soxhlet extracted oils were between 19.88 (walnut) and 69.43% (pecan) to 19.07 (walnut) and 68.53% (pecan), respectively. The linoleic acid contents of nut oils from cold press system vary between 12.78 (hazelnut) and

63.56% (walnut), whereas in case of soxhlet extraction, it changed between 11.78 (hazelnut) and 62.41% (walnut).

Piva et al. (2018) [14] found that there were no significant differences among the ω-3, 6 and 9 fatty acids from linseed oil obtained using different extraction methods. Only the acidity of linseed oil extracted by subcritical propane (0.956 %) showed statistically significant differences among the physicochemical parameters. Extraction using organic solvent (Soxhlet) produced 36.12% yield. Extraction using subcritical propane at 107 Pa and 40°C for 1.5 h produced a higher yield (28.39%) than pressurized ethanol (8.05 %) treated by similar conditions.

Green Oil Extract was reviewed by Tanzi et al. (2012) [19] described a green and original alternative procedure for the extraction of oil from microalgae. The described method was achieved in two steps using Soxhlet extraction followed by the elimination of the solvent from the medium using Clevenger distillation in the second step. Oils extracted from microalgae were compared in terms of qualitative and quantitative determination. No significant difference was noticed between each extract, revealing that the proposed method is green, clean and efficient.

Sahad et al. (2014) [15] provided an overview of the use of green solvents for oil extraction from natural products using soxhlet extraction and supercritical fluid extraction (SFE) methods. In terms of qualitative and quantitative determinations on the extracted oils, the use of green solvents was comparable with n-hexane. For soxhlet extraction method, the integration of microwave application into the soxhlet at their optimum conditions has shown improvement in oil yield, oil quality, solvent consumption and extraction time.

Kumar et al. (2017) [12] assessed the potential of a novel green technology for oil extraction from various oilseeds. As each oilseed comprises different architecture, the process needs to look for suitability of technology in economical and technical ways. Green solvents are effective in consumption of solvent, reduction of downstream processing steps (reclamation of solvent) causing no effect to other desired products.

Cold and hot Extract was reviewed by Mwithiga and Moriasi (2007) [13] concluded that oil yield from the various operations was measured and expressed as a percentage of the original mass of crushed seeds. It was found that oil yields increased linearly with increasing the pressure as the compression pressure was increased from 40 to 80 kgf/m^2 and that oil yield also increased linearly when the duration of pressing increased within the time range of 6 to 12 min.

Hesham et al. (2016) [9] mentioned that cold press method is one of the best methods to extract essential oils. This process is used for most carrier oils and many essential oils. This process ensures that the produced oil is 100% pure and retains all the properties of the plant. It is a method of mechanical extraction where heat is reduced and minimized throughout the batching of the raw material. The cold press method is also known as a scarification method.

Siger et al. (2017) [17] concluded that cold-pressed oils produced from rapeseeds with a 5% moisture content were characterized by higher levels of tocopherols and plastochromanol-8. In the case of hot-pressed oils, the highest levels of tocopherols were found in oils produced from seeds with a7.5% moisture content, and the greatest amount of PC-8 (more than 4 mg/100 g) was found in oils produced from seeds with a 10% moisture content.

Çakaloğlu et al. (2018) [5] stated that cold press extraction is one of the methods of mechanical extraction which consumes less energy than other oil extraction techniques and also environmental friendly. It is used to extract oil from a range of matrices and is produced especially in the oil production from oilseeds. High-quality oils can be obtained by performing production at low temperatures using cold press method. It has an environmentally friendly use with no solvents. In other words, the cold-press extraction does not involve either heat or chemical extraction.

Parameters Affecting oil Extraction was reviewed by Fouda (2018) [6] showed that more than 18 % of oil fish per one kg of salmon wastes. The oil weight from by-products increased with increasing pressing

time and oil yield also increased. The oil extraction increased and characterization of quality.

This study aimed to use cold pressing and low temperature techniques for producing high quality oil and cake from flaxseeds and assess the effect of feeding rate and operating time on oil yield.

MATERIALS AND METHODS

Experiments were conducted to test the cold pressing (using oil extraction machine with out heater) and low temperature techniques (using oil extraction machine with heater at constant temperature 50 C^{o}) to preserve of flax seed oil quality and cake product

Sampling

Flaxseeds harvested from Gimiza Research station variety Evona.

Table 1. Physical Properties of flax seeds:

Properties	Whole seed
Length (mm)*	5.50±0.23
Width (mm)*	2.68±0.18
Thickness (mm)*	1.17±0.24
Geometric mean diameter (mm)	2.58±0.18
Sphericity (%)**	42.31±0.49
True density (kg/m^{-3})	1,025.33±2.89
Bulk density (kg/m^{-3})	696.67±1.15
Angle of repose (°)	26.29±0.46
Rupture force (N)	41.97±0.38
Deformation (mm)	0.37±0.13
1,000 seed mass (g)	7.38±0.14

Source: Authors' determination.

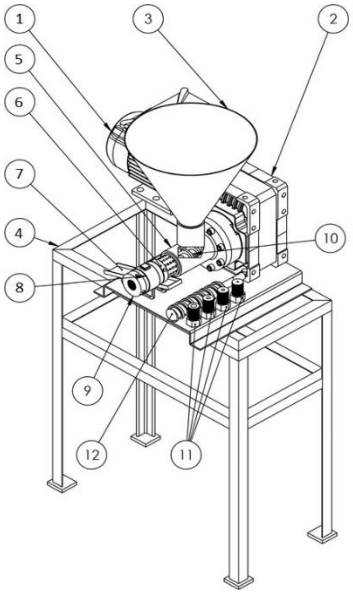
Table 2. Chemical Properties of flax seeds

Properties	Whole seed
Moisture (%)	5.08±0.45
Fat (%)	39.51±1.05
Protein (%N×6.25)	21.38±0.38
Ash (%)	2.83±0.20
Crude fiber (%)	3.57±0.48
Carbohydrate (%) **	28.04±0.36**
Trypsin inhibitors (TIU/g)	29.33±0.23
Flavonoid compounds(mg/100g)	39.99±1.41
Total phenolics as gallic acid (mg/100g)	230.0±1.04
Phytic acid (mg/100 g)	770.0±0.5

Source: Authors' determination.

The oil extraction machine

The oil extraction machine was used to terminate low of extraction efficiency with bad quality seeds for extraction oil and cake. The oil extraction machine, which used in this work, is illustrated schematically in Fig. (1).



No.	Part Name
1	Motor
2	Worm gear speed reducer
3	Hopper
4	Chassis
5	Chemise
6	Pushing
7	Oil outlet
8	Heater
9	Mold
10	Screw type 1
11	Spare parts
12	Screw type 2

Fig. 1. The oil extraction machine

Source: Authors' drawing.

The extraction machine, consists mainly of press screw pitch of single flight. The oil extraction machine consists of the following parts:

1- **Machine base**

Machine base was made from U shape steel bars having width of 50 mm, length of 30 mm, and thickness of 10 mm, the base has dimensions of 700 mm length, 350 mm width and 810 mm height.

2-Feeding hopper

The feeding hopped of flax seed made from steel sheets has a thickness of 1mm, and upper diameter of 355 mm, and bottom diameter of 64.5 mm, the height of feeding hopper was 370 mm. It was used to feed the flax seeds into the extraction barrel.

3-Extraction barrel

The extraction barrel has a cylindrical shape of 300 mm length, and 70 mm diameter in the extraction zone and 64.5 mm in the feeding zone with 2 mm thickness, both cylinders were connected together by a plate which has a diameter of 176 mm using four long bolts of 16 inch, the cylinder opening from both sides the front end fixed with the extraction head, and the back end closed by bearing plate has a diameter of 116 mm, and thickness of 100 mm. There are 8 holes of 12 mm diameters, for oil output. The extraction cylinder has eight holes for oil output has

diameter of 8 mm. and the barrel unit constricted with the machine base by four long bolts of 19 inch.

4-Extraction screw press

The extraction screw press, has a length of 360 mm, 30 mm diameters, 40 mm diameters in bearings section, and 33.5 mm pitch. The screw tooth has a width of 10 mm, and tooth height of 12 mm.

5-Extraction head

Compressing head has a conical with a big and small diameters of 116 and 95mm.

6- Heater

Heater placed on the end of extraction screw to start with room temperature to 50 C^o

7- Power transmission

Power transmission and electric motors: The power transmitted from 4 kW electric motor, which rotates at 1,400 rpm 3 phase. The electric motor shaft has a pulley of 120 mm in diameter, connected with the screw pulley which has a diameter of 100 mm by a 17 inch rubber belt.

Factors under study

1- Five different mass of seeds feed at 1, 2, 3, 4 and 5 kg. at 12% moisture content (db).

2- Cold pressing start with room temperature

3-Low temperature techniques pressing under to 50^0C.

Measurements

Oil mass in sample was determined five times for 1, 2, 3, 4 and 5 kg. of Flaxseeds by-products by cold pressing (cold pressing after 8, 16, 23, 32 and 38 min) and low temperature techniques pressing after (6, 12, 18, 24 and 30 min).

Oil extract (g) = Extract oil from flax by product sample (1,000 g.)

Cake product (g) = Cake product from flax by product sample (1,000 g.)

O.I. – oxidizability index, it was calculated using the formula:

OI = (0.02·C18:1 + 1·C18:2 + 2·C18:3)/100.

RESULTS AND DISCUSSIONS

The small production expeller using cold pressing and low temperature techniques, the relationship between the amount of seeds amount were used and the extraction times for cold pressing start with room temperature and low temperature techniques pressing under to 50^0C.

Regarding to Fig. 2 the operation time for small expeller increased from 6 to 30 min. with amount of seeds increased from 1 to 5 kg. for low temperature techniques pressing. While when used cold pressing the operation time for small expeller increased from 8 to 39 min. the amount of seeds amount were increased from 1 to 5 kg. for cold pressing.

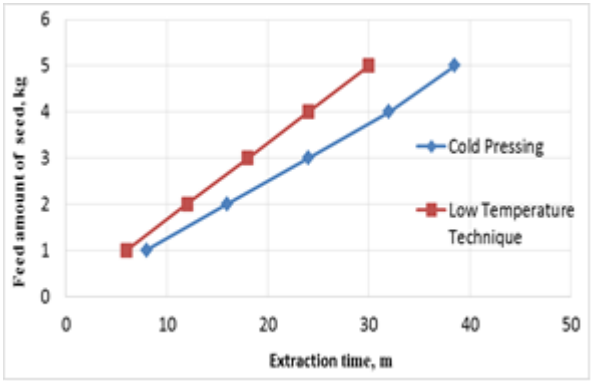


Fig. 2. Effect of use cold pressing and low temperature techniques on the amount of seeds amount and the extraction times

Source: Authors' determination.

From Fig. 3 and 4 showed that, when the operation time for extract increased from 6 to 30 min. the oil extracted increased from 187 to 991 g. Also cake product increased from 800 to 3,900 g. for low temperature techniques pressing.

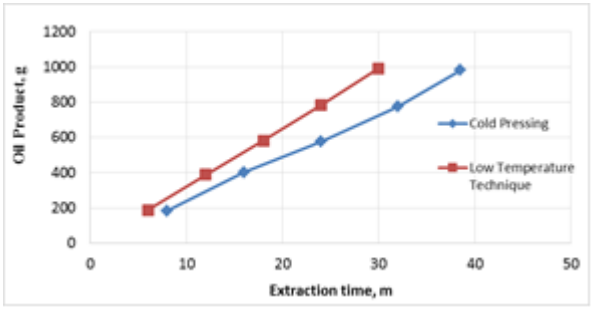


Fig. 3. Effect of use cold pressing and low temperature techniques on the oil extracted and the extraction times

Source: Authors' determination.

While when used cold pressing the operation time for small expeller increased from 8 to 39 min. the amount of seeds amount were increased from 184 to 982 g.

Also cake product increased from 786 to 3,991 g. for cold pressing.

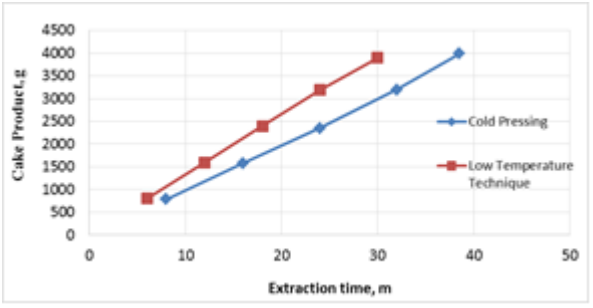


Fig. 4. Effect of use cold pressing and low temperature techniques on the cake product and the extracted times. Source: Authors' determination.

From Fig. 5 and 6 showed that, the temperature increased by compressed act on the extraction screw press from 31 to 37^{0}C when amount of seed feed increased from 1 to 5 kg. oil extract increased from 184 to 982 g. Also cake product increased from 800 to 3,900 g. for cold pressing. While when used techniques pressing the temperature start with constant 50^{0}C by heater act on the extraction screw press but the temperature decreased by oil cooling act from 44 to 39^{0}C when amount of seed feed increased from 1 to 5 kg. the amount of oil extract increased from 187 to 991 g. Also cake product increased from 786 to 3,991 g. for low temperature .

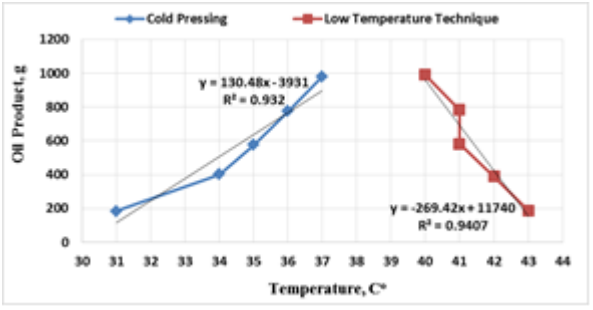


Fig. 5. Effect of use cold pressing and low temperature techniques on the oil extracted with the temperature. Source: Authors' determination.

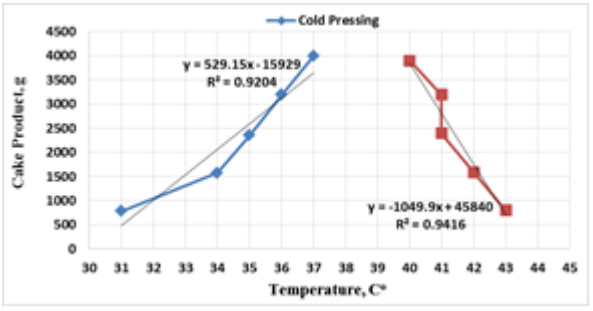


Fig. 6. Effect of use cold pressing and low temperature techniques on the cake product with the temperature. Source: Authors' determination.

Fatty acids composition

To extract the highest quality oil and maintain sensitive and important components, the most important of which are Omega-3 and Omega-6 and not to break the bonds that cause rapid oxidation of the oil.

The results in Table 3 indicated that the major saturated fatty acids from flaxseeds is polmetic acids (C16:0) which represented about 4.85 %. the second one is myristic acid (C14:0) 0.03 % followed by stearic acids (C18:0) 4.94 %. The predominant MUSFA is oleic acids (C18:1) which is represented 16.94 % Lenolic Acid (C18:2 ω6) 13.63 % and Linolenic Acid (C18:3 ω3) is 58.92 %. These types of FA represented more than 72 % of ω3 and ω6 fatty acids, these fatty acids playing very important jobs in healthy nutrition.

Table 3. Oil extracted components from flaxseeds

Fatty acid	Test Methods	Total fatty acids
Myristic acid C14:0	ISO 12966 – 2 2011	0.03
Palmitic Acid C16:0		4.85
C16:1		0.05
C17:0		0.06
C17:1		0.03
Stearic Acid C18:0		4.94
Oleic Acid C18:1		16.94
Linoleic Acid C18:2 ω6		13.63
Linolenic Acid C18:3 ω3		58.92
Arachidic acid C20:0		0.17
C20:1		0.14
C22:0		0.13
C24:0		0.10
Oxidizability index, O.I.		1.318

Source: Authors' determination by Food Technology Research Institute laboratory, Department of Oil Research, Agricultural Research Center.

Flax seed oil extracted by cold pressing its content of long chain omega-3 polyunsaturated fatty acids (PUFA), such as (DHA), (DPA) and eicosapentaenoic acid (EPA), which are currently highly valued for their prophylactic and therapeutic properties in nutritional and health fields. High contents of functional EPA (20:5 ω 3) and DHA (22:6 ω 3) in the oil as showing in Table 4 and 5**.**

Table 4. Oil extracted Acidity and Peroxide value at cold pressing under to 39 ^{Co}.

Test Methods	Acidity (as Oleic Acid) %	Peroxide value (MeqO2/kg oil)
A.O.A.C 2005	0.79	3.31

Source: Authors' determination by Food Technology Research Institute laboratory, Department of Oil Research, Agricultural Research Center**.**

Table 5. Oil extracted Acidity and Peroxide value at cold pressing Low temperature under to 50 ^{Co}.

Test Methods	FFA value (Acid number	Peroxide value (MeqO2/kg oil)
A.O.A.C 2005	0.05±0.004	4±0.03

Source: Authors' determination by Food Technology Research Institute laboratory, Department of Oil Research, Agricultural Research Center**.**

CONCLUSIONS

The results show the effect of the extraction method and the effect of the limited temperature increase on the quantity of oil and cake, addition to low extraction time. Also keep the quality oil seed extraction. The samples were used from fresh flax seed weighted as a seed mass feed at 1, 2, 3, 4 and 5 kg at 12% db moisture content.

At cold pressing the temperature start at 29 ^{0}C. The results discovered the operation time increased to 6, 12, 18, 24 and 30 min The oil product increased by 184, 402, 576, 775 and 981g. The cake product increased by 786, 1,576, 2,351, 3,196 and 3,991g. Also, temperature start on 29^{0}C for all samples and increased from 31, 34, 35, 36 and 37^{0}C according seed mass feed increased from 1, 2, 3, 4 and 5 kg.

At low temperature techniques used heater temperature start on 50^{0}C to retch to 46^{0}C on the extraction screw press but the temperature decreased by oil cooling act from 43, 42, 41, 40 and 39^{0}C the extraction time increased from 8, 16, 23, 32 and 38 min

The oil product increased by 187, 388, 581, 783 and 991g. The cake product increased by 800, 1,591, 2,394, 3,191 and 3,900 g. Also, temperature start on 29^{0}C for all samples and increased from 31, 34, 35, 36 and 37^{0}C according seed mass feed increased from 1, 2, 3, 4 and 5 kg.

With the aim of to obtained oil flaxseed with high quality and preservation the flaxseed contains compounds and sensitive bonds and you obtained the cake flaxseed riches with energy, carbohydrates, dietary fibres, proteins, monounsaturated fats, saturated diets, and many vitamins such as riboflavin, thiamine, vitamin B5, vitamin B6, folic acid, and vitamin C, and many mineral salts, such as calcium, iron, magnesium, phosphorus, potassium, zinc, and omega-3 acid, the cold extraction oil the best method and when you need to decreased the time of extraction use heater can increase heat under to 50^{0}C.

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USING ALTERNATIVE REPRESENTATIONS OF THE RGB COLOR MODEL TO SEPARATE ERGOT SCLEROTIA (*CLAVICEPS PURPUREA)* FROM THE IMPORTED WHEAT

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Abstract

Sclerotium of ergot is hard fungal body which contain toxic alkaloids to human and livestock. These alkaloids include ergotamine, ergovaline, ergocornine, ergocryptine, and ergocristine. Consumption of ergot can lead to human harmful health effects. These include constriction of blood flow to extremities, gangrene, hallucinations, muscle spasms and vomiting. Livestock fed ergot sclerotia can develop gangrene symptoms of ears, hooves and tails. The alkaloids can also cause abortions and reduce mammary gland development. The study was carried out through 2019 at the agriculture engineering department, faculty of agriculture Tanta University, Egypt. To prevent the harmful health effects in humans and livestock's using separating methods which depend on physical properties and image analysis software for different varieties of wheat imported to Egypt which contaminated with ergot fungi sclerotia. The average dimensions of ergot fungi sclerotia were ranged according imported place the length ranged from 2.32 to 22.51 mm. width from 0.12 to 2.91 mm. thickness from 0.12 to 2.21 mm. volume from 0.0511 to 65.133 mm^3, geometric mean diameter from 0.46 to 4.98 mm, the arithmetic mean diameter from 1.7 to 9.10 mm, and sphericity, from 7.9 to 55.6%. Also surface area ranged from 0.66 to 78.02 mm^2. On the other hand, the average dimensions of the different varieties of Russian Ukrainian and French wheat were: length 5.24, 5.24, 5.17 mm, width 1.92, 1.92, 2.35 mm, thickness 162, 161, 186 mm, volume 8.81, 8.75, 12.1 mm^3, arithmetic mean diameter 2.52, 2.52, 2.82 mm^2, geometric mean diameter 2.92, 2.92, 3.13 mm^2, sphericity 48.2, 48.1, 57.8%, aspect ratio 36.7, 36.7, 45.9, and surface area 20.3, 20.2, 25.2 mm^2 respectively. These results revealed that the differences between the physical properties of wheat varieties and ergot sclerotia is not strong spicily for length, width and thickness this case led to obstructing separation processes.

Key words**:** *imported wheat, physical, image, properties, and Ergot fungus*

INTRODUCTION

Wheat is one of the most important and strategic crops of the Germaine family member, its source of essential nutrients, providing energy, fiber, carbohydrate, protein, Vitamins, iron, calcium, phosphorus, zinc, potassium and magnesium. the fractionation of the crushed grain during milling has critical implications for the distribution of many nutrients. Ergot of wheat is a plant fungal disease which replaces the grain of the wheat with a hard purplish dark sclerotium produces external spores as mycotoxins infects wild grasses and cereal grains, it can cause 5-10 percent yield losses in small grain cereals such as Wheat, Barely, Millet, and Oats. Untimely forming ergot sclerotia which are generally large and easily visible. The total production of wheat in the world 734 million tonnes, with harvested area 214.29 million ha. on the other hand, the harvested area in Egypt was 1.3 million ha with total production 8.8 million tonnes according to FAO 2018 [4]. The knowledge of the physical, mechanical and aerodynamic properties of agricultural products are necessary and important in design of different component of machines and equipment for processing, handling, separating, cleaning, transporting and storage. [1], [3], [10]. The term Ergot is referred to the

sclerotium of ascomycetes a protective kernel produced during resting stage of some fungi – which replaces seeds of susceptible cereals and plants intended for human and animal diet. It contains various compositions of tryptophan-derived toxins defined ergot alkaloids [8]. Ergot Alkaloids have long been known as toxic compounds with a broad spectrum of adverse effects on human and animal health leading mainly to the Ergotism disease, the alkaloids produced by the fungus severely affect the health of humans and warm-blooded animals [9]. Ergot is typically detected upon visual inspection, with dark sclerotia bodies being up to 10 times larger than grain kernels. However, ergot bodies may range in size from a few millimeters to more than 4 cm depending on the size of the host plant [7].

Concluded that Wheat is one of the most important staple crops in temperate zones and in demand of increasing in industrialization. Also being a major source of starch and energy, it can provide most of essential health protein, B vitamins, dietary fibre, and phytochemicals. the consumption of cereal dietary fibre and reduced risk of cardio-vascular disease [9].

Compared different wheat origins France, Romania, Russia and Ukraine, imported to Egypt, and to check the safety of them to be consumed in Egypt, the Ukrainian wheat was the beast among all other wheat originated from France, Romania and Russia, Ukrainian under different moisture content ranged from 10.88% to 12.43% with an average of 11.46%., test weight, ranged from 78.77 to 80.57 kg hl-1 with an average of 79.70 kg hl-1 and falling number, ranged from 322.0 to 412.0 sec with an average of 360.47 sec., and came in the second order in other tests as, protein content, which ranged from 12.21 to 13.67% with an average 12.80%, broken grains ranged from 0.746 to 1.925% with an average of 1.115%. Ukrainian wheat came in the third order [2].

Using images indices and The ENVI software package to analyze the images of fruits and three bands, RGB, (red, green, blue) were derived for each image until obtaining the R, G, B color then color indices Red/ Green ratio (R/G), hue, and intensity [5].

Ergot sclerotia caused poisoning over whole regions, causing a variety of symptoms as Two types of ergotism which can be distinguished as “convulsive” and “gangrenous” ergotism. The first type is characterized by muscle spasms, fever and hallucinations. The victims may appear dazed, be unable to speak, become manic, or have other forms of paralysis or tremors, and suffer from hallucinations and other distorted perceptions. This is caused by serotonergic stimulation of the central nervous system by some of the alkaloids. Human fertility can be reduced during ergotism outbreaks because women frequently miscarry. The second type is accompanied by violent burning, peripheral pulses and shooting pain of the poorly vascularized distal organs, such as the fingers and toes, and is caused by the potent vasoconstriction effects of some ergot alkaloids [6].

Strategically imported wheat to Egypt which contaminated with quarantine pests such as sclerotium of ergot *(Claviceps purpurea)* which have a lot of variation from size dimension. Egypt later scrapped the restrictions and is now back to accepting shipments containing a maximum 0.05 percent ergot in imports, a quantity considered the standard limit by many countries. examine imported wheat it is very difficult imported Wheat have different impurities such as straw, grains from other crops, and insects, as well as undesirable substances thus cleaning and separating machine must have adjusted to remove all it. Accordingly, the main objective of this research is to monitoring the differences between the physical, chemical and optical properties of the wheat grain different varieties and Ergot fungi sclerotia. For the cereal sector, the presence of ergot creates a high toxicity risk for animals and humans because of its alkaloid content.

MATERIALS AND METHODS

Experiment was carried out through 2018 at the department of agriculture engineering

faculty of agriculture Egypt, to investigate physical, properties of the different varieties of the grain wheat imported to Egypt. These properties used in design and development of separating machine of the wheat grain and Ergot fungus. The grain and fungus dimensions tested under four different moisture content, and %.

Materials

Wheat crops *(triticun aestivum*). Russian Ukrainian and French wheat grain as showed in Photo 1 was used in this study, and Ergot fungi (*claviceps purpurea***)** sclerotia as showed in Photo 2.

For Image Analysis system it was used **ENVI programme.**

Wheat and Ergot sclerotia samples were captured by digital camera, using the capture card to transferred the data and stored on the PC. The ENVI software package was used to analysed the images of Wheat grains and Ergot sclerotia. There were three bands, RGB, (red, green, blue) were derived for each image until obtaining the R, G, B colours then colour indices. Photo 3 and 4 show ENVI software analysis.

Ergot fungi Scientific classification is shown in Table 1.

Table 1. Scientific classification of *Claviceps purpurea* fungi

Kingdom	**Fungi**
Division	Ascomycota
Class	Sordariomycetes
Subclass	Hypocreomycetidae
Order	Hypocreales
Family	Cclavicipitaceae
Sub-family	Faboideae
Genus	*Claviceps*

Source: en.m.wikipedia.org.

Photo 1. Wheat grains varieties
Source: Authors' determination.

Photo 2. Sclerotia of *clavicipes purpurea.*
Source: Authors' determination.

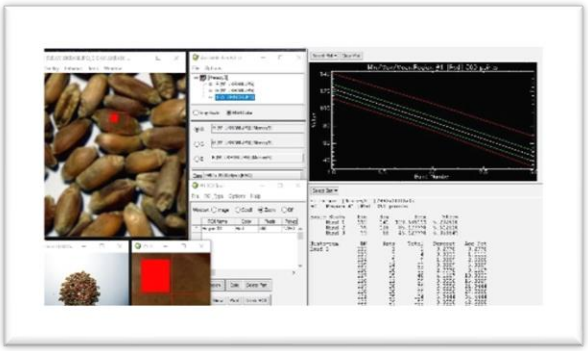

Photo 3. ENVI software analysis for Wheat
Source: Authors' determination.

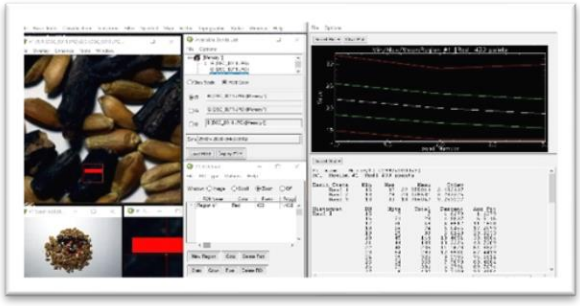

Photo 4. ENVI software analysis for Ergot
Source: Authors' determination.

Measurements and determinations.

- Physical properties.

-*Arithmetic mean diameter* (D_a), mm:

$$D_a = \frac{(x + y + z)}{3}$$

-*Geometric mean diameter* (D_g), mm:

$$D_g = (x.\ y.\ z)^{1/3}$$

-*Surface area* (A_s), mm^2:

$$A_s = \pi.,D_g^2$$

-*Volume* (V), mm^3:

$$V = \frac{\pi}{6}\ (x.\ y.z)$$

-*Sphericity* (φ), %

$$\varphi = \frac{(x.y.z)^{1/3}}{x} = \frac{D_g}{x}$$

where:

x: length of grains (mm),

y: width of grains (mm) and
z: thickness of grains (mm)

-*Density*: $\rho = m/v$ (gm./cm^3)

where:

m= Mass of sample, (gm).

v = Volume occupied by the sample, (cm^3).

-*Surface area*: $S_a = \Pi (D_g)^2$

Moisture content grains as determine as by dried in an oven of 103°C for 24h. All moisture percentages were determined on wet basis as it showed in equations below:

$M_w = (W_2 - W_1)/W_2 \times 100$

where:

M_w: Moisture content of soybean seeds sample on wet basis, (%),

W_1: Final mass of soybean seeds sample after drying, (g) and

W_2: Initial mass of soybean seeds sample before drying, (g).

Hue and saturation were calculated as these equations used to transform RGB color to HIS color determined I_2 and $I`_2$. Red/ Green ratio

$$H = COS^{-1}\left\{\frac{(2R-G-B)/2}{\left[(R-G)^2+(R-B)(G-B)\right]^{1/2}}\right\}$$

$$I = \frac{1}{3}(R+G+B)$$

$$I_2 = (R-B)/2$$

$$I'_2 = R-B$$

The three axial dimensions of seed are namely length “L, in mm” (longest intercept), width “W, in mm” (equatorial width perpendicular to L) and thickness “T, in mm” (breadth perpendicular to L and W). Measured by a digital Vernier-caliper with accuracy of 0.01 mm for randomly selected 100 seeds. Mean dimensions of wheat grain, the arithmetic mean diameter (D_a), mm, geometric mean diameter (D_g), mm, surface area (A_s), mm^2, volume (V), mm^3 and sphericity (φ), % of grains were also calculated.

RESULTS AND DISCUSSIONS

Physical properties of Ergot sclerotia (*claviceps pupepurea*)

The average length, width and thickness of Ergot sclerotia fluctuated from 2.23 to 22.51, 0.12 to 2.91 mm and 0.12 to 2.21 mm also volume ranged from 0.051 to 65.13 mm^3 as maximum and minimum value respectively. The arithmetic diameter, ranged from 1.07 to 9.1 mm, and geometric mean diameter increased from 0.46 to 4.98 mm. The surface area increased from 0.66 to 78.02 mm^2 and the sphericity increased from 7.93 to 55.6% with maximum and minimum value respectively (Table 2).

Table 2. physical properties of Ergot Sclerotia

Items	average	Min	Max
1,000 grains weight g	58.4	49.5	67.3
Length, mm	7.04	2.23	22.51
Width, mm	1.21	0.12	2.91
Thickness, mm	0.84	0.12	2.21
Volume, mm^3	6.33	0.051	65.13
Arithmetic diameter, mm	3.15	1.07	9.1
Geometric diameter, mm	1.25	0.46	4.98
Sphericity %	26.5	7.93	55.6
Flat surface area	7.82	.0523	51.42
Transfer surface area	1.03	0.013	4.94
Aspect ratio	17.8	2.06	47.2
Surface area, mm^2	13.7	0.66	78.02

Source: Authors' determination.

Physical properties of wheat grain

The average dimensions of ***Russian grain*** at constant moisture content 12.2 % were changed from min to max respectively, the length changed from 4.05 to 4.80 mm. width from 0.10, to 1.22 mm. thickness ranged from 0.10 to 1.15 mm. Volume 0.06 to 3.29 mm^3, geometric mean diameter from 0.48 to 1. 85 mm, the arithmetic mean diameter from 1.53 to 2.36 mm, and sphericity, changed to decrease from 38.4 to 10.50%. Also, surface area changed from 0.72 to 10.70 mm^2.

The average dimensions of ***Ukraine grain*** at constant moisture content 11.1 % were changed respectively, the length changed from 3.48 to 5.65 mm, width from 0.1 to 1.11 mm, thicknesses ranged from 0.10 to 0.71 mm, volume 0.07 to 1.73 mm^3, geometric mean diameter from 0.51 to 1. 49 mm, the arithmetic mean diameter from 1.32 to 2.28

mm, and sphericity changed to decrease from 31 to 14.50%. Also, surface area changed from 0.8 to 6.97 mm^2.

The average dimensions of ***French grain*** at a constant moisture content 13 % were changed respectively, the length changed from 3.38 to 6.31 mm, width from 1.67 to 2.77 mm, thickness ranged from 1.45 to 2.29 mm, volume 4.77 to 16 mm^3, geometric mean diameter from 2.09 to 3.12 mm, the arithmetic mean diameter from 2.23 to 3.47 mm, and sphericity, changed to decrease from 64.2 to 43.1%. Also, surface area changed from 13.7 to 30.6.mm^2 as showed in Table 3.

Table 3. Physical properties of wheat grain varieties

Wheat seeds	Russian	Ukraine	French
Length (mm)	5.24	5.24	5.17
width (mm)	1.92	1.92	2. 35
Thickness, mm	1.62	1.61	1.86
Volume, mm^3	8.81	8.75	12.1
Geometric mean diameter	2.52	2.52	2.82
Arithmetic mean diameter	2.92	2.92	3.13
Flat surface area	7.93	7.95	9.62
Transfer surface area	2.48	2.47	3.45
Aspect ratio	36.7	36.7	45.9
Sphericity	48.2	48.1	57.8
Surface area	20.3	20.2	25.2

Source: Authors' determination.

Physico- chemical properties of wheat grain

The physico-chemical properties are very important for detecting of wheat kernel parameters like uniformity of size, density and hardness, and also helps to determine the milling properties of different wheat varieties, the data presented in Table 4. The Russian wheat at moisture content 12.2% constant, the Hectoliter was 78.8 kg/m^3, thousand grains weight was 43.6 g, Falling number was 325, Glutens 24.8, index 97, and Immature grain 1.77%. The Ukrainian wheat at moisture content 11.1% constant, the Hectoliter was 78 kg/m^3, thousand grains weight was 42.1 g, Falling number was 351, Glutens 22.7, index 92.6, and Immature grain 1.8%. And the French wheat at moisture content 13% constant, the Hectoliter was 79.5 kg/m^3, thousand grains weight was 52.3 g, Falling number was 355, Glutens 20.7, index 95, and Immature grain 1.85%.

Table 4. Physico- chemical properties of wheat grain

Items	Russian	Ukrainian	French
Moisture content %	12.2	11.1	13
Hectoliter kg/m^3	78.8	78	79.5
1,000 grains weight g	43.6	42.1	52.3
Falling number	325	351	355
Glutens	24.8	22.7	20.7
Index	97	92.6	95
Immature grain %	1.77	1.8	1.85

Source: Authors' determination.

Optical properties of wheat varieties origin and its sclerotia

The data from Table 5 are resulted using ENVI programme analysis and investigated the colour analysis of the different varieties of wheat and sclerotia origin. Red band(R), Green band(G), Blue band(B), Intensity(I), Hue (H), and Red/Green band (R/G).

Table 5. Optical properties of wheat varieties origin and its sclerotia

Indices	W. R	W. Uk	W. F	E. R	E. Uk	E. F
R	117.8	123.3	82.6	30.8	28.9	22.9
G	89.2	89.7	58.2	26	23.7	20.1
B	46.5	50	26.5	25.2	20.8	19.1
H	0.64	0.57	0.59	0.5	0.47	0.78
I	84.5	87.7	55.8	27.3	24.5	20.7
I2	35.6	36.6	28	2.76	4	1.9
I3	3.5	1.5	1.8	-1	-0.5	-0.4
I-2	71.3	73.3	56	5.5	8	3.8
I-3	7	3.1	3.6	-2	-1.1	-0.8
R/G	1.3	1.39	1.5	1.17	1.2	1.14

Source: Authors' determination.

The results showed that the Ukrainian wheat recorded the highest value of RGB band 123.3, 89.7, 50 and Intensity 87.7.

But the highest Hue value 0.64 observed in the Russian wheat, while the French wheat recorded the lowest value of RGB band 82.6, 58.2, 26.5 and Intensity 55.8. On the other hand, Russian ergot sclerotia recorded the highest value of RGB band 30.8, 26, 25.2 and Intensity 27.3.

While the French ergot sclerotia recorded the lowest value of RGB band 22.9, 20.1, 19.1 and Intensity 20.7. and the highest Hue value 0.78.

Color indices for Wheat varieties origin and Ergot sclerotia

The figures study the relationship between color indices and different varieties of wheat & Ergot sclerotia. The results show high variances in color indices for different wheat varieties and ergot sclerotia origin in Figs. 1, 2, and 3.

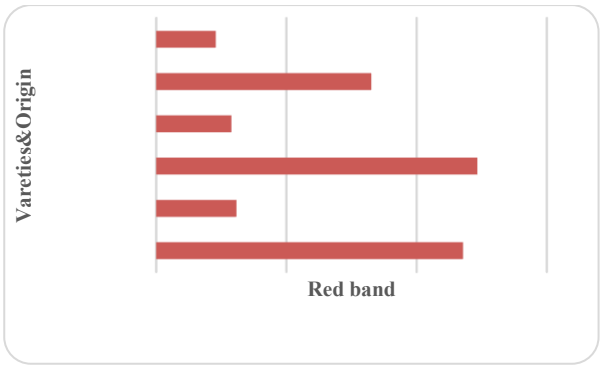

Fig. 1. Relationship between Red band and different varieties of wheat and Ergot sclerotia
Source: Authors' determination.

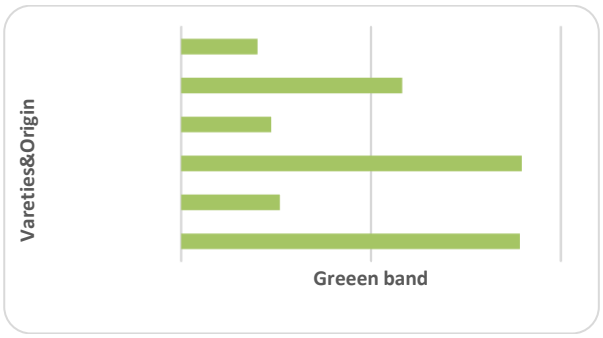

Fig. 2. Relationship between Green band and different varieties of wheat and Ergot sclerotia
Source: Authors' determination.

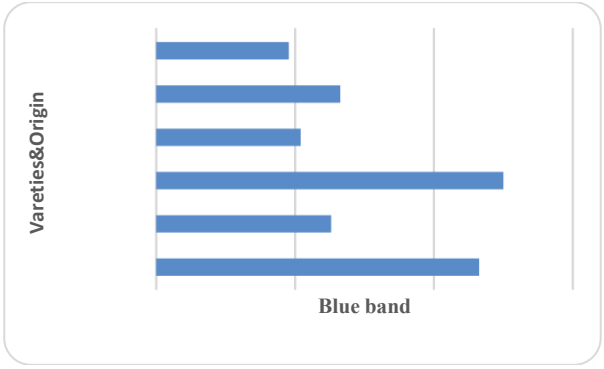

Fig. 3. Relationship between Blue band and different varieties of wheat and Ergot sclerotia
Source: Author determination.

The highest value of RGB band 123.3, 89.7, 50 were observed in the Ukrainian wheat. On the other hand, Russian ergot sclerotia recorded the highest value of RGB band 30.8, 26, and 25.

Fig. 4 illustrates the relationship between intensity and different varieties of wheat & Ergot sclerotia. The Ukrainian origin was the highest variances between wheat and sclerotia where 87.7 and 24.5 intensity, the French origin recorded the lowest value of Intensity for Wheat 55.8 ergot sclerotia 20.7 .

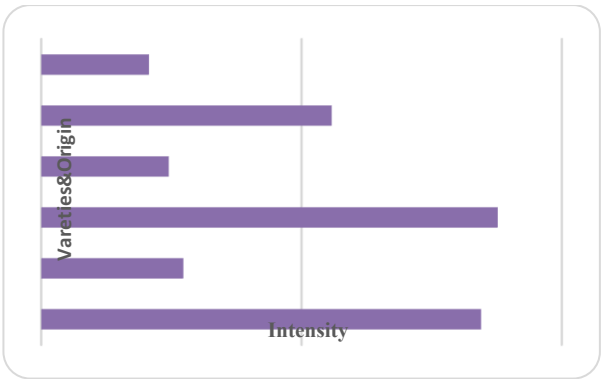

Fig. 4. Relationship between Intensity band and different varieties of wheat and Ergot sclerotia
Source: Authors' determination.

Fig. 5 explicates the relationship between Hue band and different varieties of wheat and Ergot sclerotia whereas, the ergot French was the highest 0.78 value and the Ukrainian was the lowest 0.47 value. There weren't clear Hue variances between different origin.

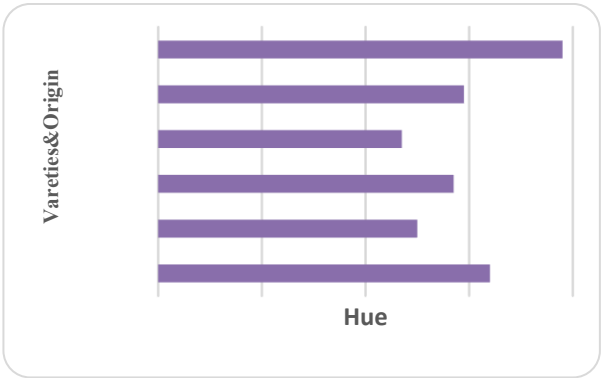

Fig. 6. Relationship between Hue band and different varieties of wheat and Ergot sclerotia
Source: Authors' determination.

Fig. 7 shows the relationship between Red/Green band and different varieties of wheat and Ergot sclerotia. The French wheat was 1.5 value followed by the Ukrainian

wheat 1.39 but the Russian wheat was 1.3, on the other hand the variances between different origin for ergot are close where 1.17, 1.2, and 1.14 for Russian, Ukrainian and French Ergot respectively.

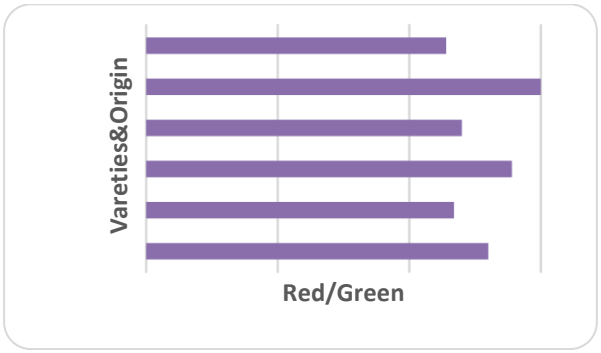

Fig. 7. Relationship between Red/Green band and different varieties of wheat and Ergot sclerotia
Source: Authors' determination.

CONCLUSIONS

Color can distinguish between different varieties of wheat imported from different countries. It is also possible to distinguish between Ergot fungi sclerotia and between different types of imported wheat, and the color indicators used showed a clear contrast between wheat and Ergot fungi sclerotia, for example. The physical specifications also showed the differences that distinguish between mushrooms and wheat, which can be used to design the sieve holes for the specific separation.

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OVERCOMING SMALL HOLDER FARMERS' FINANCIAL EXCLUSION USING ANCHOR BORROWERS' PROGRAMME IN YOLA NORTH AND YOLA SOUTH LOCAL GOVERNMENT AREAS, ADAMAWA STATE, NIGERIA

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Abstract

Rural areas in Nigeria are the centres of agriculture-based economic activity and fuel the livelihoods of 70% and contribute over 22.30% of the country's Gross Domestic Product (GDP). It is estimated that Nigerian agricultural output would increase if farmers were able to access the finance they need to expand both the quality and quantity of their produce. The limited level of Agricultural credit is considered an important factor for increased agricultural production and food security because, it enhances productivity and promotes standard of living by breaking the vicious cycle of poverty of small scale farmers. The study was conducted on Overcoming Small holder Farmers' Financial Exclusion using Anchor Borrowers' Programme in Yola North and Yola South Local Government Areas, Adamawa State, Nigeria. Data were collected using structured on 94 farmers randomly selected. Descriptive and inferential statistics were used in the analysis of the data collected. Descriptive analysis revealed that respondents were relatively young with a mean age of 40 years, a mean family size of 6 people who are mostly small holder farmers with the mean farm size of 3.21 hectares and are experienced with a mean experience of 10 years. Logit result with Diagnostic statistics and VIF test results indicated that the Hosmer and Lemeshow goodness of fit test indicating that our model fits the data well. The model also correctly predicted 73.68 % of the dependent variables. The estimated VIF suggested that the explanatory variables specified in the model do not cluster together or exhibit multicollinearity tendencies. This implies that the estimates of the model to an appreciable extent are consistent and unbiased, stable over time and there was also no problem of multicollinearity. Furthermore, the result showed that membership of cooperative society, age, primary occupation, income and training were statistically significant and increases the probability of access to agricultural credit. Government policies that would encourage young people to go into agriculture should be sustained by the government at all levels in areas of credit supply, training and supply of basic production inputs to boost production, increase food security and reduction in poverty. Farmers should be encouraged to form cooperative societies to maximize the economics of scale.

Key words**:** *Anchor Borrower programme, credit, cereals, logit regression, Yola, Adamawa*

introduction

A wide range of financial policy efforts for the improvement of small holder farmers' productivity have been put in place over the years by successive governments in Nigeria for the transformation of the agricultural subsector of the economy.

However, the desired goals have not been achieved because of some of the peculiarities of the smallholder farmers. Prominent among these are their poor access to finance and lucrative markets to dispose of their produce, which have left them in a vicious cycle of poverty [6, 12]. In order to address the agricultural credit problem of the smallholder farmer in Nigeria, the Central Bank of Nigeria and the Federal Government launched the Anchor Borrowers Programme, ABP in 2015. The ABP concept is like the contract farmer concept which has been found to be effective in other developing countries like India. The pilot project was launched by the Federal Government of Nigeria in November, 2015 in

Kebbi State to link smallholder farmers to the integrated rice scheme and to boost local production of rice with about 78,000 rural farmers in Kebbi State benefitted from the Programme. Yields as high as 7.5 to 8.0 tonnes per hectare were obtained by farmers compared with less than 2.0 tonnes per hectare previously obtained [4]. The extension of ABP cover crops like rice, maize and wheat farmers in 14 out of the 36 States in Nigeria, namely; Kebbi, Sokoto, Niger, Kaduna, Katsina, Jigawa, Kano, Zamfara, Adamawa, Plateau, Lagos, Ogun, Cross River and Ebonyi was as a result of the success achieved in Kebbi State in 2016 by the first quarter of 2017. The Programme involved the identification and selection of small scale farmers, grouping out growers into viable cooperatives or clusters and registration of the cooperatives. It also ensured the selection and engagement of banks and insurance companies execution of memorandum of understanding, MOUs, capacity building of out growers, banks, staff and extension agents, opening of bank accounts by cooperative/farmers, loan application and disbursement ,commencement of agronomic practices and distribution of agro inputs at recommended periods (funds for agro inputs are deducted from the loan and paid to the input suppliers) and fortnightly meetings to discuss development by project management team. The key stakeholders include the CBN, NIRSAL, federal ministry of finance and agriculture, state government/agricultural development programmes (ADPS), anchor companies, financing banks, insurance companies, development partners, farmers/out growers and project management team. Nigeria agricultural insurance corporation (NAIC) on the other hand provided insurance cover for the project under the Programme.

Rural areas in Nigeria are the centres of agriculture-based economic activity and fuel the livelihoods of 70% of Nigeria and contribute over 22.30 % of the country's GDP. However, it is surprising that only about 10% of Africa's commercial bank lending goes to agriculture and agro-industries, and more surprising still that less than 5%, on average, of national budgets are allocated to the agricultural sector, a fraction of which makes its way into rural communities. It is estimated that Nigerian agricultural output would increase if farmers were able to access the finance they need to expand both the quality and quantity of their produce. Given these facts, it is easy to see how financial inclusion for rural areas and agriculture is critical to achieving sustainable and inclusive growth in the country. The limited level of finance provided to rural areas in Africa seems to be a consistent pattern across different types of finance providers [7].

Agricultural credit is considered an important factor for increased agricultural production and food security because, it enhances productivity and promotes standard of living by breaking the vicious cycle of poverty of small scale farmers. Credit is regarded as more than just another resource such as land, labour and equipment, because it determines access to most of the farm resources required by farmers. Farmers' adoption of new technologies requires the use of improved inputs which may be purchased. Agricultural credit can be obtained from both formal institutions and informal sources. In most cases, small scale farmers are seen as conservative and unattractive to new and improved technology. The availability of credit from formal sources are constrained by factors such as lack of adequate security and rural branches, however late disbursement of funds, time and form of repayment are identified to be the causes of the default in repayment. Adequacy and availability of credit will help increase the capital base and raise the socio-economic statuses of the farmers. Majority of the farmers in Nigeria make use of credit from friends and relations (informal source), although some farmers make use of credit from formal sources, however credit from these sources are not readily available as those from informal sources [11]. Access to agricultural credit has been positively linked to agricultural productivity in several studies. Yet this vital input has eluded smallholder farmers in Nigeria. Issues of collateral and high interest rates screen out most rural smallholders. Another problem associated with

smallholders' access to agricultural credit is that agricultural loans are often short term, with fixed repayment periods; this may not suit annual cropping, especially when loan release is not coordinated with growing cycles of crops. For credit to be most effective, loan terms must flexibly relate to cash flows in the target business, the input demand/supply structure, and quantifiable business risks. Despite the investment opportunities which credit would offer poor households, formal banks hardly lend to the rural people engaged in agricultural production because, they lack collateral that they could offer as security for loans. Furthermore, owing to the small size of loans, formal banks are averse to lending to the small borrowers because of high transaction cost. Another reason why formal banks are reluctant to lend to people employed in agriculture is the high uncertainty of their incomes which is highly dependent on weather and providence. The recognition of credit as a powerful instrument for the reduction of poverty and food insecurity has led to multitude of programmes, aimed at providing credit to small scale farmers in Nigeria [10, 17]. Low incomes and the savings capacity of people in most developing countries are Insufficient to finance farmers' investment in new technology, therefore external capital is required to facilitate agricultural production which is dominated by small scale farmers, who produce mainly for subsistence and have small land holdings which makes their demand for credit small [5].

Theoretical Framework and Empirical Review

The theory of imperfect credit is considered relevant in the study. When people living in poverty lack financial citizenship, this will affect their acquisition of other livelihood activities. In the Nigerian situation, it is important to examine the effect of financial exclusion of farmers living in poverty which may worsen their vulnerability to lack of the various livelihood assets. These assets are needed to survive, exit or even avoid transmission of their abject state of being across generations. Financial exclusion is the inability of some individuals to access and use basic financial services which may include savings, loans, and remittances. Recent study in Adamawa State conducted by Food and Agriculture Organization, FAO (2015) as cited by [18] has shown that 49.9% borrowed money averaged at N25,000 from various sources; 31.2% from relations, 35.9% from friends 8.3% from local lenders, 2.0% from cooperative, 3.7% from banks. The extension of ABP to Adamawa State is expected to enhance farmers' access to it with attendance consequences of improved production and increase in livelihoods of the beneficiaries.

This study was therefore conducted to examine Anchor Borrowers' Programme as a factor mitigating financial exclusion of Small holder Farmers in Yola North and Yola South Local Government Areas of Adamawa State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of the respondents; examine the factors influencing access to financial incentives in the package among the respondents.

MATERIALS AND METHODS

The Study Area

This study was conducted in Yola North and Yola South Local Government Areas of Adamawa State Nigeria located on Latitude 9^o 14'48' N and 9^o 16'N of the Equator and Longitude 12^o 12' 28'E and 12^o 35'E, having an average elevation of about 192 m [2]. The area falls within the Northern Guinea Savannah Zone and has a tropical wet and dry climate. Dry season lasts for a minimum of five months (November-March) while the wet season spans April to October and mean annual rainfall is about 700 mm. The areas has a land mass of 2,310.05 km^2 and a population of 522,849 people, the areas are bounded by Girei to the North, Fufore to the East and Demsa to the West [9]. The maximum temperature is as high as 40^{0}C particularly in March and April when we have the hottest period while the minimum temperature is as low as 18^{0}C between December and January [3]. Agriculture is one of the major economic activities followed by civil service and trading among the people. The soil in these areas is generally loamy clay

in marshy areas (Fadama) and alluvial soil can be found around rivers and valley. The areas are generally good for agricultural activities. The major crops grown in the areas include; rice, maize, sorghum, cowpea, millet and groundnut. During the dry season, some residents engage in dry season production. Fishing activities is mostly carried out by residents along the Benue River bank and Lake Njuwa and cattle rearing [8].

Sampling Technique

Small holder farmers, specifically those who cultivate maize and rice and have applied for anchor borrowers facilities in Yola North and Yola South LGAs formed the population for the study. The list of 180 of farmers who applied for the loan was obtained from the records of ABP in the State. Structured questionnaire were used to randomly select 94 respondents used for the study.

Methods of Data Analysis

Descriptive statistics and binary logit regression were used to determine the socio-economic characteristics and factors that influence access to anchor borrowers programmed farmers in the study area.

Binary Logit Regression

Binary logit model was employed in the study because of its comparable simplicity to probit and tobit regressions. By using the logistic regression the probability of a result being in one of two response groups (binary response) is modelled as a function of the level of one or more explanatory variables.

Thus, the probability of farmers' access to agricultural credit is modelled as a function of the level of some socio-economic attributes. For this study, the response variable is 1, when the farmers had access or financially included and 0, when they had no access or financially excluded . The functional form is denoted in equation (3):

$$Y = ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right) = \beta_0 + \sum_{j=1}^{k}\beta_j X_{ij} + \varepsilon_i \text{ ..(1)}$$

where:

Y is the response category (1 if the respondent is financially included or 0 when excluded),

i denotes cases (1, 2, 3, 4.,…., 94),

$\emptyset$ is the conditional probability,

β_0 is the coefficient of the constant term,

β_j is the coefficient of the independent variable,

X_{ij} is the matrix of observed values as presented in Table 1,

ε_i is the matrix of unobserved random effects,

$\frac{\emptyset_i}{1-\emptyset_i}$ is "odd", and

$ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right)$ is the logarithm of "odds".

Equation (1) can be manipulated to give the odds ratio using equation (2):

$$\frac{\emptyset_i}{1-\emptyset_i} = \exp\left(\beta_0 + \sum_{i=1}^{k}\beta_i X_i\right) \text{ ……(2)}$$

The probability of the extent of access was calculated using equation (3):

$$\emptyset_i = \frac{exp\left(\beta_0+\sum_{i=1}^{k}\beta_j X_{ij}\right)}{1+exp\left(\beta_0+\sum_{i=1}^{k}\beta_j X_{ij}\right)} \text{ ……(3)}$$

Equation (5) is intrinsically linear since the logit is linear in X_i ; it indicates that probability $\emptyset_i$ lies between zero and one and vary non-linearly with X_i. The equation for calculating partial effects of continuous variable is denoted by:

$$\frac{\partial \emptyset_i}{\partial x_i} = \emptyset_i(1-\emptyset)\beta_j \text{ ……(4)}$$

The partial effects of the discrete variables will be calculated by taking the difference of the mean probabilities estimated for the respective discrete variable, X_i = 0 and X_i = 1.

Table 1. Exogenous variables in the binary logit regression model

Variable	Measurement	Expected sign
Age	In years	±
Household size	Number of people	+
Membership of cooperative society	Binary variable (1 = member, 0 = not a member)	+
Primary occupation	Binary variable (1=farmer, 0=otherwise)	+
Farming experience	In years	±
Income	In naira	+
Training	In days	+

Source: Data Analysis, 2020.

RESULTS AND DISCUSSIONS

Selected Socio-economic Characteristics of the Respondents

Socio-economic characteristics are an economic and sociological combination of total measure of a person's economic and social position relative to others. These characteristics as they relate to the respondents are presented in Table 2. It revealed that the mean age of the respondents was 40 years with a standard deviation of 10.3 years which implied that they are relatively young. The minimum and maximum ages were 22 and 77 years respectively. The result revealed that young farmers dominate cereal crop production especially maize and rice which were the commodity driven crops meant for the State in the Anchor Borrowers Programme of the government. Low mechanization of agriculture in developing countries of the world poses the need for manual labour which is usually provided by large household sizes of rural farmers. Apart from serving as a reliable source of labour for most productive activities, they have the tendency of putting more pressure on household heads to devising means of production to meet the needs of their families. Analysis in Table 2 indicated the mean family size of 6 people with a standard deviation of 3.86 which is a reflection of the fact that many of the respondents were married with minimum and maximum family sizes of 1 and 20 people respectively. Furthermore, analysis based on farm size also revealed that respondents are small holder farmers with the mean farm size of 3.21 hectares with a standard deviation of 1.29 which implies that farmers operated at different levels of farm sizes which tend to affect their production levels. The result is line with several studies conducted which showed that agriculture in Nigeria are dominated by small scale farmers producing the bulk of both food and cash crops [1]. Years of farming experience have been reported to provide a measure of managerial ability among farmers in Nigeria. The mean farming experience was 10 years with standard deviation of 8.49 years. This implies that there were variations in farming experience among the respondents. The more experienced the farmer is the better he/she is in the management of farm enterprise.

Table 2. Summary statistics of selected Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Age	40.05319	10.82944	21	77
Household	5.893617	3.861773	1	20
Farm size	3.212766	1.294092	1	6
Farm experience	9.989362	8.489709	2	42

Source: Data Analysis 2020.

Factors affecting access to Agricultural Credit by Respondents

Logit result with Diagnostic statistics and VIF test result are contained in Tables 3 and 4. The model was tested for specification error using link test. The result indicated a hat-square value of 0.1131204(p-value = 0.68) which shows that there was no specification error. The Hosmer and Lemeshow goodness of fit test has a Pearson chi-square value of 80.29 (p-value of 0.0000) indicating that the model fits the data well. The model also correctly predicted 73.68 % of the dependent variables. The estimated VIF with respect to each variable was greater than unity but less than the threshold level of 10 (Table 4). The result suggests that the explanatory variables specified in the model do not cluster together or exhibit multicollinearity tendencies. This implies that the estimates of the model to an appreciable extent are consistent and unbiased, stable over time and there was also no problem of multicollinearity since none of the variance inflation factors (VIF) is more than 10. Result presented in Table 3 indicates that five out of the seven variables included in the model namely membership of cooperative society, age, primary occupation, income and

training were significant, while farming experience and household size were not significant. Okeke *et al.* [13] found out in their studies that rice farmers' access to ABP was significantly influenced by their socio-economic characteristics.

Access to agricultural credit by farmers can be determined by their age. Young farmers are able to access and utilized agricultural credit because they are active, productive and eager to take risk associated with production than older farmers. Elderly farmers are risk averse and less flexible and lesser likelihood of accessing credit and utilizing them. This study found a negative but significant at 5% level relationship between age and access to agricultural credit (Table 3). Furthermore, the result indicated that one year increase in age reduces the probability of having high access to agricultural credit by 0.000059%. Training builds capacity for the performance of productive activities. Training enhances managerial ability in people and can adopt innovations easily than those who are not trained. Sourcing for information and their interpretation and investment decision are easier with trained people. It is therefore, hypothesized that training will increase the probability of access to agricultural credit among farmers. Result in Table 3 revealed training had significant relationship with access to agricultural credit at 5% probability level. This implies that being trained increases the intensity of access to agricultural credit. High premium was attached to training in Anchor Borrowers Programme to equip participating farmers in the programme. Income is one of the critical factors of technology adoption and improved production. Farmers with high levels of income are better off than those with low levels of income. It is hypothesized that income will increase the level of access to agricultural credit. Income had a significant relationship with access to agricultural credit at 5% probability level. The result suggests that a unit increase in the income of respondents increases the probability of having access to agricultural credit by 18.19%. Cooperative society is one of the media through which agricultural technologies are conveyed to farmers. It is hypothesized that being a member of cooperative society will increase a farmer's probability of getting access to agricultural credit.

The coefficient of the variable was positive and statistically significant at 5%. More specifically, the marginal effect estimates show that farmers' decision to be a member of cooperative society increases the likelihood of access to agricultural credit by 70.36%. Opeyemi [16] attributed decision to belong to any membership of cooperative group is influenced by awareness.

This could be adjudged to flow of information that is always associated with membership of associations that address mutual interest. This is consistent with findings of [15] who also found out that membership of a cooperative society influences an individual farmer's decision in farm technologies adoption. Oladele and Wakatsuki [14] also established that adopting a new technology would be influenced by other farmers in their social group where they share information and learn from each other. Individual farmers are expected to be more likely to apply for credit when they know many other farmers who have benefitted from the credit facility provided by ABP. Occupation is a sustainable livelihood activity in which people earn a living.

A primary occupation takes a large chunk of time of an individual. Agriculture is the major occupation in rural farming households in Nigeria accounting for over 70% of employment. It is hypothesized that farming as a primary occupation of the respondents will increase the level of access to agricultural credit.

As shown in Table 3, a significant relationship existed between primary occupation and access to agricultural credit is statistically significant at 5% probability level. The result suggests that farming as primary occupation will increase the probability of access to agricultural credit.

Table 3. Logit Regression Result for Factors influencing Access to Agricultural credit

Variable	**Coefficient**	**Standard error**	**Z-value**	**P-value**	**Marginal effect**
Age	.0168403	.0054443	3.09**	0.002	.000059
Household size	.1635544	.3605655	0.45	0.650	.0251453
Membership of cooperative society	.0014575	.0005563	2.62**	0.009	.7036445
Primary occupation	.0245397	.0117657	2.09**	0.037	.1015077
Farming experience	.0082431	.050297	0.16	0.870	.0088223
Income	.001381	.0005427	2.54**	0.011	.1819219
Training	.0182888	.0054219	3.37**	0.001	.6298849
Constant	7.777747	3.136501	2.48**	0.013	
Diagnostic Statistics					
Chi-square 32.84**					
Log likelihood -47.516953					
Pseudo R^2 0.6568					
Specification test					
_hat	.934658	.2609334	3.58**	0.000	
_hatsq	.1131204	.1654827	0.68		
goodness-of-fit test Pearson chi2(84) 80.29**					
Correctly classified: 73.68%					
Number of respondents 95					

Source: Data Analysis 2020. ** Significant at 5%

Table 4. Variance Inflation Factors (VIF) Result

Variable	**VIF**
Membership of cooperative society	2.41
Household size	2.16
Age	2.12
Training	1.24
Farming experience	1.20
Primary occupation	1.13
Income	1.11
MEAN VIF	1.62

Source: Data Analysis 2020.

CONCLUSIONS

Based on the findings of the study, it can be concluded that respondents were relatively young with the mean family size of 6 people who are mostly small holder farmers and are experienced. Socio-economic disposition have influence on their ability to access agricultural credit.

Government policies that would encourage young people to go into agriculture should be sustained by the government at all levels in areas of credit supply, training and supply of basic production inputs to boost production, increase food security and reduction in poverty.

Farmers should be encouraged to form cooperative societies to maximize the economics of scale.

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MARKETING STUDY ON ROMANIAN CONSUMER PREFERENCES FOR COW MILK

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Abstract

The main purpose of the paper is to analyze the preferences of Romanian consumers towards cow's milk, following the frequency of milk consumption, quantities consumed, brands and type of packaging preferred, the price they are willing to allocate per liter of milk, depending on: of residence, age and income. In this sense, a questionnaire was made on the Google Forms platform on a sample of 84 people, female and male, which was processed through the SPSS program, the results being interpreted analytically and presented in the form of graphs. Following the study, there was a declining trend in milk consumption among the population, fueled by new food styles, especially among young people and females, two categories influenced by new consumption trends. Among the respondents, a significant number of people consuming milk was noticed, in proportion of 90.5%, and 9.5% stating that they do not consume this product. The most important criterion underlying the decision to buy milk among respondents is the taste, followed by packaging and shelf life, thus finding a consumer behavior inclined to quality, to the detriment of the quantity of products purchased.

Key words**:** *consumption, marketing, milk, Romania*

INTRODUCTION

Food is a hotly debated topic in recent years, not only nationally but globally, its problem being more and more serious, due to the new modern lifestyle, which has emerged among the population.

Milk is one of the most complex food products, containing protein, vitamins and minerals, being one of the basic products found in the food pyramid.

Milk production is one of the most important sub-branches of agriculture in Romania, with a significant contribution on the economy [3, 4].

The Romanian milk and dairy market has made substantial progress in recent years. There are over 360 milk processing factories in the country, of which 120 with a high level of capacity, Romania having a great potential for milk production, thus becoming one of the main producers of certified dairy products in the European Union, after Germany , France, the United Kingdom, the Netherlands, Poland, Italy and Spain. However, Romania remains a net importer of dairy products [2, 5, 12].

In Romania, the largest players on the dairy market are represented by the companies: Albalact, Olympus and Covalact, the highest business growth in the last decade being recorded at Olympus, starting from over 30 million lei and reaching approximately 370 million lei. The dairy market in Romania is characterized as extremely competitive among companies operating in the milk processing industry [7, 11].

Current daily milk consumption does not meet the normal physiological requirement for the population's diet. At European level, the highest consumption of milk is recorded in Western countries, consumers in this area consider milk, a healthy nutritious product, being a rich source of calcium. In Romania, milk consumption is low compared to other countries in the European Union, thus occupying the penultimate place in the consumption of cow's milk packaged with a consumption of 32 ml of milk per person/day, followed by Bulgaria which records a consumption of 23 ml person/day, according to a study conducted by the research company Euromonitor [13].

In 2019, the average annual milk consumption in Romania was 66.28 liters, down from previous years. By area of residence, the average annual consumption in rural areas is higher than in urban areas, a possible cause of this discrepancy may be represented by the low incomes of the rural population compared to those in urban areas.

The purpose of this paper is to analyze and present the preferences of Romanian consumers towards cow's milk and how they perceive this product.

MATERIALS AND METHODS

The paper analyzes consumers' preferences for cow's milk in Romania. For the study, the survey method and the ranking of results were used, having as main tool the questionnaire. It consisted of a set of 14 questions, for the study the following questions from the questionnaire were selected:

-Do you consume milk?
-What is the frequency of milk consumption?
-What is the budget allocated for a liter of milk?
-What type of packaging do you prefer?
-What is the amount of milk consumed in a week?
-What brand of milk do you prefer?
-Where do you usually buy milk from?
-What is your favorite brand of milk?
-What is the criterion underlying the decision to buy milk?
–How do you rate the following statements about Zuzu milk? (total agreement, indifferent, total disagreement)
–What is your gender?
-What age category do you fall into? (under 18, 18-35 years, 36-50 years, over 50 years) - What income category do you fall into? (under 1,000 lei, 1,000-2,000 lei, 2,001-3,000 lei, over 3,000 lei)
-What is the environment of residence? (urban, rural).

Two ways of researching consumer preferences were addressed, namely: qualitative research and quantitative research, starting from the objectives of research on consumer preferences for milk, followed by assumptions, on the basis of which a questionnaire was conducted. The data collection process took place in November 2020 and included the following steps: posting the questionnaire on the Google Forms platform, distributing it on social networks, taking over the answers and centralizing them. The result obtained after completing the questionnaire by a sample of 84 people was processed using the SPSS program and interpreted, thus analyzing the behavior of the Romanian consumer towards milk. An analysis was made on the basis of the graphs made through the program, following which the trends in milk consumer behavior were presented, as well as the possible causes that led to these results.

RESULTS AND DISCUSSIONS

To carry out the marketing study on consumer preferences for milk, it was used a special questionnaire and a sample of 84 people, female and male who come from both urban and rural areas, from different social categories [6].

Analyzing the answers ***according to the gender*** of the respondents, it was noticed that the male population consumes 100% milk, while the female population consumes 84%, the remaining 16% do not consume. It was observed that the respondents who do not consume milk are female (Fig. 1).

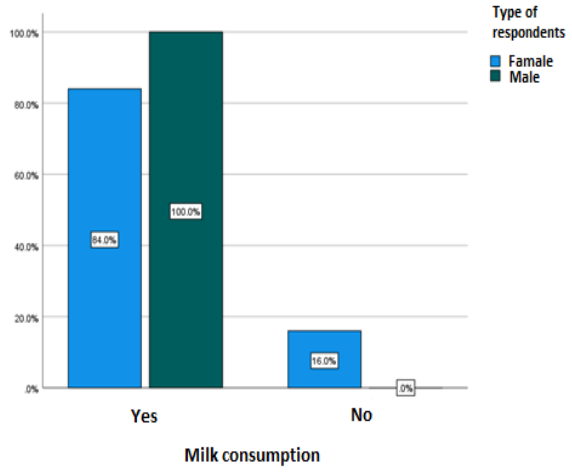

Fig. 1. Milk consumption by gender
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

Recent years have seen a reduction in milk consumption and even its elimination, especially among women, the main reason being the trend towards a healthy and balanced lifestyle, with many people choosing to adopt a vegan diet, which completely excludes the consumption of milk, products of animal origin, such as milk. In the last two years, the vegan lifestyle has become increasingly popular among the European population, with an increase in the number of vegans and a decrease in cow's milk consumption.

Cow's milk is one of the foods on a downward trend in popularity, with the advent of milk alternatives, such as soy milk, almonds milk or coconut milk.

Population aging, urbanization and a growing middle class are the main factors determining important changes in living conditions and consumption patterns [14, 15].

Following the analysis according to the environment of ***residence of the respondents***, it was observed that in rural areas 42.9% of respondents consume milk 2-3 times a week, 28.6% 4-5 times a month, 14.3% do not consume, 9.5% consume daily, and 4.8% consume milk less than 2 times a month. Regarding the frequency of milk consumption in urban areas, it was noted that 33.3% consume 2-3 times a week, 23.8% consume daily, 23.8% consume 4-5 times a week, 14.3 consume less 2 times a month, 4.8% do not consume.

For both rural and urban areas, the highest frequency of responses was recorded as "2-3 times a week", which means that most respondents consume milk weekly (Fig.2).

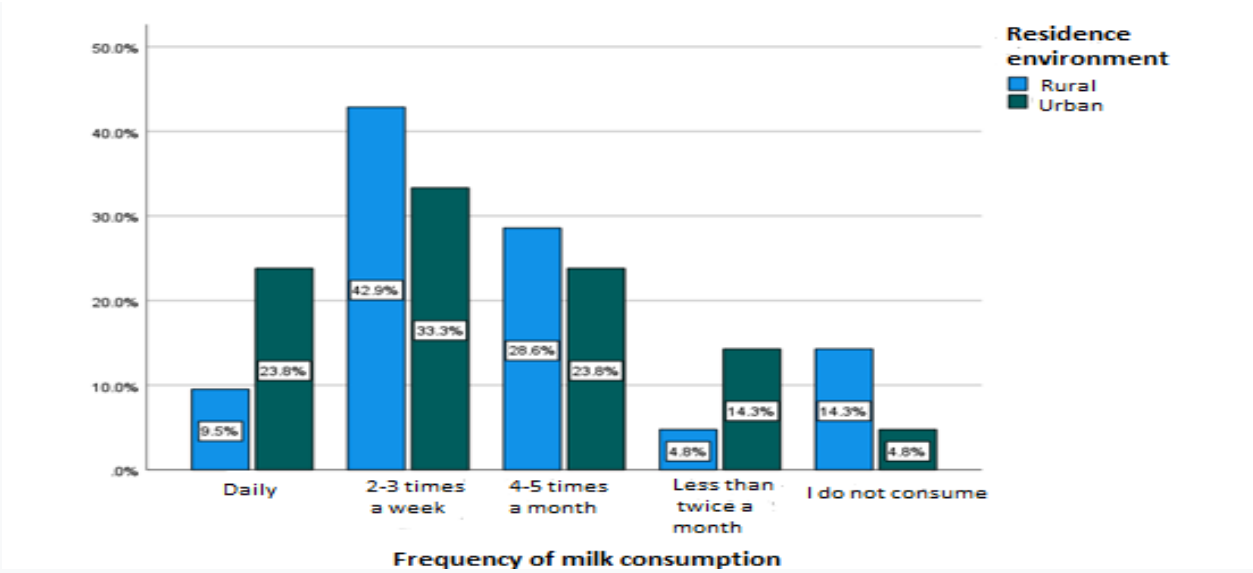

Fig. 2. Frequency of milk consumption depending on the environment of residence of the respondents
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

According to statistics, milk consumption per person in rural areas is significantly higher than in urban areas, as well as its frequency.

How much money consumers are willing to pay per one liter of milk? It was noted that those who are willing to pay more than 3 lei per liter of milk are people living in urban areas.

People in rural areas are willing to pay 5 lei or less per liter of milk, the main factor influencing these discrepancies being the standard of living, which is lower in rural areas than in urban areas (Fig. 3).

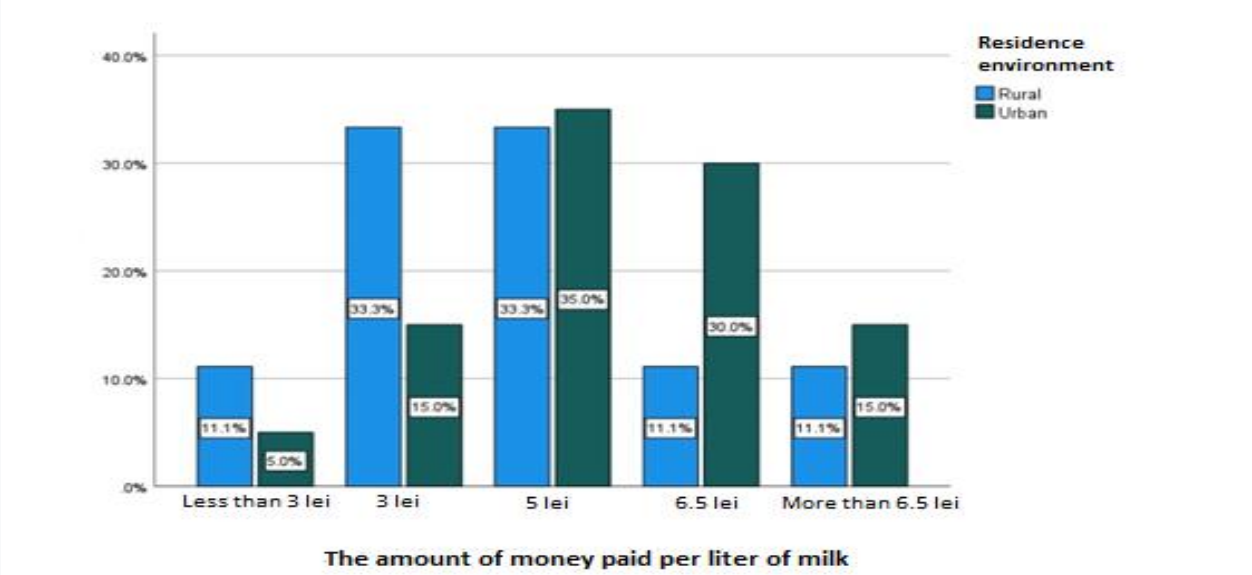

Fig. 3.The amount of money paid per liter of milk depending on the environment of residence of the respondents
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

Analyzing the answers of the surveyed respondents to the question, ***„What type of packaging do they prefer ?'',*** it was observed that urban residents prefer milk packaged in glass (50%) and cardboard (30%), while rural respondents mostly prefer milk packed in plastic (38.9%) and glass (33.3%) (Fig.4).

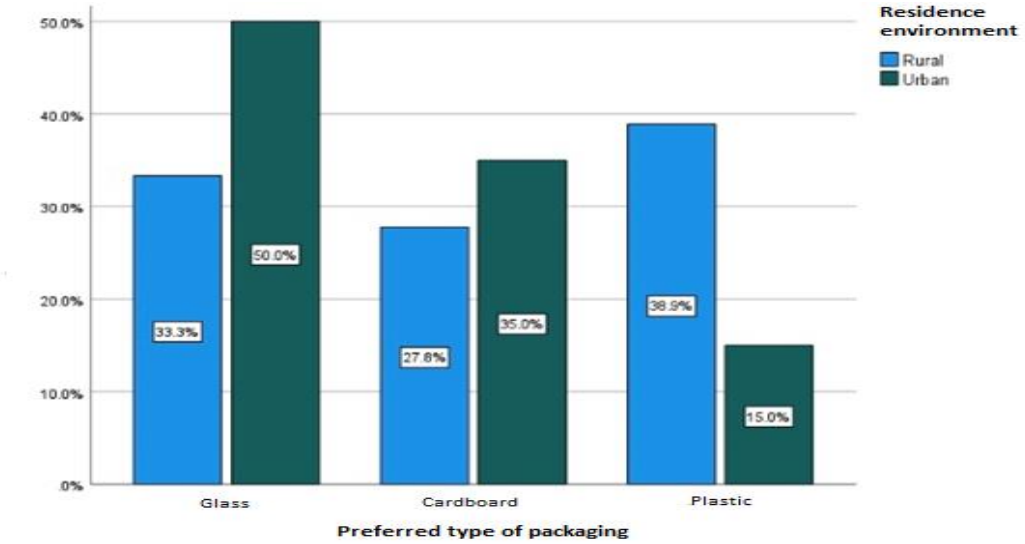

Fig. 4. The type of packaging preferred by consumers depending on the environment of residence
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

It is noteworthy the tendency of consumers to glass packaging, a material that can be recycled by melting without damaging its quality. Glass is an optimal material for health and taste, as it does not influence the aroma of milk and there is no chemical that could interact with the liquid, which can not be said about plastic, which in urban areas is the least preferred packaging for such of products.

How much milk is consumed per week? Following the amount of milk consumed per week according to the age of the respondents, the following were observed: among the respondents under the age of 18, 50% consume between 0.5 and 1 liter, 31.2% consume between 1-3 liters per week and 18.8% do not consume. At the level of respondents aged between 8 and 35 years: 60.9% consume milk between 0.5 and 1 liter,

26.1% consume between 1 and 3 liters, and 8.7% do not consume. Regarding consumers aged between 36 and 50 years, 50% consume milk in an amount between 0.5-1 liters, and the remaining 50% consume between 1-3 liters.

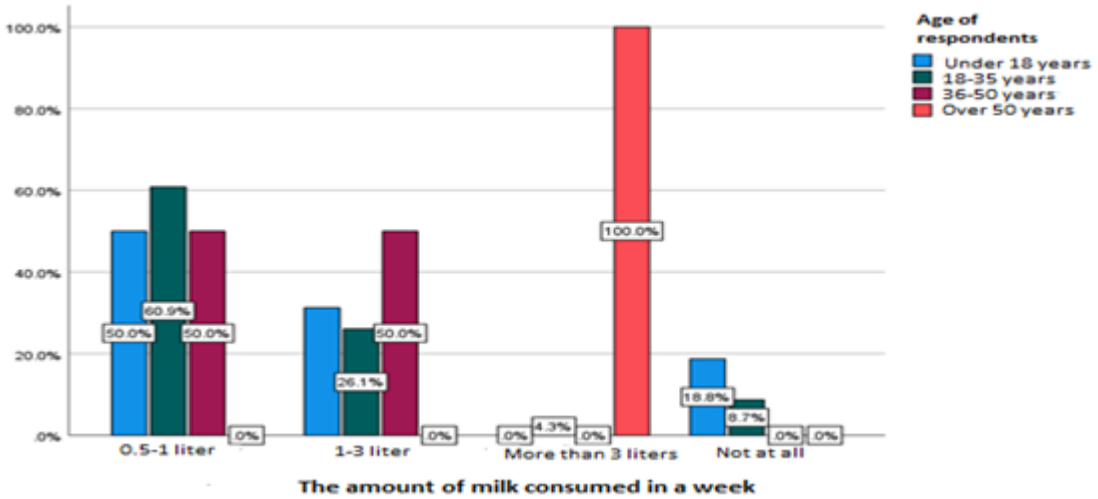

Fig. 5. The amount of milk consumed in a week depending on the age of the respondents
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

Only one respondent over 50 years old (100%) stated that he consumes milk in an amount greater than 3 liters per week. Of note is the trend of consumption in an amount between 0.5 and 1 liter per week for most age groups, which is a low milk consumption (Fig. 5).

Which is the place from where consumers prefer to buy milk, depending on their age? Researching the respondents' preferences regarding the place where they buy milk according to age, it was observed that the people who choose to buy milk from the supermarket are those who are part of the age category 36-50 years in proportion of 100%. Consumers who buy milk from local producers are 100%, those over 50 years old, and those who choose to buy milk from small shops are represented in proportion of 9.1% by people aged between 18 and 35 for years. (Fig. 6).

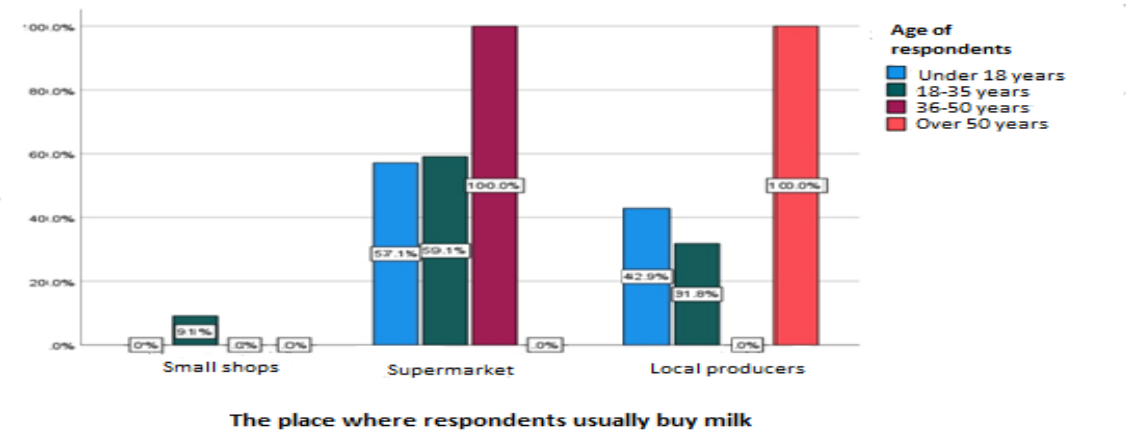

Fig. 6. The place where consumers are accustomed to buy milk according to age
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

How respondents' income infuence the choice of the milk brand? Depending on the income of the respondents, it was noted that: respondents with incomes below 1,000 lei

prefer in a proportion of 66.7% the Albalact brand, 16.7% Dairy with creme and 16.7% Olympus. Respondents whose income is between 1,000 and 2,000 lei in a proportion of 33.3% equally prefer the Albalact, Pilos and Muller brands. Respondents with an income between 2,001 and 3,000 lei prefer in proportion of 53.8% the Albalact brand, 23.1% prefer Pilos, 15.4% Olympus and 7.7% Caimac Dairy.

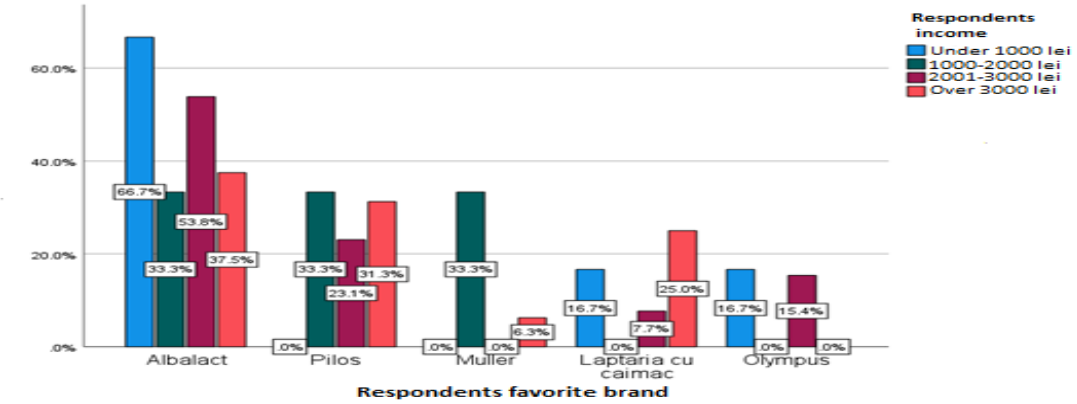

Fig. 7. Preferred brand depending on the income of the respondents
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

Regarding the milk consumers with an income of over 3,000 lei, it is observed that in a proportion of 37.5% they prefer milk from the Albalact brand, 31.3% Pilos, 25% Dairy with caimac and the remaining 6.3% prefer Muller (Fig.7).

It should be noted that the Albalact brand is the most preferred milk brand among respondents for all income categories analyzed. The main reason why the Albalact brand is a favorite can be the fact that it has a monopoly on the dairy market and has a diversified portfolio of brands and products for all age categories and at affordable prices [9].

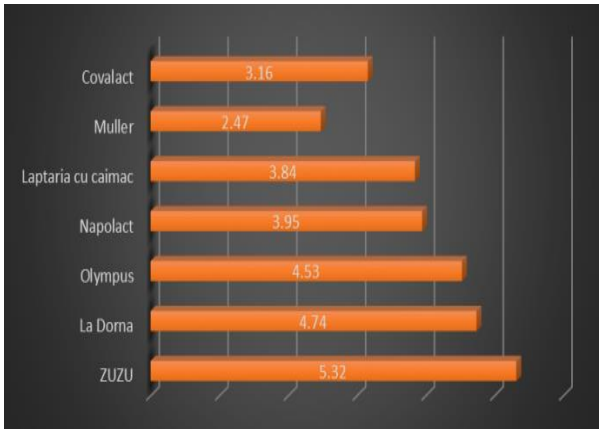

Fig. 8. Respondent's preferences regarding the milk brand
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

The best ranked brand in the top of consumer preferences is Zuzu, a brand that belongs to the brand with the highest notoriety among respondents, namely Albalact, with a percentage of 5.32%, followed by La Dorna 4.74%, Olympus 4.53%, Napolact 3.95%, Caimac dairy 3.84%, Covalact 3.16% the last ranked being Muller, with a percentage of 2.47% (Fig. 8).

The number 1 consumer choice, Zuzu is one of the most favorite Romanian brands, remaining a leader on the dairy market for almost a decade.

Zuzu is the brand that brought to Romania the first and most used modern packaging for fresh milk - the Tetra Top cardboard box.

The innovation of 2006, but not only, led to an increase in milk consumption and made Zuzu the leader in the fresh milk market [1].

Given the market acceptability score, consumers appreciate the milk sold by the Zuzu brand as a product with a pleasant taste. As regards the packaging of the milk and the quality-price ratio, it is indifferent, these criteria not being among those taken into account in the decision to purchase the milk. (Fig.9).

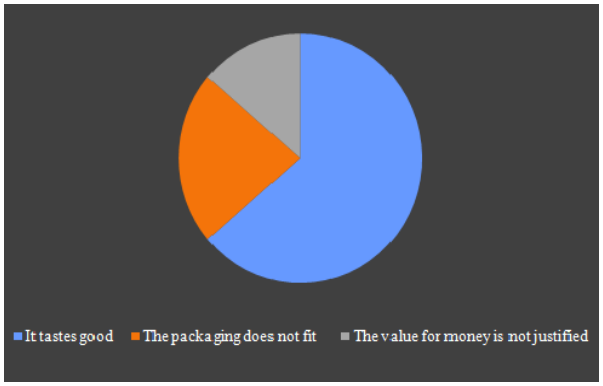

Fig. 9. Acceptability score of the Zuzu brand
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

It is worth noting the consumers' preference over the quality of the milk, which is distinguished by the taste of the products.

Which are the criteria taken into account for milk purchase? The most important criterion taken into account by consumers when they decide to buy milk is the taste, in percentage of 4.87%, followed by the term of validity and packaging (4.39%), criteria that are equal from this point of view. Brand (3.89%) and fat content (3.87%) are criteria that are also of almost equal importance for them, so that in the end the factor that least influences the purchase decision is the price (3.26%).

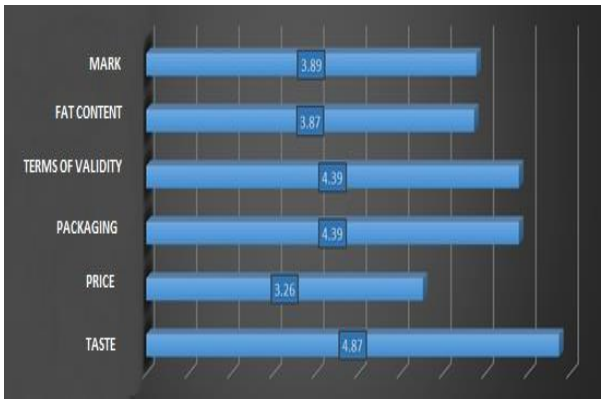

Fig. 10. Criteria in the purchase decision
Source: data processed on the basis of the questionnaire - Study on consumer preferences for milk.

Thus, it turns out that a consumer chooses to buy milk according to taste, placing more emphasis on the quality of milk, which is determined by its composition, especially in the percentages of fat and protein, than on the price paid, which has a slight trend. growth influenced by increased production costs of farmers and processors (Fig. 10) [8, 10, 11].

CONCLUSIONS

In Romania, there has been a downward trend in milk consumption, with consumers becoming increasingly demanding in terms of quality and quantity of milk consumed. Of note is the trend of consumers towards a healthier and more balanced diet, choosing to adopt vegan diets, excluding from consumption animal products such as milk and replacing them with products of vegetable origin.

Following the study based on the questionnaire applied to a sample of 84 people, of which a share of 90.5% consume milk, and the remaining 9.5% do not consume, the following aspects were concluded by consumers' preferences for milk: most respondents (38, 1%) consume milk 2-3 times a week, 26.2% of them consume milk 4-5 times a month, 16.7% consume daily, 9.5% consume less than 2 times a week and 9.5% do not consume. Following the answers, there was a fairly high frequency of milk consumption. Regarding the amount of milk consumed in a week, in a majority proportion of 54.8% stated that they consume milk in an amount between 0.5 and 1 liter, the remaining 28.6% answered between 1 and 3 liters, 11.9 % answered that they do not consume and 4.8% consume more than 3 liters.

It was observed that brands (3.89%) represent one of the main criteria for choosing and buying milk, by taste (4.87%). It should be noted that at the level of the analyzed sample, the most preferred brand is Albalact, Zuzu milk being in the top of milk consumers' preferences. Albalact is the largest milk processing company in Romania, with a diverse range of products in its portfolio. Regarding the place where they prefer to buy milk, respondents said 57.9% that the chosen place is the supermarket, followed by local producers (36.8%) and small shops (5.3%). The supermarket is ranked in the top of consumers' preferences in terms of where to buy milk, being an accessible place that meets the quality and marketing standards of the European Union.

One of the criteria that had a minimal influence on the decision to buy milk for the respondents was the price, 34.2% said they are willing to allocate the amount of 5 lei per liter of milk, 23.7% allocate 3 lei, 21.1% are willing to spend 6.5 lei, 13.2% pay a price higher than 6.5, and 7.9% allocate a price lower than 3 lei.

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FOOD GEOGRAPHICAL INDICATION IN ENHANCING AGRICULTURAL AND TOURISM PERFORMANCE

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Abstract

Food Geographical Indication (GI) are labels that guarantee consumers that this is an original food product of the highest quality whose origin is linked to a specific region. The aim of the study was to determine the current state of GI, i.e. the number and spatial distribution in the EU and to examine their relationship with the performance indicator of agriculture and tourism in the EU. At the time of writing the paper in the EU Geographical indications register, 1,507 food products were recorded, which were unevenly distributed in the members of the Union. Most of them are in the southern Mediterranean member states, while their number is decreasing towards the north of Europe. The results of the paper reject the assumption of a positive correlation between the number of GIs and the performance of agriculture in the EU28. Indeed, the leading EU members in terms of agricultural output are also those with relatively few GIs. On the other hand, most GIs are found in EU member states with below-average developed agriculture but with an important role of tourism in their economy. The conclusion of the paper is that in most countries with less developed agriculture, GIs cannot significantly improve unfavourable macroeconomic agricultural indicators but have a multiplier contribution to the development of the tourist offer and tourism in general.

Key words**:** *correlation, EU, Food Geographical Indication, tourism, performance of agriculture*

INTRODUCTION

One of the most important goals of the European Union's agricultural policy is to ensure a sufficient amount of safe and quality food. With the rise in living standards, consumers in EU countries are showing an increasing interest in quality foods with traditional characteristics. This causes a growing demand for foodstuffs specifically related to the geographical area in which they are produced.

During the 1990s, the European Union established a unique system that allows the protection of the names of agricultural and traditional products that are either related to a particular geographical area in terms of quality and special characteristics or the method of their production follows traditional recipes and / or methods. In June 1993, the European Union adopted Regulation 2081/92 laying down criteria for obtaining quality labels for agri-food products from a geographical area: Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). In 1999 (Regulation 1804/99), protection was extended to Traditional Specialties Guaranteed (TSG) products whose specific characteristics are conditioned by the method of manufacture and traditional composition. These markings on the product packaging, next to the name, guarantee the consumer the purchase of an authentic and controlled product, of recognized quality and local origin.

The European Commission keeps a record of geographical quality labels in eAmbrosia – EU Geographical Indications registers. This base was launched in 2019 replacing previous databases for wine (e-Bacchus), spirits (e-

Spirit-Drinks) and food (Door). It includes a list of product names (agricultural products and foodstuffs) registered as PDO, PGI or TSG as well as the names for the registration of which it has been applied [22].

At the beginning of 2021, 3,736 products were recorded in the database, divided into four groups: (1) food, (2) wine, (3) spirit drinks, (4) aromatized wines. The subject of this paper are Food Indications, which make up 1,507 or 40.3% of all quality labels in the register.

An observation of the items and their distribution among the members of the European Union reveals a noticeable spatial inequality. Albuquerque et al. [2] conclude that the largest number of registered products is found in the countries of southern Europe, continuously increasing in comparison with the countries of northern Europe. In her dissertation, Bitota [5] from the Faculty of Agricultural Sciences, Uppsala in Sweden researched the reasons why, at the time of the research, there were only three protected products in Sweden while in France there were 170. The author concludes that the labelling system in France is suitably presented and functions very well. On the other hand, producers and consumers in Sweden are not sufficiently informed about the benefits and are generally more cautious in their opinions on the extent in which food protection systems would encourage the consumption of thus labelled foods.

Unlike their counterparts in Sweden, it seems that Croatian producers are more familiar with the benefits of product geo-labelling. This is confirmed in the research by Mesic et al. [16] who, using a sample of 30 Slavonian kulen producers, found that a significant share of producers (43%) is fully familiar with geographical indications, and that they have very positive expectations from the impact of GI on the increased competitiveness of Slavonian kulen producers.

Aside from the contribution to the food market development, products with a geographical indication give added value to the rural area in which they are protected, and are aimed at revaluing the range of local origin products. In their research, Spilková and Fialová [20] emphasize that the labels aim to encourage regional development, as the vast majority of products carrying these labels come from Less Favoured Areas. Academic circles are increasingly discussing food as a distinguishing component and its potential for contributing to the tourists' decision to visit a destination. Different countries also use different approaches when linking food and tourism. Concepts such as gastronomic or culinary tourism or food tourism are being developed [17]. Furthermore, the labels, in addition to being present on the food product, also represent the locality and the recipe (culinary secret), thus representing the history of that tourist destination [18].

According to Hall et al. [12] and Hjalager & Richards [13] the experience of tasting specific food in a tourist destination has added value both on the supply side and on the demand side of the tourist experience. Food is very often a key aspect of a travel experience or may be key to understanding the culture of an area [11]. Another important part of the tourist offer are specific gastronomic specialties and national cuisines, both directly related to geographic food labels. Duvnjak [8] conducted a survey on a sample of 107 adult respondents and found that tourists at a rural tourist destination are most attracted to the gastronomic offer. More than half of the respondents (65%) believe that food at a rural tourist destination should come from nearby family farms, and 39% of respondents said that when they are consuming food it is important that the product has at least one local origin label. Balabanova [3] concludes that the introduction of a system for the protection of rural gastronomy in the EU has contributed to the awakening, preservation and improvement of the local food production quality and the development of entrepreneurship and self-employment in rural areas. He mentions the example of France, which promotes cheeses, wines, seafood and other agri-food products through the cooperation of local organizations and travel agencies. In this way, the rural area and local food producers are developing synergistically. A similar idea of mutual cooperation between the food production and tourism sectors in

Spain is emphasized by Xosé et al. [23], underlining the importance of local food products as a resource for gastronomic tourism. Combining food and tourism affects the development of tourism, and at the same time promotes the quality of agricultural products, which further develops the local gastronomic offer.

MATERIALS AND METHODS

The aim of this paper is to analyse the use of the Food Geographical Indication Scheme in the European Union countries and to determine their statistical connection with the development indicators in agriculture and tourism.

In the first part of the paper the displayed results will show:

a. the number of protected products in EU member states in absolute and relative amounts (number of labels per 106 ha of used agricultural land.), and

b. the representation of certain product categories among protected products.

The paper used secondary data from the EU geographical indications register (eAmbrosia). A similar survey was conducted by Velčovská & Sadílek in 2014 [22], and this paper will identify any changes in the leading countries and product categories in the protection processes that occurred in the meantime.

In the second part of the Results section, a correlation analysis will be conducted in order to determine the relationship between the number of protected products and development indicators in agriculture and tourism. The first assumption of the paper is that there is a measurable and statistically significant positive contribution of food protection to the total value of agricultural output. To this end, the correlation between the number of GIs per million inhabitants of EU members and agricultural output per unit of labour will be investigated. Another assumption of the paper is that there is a connection between the number of GIs and the economic tourism indicators of EU member states. This assumption is based on the fact that food and culinary delights play a crucial role in the tourists' demands [6], [15], [19].

In order to confirm the second hypothesis, the GI number will be matched with the Tourism Intensity indicator, which is expressed by the number of overnight stays in the receptive country per capita. The analysis will be conducted on the example of EU member states and UK (N = 28) according to data for 2018. Due to the relatively small sample and lack of normal distribution, a nonparametric test of the Spearman correlation coefficient will be used. The correlation will also be displayed graphically using a Scatter Plot.

RESULTS AND DISCUSSIONS

The results of the GI number analysis are determined as the situation on January 26, 2021 when there were 1,507 food products in the Food Register, which ispart of the EU geographical indications register eAmbrosia. Compared to March 2013, when 1,146 product items certified with PGI, PDO or TSG label were registered in the DOOR database [22], this is an increase of 31.5%.

Among 1507 GIs, the majority are those with PGI labels (784). PDOs (659) follow, while TSG labels (64) are the least numerous. Compared to 2013, the number of PGI labels increased by 236, the number of PDO labels increased by 99, while the number of products with TSG labels increased by 26 more than in 2013.

Table 1. Geographical Indication Labels type share (N=1,507)

Label type	PGI	52.0 %
	PDO	43.7 %
	TSG	4.3 %

Source: Author's processing according to the data from "eAmbrosia – the EU geographical indications register"[8].

Considering the product categories, the most common are fresh and processed fruits, vegetables and cereals. This category was the most represented in 2013 as well, with approximately the same share [22]. In terms of share, meat and meat products hold the second place and thus, combined with the

leading category, account for half of all Geographical Indication Labels.

Table 2. The most common food categories in the GI register (January 26, 2021)

Product category	Fruit, vegetables and cereals, fresh or processed	404	26.8 %
	Meat. fresh and processed	367	24.4 %
	Cheeses	255	16.9 %
	Oil and fats (butter, margarine. oil etc.)	143	9.5 %
	Bread, pastry, cakes, biscuits etc	100	6.6 %
	Fresh fish, molluscs, crustaceans etc	57	3.8 %
	Beers	27	1.8 %
	Pasta	12	0.8 %
	Other	142	9.4 %

Source: Author's processing according to the data from "eAmbrosia – the EU geographical indications register"[8].

When observing the geographical distribution, it is noticeable that GIs are most numerous in the Mediterranean EU member states. Italy has the most labels (312), followed by France (257) and Spain (203). These three EU members have 51.2% of all labels in the Union. The concentration of GI distribution is evident from the fact that the cumulative share of 21 EU member states is less than 20%. There are no GIs in Estonia and Malta (Fig.1). Due to the differences in the area size and population of EU member states, a more objective picture of GI quantity and their importance to the local economy is likely to be obtained by an indicator of relative GI numbers calculated by the ratio of GI to population in EU member states.

Expressed in this way, Portugal is the leading country with 10.6 GI per million inhabitants. Countries with more GIs include Slovenia (12.4 GI per million population) and Greece (10.6 GI per million population) (Fig. 2).

Among the eight leading countries in terms of the relative number of GIs, as many as seven of them are part of the Mediterranean geographical area.

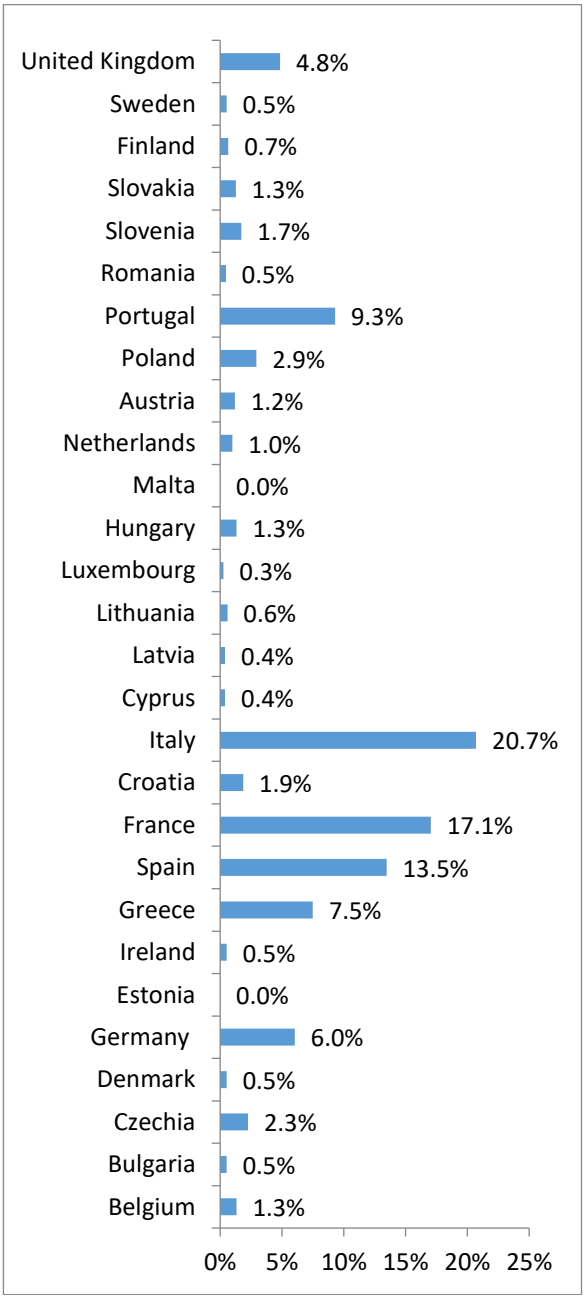

Fig. 1. Share of EU members Geographic Indication Label in total EU labels.
Source: Author's processing according to data from "eAmbrosia – the EU geographical indications register", on January 26, 2021 [8].

On the other hand, the bottom of the list is occupied by the northern European members, Sweden and the Netherlands with less than one GI per million inhabitants. The disinterest of consumers and food producers towards

labelling in Sweden was also confirmed by Bitota Mudibu Sparf in her 2010 dissertation [5].

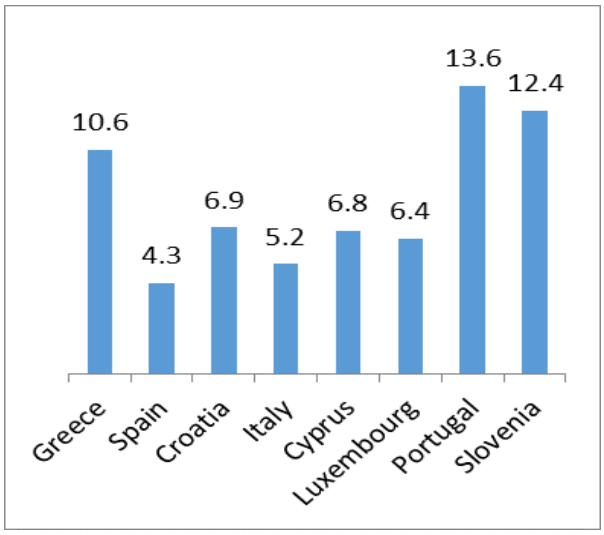

Fig. 2. GI number per million inhabitants – eight leading EU member states
Source: Author's processing according to data from "eAmbrosia – the EU geographical indications register", on January 26, 2021 [8].

The author states that Swedish consumers and producers may not be sufficiently informed about the advantages of GI. Furthermore, representatives of two Swedish companies agreed that the geographical indication is good as a system of protection, but they are not so convinced that the geographical indication label can enhance their already strong trademarks. The Swedish government might also be sceptical about the benefits of a labelling system. The fact that the most food produced in Sweden is consumed locally may be one of the reasons why there is not as much interest in product labels. If their production were intended for export, it is likely that producers would have an economically justified interest in protecting their products with designations of origin or geographical origin. Bitota [5] states that Scandinavian producers are hesitant with the labelling system. The needs of such a labelling system are difficult to combine and understand in the countries of northern cultures. In these countries, food products are often associated with industrial value and quality based on standardization and hygiene. On the other hand, there is a small portion of those familiar with such a system (in France 10-12% are not familiar with PDO, while in Scandinavia 10-12% of consumers are familiar with it).

Although the Netherlands is the world's leading country considering the value of food exports per capita, only 15 food items have a GI label, among which there are only four types of cheese. This data contradicts the conclusions reached by Balogh and Jambor [4] who found that countries exporting cheeses with a PDO label have a comparative advantage over other countries without GI cheeses.

Like the Netherlands, many other EU members with highly developed agriculture and good agro-economic indicators, have relatively little food protected by GI. For example, Germany, Denmark and Belgium have less than 2 GIs per million inhabitants. In order to determine the statistical correlation of development indicators with the number of GIs, a correlation analysis was performed. By calculating the Spearman correlation coefficient, the economic indicator agricultural output per annual working unit and the number of GI per capita were matched (Fig. 3).

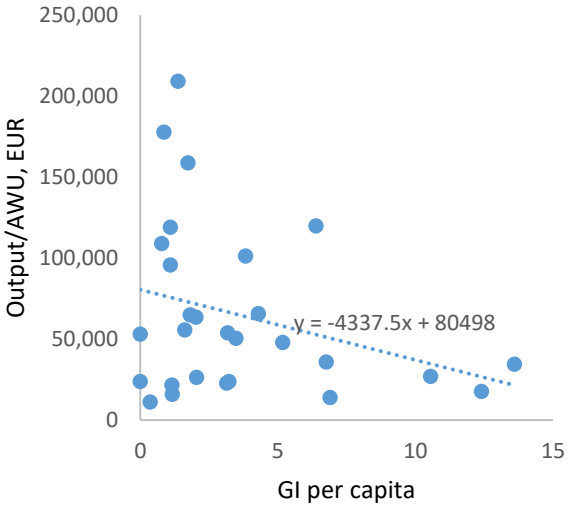

Fig. 3. The correlation between the number of GI and the EU agriculture productivity
Source: author's processing according to data from "eAmbrosia – the EU geographical indications register", on January 26, 2021 and Economic accounts for agriculture (2020) [8].

The presented graph shows a negative correlation, which, expressed by Spearman's correlation coefficient, is -0.19436. Although it is not possible to talk about a statistically significant relationship (r_s = -0.19436), this rejects the first assumption of the paper about the positive contribution of GI to economic performance of agriculture. On the contrary, the members with the most productive agriculture in the Union (Denmark, the Netherlands, Belgium) are also members with a relatively small number of GIs.

Table 3. Order of countries according to agricultural productivity and number of GIs

	Agricutural Output/AWU		GI's	
	EUR	Rank in EU	Number per million inhabitants	Rank in EU
Denmark	209.109	1	1.4	19
Netherlands	177.689	2	0.9	24
Belgium	158.727	3	1.7	17
.....				
Portugal	34.519	18	13.6	1
Slovenia	17.622	25	12.4	2
Croatia	13.972	27	6.9	4

Source: Author's processing according to data from "eAmbrosia – the EU geographical indications register", on January 26, 2021 and Economic accounts for agriculture (2020) [8].

These results differ from the conclusions that the adoption of PDI/PGI is associated with a positive effect on farmers' economic performance presented studies by Diallo [7], Vandecandelaere et al. [21], and Hoang et al. [14]. Given that the establishment of a correlation should never imply the causal relationship, it would be unreasonable to reach a conclusion based on this data that GIs do not create added value in the food sector or improve market access. For example, Croatia is characterized by low-intensity agriculture which does not generate high output, but numerous GIs (6.9 per million inhabitants) have a catalytic effect on related activities such as rural and maritime tourism, which are an important pillar of the Croatian economy. In order to test this assumption, the number of GIs was compared with the tourism indicators of the EU member states (*Tourism Intensity*, *Tourist Receipts to GDP*). *Tourism Intensity* was determined by the ratio of the number of tourist nights per capita in the receptive country. *Tourist receipts to GDP* represents the ratio of income of tourist activity and gross domestic production of the receptive country. In the case of both tourism indicators, a statistically significant positive medium correlation was found, suggesting that countries with a higher relative number of GIs are also those in which tourism is an important economic activity (Fig. 4 and 5, and Table 6).

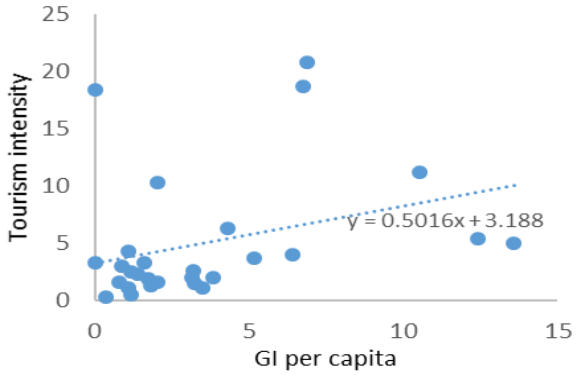

Fig. 4. Correlation between the number of GI and tourism intensity
Source: Eurostat: Tourism statistics for 2018.

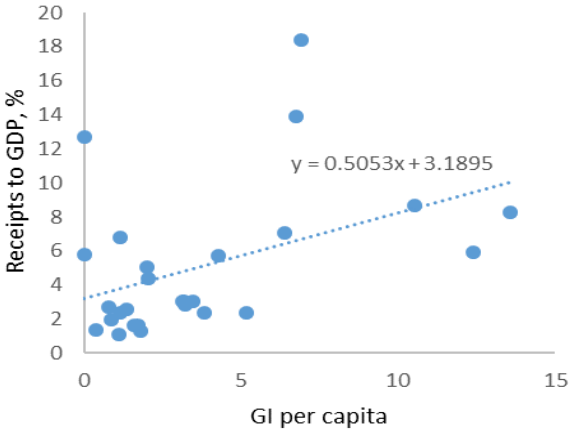

Fig. 5. Correlation between the number of GI and tourism receipts
Source: Eurostat: Tourism statistics for 2018 [9].

Table 4. Correlation between the number of GI, tourism intensity and tourism receipts

	Tourism intensity		Receipts relative to GDP	
	r_s	p (2-tailed)	r_s	p (2-tailed)
Number of GI per capita	0.42595	0.02382*	0.47392	0.01084*

Source: Eurostat: Tourism statistics for 2018 [9].

On the example of Croatia, it would be justified to think of GIs as products that characterize a narrow locality and whose labelling is motivated by the wish to maintain a certain degree of agro-sovereignty in the conditions of growing food imports and increasing foreign trade deficit. Given that they are mainly produced on small and unconnected farms and sold mainly on the doorstep and folk festivals, their market potential is extremely small. Therefore, they cannot have a greater impact on the improvement of macroeconomic agricultural indicators. On the other hand, tourism in Croatia accounts for 18% of GDP with three times the number of foreign tourists compared to the total domestic population. Mass tourism in which only "sun and sea" is offered is not enough to satisfy modern tourists. Eno-gastro tourism, as diversifying tourist content, includes the tasting of certain local food products of the region, which is proved by PDO and PGI labels. The role of GI in Croatian tourism is also shown by the data from the Croatian Ministry of Agriculture, showing that 82 percent of products with a designation of origin or geographical origin are sold in the domestic market [1] which in Croatia comes as a consequence of the role of tourism in the economy.

CONCLUSIONS

The European Union established a unique system in the 1990s to protect the names of traditional products whose quality and special characteristics are influenced by human or natural factors specific to a particular geographical area or produced according to traditional recipes or production methods. A product bearing one of the quality labels consequently becomes more recognizable, potentially achieves a higher selling price and a better market position. From the consumer's point of view, this prevents the possibility of deception about the origin of the product, while the direct connection between the product and a certain geographical area gives additional value and recognisability to that area. Despite the aforementioned benefits of labelling food with geographical indications, the results of the paper reject the assumption of a positive correlation between the number of protected products and the macroeconomic performance of agriculture. EU members are characterized by very uneven production and organizational characteristics of agriculture, which makes it impossible to define the importance of GI for European agriculture in total. On the other hand, the paper confirms the hypothesis that a larger number of GIs occur in countries where tourism plays an important role and in which GIs enable a diversified and enriched tourist offer. Due to the synergistic interaction of agriculture and tourism, it would be more justified to talk about the contribution of GI to the overall economy instead of their contribution to its partial units.

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IMPACT OF RURAL DEVELOPMENT PROGRAM ON ACHIEVIENG VIABILITY OF RURAL AREAS IN BULGARIA

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Abstract

Development of agricultural sector requires a complex approach toward reaching viability of rural arias. By application of correct government support measures, it is possible to achieve sustainability in agricultural sector. The main aim of the study is to assess the impact of changes of Rural Development Program (RDP) on achieving viability of rural arias in Bulgaria. The tasks of the paper are as follows: 1) Literature review of the role of the policy in RDP; 2) Changes in RDP 2007-2020 in Bulgaria; 3) Impact of the changes of RDP on reaching viability of rural areas by ARDL models. The conducted analyses resulted in conclusions and relevant policy recommendations. Results are part of the scientific project DN 15/8 11.12. 2017 Sustainable multifunctional rural areas: reconsidering agricultural models and systems with increased demands and limited resources, funded by the Bulgarian research fund.

Key words**:** *RDP, ARDL Bulgaria, agriculture, policy change, policy recommendation*

INTRODUCTION

In many European countries the main focus of agricultural policy is directed to support prices and incomes of the farmers. In the last several years there is a tendency of adopting a wide range of policy measures ad-dressed to economic sustainability in rural areas. The purpose of this policy is to ensure that farmers will continue to contribute to the supply of re-sources from rural areas. Some authors [5] consider that agriculture is the main driving force of rural economies and in this respect it is necessary to promote the sustainable development of rural areas and improve the living conditions of local communities. In addition to the previous authors [1] states that Rural Development Programme (RDP) provides a major opportunity to overcome the existing problems in the agricultural sector and not to face significant differences between the development of rural and urban municipalities. The RDP and the Leader approach, as tools for decentralized management and integrated development of rural areas, create the conditions for cooperation and partnership, between different municipalities and areas [16]. Applied agricultural policies support production diversification in agriculture to achieve poverty reduction. According to [4], as a result of applied agricultural policies, investment support and development programmes, there is a positive impact on farm incomes and the environment as well as on enhancing environmental awareness among farmers. Agricultural policies and the RDPs have a positive impact on the diversification of agricultural activities in rural areas and rural landscapes. According to some authors [11] although rural development policy is directed to rural development, most of the policy measures are related to agricultural development by promoting restructuring and diversification and few of the measurements promote non-agricultural activities. An OECD research [14] presents agricultural policy as important for those who receive in-come from agriculture, but the role of these policies for rural economies is declining. The study argues that the emphasis in agricultural policy in many OECD countries is shifting from agricultural production to land use and the environment. In a different research, it is considered that rural development policies have a poor

emphasis on promoting sustainable resource use or biodiversity conservation [3].

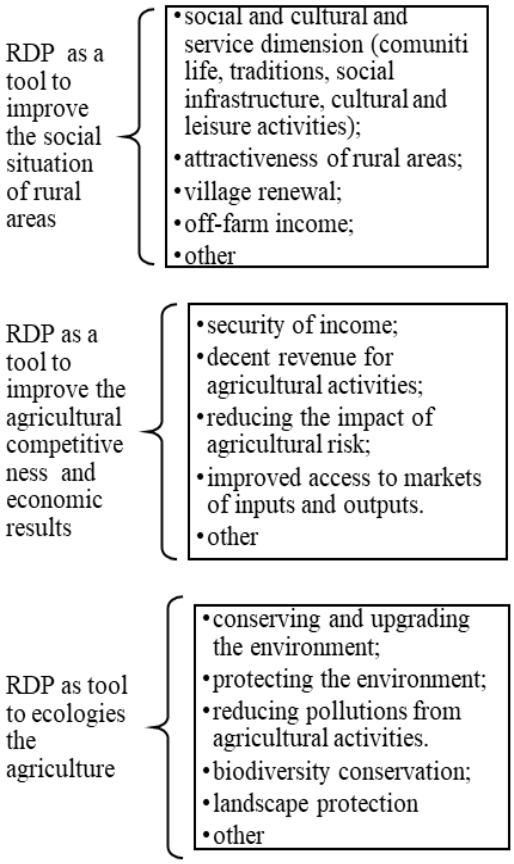

Fig. 1. Main findings of literature review
Source: own findings.

Some of the theories connect the RDPs with possible transformation of the small farms to sustainable market-orientated structures. Authors [12] consider that the RDP measures are related to overcoming the existing constrains of small farms, their restructuring and turning them into modern and competitive agricultural production units. As a consequence, they have a socio-economic role and an important role for the development of agriculture and rural areas in Bulgaria. The EU supports the sustainable and integrated development of rural areas and plays a significant role in the management of agricultural land, environmental protection, biodiversity and landscape. According to a research, even by increasing the profitability of agriculture, the agricultural policy leads to disruption of the land use model [10]. The conclusions of the literature review are shown in Figure 1.

MATERIALS AND METHODS

The main aim of the study is: to assess the impact of changes of the RDP on achieving viability of rural arias in Bulgaria.

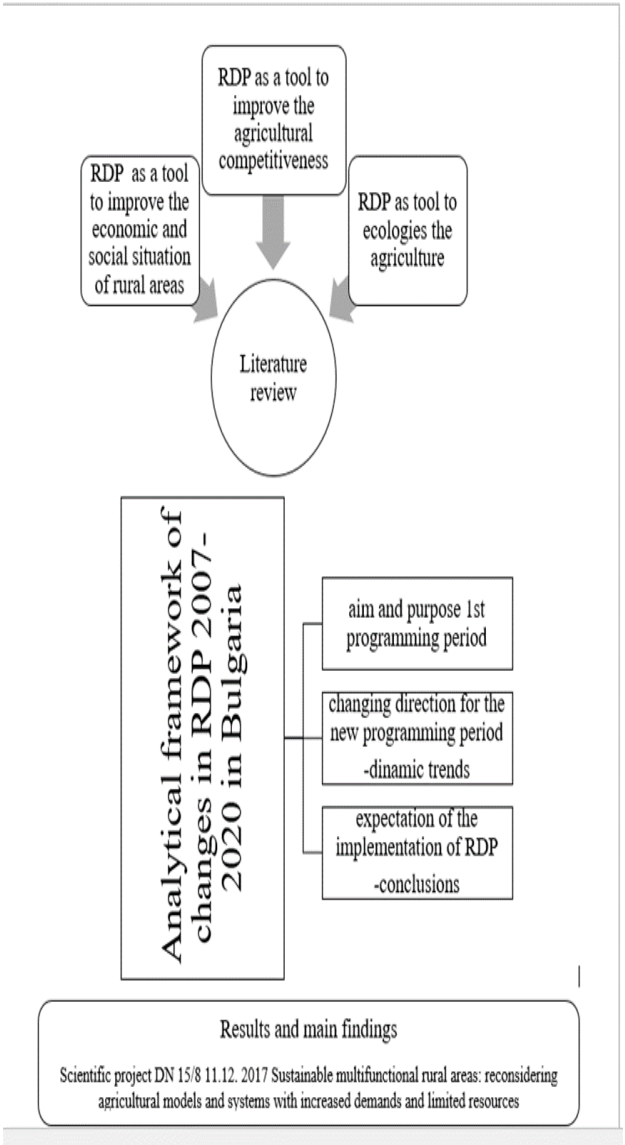

Fig. 2. Methodological framework
Source: own findings.

The proposed research has set up the following tasks:
(1)Literature review of the role of the RDP policy. The aim of this part is to find the main factors influenced by RDP.
(2)Changes in RDP 2007-2020 in Bulgaria. Two full periods of RDP were obtained in Bulgaria until own, which reflect the agriculture and rural areas. The study shows the difference allocations between the studied periods.

(3)Impact of the changes of RDP on reaching viability of rural areas by ARDL models. The model includes estimation of the variables which have significant impact on GVA. The developed ARDL model estimates the effect of the change between the periods.

On the basis of the analysis conclusions and relevant policy recommendations are made. The logic of the study is shown in Figure 2.

The model in the study is based on Harizanova-Metodeva and Metodiev discoveries and is adaped by the collected data for this paper [8], [9].

Results are part of the scientific project DN 15/8 Sustainable multi-functional rural areas: reconsidering agricultural models and systems with increased demands and limited resources, funded by the Bulgarian research fund.

RESULTS AND DISCUSSIONS

Impact of the changes of RDP on reaching viability of rural areas

National economy of Bulgaria for the last 10 years noted a positive trend and has around 15% total growth. The dynamic is shown in Figure 3. For the last 5 years the share of agricultural GDP according to other sectors is stable around 4.8%.

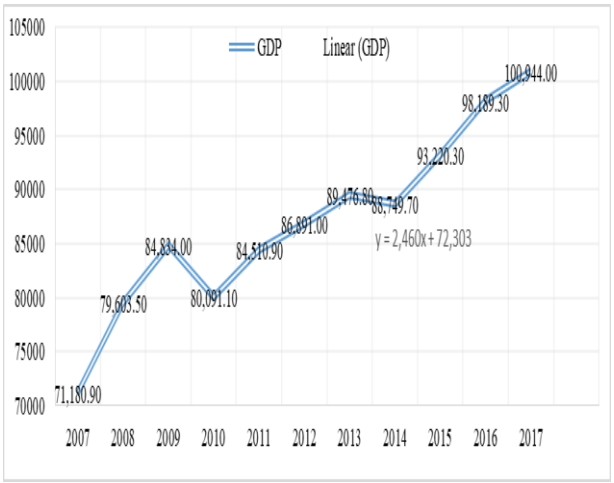

Fig. 3. State and development of the national economy, macroeconomic framework
Source: [13].

Figure 4 presents the dynamics of GDP of agriculture. The numbers show a positive trend, but with very low change. In the first programming period the change is visibly higher than in the second period, when the levels can be described as stable with very low fluctuation.

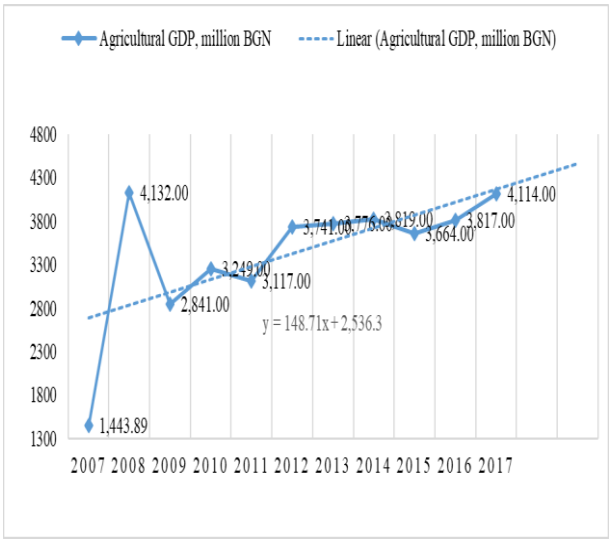

Fig. 4. Development of Agricultural sector by GDP change
Source: NSI (2007-2018) [13].

The income per household in Bulgaria is increasing since Bulgaria's joined the EU. The data is presented in Figure 5.

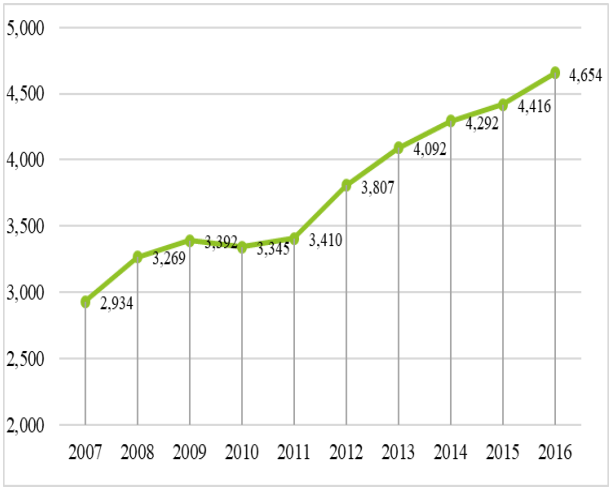

Fig. 5. Average annual income per household member in 2007-2016, BGN
Source: [13].

Analysis of RDP for 2007-2017

There is a difference in measures between both programming periods. The measures in the present programming period are simplified. The number of measures for 2014-2020 is reduced to achieve more flexibility. (Table 1).

Table 1. Changes in RDP measures for 2007-2020

MEASURES in 2007-2013	MEASURES in 2014-2020
111 Training, information and diffusion of knowledge 112 Setting-up of young farmers 114 Use by farmers and forest holders of advisory services 121 Modernisation of agricultural holdings 122 Improving the economic value of the forests 123 Adding value to agricultural and forestry products 141 Semi-subsistence farming 142 Setting-up of producer groups 143 Provision of farm advisory and extension services in Bulgaria and Romania 211 Natural handicap payments to farmers in mountain areas 212 Payments to farmers in areas with handicaps, other than mountain areas 213 Natura 2000 payments and payments related to Directive 2000/60 / EC (WFD) 214 Agri-environmental payments 223 First afforestation of non-agricultural land 226 Restoring forestry potential and introducing prevention actions 311 Diversification into non-agricultural activities 312 Support for the creation and development of micro-enterprises 313 Encouragement of tourism activities 321 Basic services for the economy and rural population 322 Village renewal and development 41 Implementation of the local development strategies: 411 Improving the competitiveness of the agricultural and forestry sector 412 Improving the environment and the countryside 413 Quality of life in rural areas and diversification of the rural economy 421 Inter-territorial and transnational cooperation 431 Running costs, acquisition of skills and animation Technical assistance	Measure 1 Transfer of knowledge and awareness actions Measure 2 Consultancy, farm management services and farm replacement Measure 4 Investments in physical assets Measure 6 Farm development and business Measure 7 Basic services and village renewal in rural areas Measure 8 Investments in the development of forest areas and improvement of the viability of forests Measure 9 Creating producer groups and organizations Measure 10 Agroecology and climate Measure 11 Organic Farming Measure 12 Payments on "Natura 2000" and the Water Framework Directive Measure 13 Payments to areas facing natural or other specific constraints Measure 14 Animal Welfare Measure 15 Environmental services and climate in forestry and forest protection Measure 16 Collaboration Measure 17 Risk Management Measure 19 Leader Measure 20 Technical Assistance

Source: [6].

In the period of 2014-2020, the European Commission proposes a new programming framework with decreasing the axes from the previous programming period and greater flexibility in the transfer of financial resources between measures and priorities.

Table 2 presents that the accumulation of the budget for all the measures is more than 90 % excluding measures "Use by farmers and forest holders of advisory services", "Setting-up of producer groups" and "First afforestation of non-agricultural land".

Table 2. Assimilation of the RDP for 2007-2013 by measures

	Measure	Budget EAFRD, euro	% Assimilation
M111	Training, information and diffusion of knowledge	7,424,000	98.72
M112	Setting-up of young farmers	95,100,000	97.08
M114	Use by farmers and forest holders of advisory services	81,000	36.88
M121	Modernisation of agricultural holdings	433,366, 038	99.35
M122	Improving the economic value of the forests	445,000	95.52
M123	Adding value to agricultural and forestry products	167,082, 500	101.04
M141	Semi-subsistence farming	36,116,000	99.28
M142	Setting-up of producer groups	196,000	48.64
M143	Provision of farm advisory and extension services in Bulgaria and Romania	4,819,468	100.24
M211	Natural handicap payments to farmers in mountain areas	134,900	99.88
M212	Payments to farmers in areas with handicaps, other than mountain areas	42,130,000	99.91
M213	Natura 2000 payments and payments related to Directive 2000/60/EC	40,780,000	99.88
M214	Agro-environmental payments	379,300	100.04
M223	First afforestation of non-agricultural land	6,450,000	77.48
M226	Restoring forestry potential and introducing prevention actions	12,370,000	101.58
M311	Diversification into non-agricultural activities	60,147,500	97.22
M312	Support for the creation and development of micro-enterprises	88,630,000	97.09
M313	Encouragement of tourism activities	19,150,000	97.05
M321	Basic services for the economy and rural population	610,953	97.84
M322	Village renewal and development	164,000	98.63
M411	Improving the competitiveness of the agricultural and forestry sector	8,565,135	99.34
M412	Improving the environment and the countryside	401,982	100.76
M413	Quality of life in rural areas and diversification of the rural economy	22,832,884	98.48
M421	Inter-territorial and transnational cooperation	270,000	90.62
M431	Running costs, acquisition of skills and animation	10,640,000	99.99
M511	Technical assistance	31,300,000	97.47
M611	Supplements to direct payments	123,386, 000	99.99
	Total	2,500,837, 172	98.91

Source: [6].

The accumulation of the funds from 2014 to the beginning of 2017 shows that the level of accumulation of the sources is very low (Table 3). The reason is that some of the

measures were started recently. At the same time, some of the Ordinances for implementation of the measures are not developed.

Table 3. Accumulation of the RDP 2014-2020 by measures

	Measure	Budget EAFRD, euro	% accumulation
2.1.1	Consultancy, farm management services and farm replacement	1,414,435.01	55.82
4.1	Support for investments in agricultural holdings	160,429,966.25	17.47
4.2	Support for investment in the development of agricultural products	111,654,565.91	1.98
6.3	Start-up support for the development of small farms	26,487,115.25	17.33
6.1	Start-up support for young farmers	35,208,977.91	72.98
8.1	Investments in the development of forest areas and improvement of the viability of forests	3,534,785.77	5.50
9	Creating producer groups and organizations	3,587,458.84	0.65
10	Agroecology and climate	85,647,817.77	25.35
	Agroecology and climate		
11	Organic Farming	58,132,262.50	18.97
213	Payments on "Natura 2000" and the Water Framework Directive	47,092,626.04	39.25
12	Natura 2000		
13	Payments to areas facing natural or other specific constraints.	93,161,938.85	35.04
19.1	Leader	2,193,372.53	9.53
20	Technical Assistance	19,170,300.64	16.22
	TOTAL	**647,715,623.27**	**22.96***

Source: [6].

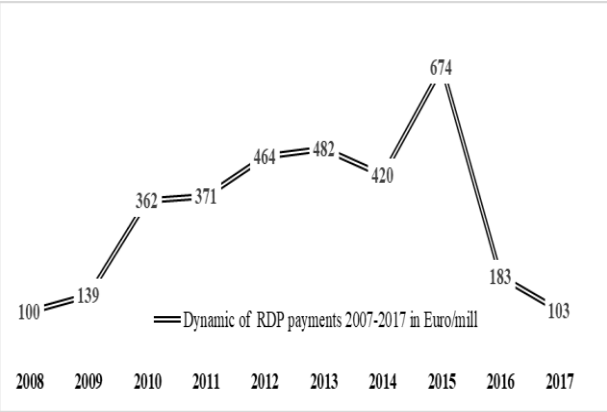

Fig. 6. Dynamics of RDP payments in Bulgaria 2007-2017 in million EUR
Source: [6].

In Bulgaria the payments from the program are connected to the budget of the program (Figure 6).

The lowest numbers are observed in 2008 which is the year when the first payments arose and in 2017, when the levels are around euro 1 million.

The most successful period was 2015, when the two periods were the payment of the two periods were applicable.

ARDL model for 2007-2013 and 2014-2017

For the purpose of the study an ARDL model was developed for social characteristic of farmers [7]. The model analyses GVA in agriculture and is based on the following variables:

-Gross value added in agriculture (BGN million) – Data for the period of 2006-2017 from NSI were collected. Nominal values are deflated by the consumer price index, and then converted to logarithms.

-Average land sales price (BGN/dka) – data for the period 2006-2009 are taken from [2], and data for 2010 to 2017 are from the NSI. The price of the land has been transformed first in real values, then below the logarithm as well Gross value added in agriculture.

-Dummy – has a value of 0 for the period from 2008 to 2013 and a value of 1 for 2014-2017. The Dummy reflects the two sub-periods of the Rural Development Program: the first period – 2008-2013 and the second period 2014-2017.

Analyzed are variable in terms of whether they are stationary or not. Table 4 shows Augmented results of Dickey–Fuller unit root test and Phil-lips–Perron test.

Table 4. Augmented results Dickey–Fuller unit root test and Phillips–Perron test

Time series	Augmented Dickey–Fuller unit root test (probability); (maximum number of lags)	Phillips–Perron (probability)
ln_Pl	I(1) (0.0089); (3)	I(1) (0.0236)
ln_Gva_agr	I(1) (0.0325); (2)	I(0) (0.0011)

Source: adapted by [8], [9].

Table 4 found that the variables are not stationary at the level according to Augmented Dickey–Fuller unit root test. They are stationary at first difference. According to

and Phillips–Perron test ln_Gva_agr is stationary at the level.

The basis on which the model is developed is the following:

ln_GVA_agr = c0 + c1ln_Pl + e .....(1)

where:

ln_GVA_agr – is GVA from agriculture,

ln_Pl – is the price of the land,

c0 – is the constant of the model,

e – random error.

The studied ARDL model has the following expression:

$$d(\ln\_GVA\_agr)_t = c_0 + c_1 d(\ln\_GVA\_agr)_{t-1} + c_2 d(\ln\_Pl)t + c_3 Du + + c_4 \ln\_GVA\_agr_{t-1} + c_5 \ln\_Pl_{t-1} + u_t \quad .....(2)$$

where:

d – first difference,

Du – dummy variable,

co – constant of the model,

c1 and c2 – short-term coefficients,

c3 – coefficient in front dummy variable,

c4 and c5 – long-term coefficients,

ut – random error of the model.

Long-run relation between the variables was checked with Wald coefficient test, in which the H0 was c4=c5=0.

The F-statistics of Wald test was compared with the critical bonds at 5% significance level of Pesaran, Shin and Smith [15].

Table 5 shows the estimations of the model D(ln_GVA_agr). The study found that F – statistics of Wald test is 2.16, which is below lowed bond of Pesaran, Shin and Smith [15].

Table 5. Model estimations

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(ln_GVA_agr(-1))	-1.298844	0.318501	-4.078	0.0151
D(LN_Pl)	1.286525	0.260301	4.942451	0.0078
Du	0.010772	0.072073	0.149456	0.8884
Intercept	-5.223167	2.467725	-2.11659	0.1017
ln_GVA_agr(-1)	1.212078	0.58883	2.058453	0.1086
LN_Pl(-1)	0.092327	0.100603	0.917733	0.4107
Diagnostic tests and goodness of fit of the ARDL model for D(LN_GVA_AGRI)				
R^2	0.952708	Adjusted R^2	0.893593	
F-statistic	16.11617	Probability of F-statistic	0.009326	
Breusch–Godfrey Serial Correlation Test (probability)	0.2014	CUSUM test	the graphics is within the 5% boundary interval	
ARCH Heteroskedasticity Test (probability)	0.3186	CUSUMSQ test	the graphics is within the 5% boundary interval	
Jarque–Bera test (probability)	0.662197			

Source: adapted by [8], [9].

Therefore, there is no long-term cointegration between the variables in the model. For this reason, the model has been modified by removing the long-term variables, i.e. the publication will only review the short-run ARDL model for D (LN_GVA_AGR). The model has the following form:

$$d(\ln\_GVA\_agr)_t = c_0 + c_1 d(\ln\_GVA\_agr)_{t-1} + c_2 d(\ln\_Pl)t + c_3 Du + u_t \quad .....(3)$$

Table 6 shows the estimation of short-run ARDL model for D(LN_GVA_AGR). We can conclude that all variables have had significant impact on gross value added of agriculture except dummy variable. Consequently, in terms of GVA_agr, there is no significant difference between the two subperiods of the studied RDP.

Land price ratio is a positive number, which means that with the in-crease in the real price of land, the gross value added from agriculture also increases.

Table 6. Estimation of the short-run ARDL model

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(ln_GVA_agr(-1))	-0.671545	0.118553	-5.66451	0.0013
D(LN_Pl)	0.816049	0.150804	5.411317	0.0016
Du	0.060022	0.039945	1.502593	0.1836
Intercept	-0.109611	0.0316	-3.4687	0.0133
Diagnostic tests and goodness of fit of the short-run ARDL model for D(LN_GVA_AGRI)				
R^2	0.901709	Adjusted R^2	0.852563	
F-statistic	18.34773	Probability of F-statistic	0.001999	
Breusch–Godfrey Serial Correlation Test (probability)	0.5396	CUSUM test	the graphics is within the 5% boundary interval	
ARCH Heteroskedasticity Test (probability)	0.1532	CUSUMSQ test	the graphics is within the 5% boundary interval	
Jarque–Bera test (probability)	0.725968			

Source: adapted by [8], [9].

CONCLUSIONS

(i)Based on the data of the statistics and the conclusions of the literary review it can be concluded that RDP has contributed and helped to:
-increase labour productivity;
-improve continuity and rejuvenation of the agricultural sector;
-create sustainable employment;
-increase mechanization in the sector;
-renovate the machinery-tractor park;
-implement innovation;
-increase areas and products with organic production;
-improve infrastructure in rural areas.
(ii)The effects of the programme are also reflected in an improved quality of life in rural areas.
(iii)In the first programming period the change of GDP in agricultural sector is higher than in the second period, where the levels can be described as a stable with very low fluctuation.
(iv)In the new programming period and the new framework some simplifications of the measures have been introduced in terms of their number and flexibility.
(v)The level of assimilation of the RDP for the period from 2007 to 2013 is high-reaching 90% for almost all of the measures and for the period of 2014-2017 is low due to the fact that some of the measures were launched recently and some of the implementing Ordinances have not been developed yet.
(vi)According to the ARDL model there is no significant improvement between the two program periods of RDP.
The allocation of funds is not reflecting that GVA differently between 2007-2013 and 2014-2017.
(vii)Future policy should follow the lines to reach:
-rejuvenating the sector;
-decent income from agricultural activities;
-improving the prestige of the sector;
-implementing policies according to the new model of farming activities aimed at environmental protection;
-supporting and promoting diversification and multifunctional production activities;
-helping to increase knowledge in the field of agriculture and the application of innovative practices;
-flexibility in addressing measures to move them into ones that would deliver a sustainable outcome for the whole sector and improve the quality of life in rural areas.

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ENVIRONMENTAL CONCERN AMONG SHEEP FARMERS IN BULGARIA

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Abstract

The aim of the research was to study the environmental concern among sheep farmers in Bulgaria. Questionnaire information was collected from 22 sheep farmers in Bulgaria about their attitude toward environmental protection. It was found that more than half (66.7%) of farmers tried to purchase on a regular base equipment or raw materials that pollute the environment less. 61.9% of the respondents considered environmental protection to be very high priority for the farm. None of the farmers stated that environmental protection was very low priority for the farm.
The surveyed Bulgarian sheep farmers were in general interested in environmental protection, they strove to purchase equipment and raw materials that were safe for the environment, but this wasn't always possible for them mainly due to lack of funds and insufficient awareness of environmental issues. We also concluded that the better competitiveness of the farm led to higher willingness for investing in environment friendly materials and equipment ($p < 0.05$). There was a tendency for an increase of the environmental concern with the increase of the competitiveness of farms. One of the methods for farmers to protect the environment was by usage of pesticides that did not affect bees and aquatic organisms, and packaging collection. Biggest part of manure and animal bedding were utilized as soil fertilizers. About a third of crop leftovers was used to feed sheep. Another part was used as bedding material. Only 13.6% of farmers used renewable resources and energy: solar photovoltaic and collecting rainwater in micro-dams. 45.5% of the farms had their own water source: water pump and / or micro-dam. A small part of the farmers (13.6%) had certified organic production: they produced organic meat, milk, and fodder.

Key words**:** *sheep farms, environmental protection, competitiveness*

INTRODUCTION

Agriculture is influenced by many risk factors, some of which may have adverse effect on a farm level [6]. It could be seen in sheep breeding: the sector provides traditional livelihoods for the population in rural areas. But in the last 20 years sheep farming in Bulgaria had largely lost its attractiveness, which reflected in the decrease in the number of animals: from 1,571.41 thousand heads in 2001 to 1,281 thousand heads in 2019 [7], [8]. Pollution, connected with animal husbandry is mainly due to nitrogenous substances [13]. Poor management in animal production can potentially provide harmful impact of the environment [11]. Waste management of farms is important topic and one of the problems it considers is the air pollution by farm animals [1].
Greenhouse gas emissions from the sheep sector in Bulgaria had also decreased significantly over the last two decades in parallel with the decrease in the number of animals: from 0.4843 gigagrams of methane (CH_4) in 2000 to 0.266 gigagrams in 2010 and 0.2502 gigagrams in 2018, respectively [5]. Therefore, in the period 2000 – 2018, there was a decrease of 48% of methane emitted by sheep. The same percentage of decrease was observed for the released nitric oxide (N_2O) (from 0.0862 gigagrams in 2000 to 0.0445 gigagrams in 2018) and for the emissions in carbon dioxide equivalent (from 36.8766 gigagrams in 2000 to 19.0509 gigagram in 2018). The methane emitted in 2018 by the total livestock sector in the country was 9.086 gigagrams, and sheep breeding accounted for 2.8% of this amount. The largest share was occupied by cattle breeding (50.7%), poultry breeding (23.7%) and pig breeding (20.5%) (own calculations, based on data [5]).
The protection of the environment is connected with the applied technologies in the sheep farms. The purchase of modern equipment with low fuel consumption and

high performance creates prerequisites for better care for the environment and more effective use of the raw materials and labor.
The aim of the research is to study the environmental concern among sheep farmers in Bulgaria.

MATERIALS AND METHODS

Questionnaire information was collected from 22 sheep farmers in Bulgaria about their attitude toward environmental protection. Farmers estimated through the scale from 1 to 5 to what extent the environmental protection was a priority in the activity of their farms by answering to the next statements:
-"Yes, I always try to purchase equipment or raw materials that pollute the environment less". With that statement the willingness for purchasing of equipment or raw materials that pollute the environment less was measured.
-"The care for the environment is a priority for my farm". With that statement the care for the environment as a priority was measured.
The studied farmers were divided into 3 groups according to the competitiveness of their farms: first group – farmers, who failed to cover the current expenses of the farm; second group – farmers, who covered all current expenses of the farm, but could not allocate funds for investments; third group - farmers, who managed to cover the current expenses of the farm and managed to invest in equipment, buildings or animals. The mean values of the groups were compared by ANOVA.
In order to gather information on the extent to which sheep farmers' activities fell within the scope of the term "clean technology", the following questions were asked:
-Do you utilize animal waste products?
-Are the waste products from fodder production / plant materials used as animal feed?
-Do you use renewable resources and energy?
-Is the sheep farm with its own water source?
The farmers were also asked if they had a certified organic production and what was it. They also answered if they were planning to buy new high-performance machinery on the farm.
The number of observations varied from 20 to 22, because some of the farmers didn't answer to all questions.

RESULTS AND DISCUSSIONS

It was found that 19% of respondents think that the statement "Yes, I always try to purchase equipment or raw materials that pollute the environment less" was absolutely not applicable to their farms, meaning that they did not try to buy equipment and raw materials that pollute less the environment (Fig. 1).

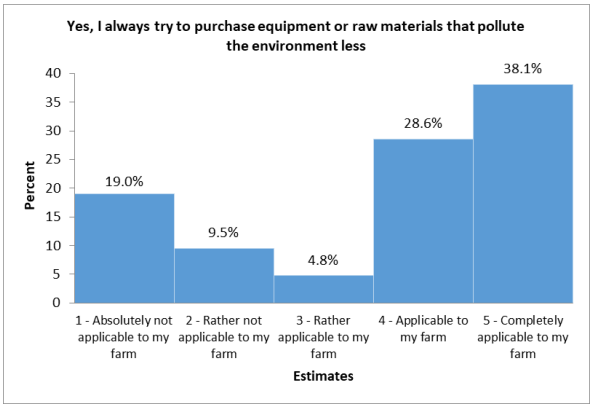

Fig 1. Willingness for purchasing of equipment or raw materials that pollute the environment less (n = 21)
Source: own calculations.

9.5% thought that the statement was rather not applicable to their farms, so these farmers were not so interested in at what extend the equipment and raw materials pollute the environment, although they considered this when they bought equipment and row materials. According to us the main reason for this was on the one hand, the insufficient information on environmental issues by some of the farmers, and on the other hand - the financial motives - more precisely, the additional costs of purchasing environmentally friendly equipment and materials.
4.8% of farmers thought that it was rather applicable to their farms. Respondents tried to buy materials that were environment friendly, but they made exceptions regularly. 28.6% of sheep farmers considered the statement as applicable to their farms and they often bought raw materials and equipment that

pollute less. 38.1% of farmers answered that they always comply with this.
So we concluded that more than half (66.7%) of farmers tried to purchase on a regular base equipment or raw materials that pollute the environment less (estimates 4 and 5).

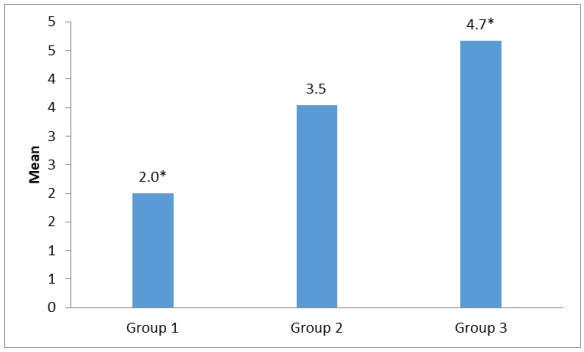

Fig 2. Mean values of the willingness for purchasing of equipment or raw materials that pollute the environment less
*The difference between the first and third group is significant at 5% level.
Source: own calculations.

The mean values for the three groups of farmers of their willingness to purchase equipment and raw materials that pollute less, were presented in Fig. 2.
The difference between the means of the groups was significant ($p < 0.05$).
The mean value of the indicator for the first group of farmers (those, who failed to cover the current expenses of their farms) differed significantly from the mean value of the third group (those, who managed to cover the current expenses of the farm and managed to invest in equipment, buildings or animals), meaning that the better competitiveness of farms led to stronger willingness to invest in environmentally friendly raw materials and equipment. The second group had a mean value of 3.5, lower than the third group, but higher than the first group. Although the mean value of the second group did not differ significantly from the other two groups, it indicated that the better competitiveness of the farm, the higher willingness for investing in environment friendly materials and equipment.

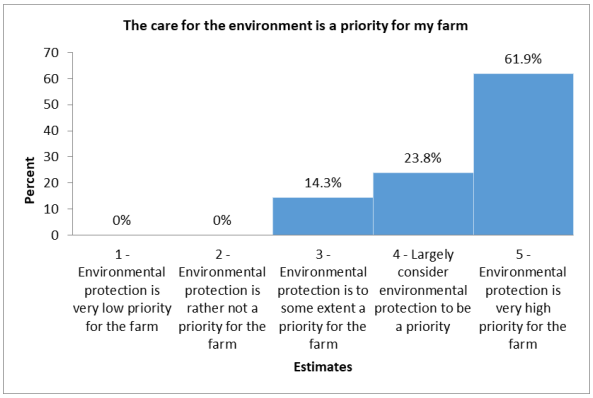

Fig 3. Care for the environment as a priority (n = 21)
Source: own calculations.

The present study found (Fig. 3), that 14.3% of the surveyed farmers stated that environmental protection was to some extent their priority; 23.8% largely consider environmental protection to be their priority. 61.9% considered environmental protection to be very high priority for their farms. None of the farmers stated that environmental protection was very low priority for the farm. It was noted by the farmers that usage of pesticides that did not affect bees and aquatic organisms, and packaging collection were one of the methods to protect the environment.

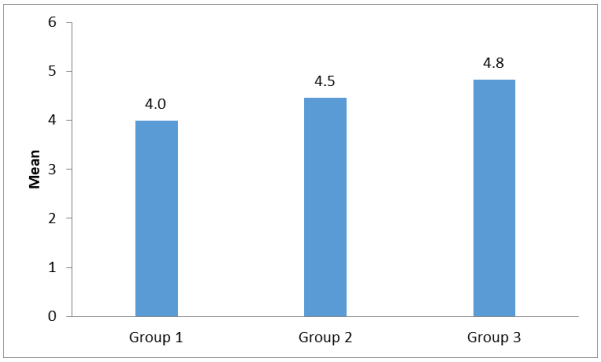

Fig 4. Mean values of the care for the environment as a priority
Source: own calculations.

The mean value for the first group was 4.0, for the second group the indicator was 4.5 and for the last group it was slightly higher than the second group - 4.8 (Fig. 4). The differences between the groups were not significant, but they presented a tendency for an increase of the environmental concern with the increase of the competitiveness of farms.

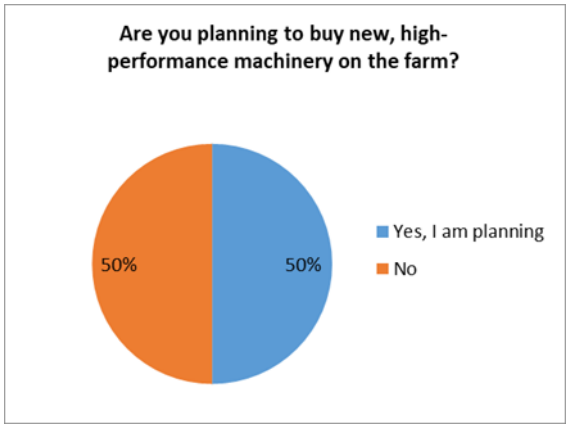

Fig 5. Plans for buying new, high-performance machinery (n = 22)
Source: own calculations.

50% of farmers were willing to buy new, high-performance machinery, and the remaining 50% of sheep farmers did not have such plans (fig. 5).

The application of clean technologies in agriculture gain importance as a sequence of its negative environmental impact [12]. One of the ways to reduce the harmful impact of animal husbandry on the environment is by applying clean technologies on a farm level as far as possible.

Clean technologies are those that lead to more efficient use of resources, generate less pollution to the environment; for the production is used as little energy as possible; generate less waste and recycle waste materials where possible [2], [3], [10].

Organic farming is connected with clean technologies, because in both there is a desire to reduce environmental pollution.

In organic farming, the use of conventional plant protection products, fertilizers, hormones and, as a last resort, antibiotics for the treatment of animals, is limited. Organic farming aims to restore soil fertility through appropriate agri-environmental practices; to grow resistant plant varieties and animal breeds; to reduce pasture depletion, environmental pollution and soil erosion [4].

From the point of view of clean technologies, the utilization of waste products from animal husbandry and crop production helps to reduce environmental pollution. The data about renewable resources usage and organic production was presented in table 1. 63.6% of farmers from the present study utilized livestock waste. Sheep farmers answered that they used manure from their animals and used bedding materials to fertilize arable land, pastures and meadows. 35% of farmers used leftovers from their crop production to feed the sheep. The straw obtained from cereals was used as bedding material indoor, as well as feed. Only 13.6% of farmers used renewable resources and energy: solar photovoltaic and collecting rainwater in micro-dams. 45.5% of the farms had their own water source: water pump and/or micro-dam. A small part of the farmers (13.6%) had certified organic production: they produced organic meat, milk, and fodder.

By using the waste products in the next production cycle, the resources are utilized more efficiently. In turn, organic farming helps to reduce contamination of soil, water and air with plant protection products and fertilizers by creating in that way healthier environment.

Renewable energy production, especially from wind and solar, is an alternative to fossil fuel energy production, leading to lower carbon emissions and pollution [9]. Having own water source in the farm, especially when it is connected with collecting rainwater, helps to use natural resources more efficiently: rainwater replaces drinkable water that would otherwise come from a public water source and is proper for household needs.

Table 1. Renewable resources usage and organic production

Do you utilize animal waste products?(n=22)		**Are the waste products from fodder production/plant materials used as animal feed?(n=20)**	
Yes%	No %	Yes%	No %
63.6	36.4	35	65
Do you use renewable resources and energy? (n=22)		**Has the sheep farm its own water source? (n=22)**	
Yes%	No %	Yes%	No %
13.6	86.4	45.5	54.5
Do you have certified organic production? (n=22)			
Yes%	No %		
13.6	86.4		

Source: own calculations.

CONCLUSIONS

More than half (66.7%) of farmers tried to purchase on a regular base equipment or raw materials that pollute the environment less. 61.9% of the respondents considered environmental protection to be very high priority for the farm. None of the farmers stated that environmental protection was very low priority for the farm.

The surveyed Bulgarian sheep farmers were in general interested in environmental protection, they strove to purchase equipment and raw materials that were safe for the environment, but this was not always possible for them mainly due to lack of funds and insufficient awareness of environmental issues.

We also concluded that the better competitiveness of the farm led to higher willingness for investing in environment friendly materials and equipment ($p < 0.05$). There was a tendency for an increase of the environmental concern with the increase of the competitiveness of farms. One of the methods for farmers to protect the environment was by usage of pesticides that did not affect bees and aquatic organisms, and packaging collection.

Biggest part of manure and animal bedding were utilized as soil fertilizers. About a third of crop leftovers was used to feed sheep. Another part was used as bedding material. Only 13.6% of farmers used renewable resources and energy: solar photovoltaic and collecting rainwater in micro-dams. 45.5% of the farms had their own water source: water pump and / or micro-dam. A small part of the farmers (13.6%) had certified organic production: they produced organic meat, milk, and fodder.

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EVOLUTION OF THE AGRICULTURAL LABOUR MARKET IN THE EUROPEAN UNION BETWEEN 2011-2020

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Abstract

In the current context, in which the pandemic crisis is wreaking havoc in all socio-economic fields, causing both loss of life and immeasurable economic losses, fundamental research conducted to identify directions for rapid and sustainable socio-economic recovery is of great importance. Over time, the agricultural sector has played a particularly important role in accelerating the expansion and economic development of the least developed countries and their integration into world trade. The basic hypothesis is that, over time, agriculture has been the premise for the economic development of the world's states, the agricultural transition being quite well correlated with general growth processes. By improving their competitiveness and strengthening their agricultural production capacities, the countries of the world can recover from any crisis, especially after a health crisis. The work aims to present the possible impact that agriculture can have on economic development by applying known principles and foundations. Making investments in agriculture, increasing the level of employability leads to the development of this branch of the economy and implicitly of the other branches of industry that are connected with agriculture, such as the food industry. Using a mathematical algorithm for studying the impact of the evolution of the agricultural labour (salaried) in the context in which it is desired that agriculture be a sustainable branch from the point of view of employability at the level of the European Union. The results of this study can then be materialized in strategic directions of development of every country, in the hope of moving to another level of development. In the context in which agriculture is the basis for the horizontal development of other industries (such as the food industry) it is necessary to carry out an investment program and research programs in the agricultural field. Applying Lewis's model of development, governments must strive to increase agricultural productivity while stimulating capital accumulation and in the other sectors of the economy.

Key words**:** *agricultural, Lewis's theory, human development, labour, employees, investments*

INTRODUCTION

Agriculture is the cradle of human activity and this activity continued to be at the centre of development from then until today. This is because even if less than 5% of the active population in developed countries work in agriculture, it remains the main activity of people in poor and developing countries. In fact, it is this human activity that provides food for the world's population, hence its consideration as the primary sector of the economy. Over time, economists have looked at the various stages of human development to understand the role and importance of the primary sector in securing a country's wealth, what are the factors influencing it, and how poor countries can develop to catch up with rich countries. This research only seeks to shed light on the importance of agriculture in the formation of national wealth, in the development process of a country, taking into account the degree of development of society and public policies specific to the field [1, 6, 10].

Agriculture is changing due to globalization, climate and societal change. Partly in response, the common agricultural policy (CAP) and other EU agricultural policies are changing. This creates important new data

needs for agricultural statistics that are currently not being met. At the same time, official statistics are changing due to technological progress and the availability of new data sources, while resources continue to be depleted.

According to European Strategy, the priorities in the field of agriculture and rural development are: increasing competitiveness, ensuring the sustainable management of natural resources in agriculture and improving the standard of living in rural areas. The lack of financial resources and the non-operationalization of the objectives included in the European Strategy at budgetary level, as well as the reduced attention for human resources in rural areas were just some of the problems identified regarding the non-achievement of the objectives proposed [5, 8, 9].

In all political currents and economic theories, over time, agriculture has been seen as a major element in changing and improving the structuring of economies. But in practice, the rhythm of these structural changes and their impact on the growth and development of economies vary greatly from country to country and often in an uncertain way. In addition, since Adam Smith, the theory and practice of international trade have changed; the era of liberalization promotes trade based on comparative advantages [10]. The general movement is then questioned and the ideology that agriculture is the engine of development is challenged. However, it would seem that the development of many poor countries depends on the agricultural transition, even if the process resulting from the industrial revolution leading to a transfer of assets from agriculture to other sectors seems difficult.

However, a look at the evolution of the primary sector of the economy throughout human society reveals that the infusion of financial and human resources, innovation and development can lead to an evolution of the sector.

Thus, innovations in certain agricultural sectors have led to increased productivity, which has not only made it possible to increase profits and therefore wages, but has also helped to reduce the price of agricultural goods. The increase in profits and salaries in this sector has generated an increase in demand attributed to the whole economy and thus created new jobs in other sectors of the economy.

According to Eurostat [2], production in Agriculture, Forestry and Fisheries in the EU-28 has evolved in the last 10 years: it decreased in 2010 by 3.9% and in 2012 by 5.5%; after increasing by 3.8% in 2013 and 6.1% in 2014, production in agriculture, forestry and fishing decreased by 0.9% in 2015 and again in 2016 before returning to an upward trend in 2017 (increase of 2.1%) and in 2018 (increase of 0.6%).

The current context of the pandemic crisis is an opportunity for all countries in the world to find effective ways to recover the agricultural sector, which will help improve the socio-economic situation of the world, overcoming the constraints of the past and those created by the current crisis. The current situation is a major turning point in the development of human society, and the reservoir of agricultural labour can be used as fuel for sustainable economic growth.

MATERIALS AND METHODS

The proposed analysis will use data published by Eurostat on labour market information for agriculture in the context of increasing agricultural production.

Table 1. Employees in agricultural labour in European Union (1,000 annual work units)

Years	Number of employees (salaried)
2011	9,803.99
2012	9,760.55
2013	9,655.40
2014	9,469.56
2015	9,303.02
2016	9,240.82
2017	9,104.88
2018	8,931.49
2019	8,737.83
2020	8,482.82

Source: Eurostat, Agriculture labor input statistics: absolute figures (1,000 annual work units), https://ec.europa.eu/eurostat/databrowser/view/aact_ali01/default/table?lang=en, Accessed on 19.02.2021 [2].

The information's about the number of employees in agriculture in absolute value (1,000 annual work units) are presented in Table 1.

Figure 1 presents the evolution of the number of employees in agriculture.

People working in agriculture accounted for about 4.2 % of total employment in the EU in 2016, corresponding to 9.7 million persons. In some countries in European Union are a lot of employees in agriculture.

In Romania, agriculture is one of the largest employers and represents only less than one in four people (23.0%) employed in the country. In Bulgaria, 17.5% of all jobs are in agriculture, Greece is in agriculture 10.7% of total jobs and Poland is 10.1%. [2, 7].

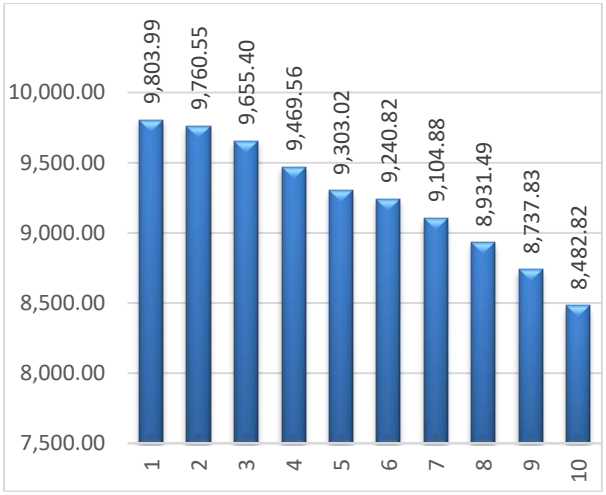

Fig. 1. Evolution of the number of employees in agriculture in European Union (1000 annual work units)

Source: Own design based on the data from Table 1.

In agriculture there are many more people involved in the activity of farms without being employed by them. Thus, the labour force in agriculture in the European Union is much higher, in the context in which for many of these people, working on the farm was only a minor activity.

Between 2005 and 2019, the employment rate for the total population with age between 20-64 has increased by 6.3 percentage points (p.p.) in the EU-27, from 66.8 % to 73.1 %. Countries have experienced very different labour market situations over the past years, so the employment rate has increased in the aforementioned period in all countries except Greece (-3.2 p.p.).

The largest increases are observed in Malta (19.8 p.p.: from 57.4 % to 77.2 %) and in Poland (14.7 p.p.: from 58.3 % to 73.0 %).

Table 2. Total employment in European Union (Thousand persons)

Years	Number of employees in Europe
2011	180,421
2012	179,695
2013	178,936
2014	180,407
2015	182,248
2016	184,812
2017	187,336
2018	189,298
2019	190,921

Source: Eurostat, Employment and activity by sex and age- annual data, https://ec.europa.eu/eurostat/databrowser/view/lfsi_emp_a/default/table?lang=en, Accessed on 19.02.2021 [3].

The information's about the total employment in European economy (salaried) are presented in Table 2 and Fig. 2.

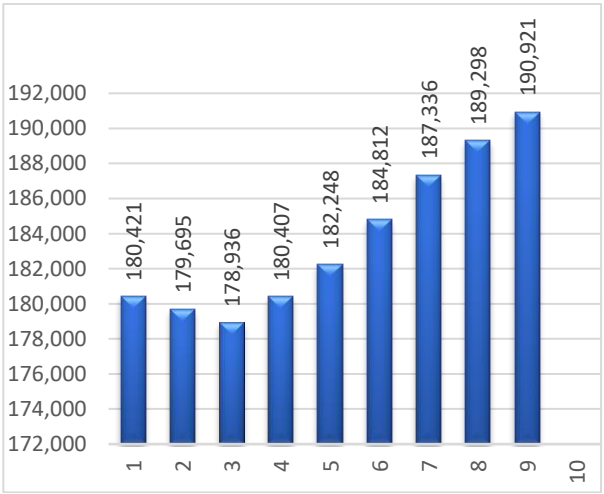

Fig. 2. Evolution of total employees in European Union (Thousand persons)

Source: Own design based on the data from Table 2.

It can be seen that the number of people permanently employed in agriculture is small compared to the total number of employees in the European Union. This fact is also due to the fact that agriculture uses a lot of work of seasonal workers, people who have other jobs. In the present analysis it is wanted to create a discussion regarding the need to make

investments in the field of agriculture, which will create jobs and implicitly economic growth.

The following mathematical algorithm was used to perform a comparative analysis of jobs in agriculture and the total number of jobs.

The mathematical algorithm used has the following structure [4]:

One method of estimating a dimension is that of the estimation using confidence intervals. More often than not, indicating an isolated (punctual) estimated value cannot be satisfactory without referring to the variation domain and to the corresponding probability. Since the sample estimators are random variables, one of the most important issues that arises consists in expressing the estimate accuracy or the estimate probability. However, the value of the P probability covers a certain interval (x_1, x_2) according to the relation:

$$P = Prob(x_1 < X < x_2) = \int_{x_1}^{x_2} f(x)dx \qquad (1)$$

to which the respective parameter belongs. In this way, a certain interval is established, called a confidence interval, has the property of containing the true value of the respective dimension with the P probability. Let a_0 be the true value of a characteristic for which a punctual estimate $\hat{a}$ is obtained through sampling experiments. We consider that the deviation $|\hat{a} - a_0|$ is lower than a ε value with a very high β probability (0.90, 0.95 or 0.99):

$$P(|\hat{a} - a_0| < \varepsilon) = \beta \qquad (2)$$

or

$$P(\hat{a} - \varepsilon < a_0 < \hat{a} - \varepsilon) = \beta = 1 - \alpha \qquad (3)$$

The punctual value $\hat{a}$ is calculated based on a sample and it defines the limits of the confidence interval: $a_1 = \hat{a} - \varepsilon$ and $a_2 = \hat{a} + \varepsilon$. Considering the risks for the lower part α_i and the upper part α_s to be unequal, the interval limits are defined by the relations $P(a_0 > a_2) = \alpha_s$ and $P(a_0 > a_1) = \alpha_i$, with the significance level $\alpha = \alpha_i + \alpha_s$.

In order to analyse the confidence interval for the values presented above in Table 1, the confidence interval will be analysed for the theoretical mean μ of a characteristic with normal distribution, where the dispersion σ is known.

The necessary stages are the following:

-We take a population to be analysed with an X characteristic having a normal distribution $N(\mu, \sigma^2)$.

-A volume sample *n* is extracted from this population. Let us estimate the μ mean with a 95% confidence interval with symmetrical bilateral risk. The significance level is α=0.05.

-We know that the sample mean $\bar{x}$ has a normal distribution $N(\mu, \sigma^2/n)$.

-Since the μ parameter is unknown, a confidence interval will be built for this dimension, its (-*z*, *z*) limits being established with the help of the Laplace distribution.

We know that the random variable:

$$z = \frac{\mu - \bar{x}}{\sigma / \sqrt{n}} \qquad (4)$$

has a normal distribution *N*(0,1).

-According to the distribution table, the 95% probability is defined as the (-1.96; +1.96) interval.

In this way we obtain the confidence interval with the P probability $P(-1.96 < z < 1.96) = 0.95$

Starting from this relation, we can write the double inequality:

$$-1.96 < \frac{\mu - \bar{x}}{\sigma / \sqrt{n}} < 1.96 \qquad (5)$$

which leads us to the interval limits:

$$\bar{x} - 1.96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1.96\frac{\sigma}{\sqrt{n}} \qquad (6)$$

The 95% confidence interval has thus been built for μ. The result can also be expressed as:

$$\mu = \bar{x} \pm 1.96\frac{\sigma}{\sqrt{n}} \qquad (7)$$

x

the interval being symmetrical in relation to the $\bar{x}$ value.

The results were illustrated in tables and graphics, being accompanied by comments and finally the main conclusions have been drawn.

RESULTS AND DISCUSSIONS

From the information extracted from Eurostat it can be seen that there is an insignificant evolution of the number of people employed in agriculture. In order to apply the previously described methodology, the main indicators must be calculated.

Table 3 shows the results of the average and the dispersion corresponding to the values of the number of employees in agriculture, employed with an employment contract for an indefinite period. Excluded from this category are non-employees, seasonal employees, part-time employees, family members of farmers who offer help on the farm.

It should be mentioned that the number of people involved in agriculture is much higher than that of employees. In this article we want to analyze only the number of employees because we aim to show the impact that agriculture can have on employability and economic growth if sustainable investments have been made. Taking into account the previously presented baseline values, the confidence interval that can be calculated for μ is 95 %.

Table 3. Mean and dispersion values for number of employees in agriculture

Indicators	$\bar{x}$	σ
Indicators for the number of employees in agriculture	9,249.04	129,923.60
Indicators for the number of employees in European Union	183,786	

Source: Own design based on the data from Tables 1 and 2.

Table 4 Confidence interval for the number of employees in agriculture

$2746{,}08 < \mu < 14219{,}56$

Source: Own design based on the data from Table 1.

The theory of surplus based on the work of Arthur Lewis (1954), inspired by classical political economy, is a viable model of growth. According to the theory, in the model of economic development, wages in the modern capitalist sector are not determined by labour productivity, but by its opportunity costs.

As the agricultural sector develops, the share of agricultural production in national income and wealth creation increases. Once the surplus labour in rural areas is consumed, wages rise, at which point the economy moves from a dual economy to an integrated economy. Obviously, with the increase of labour productivity in agriculture, wages will also increase, in accordance with conventional growth models, which will lead, especially, to improving the socio-economic life of human resources in rural areas.

Due to the specific situation in the context of the agricultural the most important resources are human resources and time, both imposing serious constraints on the work.

It can be seen that the labour force engaged in agriculture has a small fluctuation. The reference range retains this feature. It is also observed that the labour force employed in agriculture does not have a very big impact on employability at European level.

Compared to other economic sectors, it is extremely difficult to know how many people are employed in agriculture. This is also due to the approach taken by many farmers and agricultural workers who pursue agriculture as a part-time activity or that many farms are managed within the family and family members offer farm help at different times of the year, but not in lastly, due to the fact that in agriculture there are seasonal peaks in work and the employees are only involved in the activity for these periods.

In the European Union, the number of farms has decreased steadily in recent years, which has led to a decrease in the number of farmers and employees. Thus, the share of people employed in agriculture in 2016 was 4.4% lower than in 2005 when the share was 5.7% of total jobs in the EU.

According to Eurostat [2] the agricultural workforce in the European Union decreased

by 9.5 million people between 2005 and 2016. This decrease was a reduction of almost a third (-31.7%). Also in the period 2005-2016, the volume of labor in agriculture carried out by the labor force of the European Union decreased by 3.3 million UU, which represents a decrease of a quarter (-25.7%). Three-quarters (71.1%) of this steady decline in the agricultural workforce occurred in the Member States that joined the EU after May 2004. The hardest hit states were: (1.0 million AWU), Poland (0 , 6 million AWU) and Bulgaria (0.4 million AWU).

CONCLUSIONS

Agricultural production has been affected by declining labour. The research brings to the attention of political factors the importance of agriculture in the development process of countries. The evolution of number of employees in agriculture are low. This means that that it is necessary to realize public policies in agriculture can make a difference, leading every country to economic prosperity. In order to increase the role of agriculture in European Union, it is imperative, starting to develop a development strategy in this field. It would be useful to research the share of innovation in agriculture.

The results of this study can then be materialized in strategic directions of development of every country, in the hope of moving to another level of development.

In the context in which agriculture is the basis for the horizontal development of other industries (such as the food industry) it is necessary to carry out an investment program and research programs in the agricultural field. These actions will lead to an increase in the number of employees in agriculture. In the context of the Covid 19 pandemic, when many people have lost their jobs, agriculture can be a solution in terms of reducing unemployment.

As such, it must identify its comparative advantage, to continue structural reforms and to implement a model of economic development based on Lewis's theory, on investments and innovations, which will generate the increase of labour productivity. Of course, agriculture was the first human activity and this allowed the industrial revolution; agriculture is also the guarantor of food security. But applying Lewis's model of development, that is, for the least developed and developing countries to achieve significant and sustainable levels of growth, governments must strive to increase agricultural productivity while stimulating capital accumulation in all countries and in the other sectors of the economy.

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THE IMPACT OF THE COVID-19 OUTBREAK ON LOCAL TOURIST BEHAVIOR IN ANTALYA, TURKEY

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Abstract

The purpose of this article is to inquire about potential consumer behavior of individuals to participate in domestic tourism activities in Turkey when the COVID-19 outbreak is over. In other words, it is aimed to anticipate the effects of the pandemic on consumer behaviors of local Turkish tourists in the upcoming periods. A survey was conducted over 426 local tourists accommodating in Antalya and previously involved in domestic tourism activities. The research data were analyzed via Structural Equation Modeling (SEM). The most important and fundamental finding concluded in the current study is that respondents will attach greater importance to the hygiene and safety of tourist attractions and public recreational areas after the COVID-19 outbreak. In addition, it is observed that people's considerations about the dimensions of "general impact", "attitude and preference", "hygiene and safety" differ on the basis of demographical characteristics.

Key words**:** *COVID-19 outbreak, pandemic, local tourist, tourist behavior*

INTRODUCTION

Emerging in December, 2019 and called as novel coronavirus, COVID-19 has spread across the world in a very short while and turned into a pandemic. Precautions taken with the purpose of preventing the spread of the virus have necessitated long or short-term quarantine practices. These practices were aimed to minimize human mobility and prevent the emergence of pandemic situation. The interruption of human mobility has affected a wide range of sectors; however, it has created a deep influence on the tourism industry due to suspension of tourist mobility. Tourist mobility in March, 2020 in Turkey has decreased by 53% [25] compared to the same period of the previous year. This process which affects human beings severely is expected to cause some changes in tourism demand. For this reason, it is of great importance to conduct studies to explore and understand new tourist perspective so as to ensure tourism sustainability in post-pandemic period. With this idea in mind, the present study aims to measure post-pandemic behaviors of potential tourists to be involved in domestic tourism activities in Turkey.

COVID-19, called novel coronavirus and turned into a pandemic in the world in a very short while, has not only brought the life into a standstill but also affected several sectors such as agriculture, tourism, construction, and health in particular. Since the tourism industry is based on the mobility of human beings, it is one of the top sectors which have been adversely affected by the pandemic. It is assumed that attitudes and behaviors of people around the world might be different when the pandemic is overcome. In the light of this assumption, the main aim of this research is to examine the post-pandemic consumer behaviors of local tourists to be involved in domestic tourism activities. As a primary step, an in-depth literature review was conducted within the scope of the study.

Then, information about the COVID-19 process and tourist behavior was provided. In the practical stage of the research, a survey was applied to local tourists in Antalya, and the results were analyzed.

Background information: The COVID-19 pandemic

Coronaviruses are a family of viruses that cause illnesses ranging from the common cold to Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). COVID-19 was identified for the first time in late December in Wuhan, China as a result of the examination of a group of patients with similar respiratory symptoms (fever, cough, shortness of breath). However, the illness was named as COVID-19 on January 13, 2020. Initially, people in the seafood and animal market in Wuhan were diagnosed with the illness caused by coronavirus. Then, the virus transmitted from person to person and spread to other cities in Hubei province, especially to Wuhan, and other provinces of China and the other countries in the world [20].

Novel coronavirus is a type of virus that can be transmitted from person to person very quickly. Therefore, it has affected life in a very short time all around the world and become a pandemic. Many countries have developed certain measures against the COVID-19 outbreak. A shortage of hygienic materials and mask supply has been observed in different countries in the world. According to the data from World Health Organization, there are 3,145,407 confirmed cases and 221,823 confirmed deaths in a total of 214 countries or regions, as of May 1, 2020 [31].

As of May 1, 2020, the country with the highest number of confirmed cases worldwide is the United States of America (1,035,353), which is respectively followed by Spain (212,917), Italy (203,591), the United Kingdom (165,225), Germany (159,119), France (127,066) and Turkey (117,589) [30]. In the context of the confirmed cases in Turkey, Istanbul is the leading province with the highest number of cases as of April 10, 2020 (28,014), which is followed by İzmir (2,884), Ankara (2,032), Kocaeli (1,702) and Konya (1,690), respectively. The number of confirmed cases in Antalya is 166 by April 25, 2020 [3].

A number of measures against COVID-19 have been put into effect in various regions in Turkey. Some of these measures can be listed as follows: interprovincial travel restriction, online education, flexible working hours, temporary closure of shopping malls, obligation of wearing protective mask, and lockdown especially in the weekends. In addition, there are various measures specific to the hospitality industry: namely, personnel's maximum compliance with hygiene rules, maintenance and repair of air conditioners, removal of toys in playgrounds, closure of sauna, massage rooms and gymnasiums, airing the rooms for at least 1 hour after cleaning, and use of disposable gloves [19].

Local tourist behavior

Tourist behaviors are discussed in the literature in different contexts such as cultural [18; 4], domestic/local [5; 13], environmentally sustainable [10], origin and cognition [11; 12], gender [14], choice of destination [16; 35]. In tourism research conducted to explore and explain tourist behavior, proximal motives come to the fore in general. Kock et al. [11] examine the origin of tourist behavior within the framework of five fundamental motives [22]. The understanding of tourist behavior is discussed in psychology in the light of such motives as evading harm, exploration, affiliation, status, and mating. Research results reveal that tourists can make different decisions depending on the basic motive being activated [11].

The literature on tourist behavior generally concentrates on to what extent tourists are affected by and feel satisfied with the services provided [17]. Moreover, tourist behavior differs by cultural differences [18; 4; 35]. In the study conducted by Pizam and Jeong [18], 18 out of 20 behavioral characteristics of tourists vary on the basis of their nationalities. Similarly, it is concluded in a study by Zhang et al. [35] that tourists from different continents and countries have different behaviors and perceptions. In the study in which local and foreign tourist behaviors are

analyzed comparatively, Carr [5] puts forward that behaviors of local tourist are different than those of foreign tourists. The research results report that foreign tourists have higher tendency to engage in more passive and hedonistic behaviors.

Literature review

A comprehensive literature review was conducted on Novel Coronavirus Disease (COVID-19), which has turned into a pandemic and impacted over the world. A limited number of studies were found due to the fact that the disease has a very recent onset and its effect is still widely experienced all over the world. These studies explain the effect of the epidemic on different subject areas. In this context, the effects of the pandemic on socio-economic developments [15], finance [7], society [6], weather [21], daily life [8], environment [27; 34], communication on social media [33], tourism [32], academic research [9], undeclared-work, policy [29] and purchase behavior towards personal protective equipment [1] are discussed in the literature. According to Nicola et al. [15], the COVID-19 outbreak has induced a fear of economic crisis and stagnation in people. In addition, social distancing, self-isolation and travel restrictions have had negative impacts on employment. An increase in the need for medical supplies has been observed worldwide. Goodel [7] warns investors, politicians and the public that the financial consequences of the outbreak could be even greater than those of the past crises, and claims that COVID-19 will have a devastating effect on a global scale. Similarly, Chakraborty and Maity [6] argue that the outbreak could lead to a global breakdown. Haleem et al. [8] report in their study that the pandemic affects daily life negatively. It is explained in the study that the conditions such as restrictions in the service sector, cancellation or postponement of sports organizations, disruption in cultural and religious holidays, the concept of social distancing, closure of movie theatres, playgrounds and entertainment venues, and postponement of the exams have created stress on people.

Zambrano-Monserrate et al. [34] investigate the positive and negative indirect effects of the COVID-19 outbreak on the environment. In the study, it is stated that the pandemic has brought along travel restrictions and quarantine practices. People's staying at home due to the pandemic contributed to improved air quality, clean beaches and reduced environmental pollution. On the other hand, it caused a decrease in recycling and an increase in waste. As a result, it is concluded in the study that the contribution to the environment for a short while is not sustainable. In another study investigating the impact of the pandemic on the environment, Wang and Su [27] reveal that air quality in China improved in the short-run. The research results report that the outbreak reduces global carbon emissions. Nevertheless, it is also stated that this positive state achieved in a short time is not sustainable, as suggested by Zambrano-Monserrate et al. [34]. In the study conducted by Haleem et al. [9], academic research fields that the COVID-19 outbreak would influence are identified and listed as follows: vaccine development, medication/therapy, health care and equipment, social, economic, environmental, sustainability, psychiatrics, the emergence of a new workplace and work culture, information technology revolution, online awareness workshop and capacity building, biological warfare, psychological issues, industry 4.0, importance of home life, global trade, commerce, medical supply chains, public health and policy. It is also stated that the pandemic has brought new challenges for global research communities. Yang et al. [32] analyzed the impact of the COVID-19 outbreak on the tourism industry via a calibrated dynamic stochastic general equilibrium (DSGE) model. The analysis results reveal that all variables including production and labor force in tourism industry decrease further as the magnitude of the disaster increases. Findings in the study put forward that SARS in 2003, Middle East Respiratory Syndrome in 2014 and COVID-19 have similarities. Having similar characteristics with the current study aiming to determine the travel behaviors of local tourists in Turkey after COVID-19, a study

was conducted by Wen et al., [28] in China context. In the study, the effect of the SARS outbreak in 2003 on the consumption behavior of local tourists in China is examined. Similarities among the outbreaks on global scale (SARS, Middle East Respiratory Syndrome, COVID-19) [32] are important with regard to comparing the results. The SARS epidemic affected the attitudes of local tourists towards life and lifestyle. The greatest impact of the epidemic was the increased public awareness on safety and hygiene. SARS impacted on the tendencies and preferences of local tourists, particularly travel pattern. For example, in the post-epidemic period, tourists showed greater interest in outdoor activities and ecotourism [28]. In parallel with the information in the literature, the negative effects of the pandemic on different sectors have started to be felt more. Especially the tourism industry is one of the sectors being affected by the pandemic most. Quarantine practices and travel restrictions across the world have also affected the tourism graphics of the countries. For example, the Chinese hotel market had a 71% decrease between January 23 and 26, compared to the same period of the previous year [2]. Having received approximately 1.45 million Chinese tourists in the first quarter of 2019, Vietnam hosted 644,000 Chinese tourists in January, 2020 [15]. Similarly, the number of tourists visiting Turkey in March, 2020 decreased by 65%. Moreover, in the first quarter of 2020, the number of tourists visiting Turkey has also decreased by 22.11%, compared to the same period of the previous year [25]. Tourism statistics of the first quarter signal that the year 2020 will be quite challenging for the tourism industry. At this point, post-pandemic local tourist behavior gains great importance.

MATERIALS AND METHODS

Aim of research

The main objective of this empirical study is to inquire about potential consumer behavior of individuals to participate in domestic tourism activities in Turkey when the COVID-19 outbreak is over. In other words, it is aimed to anticipate the effects of the pandemic on consumer behaviors of local Turkish tourists in the upcoming periods. Sub-objectives set in order to achieve the main objective are expressed through the following research questions:

•Has COVID-19 affected individuals' daily life and working life?

•Has COVID-19 affected tourism activities throughout the period it dominated?

•Does COVID-19 have any influence over individuals' travel intentions, travel behaviors and travel patterns?

•Has COVID-19 caused any changes with regard to hygiene practices during journey?

•Do the effects of COVID-19 differ in line with demographical characteristics of tourists?

Population and sample

Research population is composed of local tourists who were involved in domestic tourism activities at least once with minimum one night stay in accommodation facilities in Turkey. According to the accommodation statistics provided by The Ministry of Culture and Tourism in 2019, the number of local tourist arrivals to accommodation facilities with tourism operation certificate and municipality certificate is 42 million, that of overnight stay is 78.5 million, and the average length of stay is 1.87 nights. In this regard, Istanbul with 4.7 million domestic arrivals, Antalya with 4.4 million domestic arrivals and Ankara with 2.4 domestic arrivals are the first three provinces in the ranking, respectively [23]. Considering the fact that coastal tourism dominates both domestic and international tourism in Turkey and that the coastal tourism prevailing across the country is quite underdeveloped in Istanbul, it can be indicated that Antalya province is the most popular tourism destination in the context of both domestic tourism and international tourism. To address the subject matter briefly in the context of international tourism, Antalya hosting approximately 32.51% of 45 million foreign visitors in 2019 ranked the second after Istanbul [24]. In the light of the information acquired, Antalya was considered to be the most suitable destination with regard to obtaining more sound and generalizable

data as local people in Antalya have pretty high participation in and awareness about tourism activities. The research population was limited to the individuals residing in Antalya in the research period and involved in domestic tourism activities previously. Due to the important share of Antalya within the tourism industry in Turkey, it was set as a requirement for respondents, assuming that their levels of experience would be at maximum, to having accommodated in any tourism facility in Antalya at least once a year, as well as staying at least once in any destination in Turkey. Owing to the fact that the research population was very large and it was impossible to reach the whole population, the study was conducted over a sample representing the population, as this technique was considered to be more cost and time-effective. In Antalya where approximately 2.5 million inhabitants reside according to the address-based population registration statistics for 2019 by Turkish Statistics Institute [26], 426 respondents having given consent to participate in the research filled in questionnaire forms, and all forms were subjected to analysis. Since there was no possibility to have face-to-face interviews with the respondents due to the pandemic, the link of the online survey prepared by the researchers via "google forms" was announced and shared on various social media platforms. In this way, the responses were collected between April 01 and April 20, 2020 and subjected to analysis. In the announcement published in social media platforms, it was noted that the survey must be completed by those residing in Antalya and having accommodated in any tourism facility in Antalya at least once a year, as well as staying at least once in any destination in Turkey within a year.

Measurement tools

In the current study, survey was used as data collection tool. The survey comprises two parts. The first part involves four questions aiming to identify demographical characteristics of respondents (gender, marital status, education and income level). In the second part, a 5-point Likert scale (5=agree, 4=somewhat agree, 3=neither agree nor disagree, 2=somewhat disagree, 1=disagree) composed of 3 dimensions, namely "general impacts", "attitude and preference", "hygiene and safety" and 22 items utilized by Wen et al. [28] in their study aiming to determine the effect of the SARS outbreak on consumer behaviors of local Chinese tourists was adopted in the current study in order to identify the effects of the COVID-19 outbreak on respondents' consumer behaviors. In addition, the item (I will not take wild animals as food in the future) under the dimension of "attitude and preference" in Wen et al. [28]'s scale was removed from the scale used in the current study, as Turkish people do not have such kind of eating habits to a large extent. Consequently, the current study employs a 21-item scale with the dimensions of "general impacts" (4 items), "attitude and preference" (9 items) and "hygiene and safety" (8 items).

Data analysis

SPSS and AMOS programs were utilized to analyze the survey data. Descriptive statistics involving frequency and percentage analyzes were used to analyze the demographic characteristics of the respondents. For the analysis of the responses provided by the respondents, arithmetic mean and standard deviation analyzes as well as frequency and percentage analyzes were performed. With the purpose of testing the research question "Do the effects of COVID-19 differ in line with demographical characteristics of tourists?", "Independent Samples t-test" for the variables involving two groups and "One-Way Variance Analysis (ANOVA) with Independent Samples" for the variables involving more than two groups were used for analysis. In order to determine in which combination(s) the significant difference in the variables that contain more than two groups are observed, the Bonferroni Test in cases where the homogeneity (equality) of variances is provided and Tamhane's T2 test in the opposite case were performed in line with the data obtained from the post-hoc multiple comparison test statistics, which does not necessitate the principle of equal number of samples in groups. The homogeneity of variances was analyzed via the Levene's test. The reliability of the scale was measured via

Cronbach's alpha, while exploratory and confirmatory factor analyses were used for scale validation.

RESULTS AND DISCUSSIONS

Demographical findings

Demographical characteristics of the respondents are presented in Table 1. The majority of the respondents in the study are women (61.3%), married (61.3%), have bachelor's degree (66.2%) and a monthly income of 4,001 TL - 6,000 TL (32.2%).

Table 1. Demographical characteristics of respondents*

D. Characteristics	Groups	*f*	%
Gender	Female	261	61.3
	Male	165	38.7
	Total	**426**	**100**
Marital Status	Married	261	61.3
	Single	165	38.7
	Total	**426**	**100**
Educational Background	Primary school	4	0.9
	High school	47	11
	Undergraduate	282	66.2
	Postgraduate	93	21.8
	Total	**426**	**100**
Monthly Income	2000 TL and less	43	10.1
	2001-4000	95	22.3
	4001-6000	137	32.2
	6001-8000	62	14.6
	8001 TL and more	89	20.9
	Total	**426**	**100**

Source: *Calculated by authors.

Scale findings

Reliability and exploratory factor analysis results and the findings obtained through descriptive statistics

Findings obtained through the measurement scale developed with the purpose of identifying the effects of the COVID-19 outbreak on consumer behavior are presented in Table 2.

Measurement reliability coefficients calculated via Cronbach's alpha for each dimension in the scale are also provided in Table 2.

The most important point concluded in the reliability analysis is the fact that the reliability coefficient of the "hygiene and safety" dimension experiences a remarkable increase (from .721 to .796) in the event that Item 14 (I prefer to stay in high quality star hotels after COVID-19) is removed from the scale.

According to the exploratory factor analysis results concluded via the varimax rotation method and presented in Table 2, it is seen that the lowest factor loading is .555 and there is no need to remove any item from the scale. As a result of the exploratory factor analysis, a total of 6 factors with an eigenvalue greater than 1 were identified under three dimensions, which shows parallelism with the study where the scale was first used.

Results of Confirmatory Factor Analysis

In addition to reliability analysis and exploratory factor analysis, confirmatory factor analysis was performed to achieve the soundest results especially in the context of removing items from the scale. Figure 1 demonstrates the final version of the model representing the results of the first-order confirmatory factor analysis performed through the AMOS program. The model involves the standardized regression weight estimates, as well.

Within the scope of confirmatory factor analysis, the Maximum Likelihood method was used.

Table 2. Scale findings*

Scale			$\bar{x}$	S.d	Factor loadings	Cronbach's alpha
Factors Identified in Exploratory Factor Analysis	***General Impact***		**4.34**	**.82**		**.637**
	Impact on life	1. Covid-19 has greatly affected my work and life.	4.56	.87	.857	
		2. Covid-19 has greatly affected my attitude towards life and my way of life.	4.30	1.07	.877	
	Impact on tourism	3. All of my business travels have been cancelled during the Covid-19 period.	4.12	1.44	.781	
		4. All of my leisure travels have been cancelled during the Covid-19 period.	4.37	1.29	.871	
	Cumulative Total Variance Explained %		*74.577*			
	KMO and Bartlett's Test		*KMO*			*.623*
			Barlett's Test p			*.000*
	Attitude and Preference		**4.05**	**.75**		**.762**
	Tourism inclination	5. Because of Covid-19, I believe travelling in Turkey will be unsafe.	3.34	1.52	.690	
		6. I will greatly reduce my travel plans in the next 12 months.	4.10	1.28	.764	
		7. I will avoid travelling to crowded big cities after Covid-19.	4.17	1.20	.701	
		8. I will reduce the length of travel and tourism after Covid-19.	3.84	1.37	.740	
		9. In choosing tourist destinations, I will avoid Covid-19-affected areas.	4.50	.98	.555	
	Mode of tour	10. Because of Covid-19, my interest in participating in outdoor activities and eco-tourism has increased.	4.22	1.31	.648	
		11. I prefer suburbs or areas within short distance for leisure travel after Covid-19.	4.04	1.29	.621	
		12. I will reduce the possibility of joining tour groups after Covid-19	4.48	1.01	.590	
		13. I prefer travelling with family members and relatives after Covid-19.	3.76	1.43	.595	
	Cumulative Total Variance Explained %		*52.727*			
	KMO and Bartlett'sTest		*KMO*			*.838*
			Barlett's Test p			*.000*
	Hygiene and Safety		**4.32**	**.56**		**.721**
	Food & lodging	14. I prefer to stay in high quality star hotels after Covid-19.	2.65	1.55	.799	
		15. I prefer separated dining while travelling with a tour group.	3.17	1.56	.693	
	Hygiene	16. I care more about the hygiene and safety of the tourist sites after Covid-19.	4.74	.75	.782	
		17. I care more about the hygiene and safety of the public recreation sites after Covid-19.	4.80	.66	.866	
		18. I care more about the hygiene and safety of the means of transportation after Covid-19.	4.81	.65	.879	
		19. I care more about the health of the members in the tour group after Covid-19.	4.75	.75	.757	
		20. I care more about the hygiene and safety of the hotels after Covid-19.	4.83	.62	.882	
		21. I care more about the hygiene and safety of the daily necessities while travelling after Covid-19.	4.82	.61	.866	
	Cumulative Total Variance Explained %		*68.071*			
	KMO and Bartlett's Test		*KMO*			*.883*
			Barlett's Test p			*.000*

Source: *Calculated by authors..

The final version of the model was achieved in three stages by way of testing the model at each stage. At the first stage, modification indices were analyzed in order to maximize the goodness-of-fit indices, and a covariance was developed between the error terms of Item 16 (I care more about the hygiene and safety of the tourist sites after COVID-19.) and of Item 17 (I care more about the hygiene and safety of the public recreation sites after COVID-19) which are observed to modify model fit summary at a good rate. At the second stage, Item 14 (I prefer to stay in high quality star hotels after COVID-19) which has the lowest standardized regression weight estimate (.102) was removed from the model.

At the third stage, modification indices were re-analyzed and a covariance was developed between the error terms of Item 3 (All of my business travels have been cancelled during the COVID-19 period.) and Item 4 (All of my leisure travels have been cancelled during the COVID-19 period.) which are observed to modify model fit summary at a good rate. Fit indices of the final model are presented in Table 3.

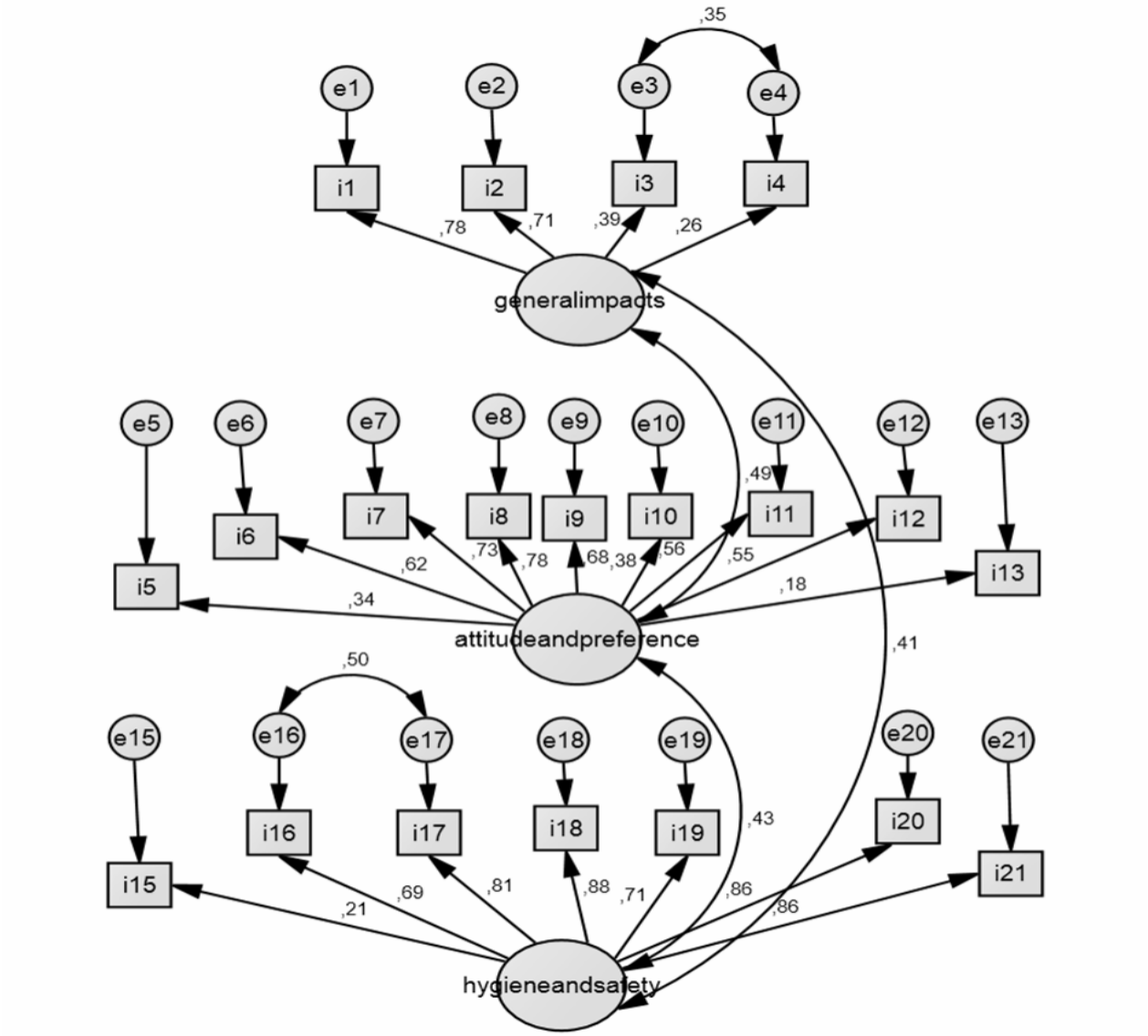

Fig. 1. Confirmatory factor analysis model
Source: Calculated by authors..

Table 3. Results of confirmatory factor analysis

CMIN	DF	CMIN/DF*	GFI**	IFI**	CFI**	RMSEA***
425.482	165	2.579	.907	.923	.923	.061

p=.000, * CMIN/DF ≤ 3, ** GFI, IFI, CFI ≥ .90, ***RMSEA ≤ .08
Source: Calculated by authors.

Interpretation of findings on the effects of COVID-19

As a result of the reliability analysis and the confirmatory factor analysis, Item 14 (I prefer to stay in high quality star hotels after COVID-19) was removed from the scale. In this respect, arithmetic means, standard deviations and reliability coefficients related to the "hygiene and safety" dimension were

revised as shown in the table below and compared with other dimensions.

In addition, the "food and lodging" factor, which consists of 2 items under the "hygiene and safety" dimension, was reduced to a single item and named as "food".

Table 4. Scale finding*

Scale	$\bar{x}$	S.d.	Cronbach's Alpha
General Impact *(2 factor: impact on life, impact on tourism)*	**4.34**	**.82**	**.637**
Attitude and Preference *(2 factor: tourism inclination, mode of tour)*	**4.05**	**.75**	**.762**
Hygiene and Safety *(2 factor:* ***food,*** hygiene)	**4.56**	**.58**	**.796**

Source: *Calculated by authors..

As the responses are analyzed in the light of Table 2, it is seen that arithmetic means of all items are above (3.00). Therefore, it can be surely indicated that the COVID-19 outbreak has affected daily life and working life, tourism activities, travel intention, behavior and pattern, and transformed the need for hygiene during journey. It has been determined that the respondents will attach greater importance to the hygiene and safety of hotels ($\bar{x}$=4.83), will pay more attention to the hygiene and safety of daily needs while traveling ($\bar{x}$=4.82), and will care more about hygiene and safety of transportation vehicles ($\bar{x}$=4.81), particularly in the post-COVID-19 period. On the other hand, it has been revealed that the respondents less prefer dining in a different place while travelling in a tour group ($\bar{x}$=3.17), have weaker beliefs that travelling across Turkey will not be safe due to the outbreak ($\bar{x}$=3.34), and they are less willing to prefer travelling with family members and relatives ($\bar{x}$=3.76). In the light of the analysis results presented in Table 4, the fact that the respondents will attach greater importance to the hygiene and safety of tourist attractions and public recreational areas after COVID-19 ($\bar{x}$=4.56) comes to the fore as the most important finding.

The different effects of COVID-19 on the basis of respondents' demographical characteristics

The scale designed with three dimensions to measure the effects of COVID-19 on consumer behaviors reflects the respondents' considerations on the subject matter. The findings obtained from the scale were compared in the light of respondents' demographical characteristics and the results were presented in Table 5. In order to determine in which combination(s) the significant difference in the variables that contain more than two groups are observed, the Bonferroni Test in cases where the homogeneity (equality) of variances is provided and Tamhane's T2 test in the opposite case were performed in line with the data obtained from the post-hoc multiple comparison test results. The homogeneity of variances was analyzed via the Levene's test.

Respondents' evaluations within the scope of the general impacts dimension differ in accordance with their educational background and monthly income. The fact that primary school graduates ($\bar{x}$=5.00) agree more than others ($\bar{x}$=4.05, $\bar{x}$=4.40, $\bar{x}$=4.26) with the assumption that the COVID-19 outbreak has affected daily life, working life and tourism activities points out the origin of the difference. In the context of monthly income, the fact that the respondents having an income of 2,000 TL and below ($\bar{x}$=3.98) agree less than others having an income of 2,001 TL - 4,000 TL ($\bar{x}$=4.47) and of 6,001 TL and 8,000 TL ($\bar{x}$=4.49) with the assumption that the COVID-19 outbreak has affected daily life, working life and tourism activities points out the origin of the difference.

Respondents' evaluations within the scope of the attitude and preference dimension involving travel intention, behavior and pattern differ in accordance with gender,

marital status and educational background. Female respondents ($\bar{x}$=4.17) compared to male respondents ($\bar{x}$=3.87), married ones ($\bar{x}$=4.13) compared to single ones ($\bar{x}$=3.93), and undergraduates ($\bar{x}$=4.12) compared to high school graduates ($\bar{x}$=3.78) have stronger believes that the outbreak will affect travel intention, behavior and pattern. Lastly, respondents' evaluations within the scope of the hygiene and safety dimension differ significantly on the basis of gender. Compared to male respondents ($\bar{x}$=4.46), female ones ($\bar{x}$=4.62) will have higher tendency to put greater attention on hygiene and safety precautions in tourism activities and places.

Table 5. Comparison of respondents' considerations on the basis of demographical characteristics

Dimensions	Variables	Groups	n	$\bar{x}$	s.d.	Levene's Test (p)*	t/F	p	Post-hoc
General impacts	Gender	Female	261	4.36	.81	.827	.818	.414	No difference
		Male	165	4.30	.84				
	Marital Status	Married	261	4.35	.82	.546	-.457	.648	No difference
		Single	165	4.31	.82				
	Educational background	Prim.school[a]	4	5.00	.00	.000	3.547	**.015****	**(a and b,c,d)** *****
		High school[b]	47	4.05	1.13				
		Undergraduate[c]	282	4.40	.77				
		Postgraduate[d]	93	4.26	.76				
	Monthly income	2,000 TL. and less[a]	43	3.98	.97	.000	3.430	**.009*****	**(a and b, c)** *****
		2,001-4,000[b]	95	4.47	.69				
		4,001-6,000	137	4.28	.90				
		6,001-8,000[c]	62	4.49	.54				
		8,001 TL and more	89	4.35	.86				
Attitude and preference	Gender	Female	261	4.17	.68	.005	3.905	**.000*****	**Difference exists**
		Male	165	3.87	.81				
	Marital status	Married	261	4.13	.74	.674	-2.614	**.009*****	**Difference exists**
		Single	165	3.93	.75				
	Educational background	Prim.school	4	4.66	.20	.089	4.629	**.003*****	**(a and b)** ****
		High school[a]	47	3.78	.86				
		Undergraduate[b]	282	4.12	.73				
		Postgraduate	93	3.94	.71				
	Monthly income	2,000 TL and less	43	4.07	.77	.131	.771	.545	No difference
		2,001-4,000	95	4.07	.65				
		4,001-6,000	137	4.09	.76				
		6,001-8,000	62	4.09	.68				
		8,001 TL and more	89	3.93	.85				
Hygiene and Safety	Gender	Female	261	4.62	.49	.000	2.687	**.008*****	**Difference exists**
		Male	165	4.46	.68				
	Marital Status	Married	261	4.60	.52	.185	-1.671	.095	No difference
		Single	165	4.50	.65				
	Educational background	Prim.school	4	4.85	.20	.000	1.878	.133	No difference
		High school	47	4.46	.72				
		Undergraduate	282	4.60	.44				
		Postgraduate	93	4.48	.81				
	Monthly income	2,000 TL and less	43	4.54	.40	.122	.708	.586	No difference
		2,001-4,000	95	4.64	.42				
		4,001-6,000	137	4.54	.63				
		6,001-8,000	62	4.56	.60				
		8,001 and more	89	4.51	.68				

* p>.05 indicates homogenous variances; **p<.05; ***p<.01, **** Bonferroni, ***** Tamhane's T2
Source: Calculated by authors.

CONCLUSIONS

Tourism industry ranks at the top among other industries being affected by the COVID-19 outbreak most, which has dragged the world into a pandemic. Along with the changing needs of individuals in this process, behaviors have also transformed. Bearing the assumption in the mind that attitudinal changes following the COVID-19 outbreak would create a remarkable impact on the tourism industry, the current study was conducted to measure the attitudes and behaviors of potential local tourists in the post-pandemic period. From this point of view, the studies conducted on the subject so far were reviewed at first. Later, research questions were developed and inquired

through appropriate analysis techniques. Research findings were discussed in two sections below.

Theoretical implications

The literature involves a very limited number of studies on the COVID-19 outbreak [15; 7; 6; 21; 8; 27; 34; 33; 32; 9; 1]. Gradual emergence of the global effects of the pandemic increases the importance of the studies to be conducted in this field. In addition, further research is needed to contribute to the literature regarding the scenarios that would arise after the pandemic. The current study sheds light on a different point than other studies as it examines the potential local tourist behavior in the post-pandemic period. The results obtained will contribute to other studies in the literature.

Findings in the current research reveal that the COVID-19 outbreak has affected the daily life, working life and tourism activities. Moreover, the outbreak has transformed the travel intentions, behaviors, patterns and hygiene perceptions of the respondents. As the relationship between demographic variables and scale dimensions is examined, it is observed that the respondents' evaluations within the scope of the general impact dimension differ by their educational background and monthly income. It is also seen that local tourists' considerations within the scope of the attitude and preference dimension vary according to gender, marital status and educational background. In the scope the hygiene and safety dimension, it is revealed that the respondents' perceptions differ only by gender.

The most important and fundamental finding concluded in the current study is that respondents will attach greater importance to the hygiene and safety of tourist attractions and public recreational areas after the COVID-19 outbreak. Therefore, hygiene and safety in all facilities, particularly in accommodation facilities, vehicles and tourism activities will be the most determinant factor in travel preferences of tourists. In this regard, it is anticipated that partial normalization process in the tourism industry in Turkey, where the COVID-19 outbreak is under control to a remarkable extent, will start in August, 2020. Pandemic struggle package released by Turkish government covers May, June and July. On the condition that the precautions laid down in the package are followed soundly, it is predicted that more active days will be experienced in domestic tourism as of August. An action plan and a precaution package covering the period until complete normalization should be prepared with the joint efforts of central government, local administrations, non-governmental organizations and sector representatives.

Practical implications

In the light of the research findings, it is suggested that the future precautions should be largely focused on "hygiene and safety". Fundamental precautions to be implemented by practitioners so as to ensure hygiene and safety in tourism facilities, especially in accommodation facilities, and tourism activities during and after the COVID-19 outbreak are suggested as follows:

-At the first stage, it is of great importance for the tourism industry that domestic tourism mobility starts within August, 2020, in which it is planned to initiate the normalization process in tourism (on the condition that a second wave does not emerge). Depending on the course of the pandemic in the upcoming periods, trips should be organized to specific countries to be selected taking into notice the countries' struggles against the pandemic. Nevertheless, it does not seem possible to start international travels especially in a short while.

-Mask-wearing and maintenance of at least 1.5 meters of physical distance which are the minimum self-protection measures must be observed while travelling.

-It is recommended for accommodation facilities to operate with half capacity. In this context, all spaces including eating and drinking facilities, bar, disco, and so on should be reduced to half capacity. Fitness hall, spa, indoor pools, and Turkish baths should be closed.

-Measuring guests' fever at the entrance of the hotel, ensuring the use of masks, especially in closed and intensely-used areas in the hotel, placing disinfectant units in certain places in the hotel for hand sanitation, and using

written and visual materials to warn guests and guide them to comply with the rule of physical distancing must be considered as the most basic and essential precautions to be followed.

-Additional precautions to be taken can be listed as follows: it must be ensured that the rooms are cleaned every day, the guests do not visit the room for a while after cleaning, the room is properly cleaned after check-out, and check-in for the same room at the same day is not allowed, the use of the elevator is prohibited, the seating capacity is reduced in the lobby and the other areas where people rest and spend time, the distance between seats is adjusted appropriately, the number of sun loungers on the beach and by the pool is reduced and the in-between distance is adjusted, the chlorine level of the pool water is well-set, a certain number of staff is assigned to ensure compliance with the physical distancing rule in the beach and pool area which are intensely used by guests, a la carte service is offered rather than open buffet, the dining tables are arranged according to the physical distancing rule, and the dishes are served with a glass protective jar.

-Not only guiding the guests through the rules that should be followed in the hotel, but also raising the awareness of the staff and providing them with training on the pandemic are one of the most important steps to be taken. The staff must have minimum knowledge of the outbreak to be able to warn the guests, ensure the hygiene and safety of the facility and take personal protective precautions.

-Another important matter is to validate and inspect that the facilities have taken the necessary precautions within the scope of the COVID-19 outbreak. For this aim, a certification system should be developed, and the facilities meeting the requirements should be granted with certificate, and it must be ensured that only the certified facilities do operate in this period. Strict inspections must be carried out, and severe criminal sanctions must be imposed on those that violate the precautionary measures.

-It may also be rendered compulsory to demonstrate with an emblem or logo at the entrance of the hotel that the facility is certified proving that hygiene and safety measures are in place. Even if complete normalization process starts after the pandemic is over, people's interest in hygiene and safety may not decrease, therefore, these certificates and signs may provide hotels with a marketing and competitive advantage in the future.

The theoretical and practical implications in this study constitute an important resource for both tourists and business owners. The research is expected to contribute to all stakeholders in the context of novel tourist behaviors that may be observed in the sector after the COVID-19 outbreak. For future research, it is recommended to focus on potential scenarios covering the post-pandemic period. Unlike the current study examining the potential local tourist behaviors after the pandemic, empirical studies can be conducted to explore the situation in travel companies, accommodation facilities and food and beverage enterprises in the post-pandemic period. Researchers wishing for carrying out interdisciplinary research are recommended to study the psychological state of the local people after the pandemic.

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SMALLHOLDERS' PRIORITIES IN FINANCING: MATHEMATICAL APPLICATIONS IN THE CONTEXT OF A POST-TRANSITION ECONOMY

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Abstract

Smallholders in the North Macedonia face different constraints in accessing to finance. Various formal institutions, mechanisms and support programmes were established to increase the external capital consumption by farmers, but still smallholders remained underserved with appropriate finance. The aim of this study is to determine the priorities of the smallholders in choosing their best alternative of financial sources under different financing incentives. The Analytical Hierarchy Process, as a multi-criteria decision making technique, enabled prioritisation in the complex financial decision- making, considering multiple conflicting criteria at once. The results show that the smallholders mostly need finance to support investments in farm modernization, followed by the need of investment capital for adaption and mitigation of negative climate change effects and environment protection. In order to meet these needs, smallholders mostly prioritise the national institutions for providing financial support in agriculture. Especially important for the smallholders is the National Rural Development Programme and IPARD Programme that follow complex procedures, and thus, these funds have a relatively low utilisation rate. Another priority of smallholders is given to the direct credits by the National Development Bank that are currently unavailable to smallholders due to legal restrictions. Analyses of this kind, considering the bottom-up approach in valuing the smallholders' opinions and needs of financing, are scarce in the practise, but they are very important in tailoring the financing offer and financial support measures in agriculture to the real needs of the smallholders.

Key words**:** *Analytical Hierarchy Process, decision making, financing alternatives, small-scale agriculture, North Macedonia*

INTRODUCTION

Even after two decades from the transition to a market economy, smallholders in North Macedonia, still face different constraints in acquiring finance to support investments and operating activities. First, small farm sizes, measured in both land and economic units, contribute to lower level of productivity and profitability of farms [11], affecting their liquidity and limiting their free cash flows [15]. Next, the lack of collateral and unsuitable credit conditions are another credit constraint to smallholders [10]. And finally, financing alternatives tailored to the needs of smallholders are lacking [15], [14]. On the other hand, smallholders are also faced with different constraints in utilisation of financial support programmes, such as the large number of measures with complex procedures for the smallholders, where the frequent changes, especially in annual programming, additionally burden less educated farmers to follow, understand and meet the set requirements [5].

The general financial infrastructure in the country that supports farm crediting is represented by nine out of thirteen private banks, three out of four savings houses and a national development bank [15], along with the established supporting mechanism of the Agricultural Credit Discount Fund (ACDF) to ease the access to loans of smallholders [17]. In addition, budgetary support to smallholders is available through the national programmes for agriculture and rural development (i.e. direct payments and investment support through the National Programme for Rural

Development) and the European Union's Instrument for Pre-Accession Assistance for Rural Development (IPARD) [8].

Although various formal institutions, mechanisms and support programmes were established to improve the flow of capital into the agricultural sector, still the access to finance in small-scale agriculture has remained one of the country's weakest segments [10]. For instance, the direct credit programmes of the national development bank are not available for smallholders that are not registered as legal entities [14]. Therefore, other formal institutions and financing instruments are missing in order to improve the access to finance of smallholders [16], which contribute to 89.4% in the total national agricultural output [18].

When developing the commercial financing offer in agriculture and when creating the national programmes and measures for farm financial support, it is important to undertake the bottom-up approach so to value the opinions and the needs of the farmers, especially those of the small sizes, which mainly face financing constraints but constitute the largest part of the Macedonian agriculture. Hence, the aim of this study is to determine the priorities of the smallholders in choosing their best alternative of financial sources under different financing incentives. This is in line with Saaty's [13] technique for a multi-criteria decision making (MCDM) based on mathematical and psychological elements, which enables analysis of complex decisions involving many stakeholders and multiple alternatives by using a hierarchical structure in the decision-making processes.

The methodological framework of MCDM is well suited to the complex nature of financial decision problems, emphasised by different researchers working in the field. Operational research has contributed to different financial decision-making problems and these contributions are not only limited to academic research, but they also extend to the daily practice of corporate decision-making processes [23], [21]. However, there is a little notice in applying MCDM in regard to farm financial decision-making for policy settings. On the other hand, MCDM has been widely used technique in other fields of agricultural research, proving to be extraordinarily elegant for solving alternative problems with multiple conflicting criteria [22], [4], [19], [1].

Thus, this study reveals how operational research models are applied in prioritizing the available financial sources, including support programmes, to smallholders under different farm financing incentives. The study is not intended to be uncritically used for immediate policy decision-making, but rather to show the importance of such prioritisation approach in the participatory policy applications. In this context, this study illustrates how smallholders' financing needs prioritization analysis could contribute to the national research-based policy decision-making. Moreover, the results may have a wider applicability if the mathematical model is applied to other related cases.

The following section briefly describes the research methods and the mathematical model, followed by a description of the prioritisation determinants. The results are then presented, followed by a short discussion and conclusions.

MATERIALS AND METHODS

To get an insight into the smallholders' priorities in their financial decision making processes with operational research techniques, primary data were collected during August 2020 from a small sample of smallholders, represented by family farmers, whose agricultural income does not exceed circa 20 thousand Euros. Additionally, a control group was introduced, consisting of farmers whose income from agriculture exceeds 20 thousand Euros. The sample selection was done in two phases. During the first phase, 50 farmers were initially selected from a national network of farmers in order to get the initial understanding of the determinants of the farm financing behaviour by using a structured questionnaire. During the second phase, 17 farmers were randomly selected out of the initial sample, which were included in the prioritization exercise to determine the smallholders' perceptions and needs in financing by using a tailor-made

questionnaire for mathematical modelling of financial decisions. Unlike the statistical methods that require an optimum sample size, mathematical modelling allows a limited number of sample population [6], as it is the case of this study.

In regard to the questionnaire used in the prioritization exercise, it was constructed exclusively for the purpose of this research. The first part of the questionnaire provides general information on the farm, while the second part contributes to the operational research, specifically the Analytical Hierarchy Process (AHP), pairwise comparison survey. All respondents used a verbal scale to make a qualitative comparisons, which were further converted into quantitative values using [13] fundamental integer scale from 1 to 9.

The obtained data were further processed by using the AHP template developed by Goepel [2], specifically designed in MS Excel for conducting the prioritization analysis. The AHP technique does not separate the intangible from the tangible decision-making factors, thus enabling both qualitative and quantitative attributes to be considered in the process [6]. The AHP hierarchy follows a descending structure starting from the overall goal to criteria, sub-criteria and alternatives in successive levels [13]. The relative importance of the criteria and the alternatives is estimated through pairwise comparisons of all elements by using the pairwise comparison scale as proposed by Saaty [12].

Depending on the complexity of the goal, the hierarchy can have multiple levels [6], however in the case of this study, a three-level decision hierarchy was developed. The top level indicates the goal, that is, increasing the availability of financing to smallholders in North Macedonia, while the second level refers to the decision-making criteria i.e. the incentives for or the benefits from the use of the financing and support funding. The decision-making criteria are determined based on the Macedonian agricultural policy strategic objectives as presented in the National Strategy for Agriculture and Rural Development 2014-2020 [7].

Consequently, the first criterion refers to the modernization of the agricultural household through farm investments leading to an increased productivity of the production factors as well as improved structure of the agricultural production. The second group of benefits relates to the improved household living conditions by increasing the farm income or by starting a new business in agriculture. The third criterion captures the benefits from use of financing and support funding that will contribute to the mitigation of the negative climate change effects, but also to the environmental protection and application of sustainable ecological practices. The third level of the hierarchy represents the available finance provided by both public and private financial institutions that will enable an accomplishment of the set criteria. Figure 1 shows the illustrative presentation of the conceptual framework of the decision hierarchy used in this study.

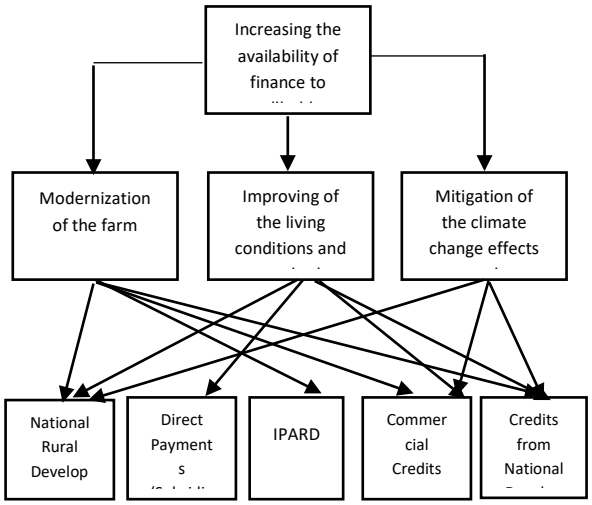

Fig. 1. AHP decision hierarchy for prioritization of the available finance to Macedonian smallholders
Source: Own determination.

RESULTS AND DISCUSSIONS

Characteristics of the sample farms

The initial sample that describes the farm determinants in regard to their financial position in obtaining different financing, includes 50 farms with an average size of the household of 4.38 ± 2.06 family members. Most of the farms generate income from agricultural activities and 54% of the sample farms generate less than 20 thousand Euros annual agricultural income (Figure 2). This

indicate that the majority of the sample represents the smallholders.

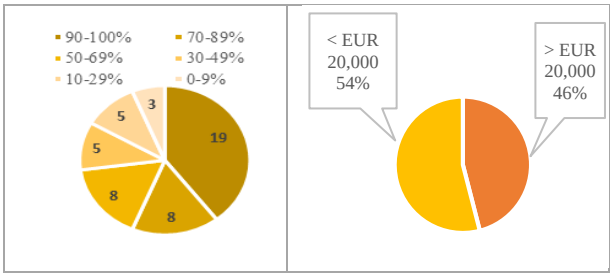

Fig. 2. Number of farms according to the share of agricultural income in total household income (left) and structure of the sample based on the annual agricultural income (right)
Source: Survey data, 2020.

Table 1 provides an insight into the farm determinants relevant for specifying the farm financial opportunities. Legal status of the farms is often a limiting factor for smallholders in accessing finance because most of the favourable commercial and uncommercial credits are aimed for legal entities. In this regard, a negative determinant is observed, that is, only 8% of sample farms are legal entities i.e. agricultural companies. Most of the sample farms or 38% are only evidenced in the farm register at the Ministry of Agriculture, Forestry and Water Economy, 28% are not registered at all, and 26% are registered farms as individual agricultural households. This determinant shows that the majority of the sample farms are limited to use the direct credit offer by the national development bank.

There is special commercial and support financing for agricultural cooperatives, but this financing is available only to 14% of the sample farms. The membership in agricultural cooperatives in general is very low. This determinant also shows that the majority of the sample farms face limited access to tailored financial products in agriculture.

An optimistic indicator in regard to tailoring the financial offer to the needs of the farmers, is the observation that most of the sample farms or 88% keep a regular farm accountancy. Farm accountancy data are the main source of information to the financial institutions in assessing the farms' creditworthiness. In addition, these data are necessary for cash flow projections of the investment. Another positive determinant was observed, which emphasises the serious intentions of the farmers in their financing decision-making process. In fact, 68% of sample farms plan further farm investments to modernize the agricultural production by introducing new technologies and innovations.

Table 1. Farm determinants in regard to their financing opportunities (n=50)

	Share of all respondents
Legal status of the farms	
Unregistered farms	28%
Evidenced farms	38%
Registered individual family farms	26%
Agricultural companies	8%
Membership in cooperatives	
Members in cooperatives	14%
Not members in cooperatives	86%
Farm Accountancy	
Farms that keep regular farm accountancy	88%
Farms that do not keep farm accountancy	12%
Future investment plans	
Farms that plan investments on farm	68%
Farms that do not plan investment on farm	32%

Source: Survey data, 2020.

Smallholders' priorities in financial decision-making

In order to better understand the smallholders' priorities in financial decision-making, 17 farms out of the initial sample were further selected for the prioritization study based on their personal preference to determine the priority of one element over another one in the hierarchy decision-making tree.

Regarding the structuring of the decision problem in a hierarchy, the application of this model is an appropriate tool if each category has at least four but not more than seven to ten sub-categories since more than that these target numbers, it will require over 45 pairwise comparisons leading to a complex and a confusing decision-making [2]. In the case of this study, only three criteria with five alternatives were considered, thus the application of this model provided plausible results.

Considering the farmers' financing incentives, Table 2 presents the consolidated priorities

and the consistency ratio (CR) for each criterion the farmer will benefit from, using the eigenvector method (EVM). The eigenvalue (lambda) of 3.001 equal to the matrix size indicates on sample consistency and enables further prioritization. Regarding the consistency ratio (in the case of this analysis CR=0.1%), the acceptable threshold of less than 0.1 or 10% was checked, and the results confirm that the judgments made by the participants are perfectly consistent (CR of 10% or less indicates on perfect consistency of the sample, while value of the CR less than 20% is tolerable for the sample consistency [20]). The consensus indicator ranges from 0% (no consensus between participants) to 100% (full consensus between participants); in the case of the prioritization of financing incentives for the smallholders, the indicator is 68.4%, illustrating a moderate consensus among the participants [2].

Table 2. Smallholders' priorities of the financial incentives (criteria)

Criterion/Financial incentive	Comment	Weights
Modernization of the farm	Investments in new technology, machinery, equipment	44.3%
Improving the living conditions and standards	Increased income, starting a business in agriculture	19.3%
Climate change and environment protection	Mitigation of the climate change effects and environment protection	36.4%
	Eigenvalue (Lambda):	3.001
	Consistency Ratio (CR)	0.1%
	Group Consensus Indicator	68.4%

Source: Own calculation based on pairwise comparison survey, 2020.

The estimated average weighting of the financing incentives for the smallholders based on the applied AHP method is presented in Figure 3. The results reflect the smallholders' needs for financing resources, i.e. the relative importance (weights) for each benefit of using the external capital offered by both private and public financial institutions. The estimated weighted average of the decision matrix elements based on the individual decision maker's weight indicates that the smallholders mostly need finance to support investments in farm modernization (44.3%), i.e. investments in new technology, machinery or other equipment that would contribute to increasing the productivity and efficiency of the production factors. Considering the negative economic effects of the climate change in the agricultural production reflected through the decrease in production yields and increase in production costs [9], smallholders additionally need financing capital for adaption and mitigation of these effects. Consequently, smallholders choose this financing incentive as a second priority with a relative importance of 36.4%.

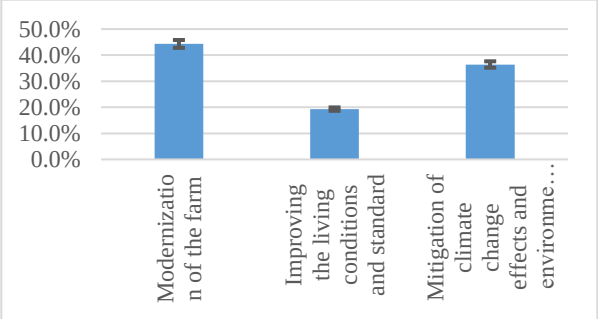

Fig. 3. Relative importance of the smallholders' financial incentives
Source: Own determination based on pairwise comparison survey, 2020.

Both financial benefits, ranked as a first and a second priority by the smallholders, could be financed through the national programme for agriculture and rural development, within the structural and rural development measures, as well as with the EU's IPARD funds.
However, the analysis of the budget transfers in the agriculture [5] reveals that most of the farmers in the country absorb finances through the direct support measures and not by the prioritised measures in this analysis (Figure 4). In fact, direct support measures in general contribute towards the second criterion i.e. improving the living conditions and the farmers' welfare, which was considered as the least important financing incentive for the smallholders in this research. Namely, the realisation of the programmed policy measures depends on many factors, among which the complex and time demanding procedures that are a big challenge for the smallholders due to their low experience, education and skills to manage

this process [5]. In this context, the participatory approach involving the smallholders' opinions and needs of finance should be applied in practice when developing and creating the national policy measures.

Smallholders are constantly coping with serious challenges arising from their limited access to finance necessary for their farm operations. Without enough finance, it is impossible for farmers to produce a surplus, to modernise the household or to change the production structure to become more competitive [3].

Therefore, the analysis further focuses on the pairwise comparison between the smallholders' prioritization of the financing alternatives available in agriculture and the prioritised financing incentive (Table 3, Figure 4). Herewith, five financing alternatives were included in the analysis, each referring to the external financial sources for meeting the farmers' financing needs, such as: financial support available through the National Rural Development Programme, direct support to farmers (Direct Payments), IPARD's support funds, loans available through the National Development Bank, as well as commercial loans issued by banks and savings houses. For the pairwise comparison of the financial alternatives, the three financial incentives were considered in the analysis, such as modernization of the farm, improving the living conditions and standards and mitigation of climate change effects and environment protection. The pairwise comparison between the available financing alternatives for each financing incentives resulted in equality of the eigenvalue with the matrix size, indicating on sample consistency (Table 3). The consistency ratio for each financing incentive also shows a perfect consistency. The group consensus indicator indicates to a high consensus reached in the prioritization of the financial sources i.e. alternatives available for mitigation of the climate change effects and the environment protection, and a moderate consensus for the prioritisation of the financial sources within the first and the second criterion, i.e. the modernization of the farm and improving of the living conditions and standards at the farm.

Table 3. Pairwise comparison results on smallholders' priorities of a financing sources under different financing incentives

Indicators	Modernization of farm	Improving the living conditions and standards	Mitigation of climate change effects and environment protection
Eigenvalue (Lambda)	4.035	4.041	3.003
Consistency Ratio (CR)	1.30%	1.50%	0.30%
Group Consensus Indicator	71.30%	70.50%	79.30%

Source: Own calculation based on pairwise comparison survey, 2020.

Considering the relative importance of the available financial alternative for each farmers' need (Figure 4), the results show that smallholders prefer the use of financial resources available through the IPARD programme for investments in new technology and modernization of the farm (35.16%), followed by available direct credit offer of the National Development Bank (27.47%), and finally, the investment support available through the National Rural Development Programme (26.08%). Additionally, the farmers recognize the National Rural Development Programme and its measures as a main source of finance also for improving the living conditions and standards at the farm (31.61%), as well as for mitigation of the climate change effects and environment protection (48.74%). In both cases, the second priority is given to the offer of the National Development Bank (relative importance of 30.93% and 37.11% respectively). This is an important result for policy applications since it reflects the smallholders' opinion and needs of a financing capital. In fact, as mentioned above, the majority of smallholders are not legal entities, and therefore, they are not eligible to use the favourable direct credit offer of the National Development Bank (since only legal entities are beneficiaries). In all prioritisation analyses, the loans supplied by the private

sector have the lowest ranking, even though more affordable interest rates to the commercial loans are now available through the Agricultural Credit Discount Fund. Even though the country had established different supporting mechanisms to improve the capital inflow to the agricultural sector, this result stresses that smallholders are still faced with different credit constraints.

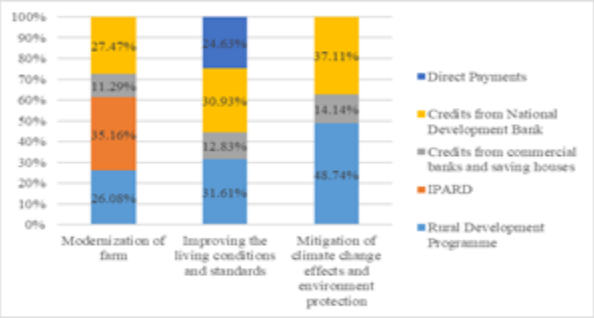

Fig. 4. Relative importance of financial alternatives under different financing incentives (in %)
Source: Own determination based on pairwise comparison survey, 2020.

CONCLUSIONS

With a multi-criteria decision making based on the analytical hierarchy process, this study determines the priorities of the smallholders in choosing their best alternative of financial sources under different financing incentives. In fact, this is a first operational research in the country attempting to consider the opinions and needs of smallholders in regard to financing issues. As such, this study contributes to the literature indicating on the importance of the bottom-up approach in considering the priorities of the smallholders, especially important when developing the commercial financing offer and when creating the national support programmes and measures in agriculture. The findings from this operational research suggest that the smallholders mostly need finances for modernization of their farms. Investments in new technology, equipment or even change of the production structure should improve the production factors productivity and consequently the farm profitability. In addition to this, the smallholders' performances are affected by the negative climate change effects, and therefore farmers need additional financial resources to also cope with this challenge. There are different financial alternatives for meeting these farmers' needs. However, the results from this prioritization exercise reveal that the smallholders mostly recognize the support programmes as a means of finance to the agricultural sector. This result confirms the presence of soft budget constraints in the national agriculture, which affect the preferred investment sources by smallholders. An optimistic observation is that the direct credit offer of the National Development Bank is given a second priority by smallholders, especially for improving the living conditions and standards at the farm and for mitigation of the climate change effects and environment protection. But, the direct credit offer of this bank supplies only legal farms with affordable loans that are not available to smallholders without a legal status. This is an important indicator for change in the financing policy settings aimed to enabling smallholders to use the direct credits by the development bank. In all prioritisation analyses, the loans supplied by the private sector have the lowest ranking, even though the country had established different supporting mechanisms to improve the commercial access to finance of the smallholders. This is also an important indicator for change in the financing policy settings. This result stresses that smallholders are still faced with different credit constraints.
Although applied on a small sample, the exercised method may be implemented on larger cases since the developed methodological framework in this study showed a well suitability in solving complex financial decision problems. The mathematical modelling proves to be effective in the multi-criteria decision making process and such methodology can be widely applied in a number of similar research analyses. The method is relatively simple, the consistency tests confirm the consistency in the individual judgments, thus leading to plausible results. Last but not least, the mathematical modelling may serve as a good tool to implement the participatory approach for providing groundwork for agricultural and financing policy settings to tailor the financing offer and

support programmes to the needs of the smallholders.

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GENETIC PARAMETERS OF LINEAR TRAITS AND THE EFFECT OF COW'S FINAL TYPE ASSESSMENT ON THE LONGEVITY OF UKRAINIAN BLACK-AND-WHITE DAIRY BREED

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Abstract

The purpose of this study was to determine the heritability level of cow's linear traits of Ukrainian Black-and-White dairy breed in herds of Ukraine, to define phenotypic relationships between linear traits and dairy productivity, and to study the impact of final assessment on traits of cow's longevity. The level of heritability coefficients of group traits testified about the efficiency of breeding on the results of cow's selection by dairy type (0,408), body (0,384), udder (0,417) and the final assessment (0,512). Heritability coefficients of descriptive traits varied by variability significantly, from 0.106 (hoof angle) to 0.477 (angularity). Correlation coefficients between group linear traits that characterize dairy type, body and udder, milk yield and milk fat for 305 days of first lactation were: 0.464 and 0.386; 0.452 and 0.463; 0.477 and 0.433, respectively. The correlation between descriptive traits and dairy productivity of cows distinguished by the high variability, from average negative (r = -0.376), between fatness and milk fat yield, to close positive (r = 0.495), between angularity and milk yield. According to longevity, economic use, and lactation, cows estimated "Very Good" were dominated by cows with lower "Good Plus", "Good" and "Insufficient" scores, with highly significant difference, on 527-1,429, 526-1,423, and 451-1,180 days (P <0.001), respectively. Over the lifetime milk yield and milk fat, the preference was 10,050-26,012 and 373.1-941.2 kg, respectively (P <0.001). Statistically significant correlations of angularity, rear width, fore and rear udder attachment, central ligament and body condition score can be used as indirect predictors of selection to increase dairy cow productivity.

Key words**:** *linear type estimation, correlation, heritability, dairy productivity*

INTRODUCTION

Modern dairy farming in the world has been required a solution to an important milk production problem regarding the duration of cow's use. Over the past 50 years, selection and breeding work with Holstein cattle culminated an unprecedented success - its productivity has increased twice. However, in most countries of the world, the genetic potential of cow productivity was steadily increasing by about 100 kg of milk per year (Shook, G. E., 2006) [33]. However, as a result of intensive breeding for milk production deteriorated reproducible quality and animal health (Van Raden, 2004; Miglior et al., 2005) [36, 23]. Since the growth of milk production - a key to the sustainability of the economy, increasing the genetic potential of dairy farming has been a priority for breeders. Therefore, to ensure the profitability of livestock, along with cows breeding on the basis of dairy productivity, the indicator duration of economic use was included as a breeding trait (Wesseldijk, B., 2004; Miglior et al., 2005) [38, 23]. Since studies have shown that longevity had low heritability, ranging from 0.03 to 0.07 (Zavadilová et al., 2009; Zavadilová and Štípková, 2012; Kern et al., 2014; Imbayarwo-Chikosi et al., 2015; Kern et al., 2015; Polupan, 2015) [38, 40, 14, 11, 13, 28], breeders are searching for traits that could be used as predictors of longevity. It was believed that such may be linear traits of type (Shook, G. E., 2006; Du Toit et al., 2012; Kern et al., 2014; Novotný et al., 2017) [33, 8, 14, 25]. Linear traits were highly inherited and there was a high positive

correlation between them and longevity (Khmelnychyi and Vechorka, 2015; Novotný et al., 2017; Ladyka et al., 2018) [17, 25, 20].

According to the method of linear classification, cows of Ukrainian Black-and-White dairy breed (UBWDB) in Cherkasy and Sumy regions of Ukraine were estimated. This breed was created by crossing the Simmental and aboriginal Lebedyn cattle with the Holstein breed. In crossbreed cows, against the background of a significant increase in milk productivity and improvement of conformation traits (Khmelnychyi, 2005; Khmelnychyi, 2013; Gladiy et al., 2016) [18, 16, 9], there was a tendency to reduce the length of productive life (Polupan, 2000; 2014; Klopenko and Stavetska, 2015) [30, 19]. Therefore, the search for predictors of longevity, in terms of the prospect of breeding cows of Ukrainian Black-and-White dairy breed, was an important and topical problem for breeders of the present.

MATERIALS AND METHODS

The firstborn cows of Ukrainian Black-and-White dairy breed (n = 1,387) were researched in the leading breeding herds of Cherkasy and Sumy regions of Ukraine. Cows were estimated according to the method of linear classification [10]. Two rating systems were used: 100 points and 9 points. The 100-point system took into account four sets of linear traits: dairy type, body, legs and udder. Each conformation complex was estimated independently and had its own weight coefficient in the overall assessment of animal: dairy type (DT) - 15%, body (B) - 20%; legs (L) - 25% and udder (U) - 40%. The final score of type was determined by the formula:

FS = (BW×0.15) + (B×0.20) + (L × 0.25) + (U × 0.40)

On a 9-point scale, 18 such linear descriptive traits were assessed as: height, chest width, body depth, angularity, rump angle, rump width, rear legs side view, rear legs rear view, hoof angle, fore udder attachment, rear udder height, central ligament, udder depth, front and rear teats position, teats length, locomotion and body condition score. Cows were evaluated on 2-4 months of the first lactation, but not earlier than the 15th day after calving. Assessment of linear descriptive traits of udder was performed no earlier than 1 hour before milking. The average degree of manifestation of the trait was estimated at five scores, and biological deviations toward minimal development reduced it to one score and, conversely, if the trait development approached maximum manifestation, the score increased to nine points. The maximum score for firstborn cows was no more than 89 for each set of traits. According to the international scale, assessment was as follows: 85-89 scores - "Very Good", 80-84 scores - "Good Plus", 75-79 scores - "Good" and 70-74 scores - "Satisfactory".

From the indicators of cow's longevity were estimated: life expectancy (number of days from date of birth to date of disposal); duration of cows economic use (number of days from the first calving to date of disposal); lifetime duration of lactations (total duration all day lactations); lifelong milk yield (amount of milk yield for all full lactations, kg); average life fat content in milk (lifelong milk fat × 100 / lifelong milk yield, %); lifelong output of milk fat (sum of milk fat for all lactations, kg); average lifelong milk yield for one day of life, of economic use, and lactation (as a proportion of dividing life yield by the duration of relevant period, kg). Milk productivity indicators - milk yield (kg), fat content (%) and milk fat yield (kg) were evaluated for 305 days of the first lactation.

The coefficient of linear phenotypic correlation was determined by the Pearson formula:

$$r_{xy} = \frac{\sum(x_i - \bar{x}) \times (y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \times \sum(y_i - \bar{y})^2}}$$

where: x_i – value for variable *X;*
y_i – value for variable *Y;*
$\bar{x}$ – average for *X;*
$\bar{y}$ – average for *Y.*

The heritability (h^2) of linear traits was evaluated as calculating the father's influence force indicator (η_x^2) in a one-factor variance

complex (Plohinskij, 1964) [27] according to the formula:

$$h^2 = \eta_x^2 = \frac{C_x}{C_y}$$

where:
C_x – factorial variance;
C_y – total variance.

The reliability of obtained data was evaluated by calculating the errors of statistical values (*S.E.*) and Student's reliability criteria (td) for correlation analysis and Fisher (F) for variance analysis. The probability level was classified by comparison with standard criteria values. The results were considered statistically significant for the first – P<0.05 (^{1}), the second – P<0.01 (^{2}), and the third – P<0.001 (^{3}) probability thresholds. Statistical processing of experimental studies was performed by the methods of mathematical statistics using formulas given by (Merkur'eva, 1977) [22] in Microsoft Excel.

RESULTS AND DISCUSSIONS

Heritability coefficients of cow's firstborn by estimation of group traits have insignificant variability (Table 1). In general, their level indicated to the effectiveness of breeding on the basis of cow's selection by the assessment of group traits that characterize dairy type, body, udder and especially the final assessment. The variability of heritability coefficients of the 18 descriptive traits was more variable and varied from 0.106 (hooves angle) to 0.477 (angularity).

Table 1. Heritability (h^2) of the linear type traits of firstborn cows and their correlation (r) with traits of milk productivity

Conformation traits		h^2 (heritability)	*r* (milk productivity traits)		
			yield	fat, %	fat, kg
Complexes of traits: dairy type		0.408^3	0.464^3	0.241^3	0.386^3
body		0.384^3	0.452^3	0.225^3	0.463^3
limbs		0.293^3	0.189^3	0.104^1	0.117^1
udder		0.415^3	0.477^3	0.214^2	0.433^3
final score		0.512^3	0.498^3	0.266^3	0.501^3
Descriptive traits: height		0.227^3	0.374^3	0.189^2	0.329^3
chest width		0.149^3	0.111^1	0.018	0.125^1
body depth		0.321^3	0.383^3	0.126^1	0.403^3
angularity		0.477^3	0.495^3	0.214^2	0.484^3
rump angle		0.122^1	0.171^1	0.058	0.152^1
rump width		0.249^3	0.414^3	0.104^1	0.374^3
hock joint angle		0.118^1	0.077	0.054	0.053
pelvic limbs posture		0.269^3	0.122^1	0.017	0.135^1
hoof angle		0.106^1	0.104^1	0.067	0.122^1
udder attachment	fore	0.375^3	0.421^3	0.211^2	0.384^3
	rear	0.326^3	0.382^3	0.184^2	0.367^3
central ligament		0.294^3	0.361^3	0.091	0.388^3
udder depth		0.188^2	0.018	0.011	0.019
teats position	front	0.142^1	-0.214^3	0.062	-0.237^3
	rear	0.154^1	-0.186^2	0.058	-0.244^2
teats length		0.253^3	-0.077	-0.024	-0.094
locomotion		0.238^3	0.281^3	0.112^1	0.311^3
body condition score		0.177^1	-0.368^3	0.135^2	-0.376^3

Source: Own calculations.

Given the economic and functional importance of each descriptive linear trait, it should be noted that the higher heritability of most of them correlated with indicators of milk productivity. These include height, body depth, angularity, rump width, fore udder attachment, rear udder attachment height, central ligament and body condition score.

The level of heritability coefficients of group and most descriptive traits, that correlate with traits of dairy productivity of cows estimated Ukrainian Black-and-White dairy breed, coincided with similar research results of other authors.

This was reported in the study of heritability of linear traits of Canadian Holstein (Bilal et al., 2016) [3], Brown Swiss and Holstein in Switzerland (De Haas et al., 2007) [7], Czech Simmentals (Novotný et al., 2017) [25], Jersey of Brazil (Sabedot et al., 2018) [31], Brown Swiss of Slovenia (Špehar et al., 2012) [34].

Correlative variability in dairy cattle breeding was as important as heritability. The close positive relationship existing between two estimated traits made it possible to more efficiently conduct breeding of cows through indirect selection according to one of the correlating traits.

The correlation coefficients between linear traits of the UBWDB firstborn cow type and their dairy productivity traits are shown in Table 1. Close relationships were obtained between group traits and milk productivity with high reliability according to the Student criterion. High correlation coefficients received between group of linear traits that characterize the dairy type, body and udder, and milk yield for the first 305 days of lactation. The correlation coefficients between these linear traits and milk fat were almost at the same level.

Between the group of traits that characterize the condition of limbs and traits of milk productivity, the phenotypic correlations appeared slightly weaker.

The highest phenotypic correlation coefficients were found between the final score and the traits of milk productivity, especially milk yield and milk fat yield.

The correlation coefficients between the descriptive traits and the milk productivity of the firstborn UBWDB cows differed significantly by variability, from moderate negative (r = -0.376), between fatness and milk fat yield, to close positive (r = 0.495), between angularity and milk yield.

According to the descriptive traits of UBWDB cows, that characterize the body development of cows, closely and positively influenced on the amount of milk yield and milk fat yield, height, body depth, angularity, and rump width. The relationship between chest width and rump width with yield and milk fat was positive but slightly weak. In other studies, phenotypic correlations between descriptive traits that characterize the body and milk productivity were different by quantity and direction depending on the breed (Pahlevan and Moghimi Esfandabadi, 2010; Tapki and Ziya Guzey, 2013; Bilal et al., 2016) [26, 35, 3].

The level of positive correlation between angularity and milk yield and milk fat in this study indicated about corresponding potential possibility of dairy productivity of UBWDB cows with high score for angularity. Similar genetic (0.58) and phenotypic (0.40) correlations between angularity and milk yield were confirmed by studies of Bilal et al. (2016) [3]. According to the linear classification of Czech Holstein cows, Zink et al. (2014) [42] found a moderate genetic correlation of milk yield (0.32), milk fat (0.42) and milk protein (0.34) with angularity. According to linear estimation of cow's type of Holstein breed of Turkey, phenotypic and genetic correlation of angularity with milk yield was 0.29 and 0.42, milk fat - 0.26 and 0.40, and milk protein - 0.25 and 0.45, respectively (Tapki and Ziya Guzey, 2013) [35]. This level of relationship indicated the need to include angularity in the group of linear selection traits that would enhance the productivity potential of dairy cows.

These studies have found that high-performance UBWDB firstborn cows were differed by rump width. This was evidenced by the level of correlation of rump width with milk yield and milk fat. In studies by other authors, variability of relationship of rump

width with milk productivity depended on the breed being estimated. In this connection, De Haas et al. (2007) [7] reported that rump width correlated positively with milk yield in Holstein (0.26) and Red-and-White (0.18) breeds, but was negative (-0.15) in Brown Swiss. Low level of genetic and phenotypic correlation of rump width with milk yield was revealed by Alphonsus et al. (2010) [1] in Friesian × Bunay cows, 0.088 and 0.109, respectively. Low similar genetic and phenotypic relationships of Holstein cows in Brazil have been reported by Campos et al. (2015) [5] (0.05 and 0.10), Turkish Holstein by Tapki and Ziya Guzey (2013) [35] (0.02 and -0.03), cows Sahival by Khan M.A. and Khan M.S. (2016) [15] (0.04 and 0.05). Such significant correlative variability between rump width and dairy productivity was explained by the origin and direction of breed selection.

Descriptive traits that characterize the limbs condition - hock joint angle, pelvic limbs posture and hoof angle, weakly correlated with indicators of milk productivity of dairy cows firstborn UBWDB. About non-effectiveness by selection on these grounds due to low or negative correlation between them and milk yield was reported by Khan M.A. and Khan M.S. (2016) [15] (from -0.20 to 0.07), Bohlouli et al. (2015) [4] (from -0.08 to 0.06), Tapki and Ziya Guzey (2013) [35] (from -0.05 to 0.05).

Out of the estimated seven morphological traits of UBWDB firstborn cows' udders, only three were positively associated with milk yield and milk fat. These are the fore udder parts attachment, height rear udder attachment and central ligament. These linear traits perform a supportive function, preventing the udder with age to fall below the hock. The phenotypic correlations of UBWDB firstborn cows, obtained between descriptive traits of udder (fore and rear udder attachment and central ligament) and dairy productivity indicated that selection for them will increase milk production.

These results were consistent with studies of Berry et al. (2004) [2] according to which these traits correlate with yield with corresponding coefficients of 0.32; 0.48 and 0.36. However, they are significantly different from results obtained by Tapki and Ziya Guzey (2013) [35], therefore genetic and phenotypic correlations between fore udder parts attachment and milk yield, fat and protein content, milk fat and protein were negative within -0.30 to -0.18. Positive but low correlations were between the rear udder attachment and central ligament with above-mentioned traits of milk productivity with the corresponding variability coefficients 0.08-0.15 and 0.07-0.18. Similar results were obtained in studies of Campos et al. (2015) [5] (0.11-0.19 and 0.07-0.15).

Between udder depth and milk productivity traits the phenotypic correlations of cows firstborn UBWDB were quite low. Similar genotypic and phenotypic correlations of udder depth with milk yield were identified by Bohlouli et al. (2015) [4] (0.12 and 0.04). In most studies (Alphonsus et al., 2010; Tapki and Ziya Guzey, 2013; Madrid and Echeverri, 2014; Campos et al., 2015; Khan M.A. and Khan M.S., 2016) [1, 35, 21, 5, 15]. such correlations are negative with coefficient variability of -0.470 to -0.129. The low or negative correlations between udder depth and milk productivity were explained by the fact that cows at the time of linear classification had high daily milk yield, by which the udder was lowered to the bottom, so the score decreased.

The position and teats length of UBWDB cows' firstborn was negatively correlated with milk yield and milk fat. These findings are consistent with similar studies by Khan M.A. and Khan M.S. (2016) [15], Bohlouli et al. (2015) [4], Campos et al. (2015) [5]. The direction and strength of this correlation depended on the filling of udder with milk at the time of cow's assessment, the greater its filling, the lower score and the higher negative correlation.

Good estimates of UBWDB firstborn cows for traits of hock joint angle, pelvic limb posture, and angle hoofs in the sum provided a positive correlation between locomotion and milk productivity. About association from moderate to low between movement and traits of milk productivity has been reported by Tapki and Ziya Guzey (2013) [35] (from 0.16

to 0.29) and Zink et al. (2014) [42](-0.04 to 0.10).

Linear score by fatness cows firstborn UBWDB negatively associated with milk yield and milk fat and positively with fat content. Monitoring such studies also pointed about negative correlations between body condition score and traits of milk productivity. For example, in studies of Alphonsus et al. (2010) [1] genetic and phenotypic correlations between fatness and milk yield were -0.465 and -0.370, respectively. According Tapki and Ziya Guzey (2013) [35] genetic and phenotypic correlations between body condition score and traits of milk productivity (yield, milk fat and protein) were negative with variability from -0.29 to -0.34 and from -0.19 to -0.21. Similar negative genetic correlations between body condition score and milk yield (-0.34), milk fat (-0.45) and milk protein (-0.39) were obtained by Zink et al. (2014) [42]. After calving in the first lactation period, dairy cows' productivity was increasing much faster than dry matter consumption, even in a complete diet, so a negative energy balance arising. To cover the energy deficit, the animal used its own body reserves, accompanied by appropriate body condition loss. As a rule, during this period, a linear classification of cows was carried out, therefore, the score in highly productive animals for fatness decreased.

The result of linear classification of dairy cattle was its final assessment, characterizing the breeding value of animal in overall harmony of the body structure development. The number of estimated firstborn cows was divided into four groups according to the final score by the international classification scale (Table 2).

Among the estimated livestock, the largest percentage of animals were rated "Good Plus". The results of cows ranking testified the dependence of longevity traits on the final score of type. With its decline, traits of duration of use and lifelong milk productivity of cows decreased accordingly. In terms of life expectancy, economic use, and lactation, cows with a “Very Good” rating were dominated by low-scoring cows with a highly significant difference, at 527-1,429, 526-1,423, and 451-1,180 days, respectively ($P < 0.001$).

Table 2. Traits of longevity depending on the size of final score of linear classification (x ± S.E.)

Traits of productive longevity		Final assessment, scores			
		85-89 “Very Good”	80-84 “Good Plus”	75-79 “Good”	70-74 “Insufficient”
Number of estimated cows	heads	115	1112	134	26
	%	8.3	80.2	9.7	1.8
Life expectancy of cows, days		3,223 ± 88.6	2,696 ± 21.4	2,044 ± 92.7	1,794 ± 144.1
Duration of cows economic use, days		2,389 ± 85.4	1,863 ± 18.8	1,177 ± 81.5	966 ± 151.1
Duration of lactation, days		2,013 ± 91.3	1,562 ± 19.2	1,091 ± 76.4	823 ± 146.4
Lifetime milk yield, kg		38,013 ± 966.1	27,963 ± 126.7	16,224 ± 1,108.3	12,001 ± 618.1
Lifetime milk fat	%	3.74 ± 0.022	3,75 ± 0.004	3.77 ± 0.028	3.79 ± 0.029
	kg	1,421.7 ± 44.35	1,048.6 ± 11.3	611.6 ± 51.1	480.5 ± 48.2
Milk yield per day of life, kg		11.8 ± 0.23	10.4 ± 0.09	7.9 ± 0.29	6.7 ± 0.45
Milk yield per day of economic use, kg		15.9 ± 0.28	15.0 ± 0.07	13.8 ± 0.33	12.4 ± 0.51
Yield of milk per day of lactation, kg		18.9 ± 0.29	17.9 ± 0.06	14.9 ± 0.35	14.6 ± 0.48

Source: Own calculations.

About effectiveness of the final assessment in the breeding and selection process of animals was evidenced by the indicators of lifelong milk productivity of animal group according to the linear classification “Very Good”. The most informative indicator of the effectiveness of longevity was a lifelong milk yield, according to which a group of cows with 85-89 scores outperformed other groups with lower estimates per 10,050-26,012 kg of

milk (P <0.001). With insignificant variability of fat content, from the same group of cows has been received at 373.1-941.2 kg milk fat more than from others (P <0.001).

Analyzing the traits that clearly complement the indicators of lifelong productivity - yield for one day of life, economic use and lactation, we can note a similar pattern, which was that higher rates of these traits also depended on the level of final assessment. Cows with a final score of "Very Good" were better by the listed traits with a significant difference in their favor respectively on 1.4–5.1, 0.9–3.5, and 1.0–4.3 kg of milk (P <0.001) compared to the rest of groups.

In general, about relationship between descriptive linear traits and functional life has been reported by many researchers (Caraviello et al., 2004; Zavadilová et al., 2009; Jovanovac and Raguž, 2011; J. du Toit et al., 2012; Morek-Kopec and Zarnecki, 2012; Kern et al., 2015 and others) [6, 41, 12, 8, 24, 13].

Whereas there are fewer reports with different correlation coefficients on the connection between the final score and life expectancy. About relationship between final assessment and duration of productive life (r = 0.22) was reported by Sawa et al. (2013) [32] and real longevity (r = 0.13) by Vanderick et al. (2006) [37].

Based on the results of these studies, the following general conclusion can be drawn. In the process of dairy cattle intensification, with introduction of advanced technologies and methods of breeding, there was a need to obtain animals with a strong conformation type that can provide them with long-lasting highly productive longevity. The selection of cows with score of "Very Good" and "Good Plus" at the age of the first lactation will contribute to this, which will provide them with high productivity in adulthood throughout life.

CONCLUSIONS

The high level of heritability coefficients of group traits characterizing dairy type, body, udder, and final assessment will ensure the effectiveness of UBWDB cow breeding in the direction of increasing milk productivity.

Close phenotypic correlations with dairy performance of such descriptive traits as: height, body depth, angularity, rump width, front udder parts attachment, height of rear parts attachment, central ligament, and body condition score indicate the need for their use in breeding programs. They can be used as indirect predictors of selection to increase dairy productivity of cows.

The selection of firstborn cows with a final score of "Very Good" and "Good Plus" will help increase the lifelong productivity of adult cows over the long term.

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EVALUATION AND VARIABILITY OF LINEAR CLASSIFICATION INDICATORS IN THEIR RELATIONSHIP WITH MILK YIELD OF COWS OF HOLSTEIN BREED OF REGIONAL SELECTION

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Abstract

Researches have been conducted to study conformation type of firstborn Holstein breed cows of Ukrainian selection. Cows at the age of first lactation were evaluated in the period of 2-4 months of its course using two systems of linear classification as recommended by ICAR. The 9-score system described 18 conformation traits. Four groups of conformation traits that characterize dairy type, body, limbs and udder, were assessed on a 100-score scale. It was found that firstborn cows have a good development of exterior traits that characterize dairy type, with an average estimate of 83.8 score, body condition (score 84.4), limbs (score 83.3) and udder quality (score 84.2). Evaluation of descriptive traits of firstborn cows showed that the degree of their development, compared with group, has a significantly higher variability in the herd with coefficients of variation of 11.2-31.4%. According to the final assessment, firstborns of Holstein breed Ukrainian selection corresponded to the desired type on the international scale "good plus" (score 84). By the 100-score system of linear assessment, all group traits and final score were positively correlated with yield at the age of first (0.233-0.455) and third (0.203-0.356) lactation and for lifetime (0.278-0.468). About sufficient level for effective selection testified relationship with milk yield: height (0.211-0.341), body depth (0.282-0.369) angularity (0.338-0.475), rump width (0.211-0.368), fore udder attachment (0.263-0.367), rear udder attachment (0.224-341), central ligament (0.233-0.362) and locomotion (0.221-0.382).

Key words**:** *Holstein breed, linear classification, type, conformation, correlation*

INTRODUCTION

There is no need to prove that the best specialized dairy breed in the world is Holstein. Animals of this breed, along with high milk productivity, are characterized by excellent conformation qualities. In fact, it was thanks to the purposeful selection of animals by exterior type that Holstein cattle were created as they are now (Eklz, 1960) [13].

Type of body structure Holstein breed, along with indicators of dairy productivity, is the main breeding trait, which is constantly used in animal improvement. The long practice of linear classification of Holstein cattle has proved the existence of a positive dependence of the level of productivity and functional use on a well-defined conformation type of cows (Liu et al., 2014; Zink et al., 2014; Campos et al., 2015; Otwinowska-Mindur et al., 2016;) [9, 22, 27, 37].

In the second half of the twentieth century began the intensification of combined livestock in the direction of specialized dairy type. Due to the unique properties of Holstein breed, its gene pool has been involved to improve a significant number of breeds of cattle in almost all countries. This allowed, already in the first stages of crossbreeding, along with increasing milk productivity, to significantly improve the exterior, morphological and functional properties of the cows udder of breeding breeds: Black-and-White Holland (Krabbenborg, 1978) [20], Poland (Pasierbski and Romer, 1978) [28] and Germany (Boie and Gravert, 1983) [7], Red-and-White Poland (Pawlina, 1980) [29] and Germany (Brilling, 1977) [8], Norman cattle of France (Flamberd, 1986) [14], Black-and-White cattle of Belgium (Leroy, 1977) [21], Red cattle of Norway (Skjervold and Odegard, 1978) [33], cows of Brown Austrian breed (Haiger et al., 1981) [16], Spotted

Slovak (Chrenek and Plesnik, 1981) [10], Black-and-White breed of Italy (Bianchini, 1982) [5], Yugoslavia (Romcevic et al., 1984) [30] and Hungary, Simmental of Switzerland (Rüegscger, 1978) [31].

A similar situation developed in Ukraine, where at that time breeds of combined type of productivity were bred and which became maternal basis for creation of new specialized dairy breeds. New Ukrainian breeds were created by the method of reproductive crossing, which provided at the final stage of their consolidation, breeding hybrid animals "in itself". Conditional blood by Holstein breed was planned to be dominant (not less than 62.5–87.5%, and in the active part of population even more) (Zubets et al., 1990; Zubets et al., 2001) [38, 39]. The peculiarity of creation of Ukrainian Black-and-White dairy breed in Sumy region was that the parent Lebedyn cattle served basis (Lobanov, 1991) [23]. The Lebedyn breed was created by the method of reproductive crossing of aboriginal Gray Ukrainian cattle with Brown Swiss (Yatsenko, and Kirichenko, 1959) [36].

Animals of Lebedyn breed of combined type, high growth, with a proportional, strong body structure and well-developed muscles and broad chest. They have dense and heavy elastic skin, thick, medium thickness and length of hair. Legs well set, strong. Cattle of Lebedyn breed are characterized by good meat qualities, endurance, adaptation to local conditions, resistant to diseases, longevity. In addition to low productivity, it was not adapted to machine milking technology, so it needed to be transformed.

At the time of 2009, Ukrainian Black-and-White dairy breed was created by the method of reproductive crossing of Lebedyn cattle with sires of Holstein and Black-and-White breeds. It was an array of animals with different conditional blood by Holstein breed. Later, in the absence of bulls of their own breeding, Holstein sires of foreign origin began to be used en masse in the selection to high-blooded crossbreeds. In accordance with the current situation, Ukrainian Black-and-White dairy breed passed in status Holstein. According to the selection program, animal's conformation of created Holstein breed should be as close as possible to the desired type and become a direct indicator of the body's adaptation to environmental conditions, good health and strength of body structure. A linear assessment of cow's conformation will help to answer this question. In this regard, the aim of research was to study features of exterior type of firstborn Holstein cows of domestic selection to determine the relationship of linear traits with milk productivity of animals in a particular herd.

MATERIALS AND METHODS

Scientific and economic research was conducted in the herd of enterprise by breeding Holstein breed of private enterprise "Burynske" Pidlisniv branch in Sumy district. Evaluation of conformation type of firstborn cows (n = 135) was performed by the method of linear classification (Khmelnychyi et al., 2008) [18] in accordance with the latest recommendations of ICAR (ICAR, 2018) [17].

Cows at the age of first lactation were evaluated in the period of 2-4 months of its course using two systems of linear estimation – 9-score, describing 18 traits of body structure, and 100-score, taking into account four groups of conformation traits that characterize harmonious development of dairy type, body development, limbs condition and udder morphological qualities. Estimation of udder linear traits was performed not earlier than one hour before milking. The average severity of linear traits was estimated at five score. At biological deviation of a trait towards the minimum development estimation decreased to one score. If the development of trait approached to the maximum manifestation, estimate increased to nine score. The maximum number of score for firstborn cows was not more than 89 for each set of traits. Each group of conformation body parts was evaluated separately and given appropriate weighting factor in the total assessment of animal: dairy type – 15%, body – 20%; limbs – 25% and udder – 40%.

The final score of type was determined by the formula:

FS = (DT × 0.15) + (B × 0.20) + (L × 0.25) + (U × 0.40),
where:
DT - dairy type
B - body
L - limbs
U - udder
The coefficient of linear phenotypic correlation was determined by the Pearson formula:

$$r_{xy} = \frac{\sum(x_i - \bar{x}) \times (y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \times \sum(y_i - \bar{y})^2}}$$

where:
x_i – value for variable *X;*
y_i – value for variable *Y;*
$\bar{x}$ – average for *X;*
$\bar{y}$ – average for *Y.*
The reliability of obtained data was evaluated by calculating the errors of statistical values (*S.E.*) and Student's reliability criteria (*td*) for correlation analysis. The level of reliability was determined by comparisons with standard indicators of the criteria. Results were considered statistically significant for the first – P <0.05 (^{1}), second – P <0.01 (^{2}) and the third – P <0.001 (^{3}) thresholds reliability. Statistical calculation of data experimental researches was performed by methods of biometric statistics according to formulas given by E.K. Merkurevoi [26] in Microsoft Excel.

RESULTS AND DISCUSSIONS

Studies on the linear classification of cows firstborn Holstein breed in controlled herd suggest that development of animals by conformation type was moving in the direction of desired dairy type. This statement was based on the results of estimation by 100-score system, which represented by indicators of four sets conformation traits and final score (Table 1).
Slight variability (1.62-1.93%) of average scores for all exterior complexes indicated a certain consolidation of animals by conformation type. The severity of traits that characterize dairy type of firstborn cows (score 83.8) indicated about biological ability of animal to high milk productivity. Aptitude to withstand in the difficult conditions of mechanization of production processes, physiological load during long term productive use, while maintaining good health. Dairy type was harmoniously combined with well and proportionally developed body parts that characterize body condition (score 84.4) and limbs (score 83.3). Obtained high level of udder assessment in herd cows (score 84.2) testified about good development of morphological traits that characterize its quality, from which will depend on high milk yield, adaptability to machine milking, in addition, high-quality udder is less vulnerable to injury and diseases (Campos et al., 2015; Otwinowska-Mindur et al., 2016) [9, 27].
The most objective idea about development of important for selection individual body parts of cow's exterior allowed composing descriptive system of linear classification. In this case, according to recommendation ICAR [17], each linear trait described unique cow body part, which was separated from other traits. This system must describe ICAR-approved traits of cow's conformation, which included to the group traits characteristics of dairy type, body, limbs and udder taking into accounts a certain list of defects that are most common in dairy cattle.
Estimation of descriptive traits of firstborn cows in controlled herd showed that degree of their development, compared with group, had a significantly higher variability in the herd interior with coefficients of variation 11.2-31.4%. This is a biologically justified phenomenon, because their development, in addition to genetic, was significantly influenced by paratypic factors (Mazza et al., 2013; Marinov et al., 2015; Güler et al., 2018) [15, 24, 25].
Estimation level of descriptive traits indicated about good growth of firstborn cows in height (score 6.8), they had a deep body (score 7.4), excellent angularity (score 7.7), which indicated about good development of dairy-type traits. Good limbs posture (score 7.7), optimal hock angle (score 5.3) and a sufficient feet angle will ensure their strength. From

udder traits, the highest score firstborns received for attachment the fore (score 7.5) and rear (score 7.1) udder parts and developing central ligament (score 7.8), which will keep udder at a sufficient height from the floor.

Increasing the genetic potential of cows' productivity was due to the corresponding improvement of functional conformation. Cows with a better appearance were able to maximize their milk production potential during more lactation.

This is convincingly evidenced by studies examining the relationship between linear type traits and dairy productivity of Holstein cattle in China (Liu et al., 2014) [22], Brazil (Campos et al., 2015) [9], the Czech Republic (Zink et al., 2014) [37], Poland (Sawa et al., 2013) [32], and Turkey (Tapki and Ziya, 2013) [34].

Table 1. Estimation and variability of linear classification indicators Holstein firstborn cows in connection with milk yield

Conformation trait	Variability of indicators				Correlation coefficient between linear type trait and milk yield:		
	x ± S.E.	Desirable score	σ	Cv, %	first lactation	third lactation	life
Set of traits that characterize: dairy type	83.8 ± 0.09	80-84 < Good plus	1.51	1.80	0.412[3]	0.269[3]	0.395[3]
body	84.4 ± 0.11		1.38	1.64	0.384[3]	0.266[3]	0.366[3]
limbs	83.3 ± 0.12		1.44	1.73	0.233[2]	0.203[2]	0.278[3]
udder	84.2 ± 0.14		1.37	1.62	0.447[3]	0.244[2]	0.455[3]
Final score	84.0 ± 0.10		1.62	1.93	0.455[3]	0.356[2]	0.468[3]
Descriptive traits: height	6.8 ± 0.12	7-8	1.08	15.9	0.322[3]	0.211[2]	0.341[3]
chest width	5.5 ± 0.13	7	1.12	20.4	0.074	0.059	0.095
body depth	7.4 ± 0.11	8-9	1.11	15.0	0.342[3]	0.282[2]	0.369[3]
angularity	7.7 ± 0.12	8-9	1.09	14.2	0.468[3]	0.338[3]	0.475[3]
rump angle	5.2 ± 0.05	5	0.72	13.8	0.076	0.101	0.093
rump width	6.8 ± 0.08	8-9	1.03	15.1	0.356[3]	0.211[1]	0.368[3]
hock angle	5.3 ± 0.11	5	1.06	20.0	0.144	0.122	0.094
pelvic limbs posture	7.7 ± 0.10	8-9	1.02	13.2	0.215[2]	0.167[1]	0.232[2]
feet angle	6.4 ± 0.11	8-9	1.07	16.7	0.173[1]	0.096	0.202[1]
fore udder attachment	7.5 ± 0.12	8-9	0.84	11.2	0.367[3]	0.263[2]	0.354[3]
rear udder attachment	7.1 ± 0.13	8-9	1.05	14.8	0.274[2]	0.224[2]	0.341[2]
central ligament	7.8 ± 0.11	8-9	0.87	11.2	0.347[3]	0.233[2]	0.362[3]
udder depth	6.5 ± 0.12	5-6	0.93	14.3	-0.119[1]	-0.232[2]	-0.144[1]
fore teats position	4.4 ± 0.11	5-6	1.38	31.4	-0.107[1]	-0.168[2]	-0.123[1]
rear teats position	5.2 ± 0.09	5-6	1.32	25.4	-0.092[1]	-0.145[1]	-0.073
teats lenght	5.1 ± 0.06	5-6	0.75	14.7	-0.144[2]	-0.061	-0.047
locomotion	5.8 ± 0.08	8-9	1.24	21.4	0.355[3]	0.221[2]	0.382[3]
body condition	7.5 ± 0.07	5-6	0.84	11.2	-0.346[3]	-0.201[2]	-0.266[3]

Note: [1] $P < 0.05$; [2] $P < 0.01$; [3] $P < 0.001$
Source: Own calculations.

According to the final assessment of linear classification of cows firstborn Holstein breed of Ukrainian selection, they corresponded to the desired type by the international scale

"good plus". All group traits and final score were positively correlated with milk yield at the age of the first and third lactation and for lifetime. The variability and reliability of correlations depend on the cow's age and group of linear traits. Almost the same level of correlations between group traits and final score and milk yield at the age of first lactation and during life indicated the possibility of effective selection of dairy cows at an early age (Weigel et al., 1998) [35].

According to (Atkins et al., 2008) [2], in the past the main direction of classification system was the final score. Therefore, attention was paid to the individual animal and its direct ancestors, who received the marks "Good plus", "Very good" or "Excellent". In contrast, today the classification emphasis is on a detailed assessment of individual functional traits that can be used as a tool to improve the herd to enhance the longevity and ability of cow to express its genetic productive and reproductive potential.

The functional individual linear type traits of cows in the controlled herd, which were positively correlated with the amount of milk for evaluated lactations and for lifetime, include height, body depth, angularity, rump width, fore and rear udder attachment, central ligament and locomotion.

Holstein cows of desired dairy type should be characterized by angular, open, well-rounded ribs, with sufficient body depth to be able to convert a large amount of roughage into high productivity. In this regard, studies have shown a relationship between milk yield and body depth (r = 0.282-0.369) and angularity (r = 0.338-0.475). According to results of studies by a number of authors (De Haas et al., 2007; Tapki and Ziya, 2013; Zink et al., 2014; Bilal et al., 2016) [6, 11, 34, 37], variability of correlations between body depth and milk yield varied widely from 0.09 [6] to 0.56 (De Haas et al., 2007; Khmelnychyi et al., 2020) [11, 19]. The same authors testified to the high potential of milk productivity of Holstein cattle with correlations between angularity and milk yield from moderate (0.29) (Tapki and Ziya, 2013) [34]) to high (0.75) (De Haas et al., 2007) [11].

Of particular note was the assessment of morphological udder traits, which is associated with productivity, health and longevity of cows. Over a long period of time, due to genetic selection, anatomical structure of cow's udder has changed. Productivity selection has led to an increase in udder size and weight. As a result, the center of gravity of udder shifted caudally, strengthened suspension apparatus, which is represented by the strength of central ligament, attachment of fore and rear parts. The good development of these traits in Holstein cows in controlled herd, respectively, was evidenced by their score - 7.8; 7.5 and 7.1. The level of correlations for evaluated lactations and for lifetime and central ligament (0.233-0.362), fore (0.263-0.367) and rear udder parts (0.224-0.341) attachment and indicators of assessment these traits of cows was a guarantee of increased productivity and health udder in the selection process.

The relationship between the linear udder traits, which are responsible for strength of its attachment, with milk productivity of cows, has been reported by many scientists. However, this relationship was significantly volatile in strength and direction. The correlation between fore udder parts attachment and milk yield in most studies in Holstein cows around the world is negative: -0.45 (DeGroot et al., 2002) [12], -0.23 (Tapki and Ziya, 2013) [34], -0.11 (Zink et al., 2014) [37], -0.09 (Campos et al., 2015) [9]. The antithetic correlation between fore udder parts attachment and milk yield was due to the coincidence of assessment time (2-4 months of lactation) and the peak of lactation, when high productivity was observed. Under the weight of a large amount of milk, the udder is lowered and score is reduced. However, a positive rather strong correlation between these traits in Holsteins of Turkey (0.32) (Berry et al., 2004) [4]) indicated about possibility of breaking this negative connection.

The validity of this conclusion regarding the udder height position relative to the hocks, depending on its filling with milk, was confirmed by established negative correlations between udder depth and amount

of milk. The correlation between these traits for all above-mentioned researchers varied from -0.65 (DeGroot et al., 2002) [12] to -0.05 (Yatsenko and Kirichenko, 1959) [36].

As for relationship between the height of rear udder part attachment with milk yield, it is, on the contrary, usually positive: from 0.12 (Tapki and Ziya, 2013) [34], 0.15 (Sawa et al., 2013; Zink et al., 2014) [32, 37], 0.19 (Campos et al., 2015) [9], 0.27 (Liu et al., 2014; Otwinowska-Mindur et al., 2016) [22, 27] to 0.48 (Berry et al., 2004) [4]. A negative association between these traits was reported in a study of Bunaji-Holstein cows (-0.30) (Alphonsus et al., 2010) [1]). The authors of above publications, in studying the relationship between the udder central ligament and yield, found a large variability of correlations in direction and strength, from -0.18 (Alphonsus et al., 2010) [1] to 0.79 (Liu et al., 2014) [22].

According to our studies, score for fattening was negatively correlated with amount of milk yield for evaluated lactations. This reality in most cases was consistent with studies of Holstein cows with genetic correlation coefficients between these traits -0.45 (De Haas et al., 2007) [11], - 0.38 (Bilal et al., 2016) [6], -0.20 (Tapki, and Ziya, 2013) [34] and -0.34 (Zink et al., 2014) [37]. As for negative relationship between fattening and milking, this situation was explained by existence of a negative energy balance of high-yielding cows in the first 100 days of lactation (Banos et al., 2005) [3]. This was exactly the time when a linear assessment was performed in accordance with requirements of the methodology. In general, from the point of view of desired conformation type of dairy cows, there is an objective, generally accepted understanding that cows of specialized dairy breeds, which belong to the intensive type, have never been fattened.

CONCLUSIONS

The use of linear classification method in the selection process - very effective means of objectively determining the breed features of dairy cows conformation type. The high level of variability coefficients of individual descriptive body parts of the exterior indicated about need for their improvement in some animals of studied breed at present stage of breeding through appropriate selection of bull improvers, estimated by their daughter's type. A reliable correlation of linear traits of conformation with milk yield for number of lactations and for lifetime confirmed the urgent need for indirect selection of dairy cattle by type, which will get not only constitutionally strong and healthy animals, but also highly productive by yield. The use of the modern method of linear classification will make it possible to control the biological patterns of the conformation type formation of cows Holstein breed of domestic selection.

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ASSESSMENT AND ANALYSIS OF REGIONAL FEATURES OF RESOURCE-SAVING LAND USE FOR SUSTAINABLE MANAGEMENT

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Abstract

The purpose of this study is a comprehensive assessment and mapping of resource-saving land use in terms of regions of Ukraine as a basis for the organization of sustainable land management in the agricultural sector. The rating of regions of Ukraine was compiled by a comprehensive assessment of land use savings, which made it possible to identify regional features and reserves of increasing resource-saving land use. It was found that land capacity index had the most significant impact on the degree of land use savings. This paper is one of the first article where a comprehensive assessment and analysis of the current state of resource-saving of land use in the agriculture of the regions of Ukraine and the search for factors of increasing land use savings based on regional differences was carried out, making a contribution to the lack of literature on this issue. The results of the study can be used to make economically sound management decisions to increase land use savings in Ukrainian regions. The practical use of the obtained results can help to improve the efficiency and effectiveness of sustainable land management at national and regional levels.

Key words**:** *resource-saving land use, regional differences, comprehensive assessment, fertility, sustainable land management*

INTRODUCTION

In the conditions of post-industrial formation society should agree that the development of the natural sciences will be more and more regulated by pragmatism [25]. In this regard, the objects of these sciences approach such categories as «spatial economy», «geoeconomics», «prostrology» and others [25, 29, 27]. It is from the standpoint of spatial economics that we consider regional features of resource-saving land use as a basis for sustainable land management in the agricultural sector of Ukraine. An analysis of recent research and publications shows that there are currently no works in Ukraine on the issue of resource-saving land use. At the same time, the problem of sustainable land and soil management is being actively studied by foreign scientists. For example, soil is recognized as the basis for creating favorable conditions for the transition to sustainable land management as a key to achieving the Sustainable Development Goals by 2030 [31]; long-term efficiency of sustainable land management for control of runoff, soil erosion, loss of nutrients in Mediterranean agroecosystems has been determined [20]; the scale of the impact of vegetation restoration on soil and water conservation in the semi-arid region of China in the context of resource conservation and sustainable management has been studied [32]; assessed the technical and environmental effectiveness of sustainable land management practices for small farmers in Ghana [8]; regional aspects of sustainable land management in Greece are substantiated [3]; spatial identification of land use functions and their trade-offs and synergies in China in the context of implications for sustainable land management [34].

Foreign scientists also thoroughly study various aspects of resource-saving activities, in particular: environmental and economic efficiency of resource-saving technologies in crop production in different countries [1, 5, 6, 13]; coordination of interaction between the environment, economy and tourism in China [19]; saving resources and increasing productivity in crop management in Ethiopia [9]; planning of resource-saving and environmentally friendly agricultural

demonstration parks [35].

The economic basis of resource conservation is formed in the work of I.M. Sotnik [26]. Modern publications of Ukrainian authors focus mainly on such issues as: economic, environmental and social aspects of land use [30]; theoretical and methodological foundations of rational and efficient use of land resources [11, 12, 28]; spatial features of soil cover as a basis for sustainable soil management [2]; sustainable soil management and its role in forming the competitiveness of agricultural enterprises [14, 15]; investment attractiveness of soils of the Carpathian region of Ukraine [22]. At the same time, the issues of substantiation of ecological-and-economic bases of organization of resource-saving land use in the agricultural sector remain unexplored in Ukraine.

The purpose of this study is a comprehensive assessment and mapping of resource-saving land use in terms of regions of Ukraine as a basis for the organization of sustainable land management in the agricultural sector.

MATERIALS AND METHODS

To achieve the goal of the research study, the following methods were used: economic-statistical, calculation-analytical and monographic (for calculation and analysis of indicators characterizing the degree of land use savings), correlation analysis (to identify the relationship between factors of land use savings), regression and analysis of variance (to determine the degree of influence of factors on which land use savings depend), cartographic method (for mapping the land consumption of the economy and land use savings). To assess the degree of savings in the use of land resources in Ukraine, we used a method developed by one of the co-authors of this article [16, 17]. The methodological plan uses a number of special indicators, in particular such as: land return – characterizes the level of economic return of land taking into account their quality, calculated by dividing the gross agricultural output (gross value of agricultural production at constant prices) of all categories of farms to the general normative monetary value of agricultural lands; land consumption of the economy (or land capacity) – determined by the ratio of the region to the volume of gross regional product; loss-making gross output with characterizes the degree of environmental friendliness of production, determined by dividing the environmental-and-economic damage from the loss of humus by the value of gross agricultural output; the loss-making capacity of the gross regional product is determined by dividing the ecological-and-economic loss from the loss of humus by the value of the gross regional product. The information base of the study was the data of the State Statistics Service of Ukraine for 2017 [21]. The study consisted of several stages:

(i) calculation of key indicators used to assess the degree of savings in land use in the regions of Ukraine;

(ii) standardization of the obtained indicators and calculation of the integrated indicator of land use savings;

(iii) correlation and regression analysis of the obtained data to determine the indicators that have the most significant impact, and the construction of maps showing the degree of land use savings in the regions of Ukraine.

RESULTS AND DISCUSSIONS

At the first stage, such indicators are calculated as: the level of economic use of land, the level of plowed land, productivity of agricultural land use, production of gross agricultural output per 1 person, coefficients: land consumption, land return and land consumption of the economy. The calculation results are presented in Table 1. According to the results of the study it was found that the highest level of economic use of land in Kirovograd (82.9%) and Zaporizhia (82.5%) regions, the lowest – in the Transcarpathian region (35.4%), in turn, with natural conditions, but the highest level of plowing was found in Kherson (90.2%) and Cherkasy (88.2%) regions. Productivity of agricultural land use (10.17 thousand UAH/ha), as well as production per 1 person (13.2 thousand UAH), were the highest in Vinnytsia region, which may indicate successful management

decisions of land users. According to the indicator of land return by gross output in agriculture, the leaders were Transcarpathian and Ivano-Frankivsk oblasts (0.519 and 0.512, respectively), with Luhansk oblast (0.115) being an outsider.

Table 1. Assessment of the degree of savings in the use of land resources in the regions of Ukraine according to the main indicators, 2017

Administrative-territorial unit	Level of economic use of land, %	Level of plowing, %	Productivity of agricultural land use, thousand UAH/ha	Produced gross output in agriculture per 1 person, thousand UAH	Land return on gross output	Land consumption of gross output	Land consumption economy, ha/thousand UAH
UKRAINE	68.4	78.8	6.04	5.93	0.249	4.012	0.020
CRIMEA	68.9	71.3	NO DATA				
VINNYTSIA	76.0	85.7	10.14	13.16	0.410	2.438	0.029
VOLYN	52.1	64.2	6.55	6.65	0.403	2.480	0.039
DNIPRO	78.8	84.6	6.07	4.78	0.220	4.551	0.010
DONETSK	77.0	81.0	3.76	1.85	0.135	7.400	0.016
ZHYTOMYR	48.2	76.5	6.92	8.19	0.386	2.590	0.049
TRANSCARPATHIAN	35.4	44.2	8.90	3.21	0.519	1.926	0.030
ZAPORIZHIA	82.5	84.9	4.28	5.66	0.189	5.285	0.021
IVANO-FRANKIVSK	44.5	63.1	9.74	4.40	0.512	1.953	0.022
KYIV	58.8	82.1	9.01	8.39	0.379	2.636	0.018
KIROVOGRAD	82.9	86.6	5.09	11.04	0.174	5.740	0.046
LUHANSK	69.7	68.8	2.43	2.11	0.115	8.730	0.088
LVIV	57.9	63.0	7.77	3.90	0.494	2.024	0.015
MYKOLAYIV	81.6	84.7	4.41	7.85	0.180	5.571	0.035
ODESSA	77.0	80.8	4.60	4.97	0.162	6.160	0.022
POLTAVA	75.2	81.8	6.62	10.27	0.249	4.012	0.019
RIVNE	46.3	70.9	7.61	6.11	0.441	2.265	0.041
SUMY	71.3	72.2	6.00	9.48	0.278	3.600	0.042
TERNOPIL	75.4	82.0	9.09	9.09	0.355	2.815	0.034
KHARKIV	76.5	80.1	5.86	5.29	0.207	4.835	0.017
KHERSON	69.2	90.2	5.68	10.83	0.248	4.038	0.059
KHMELNYTSKY	75.9	80.0	8.97	11.16	0.335	2.989	0.032
CHERKASY	69.0	88.2	9.20	11.06	0.290	3.452	0.029
CHERNIVTSI	58.1	70.5	9.59	5.00	0.335	2.981	0.028
CHERNIHIV	63.5	69.6	5.39	10.94	0.277	3.608	0.056

Source: author's calculations based on data from the State Statistics Service of Ukraine.

The next step was to calculate the specific indicators of land consumption and land return in the regions of Ukraine. According to calculations, the largest share of agricultural land in the Odessa region (6.2% of the total area in Ukraine), then, accordingly, the overall regulatory monetary value of these lands is also the largest. However, in the territory of this region the relative rate of land return is quite low, probably due to the climatic conditions of the region and the soil cover, which allows to grow not all crops. The higher level of land consumption, the worse the situation with land use savings. The highest relative level of land consumption in Luhansk region, all other indicators in this region also tended to the worst values.

Thus, the worst conditions for the preservation and reproduction of humus were observed in Zaporizhia, Mykolaiv and Kharkiv regions, which indicates insufficient efforts of farmers to protect the land on the basis of a set of anti-degradation measures. In this regard, the ecological-and-economic

assessment of the balance of humus in these areas is the lowest, and the best indicators in Chernihiv and Cherkasy regions, which indicates the effectiveness of measures to preserve and reproduce humus. The highest rate of loss of gross regional product in the Mykolayiv and Lugansk areas, the lowest – in the Ivano-Frankivsk region.

Agri-environmental monitoring of soils is the key to systematic control of fertility, as a negative balance of humus has been found in most areas of the country, which can lead to a significant deterioration in soil fertility. The points of systematic agrochemical monitoring of fields should include at least the following parameters: humus content, content of mobile forms of micro- and macroelements, soil pH [28].

The use of modern technologies, such as precision (digital) agriculture (based on satellite images make electronic maps, study the chemical composition of the soil, give recommendations for economical land use) [18], allows to rationalize the use of chemical fertilizers, harmonize land reclamation measures in time. It is also advisable to use the Satellite online service EOS Crop Monitoring, which allows us to assess the condition of sown areas and compare them with the maps of the State Geocadastre. Using this service on the territory of Ukraine, it was found that 4.3 million hectares of fields are not registered in the state cadastre. The harvest of them in monetary terms is 88.5 billion UAH per year [30]. Also, these data further explain the low land productivity in Odessa and Mykolayiv regions, because they are leaders in the shadow market of agricultural products.

In order to carry out a comprehensive assessment of resource-saving of land use in the regions of Ukraine, standardization of indicators was carried out. Since the studied phenomenon is multifaceted and is characterized by indicators that have different units of measurement, the integrated quantitative assessment of land use savings can be performed only in relative terms using multidimensional analysis methods. The following indicators were used for this: plowing level – x_1 (destimulator); productivity of agricultural land use – x_2 (stimulator); produced gross agricultural output output per 1 person – x_3 (stimulator); land return on gross agricultural output – x_4 (stimulator); land consumption of the economy – x_5 (destimulator); relative land consumption according to the natural assessment of land resources – x_6 (stimulator); relative land consumption according to the value of land resources – x_7 (stimulator) [16, 17]. Two formulas have been used to standardize these indicators: the first formula for indicators that have a positive effect (stimulators), the second – for those that have a negative effect (destimulators).

$$S = \frac{X_{max} - X_i}{X_{max} - X_{min}}, \quad (1)$$

$$S = \frac{X_i - X_{min}}{X_{max} - X_{min}}, \quad (2)$$

where X_i is the actual value of the indicator;
X_{min} – the minimum value of the indicator;
X_{max} – the maximum value of the indicator.

It should be noted that this methodological approach to standardization has been tested in previous studies [14, 16, 17, 33] and officially approved by the Cabinet of Ministers of Ukraine and is used to monitor and evaluate the effectiveness of state regional policy [24].

Table 2 shows the results of a comprehensive assessment of resource-saving of land use on the basis of standardized indicators. Unfortunately, the lack of a significant number of indicators in the Autonomous Republic of Crimea made it impossible to assess the real situation regarding the resource-saving of land use in this region.

To determine the rating of regions by the degree of land use savings, the average value of all indicators was calculated. The best assessment of resource-saving of land use is obtained by the region with the lowest average value. To expand the analytical capabilities and ease of analysis, the degree of land use savings in points on a 100-point scale was also determined. In this case, the best assessment of resource-saving of land use is the region with the highest score.

Table 2. Comprehensive assessment of resource-saving of land use in the regions of Ukraine, 2017

ADMINISTRATIVE-TERRITORIAL UNIT	STANDARDIZED INDICATORS							COMPREHENSIVE ASSESSMENT		
	SX_1	SX_2	SX_3	SX_4	SX_5	SX_6	SX_7	COEF.	POINT	PLACE
CRIMEA	NO DATA									
VINNYTSIA	0.902	0.000	0.000	0.269	0.237	0.000	0.075	0.212	79	3
VOLYN	0.434	0.466	0.576	0.287	0.367	0.173	0.081	0.340	66	11
DNIPRO	0.877	0.528	0.741	0.740	0.000	0.212	0.386	0.498	50	16
DONETSK	0.799	0.827	1.000	0.949	0.074	0.535	0.804	0.713	29	23
ZHYTOMYR	0.701	0.417	0.439	0.329	0.492	0.147	0.098	0.375	63	12
TRANSCARPATHIAN	0.000	0.160	0.880	0.000	0.250	0.044	0.000	0.191	81	1
ZAPORIZHIA	0.885	0.760	0.663	0.816	0.137	0.432	0.494	0.598	40	21
IVANO-FRANKIVSK	0.410	0.052	0.774	0.018	0.149	0.013	0.004	0.203	80	2
KYIV	0.823	0.147	0.421	0.346	0.099	0.040	0.104	0.283	72	5
KIROVOGRAD	0.920	0.655	0.188	0.853	0.464	0.313	0.561	0.565	44	19
LUHANSK	0.535	1.000	0.977	1.000	1.000	1.000	1.000	0.930	7	24
LVIV	0.407	0.308	0.818	0.062	0.060	0.096	0.014	0.252	75	4
MYKOLAYIV	0.880	0.744	0.469	0.839	0.324	0.411	0.536	0.601	40	20
ODESSA	0.795	0.718	0.724	0.882	0.155	0.380	0.622	0.611	39	22
POLTAVA	0.818	0.457	0.256	0.667	0.114	0.168	0.307	0.398	60	13
RIVNE	0.579	0.328	0.623	0.192	0.396	0.105	0.050	0.325	68	9
SUMY	0.608	0.537	0.325	0.597	0.410	0.218	0.246	0.420	58	14
TERNOPIL	0.821	0.136	0.360	0.405	0.305	0.037	0.131	0.313	69	7
KHARKIV	0.781	0.555	0.696	0.772	0.085	0.230	0.428	0.507	49	17
KHERSON	1.000	0.579	0.206	0.671	0.632	0.248	0.310	0.521	48	18
KHMELNYTSKY	0.777	0.151	0.177	0.456	0.284	0.041	0.156	0.292	71	6
CHERKASY	0.956	0.122	0.186	0.567	0.236	0.032	0.224	0.332	67	10
CHERNIVTSI	0.572	0.071	0.721	0.454	0.233	0.018	0.155	0.318	68	8
CHERNIHIV	0.551	0.616	0.196	0.598	0.592	0.278	0.247	0.440	56	15

Source: author's calculations based on data from the State Statistics Service of Ukraine.

As we can see, the first place in the ranking is occupied by Transcarpathian region, the second – Ivano-Frankivsk region and the top three is closed by Vinnytsia region, the last steps of the ranking are occupied by Odessa, Donetsk and Luhansk regions. The degree of land use savings in Ukraine ranges from 0.191 to 0.930. Thus, in the regions with the lowest level of land use savings, there is a need to green agricultural land use as a basis for sustainable land management.

The last places of Luhansk and Donetsk oblasts in the above ranking can be explained in some way by the situation related to military actions in the region, while the outsiders of Odessa oblast are directly related to irrational and «shadow» use of land resources.

The next step was to develop maps of land use savings in Ukraine by region. The constructed cartograms of land consumption of the economy (Fig. 1) and land use savings (Fig. 2) clearly represent the regional differences of the analyzed indicators in points.

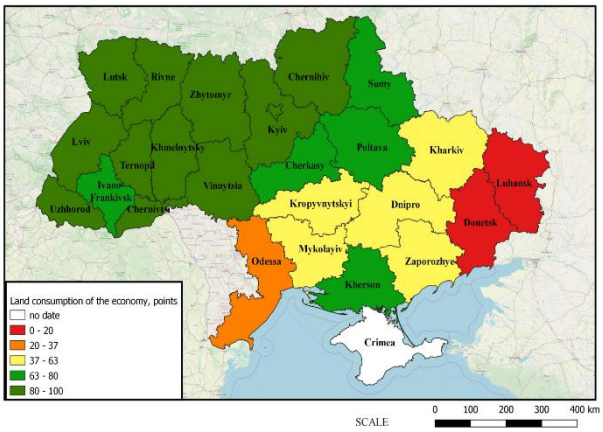

Fig. 1. Land consumption of the economy in terms of regions of Ukraine in 2017, points

Source: built by the authors on the basis of their own calculations.

Fig. 2. Land use savings in terms of regions of Ukraine in 2017, points
Source: built by the authors on the basis of their own calculations.

The gradation is performed according to the Harrington desirability scale [23], where 80–100 is a high level of savings, 63–80 is sufficient, 37–63 is medium, 20–37 is low, and 0–20 is a very low level of land use savings.

Thus, (i) a high level of land use savings is characteristic of the following regions: Transcarpathian and Ivano-Frankivsk regions; (ii) sufficient level – for the following oblasts: Vinnytsia, Lviv, Kyiv, Khmelnytsky, Ternopil, Chernivtsi, Rivne, Cherkasy and Volyn oblasts; (iii) middle level – for the following oblasts: Zhytomyr, Poltava, Sumy, Chernihiv, Dnipro, Kharkiv, Kherson, Kirovohrad, Mykolaiv, Zaporizhia and Odesa oblasts; (iv) low level – for Donetsk region; (v) very low level – for Luhansk region.

Thus, five groups (clusters) of regions with fundamentally different levels of agricultural land use savings have been identified. Therefore, the cluster approach can be promising for the organization of resource-saving land use in the agricultural sector.

Our further research was aimed at identifying reserves to improve the resource-saving of land use. There is a significant gap between the leading regions and outsiders in the degree of land use savings. Thus, the difference in points between the leader and the outsider is 74 points. Six indicators were selected as factors influencing the degree of land use savings. In order to identify the relationship between the degree of land use savings in points (y) and these factors, a correlation analysis was performed (Table 3).

Table 3. Matrix of coefficients of pair correlation between factors and a comprehensive assessment of resource-saving of land use in the regions of Ukraine, 2017

VARIABLES	У	X_1	X_2	X_3	X_4	X_5	X_6
У	1.000						
X_1	-0.332	1.000					
X_2	0.928	-0.202	1.000				
X_3	0.317	0.514	0.305	1.000			
X_4	-0.970	0.360	-0.856	-0.309	1.000		
X_5	0.108	-0.082	0.076	0.371	-0.080	1.000	
X_6	-0.282	0.701	-0.051	0.240	0.430	0.101	1.000

Note. Plowing level (%) – x_1; productivity of agricultural land use (thousand UAH/ha) – x_2; produced gross agricultural output per 1 person (thousand UAH) – x_3; land consumption of gross agricultural output (coefficient) – x_4; ecological-and-economic assessment of humus balance (UAH/ha) – x_5; monetary value of 1 ha of agricultural land (UAH) – x_6.
Source: author's calculations.

As we can see, most of the factors are not closely related, so there is no multicollinearity. To interpret the degree of relationship between the factors, the Chaddock scale was used, according to which: the value of the correlation coefficient up to 0.100 indicates the absence of a relationship; 0.100–0.300 – weak; 0.301–0.500 – moderate; 0.501–0.700 – noticeable; 0.701–0.900 – high; 0.901–0.990 – very high; 1.0 – functional connection [7]. A weak correlation was found between the degree of land use savings and: the monetary value of agricultural land (x_6), ecological-and-

economic assessment of humus balance (x_5). A moderate inverse relationship was found between the degree of land use savings and the level of plowing (x_1), and with the production of gross agricultural output per person (x_3) it was directly moderate. A high direct relationship was found between the degree of land use savings and agricultural productivity (x_2), while the land consumption of gross agricultural output (x_4) the relationship was highly inverted. The next step was to conduct a regression analysis to quantify the dependence of a comprehensive assessment of resource-saving of land use in points (y) on the following factors: productivity of agricultural land use (x_2) and land consumption of gross agricultural output (x_4). According to the results of regression analysis, the following mathematical model was obtained:

$$y = 62.50 + 3.0433x_2 – 6.5809x_4$$

Each of the coefficients characterizes the average change in excluding the influence of variation of other factors. Thus, increasing the productivity of agricultural land use (x_2) per 1 thousand UAH contributes to increasing the resource-saving of land use by 3.043 points; increase in the coefficient of land consumption of gross agricultural output (x_4) per unit causes a decrease in resource-saving of land use by 6.581 points. According to the results of regression analysis, it was found that the multiple correlation coefficient $R = 0.988$, ie there is a direct very high relationship between performance and factor indicators. The value of the coefficient of determination (R^2) is 0.976, which indicates that (i) the constructed model is close to satisfactory, ie it adequately describes the phenomenon of land use savings; (ii) the selected factors explain 97.6% of the degree of variation in land use savings. The normalized coefficient of determination ($R^2 = 0.973$) does not differ significantly from R^2 and is evidence of the reliability of the latter. Based on analysis of variance, it was found that the reliability of the model is also confirmed by the value of the Fisher's ratio, which is 420.59. According to the criterion of P-value, the influence of the analyzed factors was also statistically reliable at a given level of probability (95%).

As a result of regression analysis, it was found that the most significant impact on the degree of land use savings has a land consumption indicator, so it is important to reduce it taking into account the best domestic and international experience. On the other hand, the monetary value of agricultural land needs to be updated, especially in the context of the opening of the land market in Ukraine. In order to increase the resource-saving of land use in Ukraine, it is advisable to increase production per unit of land area in outsider regions, which is possible by regulating the sectoral structure of production, the structure of sown areas and/or through the use of innovative environmentally friendly agricultural technologies, involving the use of optimal crop fertilization systems. To do this, it is necessary to monitor the quality of agricultural soils and lands, this can be done by all types of stakeholders: the owners of these lands and their tenants to optimize the cultivation of crops; the state – as a guarantor of the preservation of agricultural land, because according to the Constitution of Ukraine, land is the main national wealth, which is under special protection of the state. Higher education seekers of various natural specialties and subjects of scientific activity can also act as a possible stakeholder, as they can use the data obtained as a result of monitoring to write their own scientific works. Another important step to improve the degree of savings in land use is to reduce land consumption, because in developed countries this figure is 2–3 times lower. By reducing this indicator, we can increase the number of products while reducing the load on the soil cover.

One of the promising areas may be the implementation of typical models of crop rotations of organic farming for crop enterprises, that are characterized by positive predictive humus balances [10].

Comparative analysis of the absolute values of key components of resource-saving of land use of leading regions (high and sufficient level), middle peasants (middle level) and outsider regions (low and very low level) using the econometric model developed above

allowed to make a forecast of comprehensive assessment through reserves in the medium term (Table 4).

Table 4. Forecast to increase the comprehensive assessment of resource-saving of land use in the regions of Ukraine through the use of reserves in the medium term

variables	Average values of variables by groups of areas			The difference between the mean values between:		Regression, coefficient	Growth reserve, coefficient	
	outsiders	among some	leader	among some and outsiders	leaders and among some		outsiders to among some	among some to leaders
x_2, thousand UAH/ha	3.10	5.54	8.78	2.44	3.24	3.0433	7.426	9.860
x_4, coef.	8.065	4.545	2.542	-3.520	-2.003	-6.5809	23.165	13.182
y, points	18.0	49.7	72.4	31.7	22.7	-	30.591	23.042

Source: author's calculations.

Therefore, if the average productivity of agricultural land use (x_2) of outsider oblasts will increase by 2.44 thousand UAH/ha, and the average land consumption coefficient of land consumption of gross agricultural output (x_4) will decrease by 4.545, they will be able to implement the growth reserve of a comprehensive assessment of resource-saving of land use by 7.426 and 23.165 points, respectively. Thus, the total growth reserve due to the improvement of these factors of outsiders to the average level is 30.591 points; in turn, due to the improvement of the indicators of middle regions to the level of leaders, the reserve for resource saving growth is 23.042 points.

CONCLUSIONS

As a result of the study of ecological-and-economic bases of resource-saving land use in the agricultural sector, a comprehensive assessment and analysis of the current state of land use in the agriculture of Ukraine and further substantiated the factors of increasing land use savings in modern realities, which allowed to draw the following main conclusions: the current state of land use in Ukraine needs optimization at the national, regional and local levels. At the mega, macro and meso levels, resource-saving land use means land use that provides a balance between society's needs for agricultural products and food and the renewable capacity of land resources, ie land use must meet the requirements of sustainable development. At the micro level, we consider resource-saving land use, which provides (i) production of the planned volume of production with minimal use of land resources or (ii) production of the maximum volume of production with a certain (fixed) land resource. The balance of humus in the arable lands of the country is negative, which indicates the need to resolve the situation in land use in the direction of creating conditions for at least simple reproduction. The worst conditions for the preservation and reproduction of humus are observed in Zaporizhia, Mykolaiv and Kharkiv regions, which indicates insufficient efforts to protect the land. In this regard, the ecological-and-economic assessment of the balance of humus in these areas is the lowest, and the best indicators in Chernihiv and Cherkasy regions, which indicates the effectiveness of measures to preserve and reproduce humus. Integral assessment of the degree of savings in the use of land resources in the regions of Ukraine ranges from 7 to 81 points.

According to the results of a comprehensive assessment of land use savings, it was found that the first place in the ranking is occupied by Transcarpathian region (81 points), the second – Ivano-Frankivsk region 80 points), and the top three is closed by Vinnytsia region (79 points); Odessa (39 points), Donetsk (29 points) and Luhansk (7 points) regions occupy the last steps of the rating. The outsider positions of Luhansk and Donetsk oblasts can be explained by the situation related to military actions in the region, while the outsidership of Odesa oblast is directly related to the irrational and «shadow» use of land resources. Management of resource-saving land use should be based on the

regulation of factors that affect the degree of land use savings.

Based on the correlation analysis, it was found that: between the degree of land use savings and the level of plowing, the production of gross agricultural output per person there is a moderate connection; a high correlation was found between the degree of land use savings and the productivity of agricultural land use and land consumption of gross agricultural output. It was found that a high rate of land use has a significant impact on the deterioration of land use savings.

As a result of building a two-factor regression model, it was found that the increase in land consumption per unit of measurement caused a decrease in resource-saving of land use by 6.581 points; increase the productivity of agricultural land use by 1 thousand UAH contributed to an increase in resource-saving of land use by 3.043 points.

Therefore, the factor of land consumption requires priority attention in the management of resource-saving land use. The reduction of land consumption can be achieved by increasing the volume of production in outsider regions per 1 ha, in particular, by regulating the sectoral structure of production, the structure of sown areas and/or the introduction of innovative agricultural technologies.

In Ukraine, there is a need to improve the resource-saving of land use, because land is a national wealth that makes a significant contribution to the economy. This is possible by improving the management of land use savings by: updating the monetary valuation of land, bringing the indicator of land consumption in outsider regions first to the average level, and in the future – to the level of leading regions, bringing the land consumption indicator of leading regions to the level of advanced European countries, regulation of land productivity by harmonization of ecological and economic aspects, ie through the selection of profitable crops taking into account the soil and climatic features of the regions of Ukraine.

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FACTOR MODEL OF RATING ASSESSMENT OF SOCIO-ECONOMIC AND DEMOGRAPHIC DEVELOPMENT OF RURAL AREAS OF RUSSIAN REGIONS

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Abstract

The purpose of the research is to work out a model of socio-economic and demographic development of rural areas in the Privolzhskiy Federal District (PFD) of the Russian Federation. When preparing the article, the scientific works of domestic and foreign scientists on the topic under research, information from the Federal State Statistics Service of the Russian Federation and the Ministry of Agriculture of the Russian Federation were used. Research methods – statistical and economic, computational and constructive, economic and mathematical, modeling, monographic, abstract logical, etc. The research developed a four-stage deterministic factor model of socio-economic and demographic development of rural areas, based on the calculation and interpretation of the integral depending on the objectives of the study, to assess the level of socio-economic and demographic development of rural areas, taking into account the impact of various indicators on the demographic indicators of population reproduction and social processes in terms of material conditions and the quality of life of rural residents, to identify the most successful rural areas to study their experience, conduct analysis of changes in the value of the integral indicator, taking into account the identified reserves for stabilizing the level of socio-economic and demographic development of rural areas and improving the life quality of the population in the Privolzhskiy Federal District.

Key words**:** *deterministic factor model, socio-demographic development, Privolzhskiy Federal District, rural areas, Russian Federation*

INTRODUCTION

The modern socio-economic and demographic situation in the rural areas of Russia is diverse. There are leading regions (Moscow, Belgorod, Samara regions, the Republic of Tatarstan), where the quality of life of the rural population and the infrastructure of the village have a fairly high level. In rural settlements of these regions, demographic growth is observed – the birth rate and migration inflow of the population are increasing [5]. However, in most of the administrative-territorial units of Russia, the standard of living of the rural population is not high – a lack of jobs, low incomes force people to leave villages, moving to cities or other regions. The current unstable socio-demographic situation in several constituent entities of the Russian Federation served as the basis for the development of a deterministic factor model of the socio-demographic development of rural areas.

The theory and methodology of socio-economic processes influencing the development of demography are disclosed in the works of many Russian and foreign scientists-economists, sociologists and demographers.

Theories of changes in fertility and mortality under the influence of various conditions were studied by G. Becker [1], D. Van de Kaa [14], R. A. Easterlin [6], J. Coleman [4], A. Landry [9], R. Lesthaeghe [10], A.G. Vishnevsky [15]. Problems of migration dynamics taking into account socio-economic aspects were studied by G. Borjas [2], W. Zelinsky [16], E. S. Lee [11], W. A. Lewis [12].

MATERIALS AND METHODS

The historical process of the evolution of economics, sociology and demography has led to their inevitable diffusion process in theoretical, methodological and empirical aspects. The existing interaction made it possible to research demographic processes in a qualitatively changing society and to give them a quantitative perspective assessment.

To construct a deterministic factor model of the socio-economic and demographic development of rural areas of the regions, the theory of the second demographic transition by R. Lesthaeghe [10] and D. Van de Kaa [14] was used, in which they prove that a key feature of the modern demographic situation is a decrease in the birth rate to the limit values that ensure simple reproduction of the population, which is a consequence of changes in the economic and cultural conditions of life. The authors come to the conclusion that it is necessary to shift the emphasis from measuring economic production to measuring the well-being of the population [3].

The socio-economic and demographic development of rural areas is influenced by many different factors, without a deep and comprehensive study of which it is impossible to draw conclusions about trends, identify ways and reserves for improvement, justify plans, forecasts and management decisions, therefore, the basis for creating a model is the use of deterministic factor systems and factor analysis described in the works of G. Harman [7] and H. Hotelling [8]. Deterministic modeling proceeds from the possibility of constructing an identical transformation of the initial formula of an economic indicator according to the theoretically assumed links of the latter with other indicators-indicators.

Changes in economic and social conditions are major determinants of demographic trends. The use of a mathematical apparatus based on deterministic modeling makes it possible to systematize indicators that have a direct impact on social (material conditions and quality of life of the rural population) and demographic (indicators of reproduction of the rural population) processes in dynamics, to assess the weight of the impact of each of them on the level of socio-economic and demographic development of rural areas of the regions.

RESULTS AND DISCUSSIONS

The territory of the Russian Federation, which includes 85 equal subjects (in legal aspect), is formally divided into 8 federal districts according to the geographical principle. The Privolzhskiy Federal District is located in the south-west of the country and includes the regions of the Volga, Ural and Ural regions, a total of 14 subjects. The area of the PFD is 1,036,975 km^2, the share of the rural population in the total number in 2019 was 27.81%, which is higher than the national average (Figure 1).

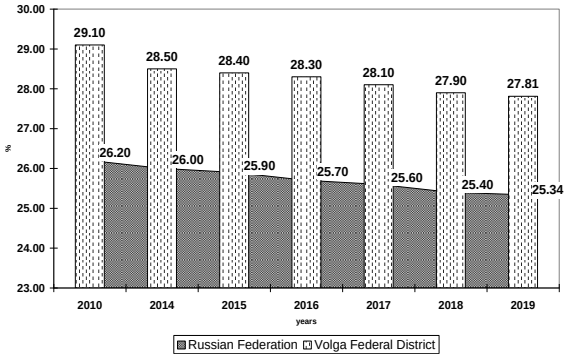

Fig. 1. Share of urban and rural population in the total, %

Source: calculated on the basis of data of [13].

Table 1. The main socio-economic indicators of the Privolzsky Federal District as a percentage of the values in Russia in 2019

Indicator	Value
The area of the land	6.06
Population	19.96
Per capita income	80.20
Consumer spending per capita	82.56
Average monthly salary of 1 employee	72.27
Gross Regional Product	14.67
Fixed capital investments	13.93
Fundamentals of funds in the economy	14.36

Source: calculated on the basis of data of [13].

19.96% of the population of Russia live on the territory of the Privolzsky Federal District, the share of the domestic regional product of the

Volga Federal District in the country's gross domestic product is 14.67%. The main socio-economic indicators of the district are below the national average (Table 1).

To research the level of socio-economic and demographic development of rural areas of the PFD, a deterministic factor model has been developed.

Modeling the socio-economic and demographic development of rural areas consists of several successive stages. The first of them selected indicators that affect the demographic indicators of population reproduction and socio-economic processes from the point of view of material conditions and the life quality of residents of rural settlements. The numerical values of the indicators are taken in dynamics over five years (from 2015 to 2019). Values of socio-economic and demographic indicators of rural settlements of the PFD are presented in Table 2.

Table 2. Average values of indicators of socio-economic and demographic development of rural areas of the PFD for 2015–2019

PFD subject	Indicators									
	availability of secondary education institutions, units for 1000 people	availability of medical institutions, units for 1000 people	disposable resources of households (on average per household member per month), rub.	employment rate of the population aged 15–72, %	number of crimes, units for 1000 people	Housing provision, thousand m2 / 1000 people	emissions of pollutants into the air in the region, thousand tons	population density, people / km2	migration growth of the population, people	natural population growth, people
Republic of Bashkortostan	0.6	1.5	24,085	57.3	4.4	27.6	448.0	352.0	–2.3	–4.068
Mari El Republic	0.7	1.1	17,626	61.6	3.5	23.6	33.6	397.7	–9.7	–671
The Republic of Mordovia	0.8	1.6	19,372	65.5	2.1	28.2	43.2	259.0	–3.6	–3.030
Republic of Tatarstan	0.9	2.0	17,304	67.8	5.9	30.1	32.4	361.6	2.3	–4.976
Udmurt republic	0.8	1.1	26,288	63.3	5.2	23.4	162.0	370.5	–4.8	–501
Chuvash Republic	0.7	1.5	20,397	63.6	2.5	29.9	34.8	431.1	–11.0	–2.970
Permian edge	0,7	1.1	17,082	56.5	8.5	22.0	301.0	313.7	–4.0	– 1.3670
Kirov region	1.1	2.0	20,412	60.9	7.2	27.0	95.2	169.4	–14.2	–2.715
Nizhny Novgorod Region	0.4	1.1	20,639	65.3	7.5	27.1	137.6	258.0	2.6	–6.181
Orenburg region	0.7	1.2	18,738	63.4	3.8	23.4	487.4	302.6	–4.7	–1.261
Penza region	0.4	1.3	20,744	58.7	2.9	30.8	35.0	249.5	–4.6	–3.386
Samara Region	0.5	1.0	24,267	61.8	7.9	27.9	247.4	337.2	7.3	–2.700
Saratov region	0.9	1.4	23,625	57.8	5.5	30.5	117.8	250.0	–7.4	–3.519
Ulyanovsk region	0.7	1.4	19,117	56.4	5.4	24.5	31.8	261.9	–5.9	–2.894

Source: calculated on the basis of data of [13].

Due to the fact that the proposed indicators to varying degrees affect the socio-economic and demographic development, the next stage of the research was to determine the weight coefficients of each of them. The calculation of the weighting coefficients was carried out on the basis of individual expert assessments obtained by interviewing 30 respondents – employees of rural administrations and specialists of enterprises of the agro-industrial complex. The experts were asked to rank the indicators by assigning the most important

factor, in their opinion, the highest rank on a scale from 1 to 10 (Table 3).

Table 3. Distribution of expert assessments and calculation of weight coefficients

Indicators	Significance of the indicator rank										Sum of ranks	Weight coefficient value
	1	2	3	4	5	6	7	8	9	10		
	the number of experts who assigned this rank to the indicator											
availability of secondary education institutions, units for 1000 people	0	1	0	0	3	5	10	6	5	0	210	0.127
availability of medical institutions, units for 1000 people	1	0	0	3	1	5	4	10	3	3	213	0.128
disposable resources of households (on average per household member per month), rub.	0	1	1	0	0	2	3	1	12	10	254	0.153
employment rate of the population aged 15–72,%	3	2	3	3	15	4	0	0	0	0	127	0.077
number of crimes, units for 1000 people	2	2	1	2	2	7	3	6	3	2	185	0.112
housing provision, thousand m2 / 1000 people	5	3	6	8	4	0	2	1	1	0	112	0.068
emissions of pollutants into the air in the region, thousand tons	3	10	9	3	2	0	1		1	1	98	0.059
population density, people / km2	10	5	2	3	2	2	1	0	0	5	117	0.071
migration growth of the population, people	0	1	1	2	1	5	1	4	5	10	232	0.140
natural population growth, people	6	3	6	5	4	2	3	1	0	0	111	0.067

Source: calculated by authors.

The degree of consistency of expert assessments was determined by calculating the Kendall coefficient of concordance. The resulting value of the coefficient of concordance was 0.43, which indicates the average agreement of the opinions of experts. The calculation of the weight coefficients (K_x) based on the obtained expert judgments was made by the formula (1):

$$k_x = \frac{\sum_{i=1}^{n} a_{ix} r_n}{T} \quad \text{..... (1)}$$

where:
a_{ix} is the score of the i–th expert assigned to the x–th indicator;
n is the number of experts;
T is the number of performance indicators.
According to experts, the most important factors in the socio-economic and demographic development of rural areas include such indicators as the size of the available resources of households, the availability of general education and treatment-and-prophylactic institutions, the employment of the rural population and the provision of housing.
Among demographic indicators, experts single out the factor of migration. In order to bring the units of measurement of the selected indicators under one basis, we standardized the factor values (by correlating the actual values with the best ones).
Based on the results of the calculations of the weight coefficients at the third stage of modeling, a deterministic factor model is built with the help of which the current demographic situation in the rural areas of the region is analyzed according to the formula (2):

$$y = \sum_{x=1}^{n} P_x^S \,/\, P_{x\max}^S \times k_x \quad \text{..... (2)}$$

where:
y – level of socio-economic and demographic development of rural areas;
x_j– indicators influencing the socio-economic and demographic development of rural areas to varying degrees;
k_x – weight coefficient;
where:
P^s – standardization of indicator values (by correlating actual values with the best);
n – numbers of indicator.
The last stage of modeling is the interpretation of the integral indicator, depending on the purpose of the study:
– assessment of the current level of socio-

economic and demographic development of rural areas;
– identifying the most successful rural areas in the PFD by the level of socio-economic and demographic development to study their experience.
The results obtained made it possible to compile a rating of rural areas of the PFD by the level of socio-economic and demographic development in the context of subjects and divide them into three groups – stable, unstable and tense (Table 4).

Table 4. Rating of the subjects of the PFD by the level of socio-economic and demographic development of rural areas

Ranking place	PFD subject	Level of socio-economic and demographic development
1	Republic of Tatarstan	0.762
2	Udmurt republic	0.711
3	Republic of Bashkortostan	0.692
4	Chuvash Republic	0.677
5	Samara Region	0.675
6	Nizhny Novgorod Region	0.656
7	Penza region	0.650
8	The Republic of Mordovia	0.638
9	Kirov region	0.637
10	Orenburg region	0.631
11	Mari El Republic	0.629
12	Ulyanovsk region	0.605
13	Perm region	0.597
14	Saratov region	0.590

Source: calculated by authors.

The group of stable settlements included 2 regions, the index of which was higher than 0.7, and the group of tense settlements included the last 2 subjects, the index of which was below 0.6. The remaining 10 subjects are located in the group of unstable rural areas.
The Perm Region and the Saratov Region are distinguished by high rates of unemployment and population migration and are centers of socio-economic and demographic disadvantage in the PFD (Fig. 2).

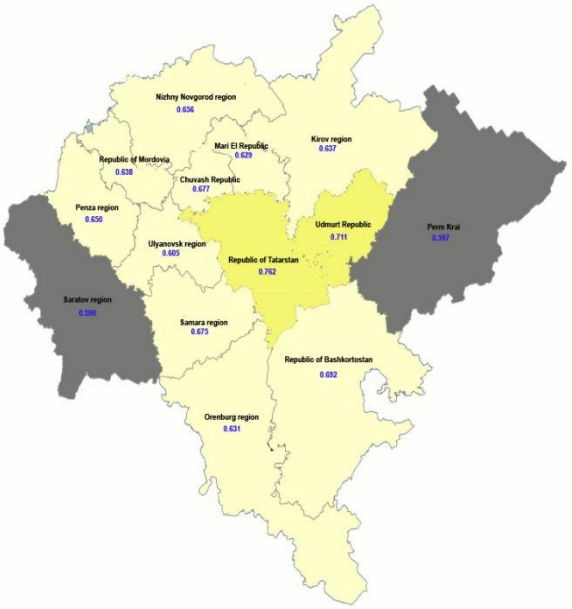

Fig. 2. Distribution of rural settlements of the PFD by region by level of socio-economic and demographic development
Source: made by authors.

Recommendations for stabilizing the level of socio-economic and demographic development of rural areas and improving the quality of life of the population are proposed on the example of the Saratov region, as the region that has the worst indicator in the ranking (14th place). For this, the base of vacancies at agricultural enterprises in the region was investigated, and the reserve for increasing employment of the rural population was calculated. Also, according to the Strategy for Socio-Economic Development of the Saratov Region until 2030, next year the incomes of the population in the region will grow by 3.5%, which will have a positive effect on the level of well-being of households.
According to the results of the model modification, the Saratov region, taking into account the identified reserves, will be transferred to the group of unstable regions. And with an integral indicator value of 0.608 it will take 12th place among the subjects of the PFD. Thus, the calculations confirm the possibility of increasing the level of socio-demographic development by an average of 3%.

CONCLUSIONS

The research developed a deterministic factor model describing the relationship between the level of socio-economic and demographic development of rural areas and its indicators. By calculating weight coefficients based on expert assessments, a rating of 14 subjects of the PFD of the Russian Federation was compiled with their subsequent distribution into three groups – stable (the Republic of Tatarstan and Udmurtia) with an integral indicator value above 0.7, unstable (10 regions) with an indicator 0.6– 0.7 and tense (Perm Territory and Saratov Region), where the indicator is less than 0.6. The group of tense regions is represented by centers of socio-demographic disadvantage, where high rates of unemployment and population migration are observed.

The developed rating will help the leadership of the specialized departments of Russia to make competent management decisions – to redistribute state support funds, to adopt regional programs for the development of rural areas, to influence the migration flows of the rural population. Knowing the weight of the influence of each factor on the quality of life of the villagers, take quick targeted support measures.

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THE ECONOMIC EFFICIENCY OF SUNFLOWER SEED PRODUCTION IN UKRAINE: STATE AND PERSPECTIVES

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Abstract

This paper aims to provide analysis of current state and perspectives of the economic efficiency of sunflower seed production in Ukraine. There are investigated economic efficiency indicators of sunflower production in contemporary conditions; price analysis; main factors of further development of sunflower growing. According to the research results, the world market of sunflower seed and products of its processing (i.e. oil and meal) is developing rapidly. Ukraine occupies a significant place in this market segment. Our research has shown the close integration of the Ukrainian sunflower, oil and meal markets with world markets. The supply of sunflower seed depends primarily on production volumes and demand is determined by the consumption level of Ukrainian processing enterprises. Production cost influence significantly on the economic efficiency of sunflower seed. In this framework we analyzed one of production cost component - crude oil prices that in turn reflect on sunflower seed prices. Co-integration results showed that in the long-run Ukrainian sunflower seed could follow crude oil prices in common path.

Key words**:** *economic efficiency, profitability, sunflower seed, oil, production, cost*

INTRODUCTION

Sunflower production is an important and profitable area of the crop industry in Ukraine. Sunflower seed contains 48-50% fat, 16-19% protein and the yield of oil for industrial processing reaches about 50%. Sunflower oil is widely used in the food production (margarine, canned food, bread, confectionery) and in soap, paint and other industries. During the processing, the companies in addition to vegetable oil, get cake or meal that is valuable feed in animal husbandry.

Nowadays sunflower is remained a priority raw material for oil processing enterprises, which are actively increasing their capacities. Due to state regulation of the sunflower market in Ukraine, where in 1999 was introduced export duty for sunflower seed in the volume of 23% from the customs value according to the Law of Ukraine "On export rates (export) duties on seeds of certain types of oilseeds cultures" (from 10.09.1999, No. 1033-XI), sunflower seed is entirely aimed for processing domestically. After joining to the World Trade Organisation (WTO) in 2008, Ukraine is remained export duty for sunflower seed, however from the beginning of 1 January 2007 it was yearly decreased on 1% to reach 10% [11].

In such circumstances, we can observe a stable demand for sunflower seed from processing plants. Thereby, special attention in the article will be paid to the questions on how this market situation affects the sunflower seed profitability; and whether agricultural enterprises have taken advantages of the future economic opportunities to improve their economic efficiency indicators.

The economic efficiency of sunflower seed production and its processing depends on a complex set of natural, economic, technological, scientific, technical and other factors. Specialized literature indicates that the transition of production to the cultivation of high-yielding hybrids and sowing dates optimization allow significantly improve the production profitability, and at the same time reduce the cost of seeds and increase profit [9, 12].

The issue of economic efficiency of sunflower production is the subject of research by many Ukrainian and foreign authors. The research findings of Gerasymchuk and Mirzoeva (2017) revealed that in last years in Ukraine the increase the economic efficiency of sunflower seed production was attained due to the production intensification [5]. According to Chekhova (2018), evaluation of economic indexes (profitability, cost, competitive position) and production components (seed quality, efficient technologies, technological modernization, production diversification) will be allowed to implement existing ones and search for new reserves to increase economic efficiency of oilseeds production [2]. Among factor competitiveness of oilseeds at the industry level are offered: formation of state regional and sectoral medium-term seed production programs of oilseeds; the introduction of innovative energy saving technologies; modern high-yielding varieties and hybrids of plants; ensuring the availability of agricultural lending enterprises.

Galushko et al. (2017) focused on researching issues about break-even price of sunflower seed depending on yield, cost of crop growing and the projected market situation. Due to proposed methodological approaches the market of crop products could be monitored and developed strategies to support agricultural producers, taking into account tax policy, internal and external conditions in food markets [4].

Rotaru and Nastase (2014) suggested that technological processes are interrelated with natural biological processes [16]. In contemporary conditions the effectiveness of intensive technology involves taking into account technical, economic, energy and environmental criteria.

In the research of many scientists (Ilkiv, (2019), Makarchuk and Kuts (2020)) highlights the tendencies of growing the interconnection of the Ukrainian and world markets of sunflower oil [8, 10].

Mykhailov et al. (2020) analyzed sunflower seed production in Ukraine and details the technical equipment of post-harvest processing of sunflower seed; theoretical studies of the separation of airborne impurities; methodological aspects of research of experimental devices; results of laboratory and field studies of experimental devices and practical application of their efficiency and evaluation [12].

Popescu (2020) indicated that to enhance performance in oilseed sector, Romanian farmers have to adapt to the climate change taking into account some technological aspects: to use high earlier and production potential varieties and hybrids and resistant to drought, diseases and pests; to choose better sowing period depending on the soil moisture and temperature, to assure an optimum level of fertilization, crop maintenance and harvesting [15].

Therefore, improving the efficiency of Ukraine's economic activity in the field of oilseed production and oil products ensuring its competitiveness in the internal and external markets in the context of integration processes is also extremely important. The economic efficiency of sunflower seed was taken into consideration in the paper because it is actual subject in the point of view close relationship this market to the sunflower oil market where Ukraine positioning itself as leadership in sourcing to the world market.

The paper is organized as follows: Section 2 discusses the materials and methods of empirical investigation; Section 3 reports getting results and discussions; and Section 4 ends with conclusions of getting results.

MATERIALS AND METHODS

The purpose of the paper is to study the economic efficiency of sunflower seed production in Ukraine and determine main factors influencing the profitability of sunflower production; identification main trends in production, consumption and processing of sunflower seed.

Based on data of the State Statistics Service of Ukraine (2021), sunflower seed profitability decreased during last 5 years and in 2019 it was equaled to 23.5%, where in 2015 it was amounted to 80.5%. In these regards, we will consider which factors could negatively influence on economic efficiency of sunflower seed production.

The theoretical and methodological basis of the research were the basics of market economy, scientific works of Ukrainian and foreign scientists, methodology and system-wide principles of complex research.

One group of methods cover research that related to market analysis of sunflower seed: historical; abstract-logical; theoretical generalization; observation, graphical and tabular.

Assessment in the analyzed period covered the values of yield, cost of 1 quintal of product, selling price, level of income and profitability describing the efficiency of sunflower production in Ukraine.

Another group of methods related to the assessment the relationship between Ukrainian (UA) sunflower seed and crude oil prices. This dependence was taken into account in the frame of efficiency analysis of sunflower seed production in Ukraine to see how influence changes in crude oil prices on sunflower seed prices, taking into account that 12% in 2019 was equaled to fuel in the total production cost of sunflower seed. According to that the paper consists of an analysis of the price linkages between the UA sunflower seed and crude oil prices. The sources of data were the APK-inform (2021) and OPEC (2021) [1, 13].

Produced sunflower seed deliver mostly for processing domestically for sunflower oil, where as noted above, sunflower oil exports in the high level. To analyze UA sunflower seed prices with crude oil prices monthly price series data was used from January 2009 till January 2021 (Fig. 1).

As we can see in Fig. 1 the prices show how UA sunflower seed prices follow closely to crude oil prices. However, in some period of time could be observed the linkages between these prices, and another period of time we see not stable paths, and in some period of time UA sunflower seed prices were not followed crude oil prices.

From the figure we could also observe sharp decrease in crude oil prices, where contrary increase in UA sunflower oil prices, e.g. 2020. All variables were expressed in US dollar.

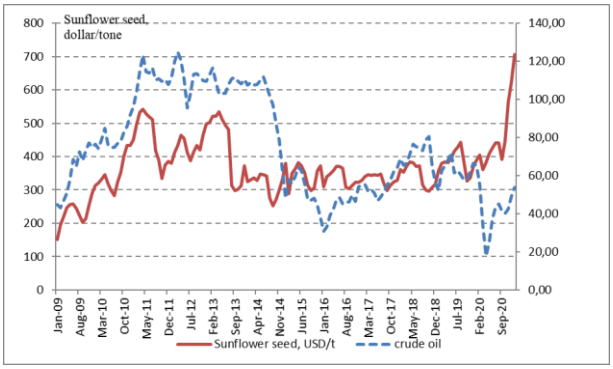

Fig. 1. Monthly UA sunflower seed price series and crude oil price series

Source: Built based on APK-inform and OPEC databases [1, 13].

The first stage of price series analysis was concerned to the statistical properties of price series. Augmented Dickey Fuller (ADF) test was applied (model with constant) to test series stationarity, where the null hypothesis states that time series is non-stationary (has unit root); the alternative is that stationary. This test statistic is based on tau-statistic of coefficient φ from OLS estimation of the following formula (Enders, 2001) [3]:

$$\Delta y_t = \alpha_t + \varphi y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

where:

y_t – analyzed price series;

α_t – deterministic term (constant, trend);

p – the number of lags ensuring white noise properties of random component;

ε_t, δ_i – coefficients that describe the short-run persistence of Δy_t.

Further the ADF-GLS test was applied. In a first step, price series y_t is detrended and demeaned via a generalized method of least squares. In the second, the residuals of the equation ($\tilde{y}t$) are used for testing the unit root by using the ADF equation:

$$\Delta \tilde{y}_t = p\, \tilde{y}_{t-1} + \sum_{i=1}^{p} \delta_i \Delta \tilde{y}_{t-p} + \varepsilon_t \quad (2)$$

where:

ρ and δ are model coefficients,

p - maximum augmentation lag.

The value of the ρ coefficient in the formula (2) significantly different from the null one makes it possible to reject the null unit root

hypothesis (Hamulczuk M. et al., 2013; Hamulczuk M. et al., 2019) [6, 7].

The structural parameters of the model were estimated using the OLS. The purpose of the lagged components is to remove the autocorrelation of the random parameter. The number of lags was chosen with the use of Akaike's Information Criterion (AIC).

Next step we checked price series for cointegration. It takes possibility to identify the long-run relationship between researched price series. To test the existence of long-term relationship of series the Engle-Granger cointegration test was applied that is based on the following regression (Enders, 2001):

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t \quad (3)$$

where:

x_t, y_t – variables tested for cointegration;

β_0, β_1 – structural parameters;

ε_t – residuals.

There is it could be stated about the cointegration between variables x_t and y_t if the residuals ε_t are stationary.

For a detailed systematization of the strengths and weaknesses of the UA sunflower seed market functioning and to generalize the opportunities and threats that affect it from the external environment, in the paper the SWOT analysis was used. The application of the SWOT analysis allowed substantiating the conclusions about perspectives of UA sunflower seed market, oil and cake at the national and international level.

RESULTS AND DISCUSSIONS

Market analysis of Ukrainian sunflower seed market. According to the results of our research and based on the balance of market demand and supply of sunflower seed, it should be noted that the Ukrainian market has been growing its capacity quite rapidly over the past 20 years (Fig. 2).

At the same time, the levels of supply and demand were mostly balanced. The supply of sunflower seed depends primarily on production volumes and demand is determined by the level of consumption by Ukrainian processing enterprises.

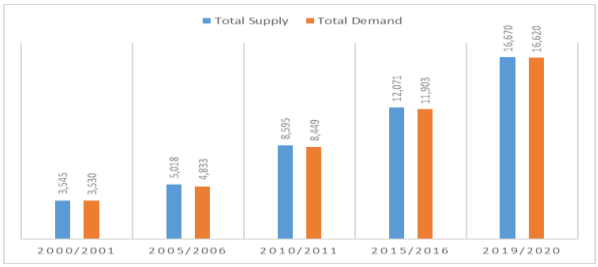

Fig. 2. Dynamics of supply and demand in the sunflower market in Ukraine, thousand MT

Source: Own calculation based on USDA-FAS (2021) [18].

In 2019, the harvest of sunflower was 16.5 MT, which was completely processed by oil and fat companies into oil. Thus, the share of production in total supply was about 99%, as well, as the share of domestic consumption in total demand. The dynamics of gross harvest growth occurs as a result of increasing sown areas and increasing yields. According to the results of the 2019/20 MY, the UA industry produced 7 million t of sunflower oil, where 6.4 million tons were exported (90%). Ukraine became the world leader in the production and export of sunflower oil during the analyzed period.

Export volume of sunflower oil from Ukraine to the EU has a growing tendency during the analyzed period. In 2019 it amounted near 1918 thousand t and the share of UA export of sunflower oil to the EU in total world export was equaled to 15.5% (Fig. 3).

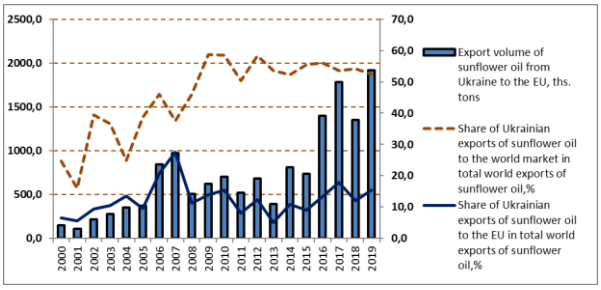

Fig. 3. Dynamics of the export volume of sunflower oil from UA to the EU and the share of it in the world export

Source: Own elaboration based on APK-Inform (2021) [1].

In 2019 EU countries became the largest importer of UA sunflower oil, where 31% of total exports were originated Ukraine. Big importers of sunflower oil from UA were also India (35%), China (14%), Iraq (7%) and other countries (13%) [17].

Thus, observing the tendency of sunflower oil production and export growing in the last decades, it is crucial important to analyze sunflower seed as the raw materials and the main part of sunflower oil cost structure (about 70%).

Our research shows that in Ukraine all categories of agricultural enterprises were engaged in sunflower production and they were increasing the level of sunflower yield each year: from 12.2 centners per ha in 2000 to 25.6 centners per ha in 2019 (Fig. 4).

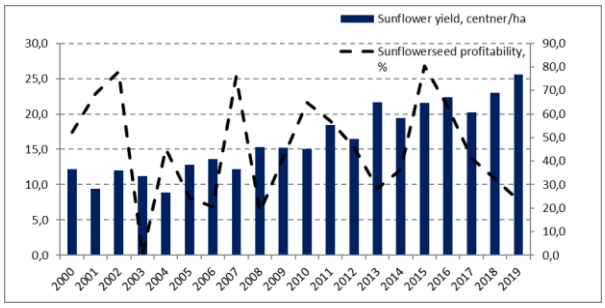

Fig. 4. Dynamics of sunflower yield and its profitability in Ukraine

Source: Own calculation based on the State Statistics Service of Ukraine (2020) [17].

According to the grouping of the enterprises by size of the sunflower harvested area in 2019, the largest share in the total production of sunflower were occupied by enterprises of third group (21.6%), fourth group (21.9%), fifth group (21.6%) (Table 1).

Table 1. Grouping Ukrainian enterprises by the size of sunflower area in 2019

Number of groups	Grouping enterprises by the area, ha	Number of enterprises		Volume of production		Yield, centner per ha
		units	in percentage to the total	thsd. tons	in % to total volume	
	Total	22,251	100.0	13,088.6	100.0	27.0
1	up to 100.00	13,602	61.1	1,051.2	8.0	21.8
2	100.01-200.00	2,821	12.7	1,090.2	8.3	26.4
3	200.01-500.00	3,313	14.9	2,830.2	21.6	26.8
4	500.01-1,000.00	1,510	6.8	2,865.6	21.9	27.1
5	1,000.01-2,000.00	736	3.3	2,819.5	21.6	27.9
6	2,000.01-3,000.00	175	0.8	1,178.5	9.0	27.9
7	more than 3,000.00	94	0.4	1,253.4	9.6	30.1

Source: Own calculation based on the State Statistics Service of Ukraine (2021) [17].

Indeed agricultural enterprises with a larger area of sunflower cultivation have higher yield, e.g. enterprises of group No. 1 (with a growing area up to 100 ha) received 21.8 centner per ha, group No. 4 (500 - 1,000 ha) - 27.1 centner per ha, group No. 7 (more than 3,000 ha) - 30.1 centner per ha.

The distribution of agricultural enterprises by size of sown areas is proved by technological and economic advantages of enterprises with a higher degree of concentration of the industry.

Sunflower is competitive oil crop. Its cultivation provides the agricultural enterprises with annual financial income and a fairly high level of profitability over the past 20 years in Ukraine.

This indicator was higher compared to grain, but its dynamic was not stable, the sharp decreases could be observed in 2005-2006, 2008, 2013 and 2019 [17].

Profitability indices depends on the level of market prices and the level of cost. We analyze the indices of economic efficiency during 2015-2019, when came conclusions about negative trend of profitability (Table 2).

Table 2. The economic efficiency of sunflower seed production in Ukraine

Indices	2015	2016	2017	2018	2019	2019 to 2015, %
Yield, centner per ha	21.6	22.4	20.2	23.0	25.6	118.50
Total cost of sunflower, UAH/t	3,621	4,483	6,266	6,795	6,542	180.67
Sales costs, UAH/t	402	515	720	816	816	202.9
Average selling price, UAH/t	6,535.9	7,307.3	8,854	9,003	8,079	123.61
Income, UAH/t	2,914.9	2,824.3	2,588	2,208	1,537	52.73
Profitability, %	80.5	63.0	41.3	32.5	23.5	X

Source: Own calculation based on the State Statistics Service of Ukraine (2021) [17].

The decline in the profitability of sunflower production was mainly due to some cost components increase.

During 2015-2019, average selling price for sunflower seed enlarged by only 20%, while the total cost of production was grew by 80%. Sales costs have doubled and its share in the cost was 12.5 %.

This situation led to significant losses of agricultural enterprises income.

In 2019 the cost structure contained the following components: direct costs – 54.6%, labor cost – 5.6% and other direct costs – 39.8%. In the structure of direct costs, a significant share was occupied by: inorganic fertilizers – 16.7%; seeds – 11.9% and oil products – 11.6% (Table 3).

Table 3. Cost structure of sunflower production in Ukrainian enterprises

Types of costs	2015	2017	2019
Total costs	100	100	100
Direct costs including:	70.8	56.7	54.6
- seeds	15.1	14.1	11.9
- mineral fertilizers	15.9	16.0	16.7
- oil products	12.9	10.5	11.6
- other direct costs	26.9	16.1	14.4
Labor costs	4.3	4.9	5.6
Other direct costs including:	24.9	38.4	39.8
- deductions on the social purposes	1.5	1.1	1.2
- depreciation of fixed assets	4.74	6.2	7.5
- payment of services and job of other organizations	-	8.1	8.1
- other direct and indirect costs	18.6	23.0	23.0

Source: Own calculation based on the State Statistics Service of Ukraine (2021) [17].

The main factors that restrained the increase in sunflower yield and the outpacing costs growth to sales prices are the low level of logistics and non-compliance with cultivation technology.

Price analysis. To analyze price series of Ukrainian sunflower seed and world crude oil, they were transformed into logarithmic data. First of all, stationarity of price series was tested using two tests: ADF and ADF-GLS. Results of these tests are presented in the table 4.

Table 4. ADF and ADF-GLS test results

Variable	ADF			ADF-GLS		
	tau	p-value	lag	tau	p-value	lag
l_UA_sun-flowerseed	-2.892	0.046	1	0.205	0.746	0
dl_UA_sun-flowerseed	-9.885	7.01E-01	0	-3.549	0.0003	0
l_crude_oil	-1.690	0.436	3	-1.108	0.244	4
dl_crude_oil	-8.356	4.39E-01	2	-8.209	1.32E-01	0

Source: authors' calculation.

Getting results from ADF and ADF-GLS tests showed that log levels are not stationary, because value tau for all variables are lower than critical value tau=3.398. Thus, we accept the null hypothesis about non-stationary of price series. In turn, first differences are stationary because the test statistics (tau) of the model for first differences of price series with a constant had following values: dl_UA_sunfloweseed – -3.549; dl_crude_oil – -8.209. Obtained values are bigger than the critical value tau=3.398 and it means that the null hypothesis was rejected for the first differences of price series. Thus, investigated price series are integrated in order one I(1).

At the next step we evaluated the nature of the linkage between Ukrainian sunflower seed prices and world crude oil prices due to the Engle-Granger co-integration test (Table 5).

Table 5. Engle-Granger co-integration test results

Specification	Cointegration equation UA-EU: $l\_UA\ Sunflower\ seed_t=5.88+0.1*l\_crude\ oil_t+\varepsilon_t$
Estimated φ	-0.0989
Tau-value	-1.7007
P-value	0.6779

Source: authors' calculation.

Obtained results for the model with constant ($l\_UA\_Sunflower\ seed_t = 5.88+ 0.1*l\_crude\_oil_t +\varepsilon_t$) confirms about existence of co-integration. In the obtained model P-value is higher than critical ones (0.05 or 0.01), thus it allows us to accept alternative hypothesis about co-integration of prices.

In the long-run it means that there is could be significant force for prices in common path.

Perspectives for Ukrainian sunflower seed production. Analyzing the economic efficiency of sunflower seed production in Ukraine, it is crucial important to find further trends taking into account internal and external factors.

Thus, we evaluated sunflower seed market based on SWOT analysis that in turn could facilitate to find significant advantages and opportunities for this sector.

Ukraine has enough land and economic resources to increase the supply of sunflower seed and meet the needs of the processing

industry. The competitive advantages of agricultural enterprises should also include a favorable geographical position for sunflower seed production (Table 6).

At the same time as was mentioned above, sunflower seed market in UA is regulated by the state. UA sunflower seed market is interdependent with UA sunflower oil and sunflower cake markets.

Table 6. SWOT analysis of Ukrainian sunflower seed market

Strength	**Weaknesses**
- availability of land and labor resources; - high technology processes that is used for production; - yield increase; - significant demand for seeds from processing companies in the domestic market; - favorable geographical position for production of seed; - protection of the domestic market through customs tariffs on sunflower seed.	- not sufficiency of working assets in producers; - low sunflower prices as a result of high supply; - high degree of competition between producers.
Opportunities	**Threats**
- production growth; - costs decrease due to implication of new technologies; - high competitiveness of the products; - demand for sunflower seed, oil and cake on external markets; - favorable geographical position for export deliveries of sunflower oil and cake; - prices increase.	- price and demand volatilities on the global market; - change in economic indicators of the macroenvironment; - weather conditions; - observance of crop rotations.

Source: Own conception.

Therefore, the active demand as in UA and worldwide for sunflower oil and cake will further determine its stability.

CONCLUSIONS

In next years, sunflower oil production industry will continue to influence sunflower seed prices, since about 95% of sunflower processed internally. Oil processing capacity is almost 5 million tons that is higher than real production, and farmers have no problems for selling sunflower seed.

The expected variation in sunflower sales prices will be influenced by the average sunflower oil export price and the average annual US dollar exchange rate on the market. Important to note that on sales prices could affect changes of cost structure component. In the paper the correlation between UA sunflower seed prices and crude oil prices was presented. As approximately 12% belongs to crude oil in total cost structure by sunflower producing, it was important to analyze whether changes in crude oil prices influence on UA sunflower seed prices. Results indicated high linkages between UA sunflower seed and world crude oil prices. The Engle-Granger co-integration test confirmed the long-run equilibrium relationship between these prices, where the model is $l\_UA\_{Sunflower\ seed t}=5.88+0.1*l\_crude\ oil_t+\varepsilon_t$.

Further research should include the development of possible scenarios for the development of the sunflower market and the impact of COVID-19 on pricing in the market for both seeds and sunflower oil. The market conditions and price dynamics will further determine the trends in the efficiency of sunflower production.

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STUDY ON THE LEVEL OF ENGLISH LANGUAGE SKILLS IN THE AGRICULTURAL SECTOR. CASE STUDY

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Abstract

The objective of this study is to find out the level of English language skills and knowledge of the persons who work in the agricultural sector. The young graduates graduate a faculty knowing very well a foreign language. The effort to learn foreign languages must be made daily, especially for the persons in the agricultural sector who get in touch with foreigners and develop international business affairs. A foreign language is the key for communication. The study was carried out based on a questionnaire on 50 respondents with the occupation in the rural area. The questions were clear, easy to understand and the answers to the questionnaire provide information about the English language skills of the persons who work in the agricultural sector and the modalities to improve their language skills in the future. The respondents were from 5 communes in Calarasi County. From this study, we draw the conclusion that English language is important for the persons in the agricultural sector, those who have farms, associations in the agricultural area, as they can extend their business, they can form partnerships with foreigners and gains new experience from them

Key words*: business sector, foreign language skills*

INTRODUCTION

A language is the key to communication, without communication I do not know how we could live. Knowledge of a foreign language is important.

A foreign language is important because if we arrive in a foreign country and we know the language of origin, we can understand the inhabitants of the country well, we can read films that are not yet in Romanian, although we are not outside the mother tongue, we can speak in a foreign language with a friend. Another reason why a language is important is that we can speak a foreign language without other people understanding us, a foreign language adds more to our experience, or brings new experiences or we can meet other people who know a certain language. language and to connect friends with them, for example, in an intensive language classroom.

English is not a difficult language, which is why many people learn it very easily.

English is a global language, the language of media industry, the language of Internet, the language of international business, a language which opens a door to multiple cultures [9].

Agricultural universities include English Language and other foreign languages in the syllabus of their faculties to prepare the students to encounter global communication challenges.

After the completion of graduation and post-graduation studies, having a high proficiency in English or any other foreign language, the graduates are ready to serve in various local and multinational organizations and companies. Many company managers are willing to employ people having abilities and skills in speaking and writing in English to be more effective in developing international collaborations. Therefore, teaching and learning English in the agricultural universities enhance the chance of the graduates for getting a better paid job [1].

In order to develop skills and abilities in English language, both qualitative and quantitative methods have to applied by the teaching staff in order to increase proficiency in using this international language [8].

In the increasingly integrated global business community, the ability to communicate in foreign languages is becoming more and more important.

Business relationships between partners and with clients founded on a direct communication in their native language are stronger and longer lasting.

"Learning to communicate fluently in multiple languages provides additional job security and advancement opportunities in uncertain economic times" [3].

In this context, the purpose of the paper was to study English language skills in agricultural sector, making a field survey among the managers and employees of various agricultural holdings in Calarasi County, Romania.

MATERIALS AND METHODS

The questionnaire is an efficient method, often used to collect data that require even more precision and consult multiple sources in order to formulate the answer.

The questions included in the questionnaire aim to obtain data necessary to know the situation existing in the analyzed area.

A questionnaire can be developed either for a larger area (a unit function, a subsystem) or for a problem with a smaller area (an activity, a special problem, a solution, etc.). The questionnaire was applied in 5 municipalities in Calarasi county, more exactly in the following communes: Cuza Voda commune, Dichiseni commune, Gradistea commune, Modelu commune and Roseti commune.

For this purpose, in this research it was used a sample of 50 respondents with occupation in the rural area, in the period May 2018.

The questionnaire was applied face to face. It is not standardized it contains 14 questions. The questionnaire is clear, easy to understand and does not influence the answer.

RESULTS AND DISCUSSIONS

The study was elaborated using the answers of the respondents questioned in the 5 communes in Calarasi county.

The communes are the following: Cuza Voda commune, Dichiseni commune, Gradistea commune, Modelu commune and Roseti commune.

The commune of Cuza Voda, is located in the southeast of the Romanian Plain, in the southern part of Călăraşi county, in the contact area of the Southern Bărăgan with the Călăraşi Terrace. East-west oriented, The commune of Cuza Voda has a total area of 14,050 hectares, of which 655 ha are lands for glazes. The inhabitants of the commune deal more with agriculture and animal husbandry, cultivating their lands with wheat, corn, barley, oats and sunflower, but also with the cultivation of vegetables from which we mention: carrot, parsley, dill, red fleas, pepper, onion , etc. Through the courts have planted fruit trees such as: apple, hair, clam, plum, cherry, etc. [2].

Dichiseni commune Dichiseni commune is located in the south-eastern part of Călărași county, on the left bank of the Danube, on the border with Constanța county. It is crossed by the Borcea arm, the arm on which the component localities are located. Through the commune passes the national road DN3B, which connects Calarasi with Fetești. has been certified documentary since 1896 [7].

Grădiștea Commune The commune is located in the central-south part of the county, to the west of the city of Calarasi, on the north bank of the Danube. It is crossed by the national road DN31 that makes the connection between Calarasi and Oltenița, and which ends, east of the village of Grădiștea, in DN3, which connects Calarasi with Bucharest. In the commune is located Lake Gălățui. The total area occupied by the commune is 7,480 hectares, of which the village hearth and the surface occupied by water represent 965 hectares. In the territory of Grădiștea commune, agriculture has the best natural conditions to develop [4].

Modelu commune has an area of 14,407.68 hectares and is composed of three villages: Modelu, Tonea and Radu Negru [5].

Roseţi commune is located in the southern part of Călăraşi county on the left bank of the Borcea arm, between Coslogeni villages to the east, Dragalina and Perişoru to the north,

Stefan Voda and Modelu to the west and Constanţa county to the south [6].

Table 1. Presentation of the agricultural companies from which the respondents were selected

Crt. No.	Name of the firm	Legal status	Locality
1	Ranch Bucur SRL	Limited Liability Company (LLC)	Modelu
2	Dumtru Impex	LLC	Modelu
3	Agramiv	LLC	Modelu
4	Agromodel	Joint Stock Company (JSC)	Modelu
5	Agromtind	JSC	Modelu
6	Ilisei Rodica	Family Association (FA)	Modelu
7	Negrila Ionel	Authorized person	Modelu
8	Dorna Agri	LLC	Roseți
9	Algap	LLC	Roseți
10	Mustatea Nicu Petronel	Individual enterprise (IE)	Roseți
11	Mesca Marian	Authorized person	Roseți
12	Constantinescu Liviu	FA	Roseți
13	Tudor 92	LLC	Dichiseni
14	Radu Germina	Authorized person	Dichiseni
15	Agroprest Mailat	LLC	Grădiștea
16	Mig Agro	LLC	Grădiștea
17	Leca T Marian	IE	Grădiștea
18	Agromec Tractorul	LLC	Cuza Vodă
19	Agromixt	JSC	Cuza Vodă
20	Vlasceanu Victor	IE	Cuza Vodă

Source: Field Survey, 2018.

The study was conducted on a sample of 50 respondents with the occupation established in the rural area, in May of 2018. As a research method, the quantitative study was carried out through a questionnaire applied face to face by the researcher.

The questionnaire is non-standardized and contains 14 questions that correspond to the purpose and objectives proposed. The questions are clear, easy to understand for any questioned person and do not influence the answer.

The questionnaire has in its composition: direct questions, some having control role; multiple choice closed questions and open questions that give the interviewee the opportunity to express their own opinion freely.

The first part of the questionnaire contains questions relating to sex, age, education, occupation and the category of agricultural holding of which they belong.

In the second part of the questionnaire are positioned questions to obtain information about the knowledge of English, the level at which they are located, ways to deepen the knowledge and skills they would like to develop within the English language.

Regarding the structure of respondents, on gender, 56% of the respondents were men and 44% were women. Regarding the structure of respondents, on studies, 4% had primary and secondary school, 54% high school and 42% higher education.

Regarding the structure of respondents by age groups, 4% were between 18-25 years old, 20% were between 26-35 years old, 54% were 36-50 years old, and 22% were over 50 years old.

The predominant age group of the subjects is 36-50 years old, being 54 percent, followed by the group of those over 50 years old with a percentage of 22%, then the group of 26-35 years old with a percentage of 20% and last group 18-25 years with a value of 4 percent (Table 2).

Table 2. Respondents' age structure

Age Group (years)	%
18-25	4
26-35	20
36-50	54
Over 50	22

Source: Field Survey, 2018

The respondents have various occupations and their structure based on this criterion is presented in Table 3.

Most of respondents are engineers (30%), farmers (14%), economists (12%), technicians (5%), accountants (5%) and workers (5%).

Table 3. Structure of respondents according to occupation

Crt. No.	Occupation	No. of answers	Percent
1.	Manager	3	6
2.	Engineer	15	30
3.	Economist	6	12
4.	Technician	5	10
5.	Accountant	5	10
6.	Worker	5	10
7.	Farmer	7	14
8.	Clerk	2	4
9.	Others	2	4

Source: Field Survey, 2018.

Regarding the type of agricultural exploitation, of the total number of respondents, 42% are part of the agricultural holding limited liability company, 20% of the joint stock company, the category of agricultural enterprise individual company and the family association is equal to a percentage of 14% and the last category is a authorized natural person with 10 % (Table 4).

Table 4. Respondents distribution by type of agricultural holding

Crt. No.	Farm	No. of answers	Percent
1.	Individual enterprise	7	14
2.	Authorized person	5	10
3.	Family association	7	14
4.	Limited liability company	21	42
5.	Joint stock company	10	20

Source: Field Survey, 2018.

At the question „Do you know English language**?" 86% respondents said Yes, and 14% said No.**

Regarding the level of learning at which the interviewees are positioned, 34% of them are at the advanced level, also at 34 percent are located and those who are at the beginner level and at the intermediate level have a value of 32 percent.

As to why the respondents learned English, 36% of them stated for the current job, 32% for communicating with business partners in the European Union, 20% for personal development, 10% stated for a work abroad and 2% other special situations.

To the question "Were there situations when you felt you needed English?", 96% answered yes and 4% answered yes to this question. As you can see on the graph, the difference is a very significant one and fortunately in a positive sense with respect to the need to know English.

Table 5. Importance of a foreign language, especially English

Crt. No.	Answer	No. of answers	Percent
1.	Yes, because it is an international language	11	22
2.	Yes, because it is the official language of the European Union	8	16
3.	Yes, because it is an usual language	7	14
4.	Yes, because it is needed for the interaction with the foreign partners	10	20
5.	Yes, for a better paid job	2	4
6.	Yes, it is needed for vocabulary development	4	8
7.	Yes, for the personal and professional life development	2	4
8.	Yes, it is essential for communication when travelling abroad	6	12

Source: Field Survey, 2018.

Therefore 22% agreed that it is important to know a foreign language, especially English because it is a language of international circulation, 20% say it is important because it is necessary in the interaction with foreign partners, 16% say it is an official language in the Union European, 14% say it is important because it is a common language, 12% think it is essential to communicate when travelling abroad, 8% say it is necessary for vocabulary development, and the last two positions are occupied by an equal number. 4 percent claims that it is important for a better paid job and for the development of personal and professional life

To the idea of participating in English language learning programs, subjects answered yes in a very large number with a percentage of 80%, and 20% of them do not

agree with these programs.
When asked "What types of materials would you like to study in English?" 46 percent said they would use written materials, 34 percent would do much more easily through interactive exercises, 30 percent would study them thoroughly on the basis of video, and 26 percent would learn using audio materials.
Regarding the context considered by the subjects that they would learn English language skills, 44% stated that they agree with the in-depth studies at the faculty, 28% are interested in language skills training courses under the guidance of a teacher, 18% stated that they would accept online courses and 10% agree with the studies learned in school.

Table 6. What skills do you want to develop in English language?

Crt. No.	Answer	No. of answers	Percent
1.	Oral expression	20	40
2.	Grammar	8	16
3.	Written expression	19	38
4.	General vocabulary	14	28
5.	Understanding oral messages	14	28
6.	Understanding written messages	10	20

Source: Field Survey, 2018.

Regarding the skills that the respondents want to develop in English, 40 percent would learn to speak orally, 38 percent would write in writing, 28 percent would be topics for understanding oral messages and deepening Of the general vocabulary, 20 percent would gain understanding of written messages and 16 percent would assimilate English grammar

CONCLUSIONS

At present, communication in English has become indispensable in all areas of social life. The accelerated rise of specific technologies has led to major changes in the knowledge of English language content and communication channels both inside and outside organizations.
Following the study, there were emphasized the advantages and disadvantages in learning English.

Advantages:
- We can study or even get a job abroad
- To communicate with friends from other countries.
- To handle our travels.
- To have access to information in the target language without calling for translation.
- To advance in your career.
- To develop our cultural life.
- We can cooperate in business with any nationality of people.

Disadvantages:
- Old age can be an obstacle.
- Insecurity about one's own learning powers.
- Poor knowledge of mother tongue.
- Installing a false sense of knowledge.
- Lack of constant and profound practice.

The case study carried out was based on the application and interpretation of the questionnaire, among the questioned persons, the male gender had a higher weight, having average education and they were between 36 and 50 years old.
The occupation that holds the widest area is that of an engineer, which shows that in the field of agricultural affairs, the engineer is the ubiquitous function and represents the essential pawn in making decisions to reach the economic optimum. The predominant category of agricultural holding is the limited liability company.
Regarding the knowledge of a foreign language, in the case of my study of English, a significant part affirms its knowledge. Those at the advanced level and those at the beginner level are at equal percentages. The main reason they learned English is their current job. The subjects consider that it is important to know the English language by expressing openly different and broad arguments such as: the idea that it is a language of international circulation, is an official language in the European Union, is necessary in collaboration with foreign business partners. They agree with the participation in programs of learning this language and argue that the most reliable context is the faculty. Interactive exercises are the most practical and efficiently help to develop oral speaking skills [9].

To increase the level of knowledge of English among children, the first meeting with this language should take place from the kindergarten period. When the first acquaintance takes place with its accent and pronunciation. Teachers should use video and audio because they are the methods that increase the attention of children.

At the school level, the continuation of the knowledge process takes place by adding the written and interactive materials. Here it is essential and compulsory the continuous and effective training of the teachers.

There are countless English language learning resources for adults, both alone with the help of books, online environment and other materials, and in a framework organized through a faculty, through a specialization course in English under the guidance of a teacher or by organizing courses in the online area.

Although we have access to many methods of learning English, the most effective and safe method is to attend a course in a college, because in this way we are motivated to devote time to study. In addition, the teacher is the most important actor who transmits the necessary knowledge to the students, decides the interactive activities for in-depth tailored to the particularities of the subjects in front of them and solves the exercises and problems encountered by them.

Taking into account the technological explosion of the means of communication through which people interact so easily, I propose to organize meetings at the level of groups or organizations whose theme is the need for communication in English.

This research work demonstrates and argues the need for continuous and constant study of the English language and it is necessary and useful to observe the evolution of the English language knowledge of the businessmen in the agricultural field in the rural area.

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STUDY REGARDING THE EVOLUTION OF MOUNTAIN TOURISM AND RURAL MOUNTAIN TOURISM IN ROMANIAN CARPATHIANS

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Abstract

The paper aimed to analyse the evolution of mountain tourism and rural mountain tourism in Romanian Carpathians for us to understand our tourists' preferences, and their reasons for that. To be able to do that, we checked the number of tourist arrivals by years and months, in each part of the Romanian Carpathians, we analysed the dynamic of the tourists number between 2014-2019 and we checked the seasonality index, to see what season they love the most. All these research were done with the help of the reports from National Institute of Statistics (NIS). We discovered that one of the main reasons that helps people on to decide about the destination is the climate and the activities that they can perform. In addition, the fact the infrastructure is in a continuing development, and that the investments in tourism are constantly growing, and also that we have lots and many Museums, castles, monasteries, memorial houses, landscapes, hiking, waterfalls and cages make our mountains attractive for our tourists. They can recharge themselves after a hard time, after a crowded city life, in an unbelievable place: Carpathians. The study showed that the tourists are very excited about the rural tourism and all that this is offering them. We have an amazing country, with amazing landscapes that can make everyone love our mountains.

Key words**:** *dynamic, mountain tourism, rural, seasonality*

INTRODUCTION

We can describe Romania as a country that presents a great variety of historical and cultural values, such as – folk art, folklore, ethnography, traditions, and historical vestiges, a harmonious natural setting combined with varied and picturesque landscapes. All of these elements are creating a valuable potential for the rural mountain tourism [9].

In Romania, rural tourism has always been practiced, but it happened in a spontaneously way, sporadically, casually, and most important unorganized. Its form of materialization started in the 20's-30's from the 20th century, with the accommodation of the occasional visitors at citizens houses [4].

Only 60 years later, ANTREC (National Association for Rural, Ecological and Cultural Tourism) made the transition from a simply holiday at the countryside, to different hosts, to the concept of rural tourism [6].

If in 1994, Lane. B, in his paper called "What is rural tourism?" he defined this concept as a sort of "tourism that is located in rural areas, is rural in scale, character and function, reflecting the differing and 'complex pattern of rural environment, economy, history and location"[5]. World Tourism Organization launched in 1997 a definition for the rural tourism as being "the form of the tourism that includes any touristic activity organized and ran in the rural space by the local population, that capitalizes the local touristic resources (natural, cultural, historical, and human) as well as tourist facilities and structures, including guesthouses and agritourist farms." [7]. According to World Tourism Organizations definition, we can consider that the rural tourism emergence and development is directly determined by the conservation of the rural infrastructure by the traditional life and by the preservation of the specific cultural identity. Based on these definitions, we could create our own interpretation by saying that basically, the tourism was born out of a necessity, when the psychic energy consumption grew and the urban area "snatched" the human being out from their

natural habitat, the only habitat able to give him strength and fresh air.

The rural space in Romania is being called "Carpato-Danubiano-Pontic"(Carpathian-Danubian-Pontic), because it is Carpathian by the relief, Danubian because hydrographic network and Pontic due to its opening to the Black Sea, implicitly to the Planetary Ocean.

Since almost a third from the surface of Romania is occupied by the Carpathian Chain, the below study was created to have an overview upon the evolution of the mountain tourism and rural mountain tourism between the years of 2014 and 2019, because the Romanian Carpathians have long tradition in tourism and rural tourism.

We can define the mountain tourism as being that type of tourism places that offers incredible landscapes, picturesque ambiances, and unpolluted environments among the specific endowments such as ski slopes, chairlifts, mountain trails.

One of the most common definition was that, says that "rural tourism includes all forms of tourism in the rural area. It includes in the same time outdoor tourists activities but also activities that allows tourists to discover the nature, the cultural environment and also the gastronomy"[3]. Another one says that "rural tourism includes all the activities that are having as final destination the rural space (farms, natural reservations, small villages) and which encompasses all the local features and the specificity of the rural regions, in order to attract tourists" [8]. Urry J. in 1988 said that "rural tourism is a form of tourism that creates individual characteristics of the tourism product, ensuring a diversification and high volatility of consumer preferences"[10].

By having almost 79,919 square kilometres. The Carpathian Mountains covers almost 66,700 square kilometres from the total mountainous area, offers a great diversity of original and particularly valuable tourist attractions.

Romanian Carpathians are being divided into three major units: Eastern Romanian Carpathians, representing 52.2% from the entire Carpathian area, Southern Carpathians that covers 21% from the entire mountain area and least but not last Western Carpathians with a percentage of 26.8% from the entire mountain area (Fig.1).

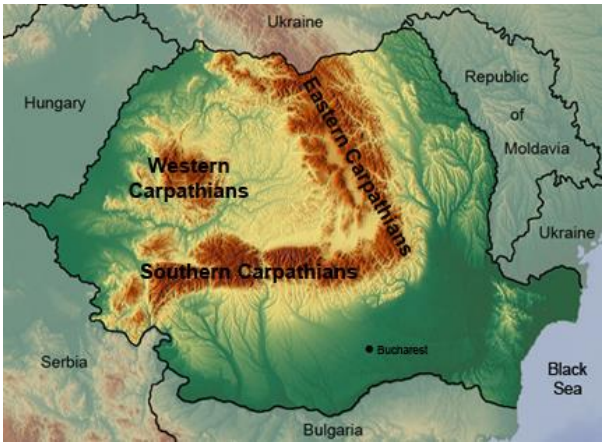

Fig.1. Carpathians Mountains in Romania
Source:https://bonebroke.org/2016/12/15/archaeological-fieldwork-in-romania/map/ [2].

Compared to other forms of tourism, rural tourism stands out for its originality and variety and it is based on the potential of the rural space, products specific to the place and on the people.

The rural tourism is the result of the modern human being behaviour, who wants to travel and visit original places that will send him back to the nature avoiding as much as possible the congestions that forms the dedicated tourism areas. On the other hand, we could say that could represent alternatives for relaunching or invigorating some rural settlements to revive popular traditions, customs and crafts. This being said, we can conclude that Romania has a very big potential to offer quality mountain tourism and rural mountain tourism.

MATERIALS AND METHODS

The main purpose of our research is to be able to see the evolution of mountain tourism and rural mountain tourism in Romania and especially in the Romanian Carpathians. The methodology we used is step by step approach:

Step 1 – we identified the cities that are based in the mountain area within the Romanian Carpathians. We realised this selection made

based on the information that we were able to find within the "Moutain Law" from 20th of July 2020. Once this was done, we generated reports with regards to the tourist arrivals from National Institute of Statistics (NIS).

Step 2 – we started to make different comparisons by making the dynamic (2014 and 2019) to see what was the flow of tourists. To determine the dynamic the formula: Dynamic = Total Number of Tourists Arrivals in 2014/Total Number of Tourists Arrivals in 2019 x 100.

Step 3 – We wanted to check also the seasonality index – to be able to understand when exactly the tourists like to travel and what reasons would they have. For this we used the formula: Seasonality Index = Average of the Season/General Average x 100.

Step 4 – We determined the total number of tourists for each group in the Romanian Carpathians within the 2014-2019 timeframe in the wintertime, to see what are the tourists preferences for winter holidays.

RESULTS AND DISCUSSIONS

To have a first observation of the tourism evolution in Romanian Carpathians, we analysed the dynamic of the tourists number between 2014–2019 (Fig.2). The analysis shows a slightly upward trend between 2014-2019 especially for the rural mountain tourism.

The rural mountain tourism becomes more and more popular among the Romanian tourists, especially for the ones that are trying to run away from the busy life of the big cities, from the artificial food, and closed spaces. The rural mountain tourism has the biggest increase, 251.41%, in the last years in Western Carpathians. Western Carpathians are followed by small differences by Eastern Carpathians with 237.70% and Southern Carpathians with a dynamic of 207.22%. By this, we could understand the fact that the people are trying to get in less polluted places, to a virgin nature, untouched by other human beings – or at least less untouched. They are trying to avoid the crowds, to enjoy the unique sensations that the rural mountain tourism offers them.

The Western Carpathians stretch between the Danube Gorge and the Somes Valley. The tectonic collapses that took place here created an insular appearance with wide colours.

At the same time the area offers a great variation of landscapes and spectacular reliefs.

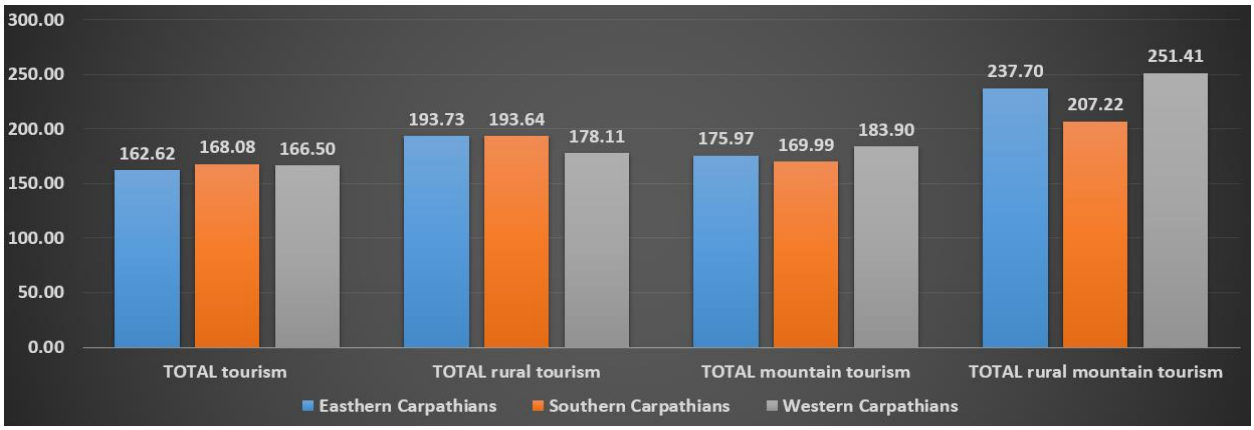

Fig. 2. The dynamic of the tourists number between 2014-2019 in the Romanian Carpathians
Source: Own calculation.

The basalts from Detunata, the gorges, the cliffs, the sinkholes and the caves are just some of most incredible tourist attractions.

And because beauty without purity is nothing, the chain has in composition the ancient and rich Apuseni Mountains plains detached from the story books.

The second place is being occupied by Eastern Carpathians with a dynamic of 237.70%. Eastern Carpathians are being known especially for the natural passes-by,

that made possible the circulation on both sides of the Carpathian Chain since ancient times. In East Carpathians we can see a wide variety of rocks, geophysical, geological and morphological aspects, heights, afforestation, flora and fauna.

The most spectacular and imposing part of the Romanian Carpathians is, without a doubt, the Southern Carpathians, also called Romanian Alps. Here we can find the highest peaks in Romania. Even though all these things are being said, the Southern Carpathians have the least dynamic within the last years with only 207.22%. Less than Eastern Carpathians with 30.48% and less than Western Carpathians with 44.19%. We can assume that being very popular and spectacular, the Southern Carpathians became a very crowded place, a characteristic that makes people to choose different places.

By having these numbers, we wanted to find out the seasonality index as well. To be able to determine when the tourists choose the most the rural tourism from different part of the Carpathians Mountains.

Within the Eastern Carpathians, as we can see below (Fig. 3), the favourite time of the year of our tourists is in the summer time. They have registered 1.65 in July and 2.09 in August. It starts to decrease in September, up until the wintertime.

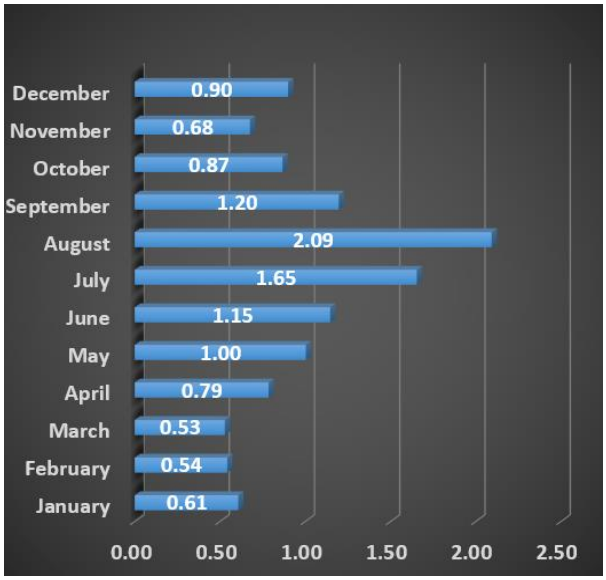

Fig. 3. Seasonality Index in Eastern Carpathians 2014-2019

Source: Own source.

Easter Carpathians, bring to the fore some of the most beautiful places in our country which tourists should not miss. The Muddy Volcanos from Buzau City, the Living Fire and the Putna Waterfall from Vrancea City, the Saint Ana volcanic lake from Harghita City, the monasteries from Moldova or the Zimbraria from Neamt are some of the reasons why our tourists chose Easter Carpathians. We could consider that they chose the summer time due to the fact that they can do long walks to visit all the tourist attractions, running away from the heat that can be found in the urban cities. The average summer temperature is 18°Celsius, a very good temperature to explore places.

Going forward to the Southern Carpathians, we can see that summer time is the preferred season for the tourists to travel (Fig.4).

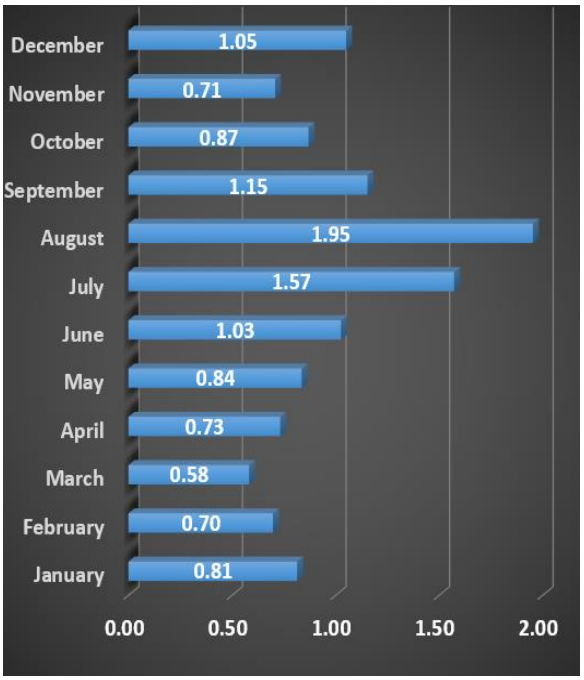

Fig. 4. Seasonality Index in Southern Carpathians 2014-2019

Source: Own source.

The seasonality index starts to increase from June, when its value is 1.03 and reaches the maximum value, 1.95, August. Right after the last month of summer, the index starts to decrease by reaching out 1.15 in September, and a maximum of 1.05 in the wintertime.

The most spectacular area of the Carpathians is being represented by the Southern

Carpathians. Also called Romanian Alps, they reach the highest altitude in Fagaras Mountains (Moldoveanu Peak – 2,544 m) and offer great views and hikes in a wonderful landscape. The Transfagarasan road, the most spectacular road in Romania, crosses the mountains and connects Transylvania with Muntenia. The most important tourist attraction in the Southern Carpathians can be considered Vidrau Lake and Dam, one of the largest in Europe, then Poienari Fortress, build in Vlad Tepe's time, the Balea Glacier Lake and Balea Waterfall. Also, in the Southern Carpathians, we can find in the Retezat Mountains, the Retezat National Park, which has the status of a protected natural area of national and international interest, and since 1979 is well known as Biosphere Reserve. With around 80 lakes, of which 58 are permanent lakes the Retezat Massif owns almost 40 percent of the glacial lakes in Romania. The lakes, fed by the melted snow of the ridges offer incredible views to the tourists. Retezat National Park entered also the race started by the New 7 Wonders Foundation to choose the seven natural wonders of the world. Also Bucegi Mountains offer some of the most beautiful excursions in Romania, with high ridges that have panoramic views, meadows with wild flowers and numerous paths and tourist attractions such as Sfinx and Babele, two major tourist attractions around which many legends have been woven – some say that the ensemble was built by aliens themselves. As well as in Easthern Carpathians, the average summer temperature is 18°Celsius. All the tourist attractions, and all the diversified flora and fauna make our tourists to choose the summertime as well to visit Southern Carpathians.

Cool temperatures and unobstructed trails, with ancient meadows, virgin forests and limestone peaks make the Western Carpathians to be the perfect place for summertime as well, for many of the tourists.

The increase starts in May from 1.09 and reaches out to its highest value in August, at 1.79 (Fig. 5). September is the month when the decrease starts from 1.19 and it reaches out to the lowest value in December – 0.78.

only few of the tourists attractions that grows the rural mountain tourism in the Western Carpathians. Even CNN included the Western Carpathians – Apuseni Mountains to be more precise – within the list of the 17 tourist destinations that best defines Europe. The average summer temperature is 18°Celsius.

Trying to understand why the tourists choose the mountain especially on summertime we looked at the Romanian climate as well (Fig.6).

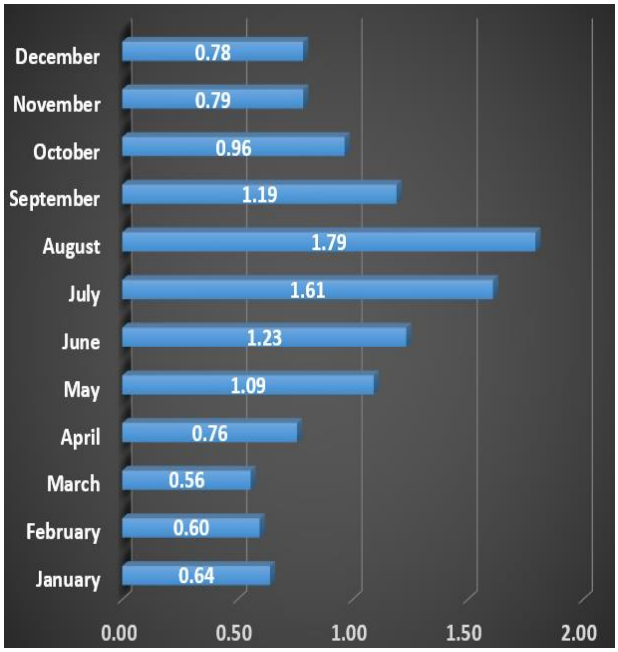

Fig. 5. Seasonality Index in Western Carpathians 2014-2019

Source: Own source.

Cheile Nerei the realm of story waterfalls, Cheile Rametului a mixed nature reserve, Apuseni Mountatins with over 400 cages, Poiana Rusca or The Marble Mountains or the mountain trails from Bihoruli Mountains are only few of the tourists attractions that grows the rural mountain tourism in the Western Carpathians. Even CNN included the Western Carpathians – Apuseni Mountains to be more precise – within the list of the 17 tourist destinations that best defines Europe. The average summer temperature is 18°Celsius.

Trying to understand why the tourists choose the mountain especially on summertime we

looked at the Romanian climate as well (Fig. 6).

We can understand from here that in a country with temperate continental transitioning climate, where summer is an extremely hot season, lasting from May until mid-September, with temperatures over 30° Celsius, the tourist often choose to travel to the mountain side where the maximum temperature is 18° Celsius.

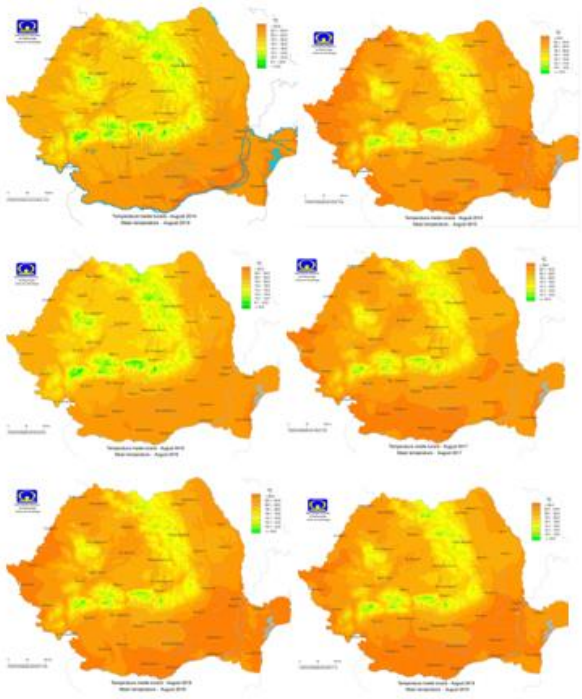

Fig. 6. Mean Monthly Temperature in August 2014-2019
Source: http://www.meteoromania.ro/clima [1].

Despite the comfort that they find here with regards to the temperature, they can visit unbelievable places, see the nature as it is, recharge themselves after an entire year of hardworking and city life.

The fact that the infrastructure is in a continuing development, that the investments in the accommodation units are growing constantly is part of their decision to travel to the mountain side.

Museums, castles, monasteries, memorial houses, landscapes, hiking, waterfalls and cages can be visited better by the Romanian tourists in the summertime. They can admire the green meadows, full of grass and flowers and can admire the diverse fauna, or can even go fishing or hunting in the rural tourism.

CONCLUSIONS

Even though, most of the people chooses the summertime and its beauty, we should not forget about the wintertime in the Carpathians.

Full of customs and traditions, in winter, the Romanian village becomes a corner of heaven. The Romanian winter holidays begin with St. Nicholas on the 06th of December, and ends on the 24th of February, with Dragobetele, which marks the beginning of spring and the agricultural year.

The winter holidays spent in the middle of Romanian villages represents a unique experience, full of joy, drama, irony and poetry. An entire amalgam of contrasts that only Romania and its people can harmonize so well. Plenty of meals, sad stories and carols, cheerful songs, warmth and hospitality of the hosts takes you out of your everyday routine. It is very difficult to choose a specific area. Whether you are in Eastern, Southern or Western Carpathian, winter has a certain and specific taste and aroma. There is no family in the countryside – rural area – who is not preparing for Christmas of for New Year's Eve. The traditions and customs of the Carpathians differ from one are to another, but their beauty, uniqueness and originality cannot be described in any words or stories. Most of the traditions and customs surrounding the winter holidays are strictly observed in the rural areas from Bucovina and Maramures – part of the Eastern Carpathians.

We determined the total number of the tourists that travelled in the winter months in Romanian Carpathians from 2014 until 2019 (Fig. 7).

In Eastern Carpathians, from 2014 up until 2019 111,437 tourists travelled in total, in the month of December. As can be seen it's the highest number of tourists from all the Carpathians, from all the winter months. This can only makes us believe that there is interest for traditions in the rural area.

At a slightly difference from Eastern Carpathians we can see the Southern Carpathians with a total number of 113,016 tourists in from 2014 to 2019.

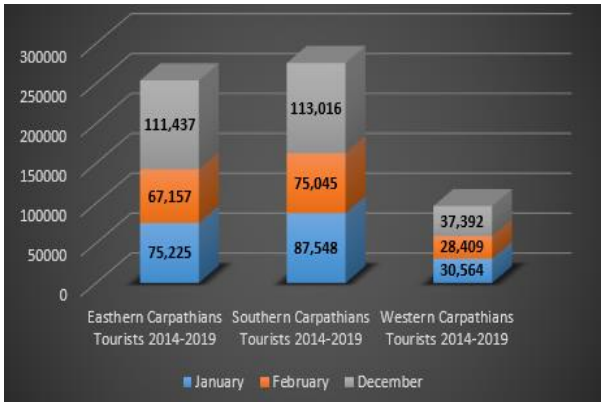

Fig. 7. Tourists in Winter Time in 2014-2019
Source: Own source.

Southern Carpathians are well known for their slopes. Whether you choose skiing or snowboarding, Southern Carpathians offers you the possibility to practice your favourite sport safely on big and modern slopes.

The study shows us that tourism was rising within the last years. People were coming to visit different places, the accommodations were more and more occupied. All the investments and all the healthy business plan were working. Everything was ok and good until February 2020. SARS-COV2 virus infection appeared in December 2019 in Wuhan, China. At that time no one knew what is really coming. At first the disease was spread to most Chinese provinces. Not to late it begun to spread all over Europe, all over the world.

The World Health Organization declared the outbreak a Public Health Emergency of International Concern in January 2020 and a pandemic in March 2020 [11]. The virus was confirmed to have reached Romania on 26th of February 2020, when the first case in Gorj County was confirmed. That was the moment when safety measurements have been taken. At the beginning, in February, Romanian government announced several preventive measures such as designation of hospitals as isolation centres for new cases, purchase and placement of thermal scanners in international airports and specially designated lines for passengers coming from areas affected by COVID-19 outbreak [11].

In march there were banned all the gatherings, school and border closure. Not too late, the state of emergency was announced. It followed a national lockdown. As a result of the pandemic, Romania imposed quarantines, bams, or other restrictions for the Romanian citizens (and not only). Movement outside the home and household was prohibited with some exceptions such as work, buying food, or medicine. People over 65 were allowed to leave their home only at certain time intervals. The SARS-COV2 spread all around the country very fast. This is the moment when the tourism started to fall off. Facing exceptional circumstances, the tourism industry has reached a point of interruption of normal activity never seen before, as more and more travel restrictions are imposed. Uncertainties and restrictions on holiday plans were growing day by day in an attempt to stop the spread of the disease. Lockdowns and social distancing measures led to strong declines in otherwise stable services consumption.

Many accommodations had to close their doors for tourists, for employees. Some of them only for the lockdown period, some of them forever. Even though the national lockdown lasted only 2 months, the people were still afraid to start travelling. All the accommodations had to comply with certain conditions to open their doors for their tourists. Many of them were not able to accommodate, hence they never opened their doors.

We could say that the SARS-COV2 pandemic did two things: created people's fear to travel, but in the same time made the people to choose wild places, unheard by anyone up until now. Made them approach even more by the nature. Searching constantly for fresh air, for places that would make them forget about everything bad that happened. To forget about the all the economic problems, the health problems. It also made them supportive with our rural tourism entrepreneurs.

They understood that they really need each other to survive this pandemic, this unbelievable situation. Solidarity became one

of the most important qualities of our citizens. The mountains are still there, with the same beauty, with the same will to receive our frightened, exhausted tourists. To offer them beautiful stories in a world where you feel nothing good is happening, at least for the moment.

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STUDY REGARDING USING SOLAR ENERGY FOR HOUSEHOLD`S SUFFICIENCY AND RURAL COMMUNITIES DEVELOPMENT IN UKRAINE

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Abstract

The recent statistical data and market studies have shown that today Ukraine electricity market requires certain changes and modifications. Reform is necessary to build a new model of interaction between all participants in the energy market. The problem is too monopolized the electricity market, lack of understanding of the marketability of the category, transparency of electricity pricing, the ability to freely choose contractors and so on. Therefore, we can safely say that the new model of the energy market of Ukraine should be a powerful impetus to the energy sector development, which will lead to key indicators of sustainable economic development - energy efficiency, energy sufficiency, energy independent, use of renewable resources. This study surveyed households using solar photovoltaics to determine the prospects for solar energy in rural communities. Like methodology of research options for the development of alternative energy households, were considered traditional, technical and economic factors such as technological readiness and ability to pay, access to information and experience, if you want to implement sustainable energy solutions in rural communities. Were also identified factors that influence the household's decision to install a photovoltaic module. The survey asked about the demographic data of the respondent (gender, age and level of education) and household (household size, type of business and income) to find out their level of electricity needs. These findings indicate that the positive experience of rural users undoubtedly offers business opportunities to interact with rural households in meeting the unmet energy needs for further market growth.

Key words**:** *sustainable development, rural communities, renewable resources, solar energy, energy sufficiency, energy independent, households*

INTRODUCTION

Nearly two billion people in developing countries - one third of the world's population - do not have access to electricity. Firewood, agricultural residues, peat and animal traction continue to be the main energy resources for millions of rural families worldwide.

Finding alternative energy sources that are economical and environmentally friendly is crucial to increase agricultural productivity and improve the quality of life in rural communities. FAO's new Alternative Energy Development Program "Solar Photovoltaic Systems for Sustainable Agriculture and Rural Development", developed for the period 2020-2030, suggests that solar photovoltaic systems may be part of the solution [13]. Thus, ensuring the preservation and rational use of natural potential to ensure the stability of the socio-economic system poses a challenge to society to find ways to modernize the country's energy market (Fig.1).

At the same time, it is necessary to take into account the threats to the sustainability of energy supply of the national economy, which are barriers to achieving the goals of energy sustainability:

- Exhaustiveness fossil fuels;
- Maintaining and/or strengthening a critically high level of import dependence;
- High level of losses in the process of transportation and supply of energy resources;
- Rapid aging of energy infrastructure;
- low energy conversion efficiency and the appropriate level of environmental energy generation and related environmental degradation;

- Risks of reliability of energy resources supply due to lack of energy generating capacities;
- Further reduction in the relative competitiveness of domestic producers due to the high share of energy in production costs and the rising cost of traditional energy resources.

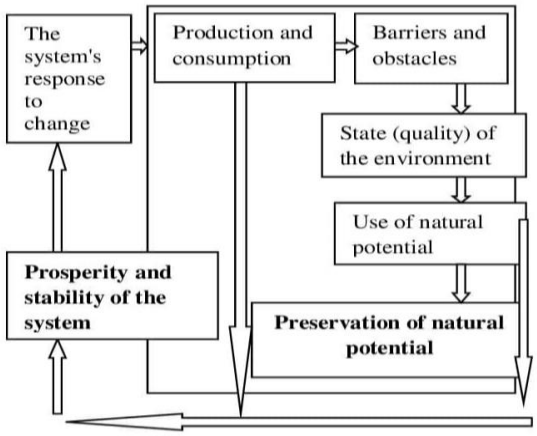

Fig.1. System diagram of energy sustainability goals
Source: Own deduction.

Distributed solar photovoltaic energy is a well-established technology to meet small rural energy needs in an affordable, reliable and carbon-neutral way [13]. These socio-technical transitions provide significant support to overcome energy poverty and act as a key tool for achieving well-being, economic prosperity and environmental protection provided for purposes of sustainable development.

This study surveyed households using solar photovoltaics to determine the prospects for solar energy in rural communities.

Factors affecting the desire to use more solar energy include income, education level, duration of solar energy, satisfaction, and time of day for electricity and public financial support procurement. This may explain the paradoxical aspects of subsidies, which are widely used as a social and political tool for improving the quality of life of those who are in financial trouble, but ignores the fundamental structural aspects of the energy system.

The world community has recognized that access to electricity is a first step and a prerequisite for socio-economic progress. Despite the fact that is passing the third decade of the XXI century, in rural areas of our country access to electricity is sometimes difficult and expensive. So, expanding the electricity grid costs a lot of money. For example, the expansion of the power grid in rural areas per 1 km costs from 65,000 to 150,000 UAH. Therefore, the use of solar energy in rural areas could become a cheaper and more environmentally friendly alternative [14]. Therefore, solar energy systems together with wind energy and other renewable energy sources are the only technically viable solution for delivering the energy needed to isolated rural communities. A small number of additional energy systems can significantly change the situation, making it possible to improve life in rural areas, increase agricultural productivity and create new opportunities for income. Solar energy is also more friendly for the environment. For example, indoor air pollution from burning non-renewable energy sources, such as wood and coal, kills more than 4 million people worldwide each year [13]. The majority of this population is poor and lives in rural areas, where the cost of expanding the network is high. Despite the price disadvantage (the installation of photovoltaic panels up to 5 kW costs $ 300, 15 kW - $ 500, more than 30 kW - $ 800-100), the benefits of solar energy in rural areas illustrate that the development of the solar technology is useful for areas that would not otherwise be able to access electricity. Thus, photovoltaic solar systems is still relatively expensive and therefore they are not a panacea for solving problems of poverty in rural areas. However, they offer a huge potential to fill certain extremely important points [13]. Currently, solar energy is used mainly for domestic lighting and household use. But the potential of solar energy is relatively untapped to increase agricultural productivity and rural development in general.

Recognizing energy inequality around the world, the UN Sustainable Development Goal (SDG) №7 seeks to provide affordable, reliable and clean energy to the population by 2030 [14].

The success of SDG № 7 lies in sustainable energy combinations, which are characterized by their multiscalarity and consist of two related but diverse elements, namely socio-technical systems involved in the integration of technology and innovation with society (supply factor) and energy equity, which is formed around the cost and risk of energy production and distribution (demand factor) [14]. SDG № 7 clearly provides complementarity of both socio-technical systems and social justice to promote sustainable energy supply to all segments of the population. To address energy poverty there are energy centers, linking production and consumption of energy and its distribution [17].

These intertwined technical and social aspects promote and enhance the current disproportionate and unequal distribution of power. For many, the failure of the principles of distributive justice in the energy sector is an insurmountable obstacle. Collectively, there is a disparity between generations and between segments of the population, which also limits the rights to energy and a clean environment, constrains social, economic and environmental conditions to break the cycle of energy poverty [11].

According to the Sustainable Development Goals, the use of solar energy has improved access to electricity in various developing countries and contributed to a 10% reduction in the global deficit of access to electricity over the past 15 years in the world [2].

In particular, India introduced a program of universal access to rural electrification and developed a National Action Plan on Climate Change, which aims is 40% production of total electricity from renewable sources by 2030 [6] to support rehabilitation climate activities.

Unreliable and highly subsidized electricity supply in rural areas is an unstable cycle when frequent interruptions and low wages lead to lower revenues and lower income restrain distribution companies to invest in rural infrastructure. Consequently, there is a need to modernize the electricity sector to destroy and break the existing carbon constraints and strengthen management systems to support the principles of justice and energy sustainable equitable economic growth [10].

From a socio-technical point of view, decentralized solar energy production is increasingly used as a viable alternative to solve existing problems of electrification of rural areas [15]. All over the world, decentralized electrification using solar photovoltaic programs is constantly used by governments and entrepreneurs to deploy electricity services in rural and remote communities in a cost-effective way [16]. At the regional level, solar photovoltaic energy (PV) is one of the most commonly used technologies for decentralized electrification of rural areas of Ukraine.

The main objective of this study is to understand the energy security of households, energy independence of solar energy sources, energy conservation and energy patriotism, which is generally consistent with the goals of sustainable development.

MATERIALS AND METHODS

For deeper understanding of current and future options for the development of alternative energy households, it should be considered traditional, technical and economic factors such as technological readiness and ability to pay, access to information and experience, if you want to implement sustainable energy solutions in rural communities [18]. Statistical data at the household level can provide detailed analysis that can help to understand the geographic, demographic and socio-economic conditions for solar energy development at the regional and national levels. There is little such data, as there is no public database on decentralized solar energy users (households).

To fill this gap, this study conducted a random selection of households in 7 districts of Sumy, Kharkiv, Poltava and Dnipropetrovsk regions as representatives of decentralized consumers of solar photovoltaic energy. 254 surveyed households were grouped into two categories: households that are only users of solar photovoltaic energy (PV) (110 households) and households that have both solar photovoltaic energy and connected to the

energy grid (PV +) (144 households). Most households used solar energy only for residential purposes. Approximately 30% of these households also used electricity for small businesses (eg vegetable greenhouses, convenience stores, processing shops, repair shops, etc.).

Table 1. Description of decentralized use of solar photovoltaics in households

Indicator	Frequency	%
Total number of surveyed households	254	100
Type of electricity use		
- Solar only (PV)	110	43.3
- Combined (solar and network) (PV +)	144	56.7
Type of photovoltaic equipment:		
- Household lighting;	45	17.6
- Solar batteries up to 40 W;	66	26.0
- Solar photovoltaic systems (40 W and above);	30	11.7
- Solar power plant	114	44.7
Duration of use of PV:		
- Up to 1 year;	63	24.8
- 1-3 years;	76	29.9
- 3-5 years;	69	27.2
- More than 5 years	46	18.1
Method of installing PV:		
- Within the grant (state, international) support program;	51	20.0
- At their own expense, including credit	203	80.0

Source: Own research

Assessing the responses of households on the adequacy of their own needs depending on the type of electricity use (sufficient/insufficient), was performed a multiominal probit regression (logistics). Methods of logistic regression and discriminant analysis are used when it is necessary to clearly differentiate respondents by target categories. The groups are represented by levels of one single-parameter parameter. Differentiation is carried out in accordance with socio-demographic characteristics. These include, in particular, age, sex, number of hectares of land, income and others. In operations there are criteria for differentiation and variable. The latter encodes the target categories, which, in fact, should be divided into respondents.

Assume for each observation t, the net utility gained from the consumption of energy sufficiency U_t, which is not observable, is related to a set of exogenous variables x_t (I×1 vector, where I is the total number of exogenous variables). Then, we are interested in coefficients β, which describe this relationship in the following latent model (as well as in the related probit model), assuming error term μ_t follows a standard normal distribution $\mu_t \sim N(0,1)$ [7]:

$$U_t = x'_t\beta + \mu_t$$

Thist model is equivalent to the probit model

$$y_t = x'_t\beta + \mu_t,$$

when the relationship between latent utility variable U_t and the observable response (0/1) variable of whether a household purchases energy sufficiency, y_t, satisfies:

$$Y_t = \begin{cases} 1 \; if \; U_t > 0 \\ 0 \; otherwise \end{cases}$$

Note that in the above model, the *j-th* element of coefficients vector β, β_j ($j \in \{1,2,\ldots, I\}$) measures the change in the conditional probability $\Pr(y_t = 1|x_t)$ when there is unit change in x^j_t (j-th element in vector x_t). To further develop this regression model, in addition to i.i.d normally distributed error terms, we assume that the conditional probability takes the normal form:

$$\Pr(y_t=1|x_t)=\Phi(x'_t\beta),$$

where: $\Phi(.)$ is the standard normal CDF.
A standard statistical textbook such as Greene (2011) would show that the estimator β could be calculated through maximizing the following log-likelihood function $\ln£(\beta)$ [4]:

$$\beta=\operatorname{argmax}_\beta[\ln£(\beta)]=\operatorname{argmax}_\beta[(1-y_t)\ln(1-\Phi(x'_t\beta)))]$$

In order to report standard regression outcomes such as t-statistic, p-value, we need the estimated co-variance matrix of the estimator β, i.e., V_β, which is based on the

inverse Hessian matrix according to Greene (2011),

$$V_\beta=(H)^{-}1$$

where: $H=\nabla 2\ln£(\beta)$ is the estimated Hessian of the log-likelihood function $\ln£(\beta)$ at the solution point β.
GAMS (General Algebraic Modeling System) provides a mechanism for generating a Hessen matrix *H* at the solution point. We used a discrete selection model in GAMS, the results of which are recorded in NEOS Server.

RESULTS AND DISCUSSIONS

Table 2 shows the level of satisfaction reported by participants compared to the previous power supply used in households. A high level of satisfaction was recorded among rural consumers of solar energy. Customer satisfaction was extremely high in households using only solar energy (PV). For this group, more than 67% of participants (compared to 76% of PV + households) rated solar energy better than previously used light sources, in which case respondents reported power outages through the central grid.

Table 2. Household satisfaction of solar photovoltaic power compared to previous power supply

Level of satisfaction	Total amount (254)		PV (110)		PV + (144)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Below expectations	25	9.8	16	14.5	9	6.3
At the level of the previous source	45	17.7	20	18.2	25	17.4
Above expectations	184	72.5	74	67.3	110	76.3

Source: Own calculation

The level of satisfaction was checked by six variables: safety, total productivity, battery life, equipment quality, maintenance support and access to the electricity grid (Fig. 2).

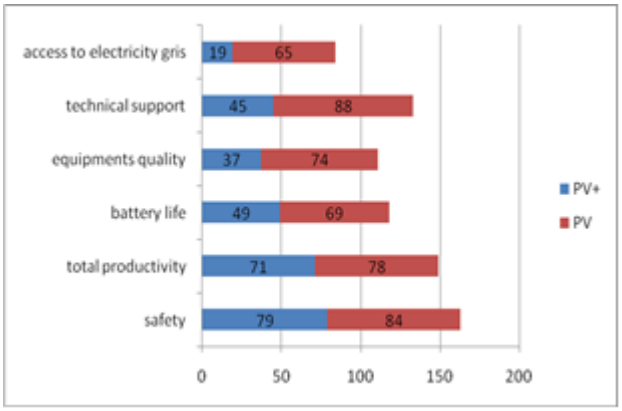

Fig. 2. Estimation of households using solar energy
Source: Own calculation.

Households reported high levels of satisfaction in all six aspects, although some households had lower views on service levels. Satisfaction with the comparison of household types (PV and PV +) also showed similar trends (Fig. 3), when households that use only solar energy were more satisfied than used solar energy in addition to the grid.

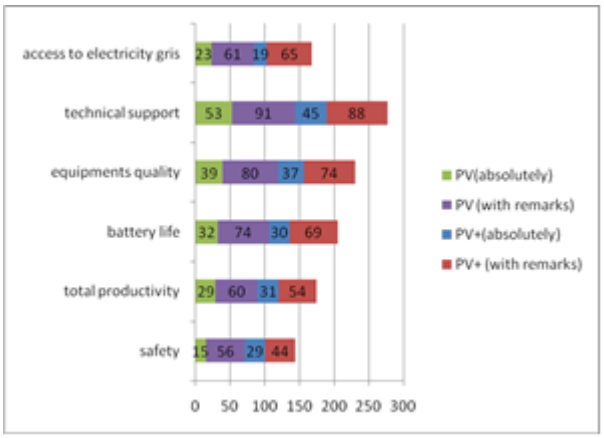

Fig.3. The level of satisfaction households using solar energy
Source: Own calculation

These findings indicate that the positive experience of rural users undoubtedly offers business opportunities to interact with rural households in meeting the unmet energy needs for further market growth.
We found that satisfied households likely will want more solar energy. In other words, changing the satisfaction of households by 1% increases commitment to solar energy by 0.16% (correlation coefficient of 0.161 with a standard error of 0.0186).

Table 3. Consolidated portrait of households using solar energy

Indicator	Total amount (254)		PV (110)		PV + (144)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Sex						
- Male	189	74.4	100	90.9	89	61.8
- Female	65	25.6	10	9.1	55	38.2
Age						
- 18-25	9	3.5	3	2.7	6	4.2
- 26-32	36	14.2	17	15.5	19	13.2
- 33-40	89	35.0	27	24.5	62	43.1
- 41-55	97	38.2	54	49.1	43	29.9
- 56 and more	23	9.1	9	8.2	14	9.7
Educational level						
- Secondary	16	6.3	9	8.2	7	4.9
- Professional and technical	97	38.2	54	49.1	43	29.9
- Bachelor	89	35.0	19	17.3	70	48.6
- Master	52	20.5	28	25.5	24	16.7
Type of business						
- None	42	16.5	11	10.0	31	21.5
- Agricultural production	182	71.7	78	70.9	104	72.2
- Service and trade	30	11.8	21	19.1	9	6.3
The size of the farm						
- Up to 3 hectares	51	20.1	19	17.3	32	22.2
- 3-5 ha	176	69.3	76	69.1	100	69.4
- More than 5 hectares	27	10.6	15	13.6	12	8.3
Average annual income per 1 household member, UAH						
- Up to 50,000	65	25.6	26	23.6	39	27.1
- 50,000-200,000	119	46.9	68	61.2	51	35.4
- Over 200,000	70	27.5	16	15.2	54	37.5

Source: Own calculation.

We also identified factors that influence the household's decision to install a photovoltaic module. The survey asked about the demographic data of the respondent (gender, age and level of education) and household (household size, type of business and income) to find out their level of electricity needs. Table 3 summarizes the statistics of households that participated in the survey and use solar photovoltaic energy.

Using a multinomial probit-regression model, the effect of these determinants was evaluated independently of each other and their combined effect in predicting the probability of households seeking to establish a source of solar energy generation. First, consider the coefficients at the output of the probit regression in Table 4.

Table 4. The results of the multinomial probit regression model

Indicator	Binary value	Coef.	SE
Sex	yes	0.528	0.298
	no	-0.144	0.366
Age	yes	0.388	0.116
	no	-0.258	0.124
Educational level	yes	0.777	0.097
	no	-0.631	0.084
Type of business	yes	-0.341	0.131
	no	-0.122	0.088
Size of household	yes	0.544	0.011
	no	-0.280	0.177
Average annual income per 1 household member, UAH	yes	0.772	0.136
	no	-0.762	0.152

Source: Own calculation.

By interpreting the marginal effects (Table 5) of the previously identified impact factors, was estimated the probability of the dependent variable with respect to the predictor variables, keeping all other predictors constant at the same values. Respondents were asked to choose one of three possible answers (no, maybe / indefinitely, yes), which were presented as a dependent variable. Thus, evaluating individual determinants, it was found that annual income, level of education, significantly influenced on the desire to install solar energy in households, thus ensuring their own energy adequacy and energy independence. Factors such as age, gender, and type of business did not significantly

influence on the decisions about the use of solar generators.

Thus, by interpreting the obtained indicators, it was found that, for example, people with higher education (master and bachelor) and an average annual income of up to UAH 200,000 per 1 household member are 13% more likely to install solar generators than people with technical education.

Table 5. The marginal effects of impact factors on the level of satisfaction households

indicator	Variable variation	dy/dx	Std. Err.
Sex	yes	0.324	0.011
	maybe / indefinitely	0.0961	0.026
	no	-0.0441	0.030
Age	yes	0.261	0.077
	maybe / indefinitely	0.319	0.013
	no	-0.0811	0.044
Educational level	yes	0.014	0.031
	maybe / indefinitely	0.239	0.063
	no	-0.101	0.019
Type of business	yes	0.0891	0.022
	maybe / indefinitely	-0.0145	0.056
	no	-0.127	0.048
Size of household	yes	0.0124	0.092
	maybe / indefinitely	0.189	0.016
	no	-0.1711	0.042
Average annual income per 1 household member, UAH	yes	0.0638	0.039
	maybe / indefinitely	-0.0181	0.057
	no	-0.1112	0.038

Source: Own calculation

The service life and the level of service of photovoltaic equipment are one of the problematic issues due to which the respondents lowered the assessment of the level of satisfaction. This becomes a constraint on people's willingness to purchase solar photovoltaic modules if there is another alternative energy [8, 13].

After review with respondents were also found that households that received their photovoltaic system under a grant (free of charge) were less likely to want more capacity than those who paid for their system in full value or those who received a partial subsidy to support them. Also notable in this analysis is that households receiving monthly fee for green tariff for excess energy produced, tended much to increase the number of photovoltaic modules, for not only feel their own energy sufficiency and independence, but also found an additional source of income [5].

CONCLUSIONS

Energy sufficiency, energy independence and environmental sustainability are equally important for achieving the goals of sustainable development and improving the well-being of the population. It is because of environmental friendliness and human health safety, the solar photovoltaic systems, so-called clean technologies, are gaining more and more popularity among consumers. In addition, they offer a reliable solution to overcome the cycle of energy independence and increase the level of energy patriotism.

Compared to fossil fuel energy, solar energy systems are flexible, maintenance-free and environmentally friendly, but they have their limitations. Thus, batteries for storing solar electricity can be expensive and problematic in service.

However, the most problematic in our country are institutional barriers: high start-up costs combined with a lack of funding mechanisms that lead to low sales, also and a relatively long chain from the solar panel manufacturer to the final consumer leads to high transaction costs. These are key reasons for the lack of infrastructure and political commitment. This vicious cycle usually makes solar energy systems unattractive for rural consumers, and for many investors.

Taking into account the existing political, social and economic realities in Ukraine, it is important to first achieve political and institutional sufficiency in the economic development of energy sources. The introduction of new technologies must comply with the principles of social justice in order to meet the energy needs of households that are making significant initial investments in their own energy independence.

To alleviate the conditions for making such a decision, it is advisable to refer to the world experience of energy cooperatives in the united territorial communities. Such organizations not only stimulate the transition to renewable sources, but also allow the use of local resources and work for the benefit of the community.

This organizational system, becoming an important element of decentralization, offers several advantages. First of all, the cooperative allows you to build the necessary infrastructure without attracting foreign investors or expensive loans. This is usually not possible for individuals or small companies.

In addition, such system reduces community dependence on large energy companies and fossil fuels that may rise in price. Using local resources help to save energy and sell excess renewable electricity by a "green" tariff". In addition, energy cooperatives are more environmentally friendly: the community switch to renewable energy sources, use local resources (such as agricultural waste) and reduce the need to transport energy.

But there is hope for overcoming financial and institutional barriers to the success of solar energy. Connecting rural communities to alternative energy networks require significant government subsidies and does not always bring the projected benefits. But here it should be remembered that rural economic and social development depends on the successful implementation of energy independence projects, and not vice versa.

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ECONOMIC VALUE OF POLLINATION OF ORCHARDS, CASE OF MOLDOVA AND POLAND

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Abstract

The aim of the paper was to estimate the economic value of pollination of fruit plants in Moldova and Poland and to determine the factors differentiating these values. The study presents the characteristics of fruit growing in the studied countries. Then, using the method of production value obtained as a result of pollination, the values of pollination of the main fruit plants in Moldova and Poland in 2014-2018 were estimated. In both countries, the value of pollination in orchards increased, in Moldova from EUR 33.8 million in 2014 to EUR 95.7 million in 2018. In Poland, the value of pollination in orchards increased from EUR 512.9 million in 2014 to EUR 679.6 million in 2018. The pollination value of 1 hectare of an orchard in Moldova increased from EUR 447.6 in 2014 to EUR 1038.7 in 2018, and in Poland from EUR 2053 in 2014 to EUR 2830.2 in 2018. The variation in pollination values for individual species resulted from differentiation purchase prices and the yield.

Key words**:** *pollination, economic value of pollination, dependency ratio method*

INTRODUCTION

Agriculture uses a variety of services provided by the natural environment [10]. The development of conventional agriculture, focused on maximizing production, has negative effects on the environment. The intensification of agriculture leads to a reduction in biodiversity in the natural environment [13] and a reduction in the value of services provided by ecosystems [12]. To counteract this, a comprehensive approach to the functions performed by agriculture should be approached through the development of multifunctional agriculture [5] or sustainable [8]. In both of these concepts, beekeeping is an important element, providing people and the natural environment with many goods and services.

Among the services provided to the environment by beekeeping, plant pollination is the most important. By pollinating plants, beekeeping has a positive effect on biodiversity, the natural environment and the yield of crops [11, 25, 23]. It is estimated that about 35% of food produced in the world depends on pollination by pollinating insects, especially by the honey bee (*Apis mellifera*) [24]. Out of 115 species of the world's major crops, 87 of them depend on animal pollination. For 70 plant species, the impact of pollination on yields can be described as at least significant [11, 14, 16]. Among the crops with the highest importance of pollination in terms of height and quality of crops are fruit plants [11, 19, 7].

The world value of pollination of arable crops was estimated at EUR 153 billion per year, of which over 30% was fruit pollination [6]. In addition to research on the global value of pollination of crops, the values for regions or individual countries were also estimated. It was estimated, among others the values of pollination of crops for European Union countries [15] and also for the USA [19], Poland [26, 17], England [2], Brazil [7] and other countries. Research was also carried out on the pollination value for individual plants. Many of these works concerned pollination of apple trees [22]. Research on the estimation of

the value of pollination of other fruit plants was conducted much less frequently.

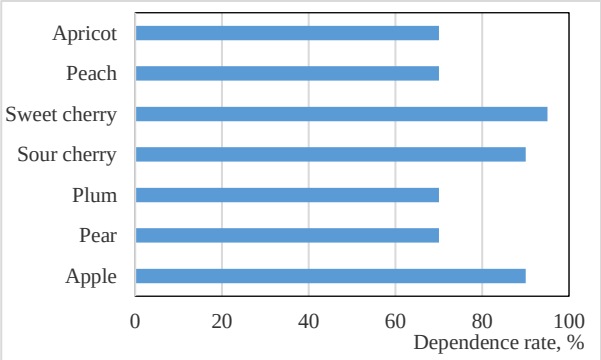

Fig.1. Pollinator dependence of yields of selected orchards plants, in %
Source: own Authors' elaboration based on [10].

The study attempts to estimate the pollination value of the main fruit plants in Moldova and Poland. According to the authors' knowledge, this type of research has not been conducted in Moldova. The authors only know the studies on the efficiency of sunflower pollination in Moldova [3]. In Poland, however, research was conducted on the determination of the value of pollination of crops [26, 17]. However, no studies on the value of pollination of fruit plants were conducted in both countries. The selection of fruit plants for analysis resulted, apart from the above, from the large influence of pollination on the yield of these plants (Fig. 1). The novelty in the study is, on the one hand, the determination of the pollination value of fruit plants in the years 2014-2018 for the studied countries, and, on the other hand, a comparison of the obtained pollination values of fruit plants and an attempt to indicate the reasons for the obtained differences. There are no studies in the literature indicating the value of pollination of fruit plants per unit area of these crops.
The main purpose of the study is to compare the pollination values of the main fruit plants in Moldova and Poland, and to attempt to identify factors that differentiate the pollination values. As part of this objective, the value of pollination of the main fruit plants (apple, pear, plum, cherry, sweet cherry, apricot and peach) was estimated using the production value obtained as a result of insects pollination (the dependency ratio method). The value of pollination for individual fruit plants was estimated for countries and per one hectare of cultivation.

MATERIALS AND METHODS

The dependency ratio method was used to estimate the value of pollination of fruit plants in Moldova and Poland. It is the method most often used to estimate the value of pollination of crops [6, 1, 4, 9, 18], therefore the obtained results can be compared with the results of other authors. In the dependency ratio method, the production value of entomophilous plants (in our case, fruit plants) is corrected by the indicator determining the influence of pollinating insects on the yield (*D*). In order to estimate the production value, the average annual fruit buying-in prices in Moldova and Poland obtained from the National Statistics Bureau of the Republic of Moldova and from Statistics Poland (Polish statistical office) were used. Data from the National Bank of Moldova and National Bank of Poland were used to convert pollination values in euro. For this purpose, the average annual exchange rates provided by the national banks of Moldova and Poland were used.
For each of the fruit plants, the value of pollination by insects was estimated according to the formula [6]:

$$EVP = D * P * Q$$

where:
EVP - plant pollination value,
D - dependence of crops on pollination by insects,
P - average annual purchase price of fruit of the plant species,
Q – annual production volume of a the plant species.
Values estimated in this way for individual fruit plants were summed up for individual countries. Moreover, the obtained values were related to the cultivation area of individual plants in the studied countries, estimating the average pollination values of 1 hectare of fruit plants.

RESULTS AND DISCUSSIONS

Characteristics of fruit production in Moldova and Poland

Horticulture production is an important part of agriculture. Fruit plants provide fruit which, apart from vegetables, are a source of vitamins and microelements, being an important element of the human diet.

Table 1. Area and structure of fruit trees cultivation in Moldova and Poland in 2014-2018

Specification	2014	2015	2016	2017	2018
Moldova					
Total, in thousands of hectares	75.52	93.04	91.92	95.04	92.11
share, in %					
Apple	59.4	59.2	57.5	56.5	56.1
Pear	2.4	2.1	2.6	2.9	3.0
Plum	21.1	20.4	21.2	20.7	21.7
Sour cherry	3.5	3.3	3.5	4.4	3.9
Sweet cherry	3.3	3.4	3.6	3.8	4.0
Apricot	3.3	3.2	3.5	3.8	4.1
Peach	7.1	8.3	8.1	7.9	7.2
Poland					
Total, in thousands of hectares	249.76	246.22	242.21	241.10	240.14
share, in %					
Apple	70.6	73.3	73.2	73.1	73.1
Pear	4.0	3.7	3.2	3.2	3.2
Plum	6.6	5.6	6.0	5.9	6.0
Sour cherry	12.8	12.0	12.1	12.2	12.2
Sweet cherry	4.3	3.9	4.0	4.0	4.1
Peach and apricot	1.6	1.5	1.5	1.5	1.5

Source: Authors' own calculation on the basis of data from Statistical Yearbook of the Republic of Moldova 2019, Chisinau 2019 and Statistical Yearbook of Agriculture 2019, Warsaw 2020 [25, 26].

The area of orchards in Moldova and Poland in 2014-2018 is presented in Table 1. Apple trees prevail in the structure of orchards in both countries. In the analyzed period, they accounted for 56 to 59% of the orchard area in Moldova. In Poland, the share of apple trees in orchards was 70-73%. In the case of Moldova, plums, whose share in the orchard area ranged from 20-22%, and peaches with 7-8% in the orchard area, played an important role in the orchard area. On the other hand, in Poland, apart from apple trees, cherries had a significant share in the orchard area, with about 12%. In the case of other fruit plants in Poland, their share did not exceed 8% of the orchard area (Table 1). The varied surface structure of orchards in the studied countries may result from natural conditions. Moldova has a milder climate than Poland, therefore peaches and apricots have a greater share in the structure of fruit crops. Poland, on the other hand, has good natural conditions for apple cultivation, therefore their share in the structure of fruit crops in Poland is the highest (Table 1).

The production of fruit from orchards in the years 2014-2018 in Moldova and Poland was characterized by an increase, however, with significant differentiation in individual years (Table 2).

Table 2. The volume of fruit production from trees and their structure in Moldova and Poland in 2014-2018

Specification	2014	2015	2016	2017	2018
Moldova					
Total, in thousands of tonnes	477.3	467.5	570.0	634.5	857.4
share, in %					
Apple	77.5	65.8	72.2	76.8	77.6
Pear	1.0	1.3	0.9	0.7	0.6
Plum	15.3	21.4	17.5	14.7	15.5
Sour cherry	0.9	1.3	0.7	0.8	0.9
Sweet cherry	1.6	2.7	1.3	1.7	1.4
Apricot	1.5	2.2	3.8	2.1	1.1
Peach	2.1	5.3	3.6	3.3	2.9
Poland					
Total, in thousands of tonnes	3,611.9	3,572.8	4,055.6	2,651.5	4,483.9
share, in %					
Apple	88.5	88.7	88.9	92.1	89.2
Pear	2.0	1.9	2.0	2.1	2.0
Plum	2.9	2.7	2.7	2.2	2.7
Sour cherry	4.9	5.0	4.8	2.7	4.5
Sweet cherry	1.3	1.3	1.3	0.7	1.3
Peach and apricot	0.3	0.3	0.3	0.2	0.3

Source: Authors' own calculation on the basis of data from Statistical Yearbook of the Republic of Moldova 2019, Chisinau 2019 and Statistical Yearbook of Agriculture 2019, Warsaw 2020 [25, 26].

The variability of the harvest in the following years was largely due to weather conditions. In Moldova, the increase in production was around 80%, and in Poland around 20%. This differentiation resulted from a larger scale of production in Poland than in Moldova. In addition, it can be concluded that fruit production in Poland is well developed, while in Moldova this development is still progressing.

Apples dominate in the structure of fruit production from trees in both analyzed countries. Their share in fruit production is higher than that in the orchard area due to higher yields than in the case of other fruit plants (Table 3). In Moldova, plums also had a relatively large share (15-21%) in fruit production. The share of other fruits usually did not exceed 5% of fruit production in Moldova. On the other hand, in Poland, apples accounted for 88-92% of fruit production in the analyzed period. Among the remaining fruits, cherries were of the greatest importance (3-5% of fruit production).

Table 3. Yields of fruit from fruit trees in Moldova and Poland in 2014-2018, tonnes per hectare

Specification	2014	2015	2016	2017	2018
Moldova					
Apple	8.3	5.6	7.8	9.1	12.9
Pear	2.8	3.0	2.0	1.6	1.9
Plum	1.7	2.0	1.3	1.2	2.2
Sour cherry	3.1	3.9	2.3	3.0	3.3
Sweet cherry	2.9	3.5	6.6	3.6	2.5
Apricot	1.9	3.2	2.7	2.8	3.7
Peach	4.6	5.3	5.1	4.7	6.7
Poland					
Apple	18.1	17.6	20.3	13.8	22.8
Pear	7.4	7.5	10.4	7.1	11.8
Plum	6.4	6.8	7.5	4.1	8.4
Sour cherry	5.5	6.1	6.6	2.4	6.9
Sweet cherry	4.5	5.1	5.6	2.1	6.1
Peach and apricot	3.0	3.3	3.1	1.5	3.3

Source: Authors' own calculation on the basis of data from Statistical Yearbook of the Republic of Moldova 2019, Chisinau 2019 and Statistical Yearbook of Agriculture 2019, Warsaw 2020 [25, 26].

There were no significant changes in the structure of fruit production from orchards in Moldova and Poland in 2014-2018. In most cases, the differences in the structure of fruit production in the analyzed years did not exceed 1 percentage point. The exception in the case of Poland is the production of sour cherries in 2017, when their share in fruit production decreased by over 40% compared to the previous year, which resulted from a drop in yields of over 4 tons per hectare. This was due to the fact that 2017 was characterized by bad weather conditions for fruit cultivation and the yields this year for all species of fruit plants in Poland were significantly lower than in the other analyzed years (Table 3). Additionally, in the case of cherries, the increase in purchase prices was not as high as in the case of other fruits, which resulted in a decrease in their share in the value of pollination of fruit plants.

The yielding of fruit plants results from many factors, related both to the species and varieties of cultivated plants, as well as to the production technology and natural conditions. When comparing the yield of fruit plants in Moldova and Poland, it can be noticed that in Poland, significantly higher yields were obtained in most species than in Moldova. This is due to the greater specialization of agriculture in Poland than in Moldova. Only in the case of peach and apricot yields, the differences can be considered slight, which may result from better natural conditions for growing these plants in Moldova than in Poland.

Economic value of pollination of fruit plants in Moldova and Poland - comparative analysis

Pollination is an essential procedure to obtain fruit from orchards. Most often, pollination of plants is carried out using the honey bee. The economic value of pollination is estimated to indicate the importance of this treatment for horticulture. It can also be the basis for determining the value of paying a beekeeper for using bees for pollination or for creating apiculture policy.

The value of pollination of fruit plants in 2014-2018 in Moldova increased almost threefold, from EUR 34 million in 2014 to almost EUR 96 million in 2018 (Table 4). It was influenced by both the increase in the

area of horticultural crops and the increase in the purchase prices of the produced fruit. In Poland, in the same period of time, the value of pollination in orchards also increased from almost EUR 513 million in 2014 to EUR 680 million in 2018 (Table 4). The lower growth rate of the pollination value in Poland compared to Moldova resulted from relatively small changes in the production volume. It is also worth noting that the highest value of pollination of fruit plants was achieved in both countries in 2017.

Table 4. The economic value of pollination of selected fruit plants in Moldova and Poland in 2014-2018, EUR million

Specification	2014	2015	2016	2017	2018
Moldova					
Total, in million EUR	33.8	57.7	64.1	102.0	95.7
share, in %					
Apple	66.4	64.7	71.1	76.1	73.5
Pear	1.6	1.9	1.0	0.8	1.0
Plum	13.4	15.2	12.1	11.7	11.4
Sour cherry	2.9	3.4	2.3	2.0	3.1
Sweet cherry	8.1	7.0	3.9	4.1	5.6
Apricot	3.5	2.9	5.5	2.4	2.1
Peach	4.1	4.9	4.1	2.8	3.4
Poland					
Total, in million EUR	512.9	713.8	596.2	694.8	679.6
share, in %					
Apple	70.8	74.3	73.1	77.1	77.0
Pear	4.1	3.3	4.3	3.4	4.3
Plum	2.7	3.3	3.4	3.3	2.5
Sour cherry	8.8	9.2	9.1	8.7	6.7
Sweet cherry	12.3	8.4	8.6	6.4	8.6
Peach and apricot	1.3	1.6	1.5	1.1	1.0

Source: Authors' own calculation on the basis of data from Statistical Yearbook of the Republic of Moldova 2019, Chisinau 2019 and Statistical Yearbook of Agriculture 2019, Warsaw 2020; National Bank of Moldova (BNM); National Bank of Poland (NBP) [20, 21, 25, 26].

In the case of Poland, it was the year with the lowest fruit production among the analyzed years. The highest value of pollination this year resulted from high purchase prices. Therefore, it can be concluded that in the years of crop failure, the purchase prices increase more than the decrease in production. The same was true in Moldova, where despite the higher fruit production in 2018 by more than 30% than the year before, the estimated value of pollination in orchards was higher in 2017.

The differences in the global value of pollination of fruit plants in Moldova and in Poland result from a significant difference in the size of the studied countries. Therefore, it is worth comparing the estimated values of pollination of fruit plants per hectare of orchards.

The average value of pollination in an orchard in Moldova in 2014 was EUR 447.6 per hectare and was almost five times lower than in Poland (Table 5).

This difference resulted from lower yields and lower fruit purchase prices in Moldova compared to Poland.

Table 5. The economic value of pollination of selected fruit plants in Moldova and Poland in 2014-2018, EUR per hectare

Specification	2014	2015	2016	2017	2018
Moldova					
Apple	500.1	677.7	862.1	1,445.8	1,360.0
Pear	300.5	555.3	258.0	303.7	330.9
Plum	364.9	625.5	456.2	496.0	832.1
Sour cherry	1,115.9	1,262.4	770.0	1,154.5	1,429.8
Sweet cherry	479.2	555.5	1,085.1	682.3	533.0
Apricot	259.5	368.1	354.6	376.3	487.4
Peach	284.8	461.1	397.5	609.2	548.4
Average	447.6	619.7	697.2	1,073.3	1,038.7
Poland					
Apple	2,060.6	2,939.3	2,460.7	3,037.6	2,981.3
Pear	2,088.5	2,530.8	3,259.1	3,047.6	3,770.7
Plum	846.4	1,708.0	1,412.5	1,602.2	1,163.4
Sour cherry	1,405.7	2,208.6	1,853.7	2,055.0	1,556.4
Sweet cherry	5,860.2	6,286.1	5,304.1	4,609.5	5,987.7
Peach and apricot	1,601.6	3,159.7	2,345.1	2,150.7	1,832.9
Average	2,053.6	2,899.2	2,461.5	2,881.6	2,830.2

Source: Authors' own calculation on the basis of data from Statistical Yearbook of the Republic of Moldova 2019, Chisinau 2019; Statistical Yearbook of Agriculture 2019, Warsaw 2020; National Bank of Moldova (BNM); National Bank of Poland (NBP) [20, 21, 25, 26].

In the following years, the differences between the value of pollination of an orchard hectare in Moldova and in Poland decreased

and in 2018 the average value of pollination of an orchard hectare in Moldova was approximately 1.8 times lower than in Poland.
In Moldova, the highest estimated pollination values were for cherries and apples. This was due to the relatively highest yielding of these crops as compared to other fruit plants in Moldova. Additionally, in the case of cherries, the high purchase prices of these fruits had an impact on the high pollination value, compared to other fruits from trees.
In Poland, the highest pollination value was estimated for sweet cherries in all the years studied. The value of hectare pollination in these orchards was estimated at EUR 4,610-6,286 per hectare (Table 5). Such a high value of pollination resulted mainly from the high purchase prices of cherries, significantly higher than in the case of other fruit from trees in Poland. For other tree fruits, the orchard hectare pollination value was at least EUR 2,000 lower. The lowest pollination values for fruit trees were obtained in Poland for plums and cherries, for which the pollination value in 2018 was EUR 1,153 per hectare and EUR 1,556 per hectare, respectively.
The diversity of the pollination value of fruit plants in Moldova and Poland was significant. The increase in fruit purchase prices in Moldova in the analyzed period resulted in a significant increase in the estimated value of pollination in orchards. In the case of Poland, the average value of pollination in orchards was more stable. However, the presented values still differ significantly in individual years.

CONCLUSIONS

Pollination of entomophilous crops is a critical procedure that determines the possibility of obtaining a crop. Their amount and quality largely depend on the pollination most frequently carried out by bees.
Horticultural plants are a group of cultivated plants, the yield of which depends to a large extent on pollination by insects. This share in the literature is usually estimated at 70% to 100% of the yield. This proves the key role of pollinating insects in obtaining crops of these plants.
The conducted research allows to conclude that the value of pollination of fruit plants in Moldova and Poland varies depending on the plant species and the year of research. This is due to the diversity of plant yields in the following years, as well as the volatility of the purchase prices of fruit.
The estimated value of pollination in orchards in Moldova in 2014 amounted to EUR 33.8 million and increased to EUR 95.7 million in 2018. In Poland, this value increased from EUR 512.9 million in 2014 to EUR 679.6 million in 2018. The difference in the value of pollination results, among others, from countries of various sizes. Per hectare of orchards, the value of pollination in Poland was 1.8 to almost five times higher than in Moldova. This was due to the higher productivity of orchards in Poland than in Moldova and higher fruit purchase prices.
The presented results indicate a decisive role of pollinating insects, especially honey bees, in the obtained yields of fruit plants. It is also worth paying attention to the fact that the pollination of orchards by insects not only determines the amount of crops, but also improves their quality..

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STUDY ON THE ROLE OF TRANSFER PRICES IN CONSOLIDATION OF THE TAX BASE AND IN DETERMINING THE TAXABLE PROFIT OF THE GROUP OF COMPANIES

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Abstract

In a globalized economy in which more and more companies are operating, expanding their activity in different fields and by setting up different groups of companies, covering different markets, the issue of transfer pricing is not only important, but also necessary in considering the implications that they have not only on the profitability of the companies, but also on the budgets of the states of which they are part. In this paper we aimed to analyze the not easy issue of transfer prices, exemplifying through case studies, the choice and use of various valuation methods that aim to strengthen the tax base and determine the taxable profit within the group of companies in a way that is as correct as possible and that does not have fiscal consequences on them. The methods used were: the price comparison method, the plus cost method, the resale price method and the profit sharing method. The study highlighted that the application of the methods is based on the characteristics of the entities, the characteristics of the transactions subject to analysis and the comparability of the data. But regardless of the applied method, the preparation of the transfer pricing file is useful both for the fiscal authorities and for the entities, considering the fact that they can contribute to the increase of the company's profitability and to the assurance of competitive advantages.

Key words**:** *transfer prices, taxation, profitability, fiscal group*

INTRODUCTION

Globalization is a complex phenomenon in which geographical distances are no longer a determining factor in establishing economic, political, social or cultural relations [1]. In turn, economic globalization is a gradual integration of national economies into a process that continues to diminish the importance of borders for economic activities, and financial globalization makes the economies of the world's states interdependent due to the existence of many channels through which it is transmitted, which makes international tax authorities concerned with strengthening control frameworks and correcting financial imbalances. And transfer pricing is such a measure, but it is more than a fiscal challenge that has been regulated by the OECD, which published the document "Transfer Pricing Recommendations for Financial Transactions". These recommendations, although mandatory, represent references that target a wide category of financial transactions (intra-group loans, hedging operations, cash-pooling mechanisms, etc.) [8], [2]. Transfer pricing is in fact a business opportunity based on strategic decisions taken within a company, being an important tool that underlies revenue growth and measuring the performance of activities [7].

Therefore, at the level of the European Union, as a result of the increasing complexity of fiscal aspects, the legislative initiatives aimed to simplify both the point of view of tax administrations and the point of view of corporations, which had to comply with tax rules from the countries with which they carried out economic activities.

Because there are different tax rules at national level, conflicts of interest may arise between tax administrations and corporations, and a lack of administrative coordination

between tax jurisdictions may lead to capital outflows and loss of tax revenues.

Member States' national fiscal policies seek to protect national tax revenues, especially in countries with high taxation, and one of the tools to limit these effects is transfer pricing. This also ensures the increase of the efficiency of income taxation as a result of the significant simplification of the way of declaring the profit that is obtained by the corporations. In this way, the level of prices at which intragroup transactions are made will no longer influence the profit tax due.

Although the application of the transfer pricing mechanism aims at the proper taxation of profits made globally, most countries, in trying to protect the tax base have applied the "market value principle" when assessing transfer pricing and which involves valuing group prices ratio of prices applied to each category of transaction, for companies acting independently in the market, without being part of a group.

In addition to its advantages, however, economic globalization reduces the ability of tax administrations to verify the accuracy of transfer pricing. And the recommendation of the rules regarding the transfer prices, and their implementation makes the companies have to elaborate complex documentation regarding the formation of the transfer prices in the countries where they carry out economic activities [9].

The application of various transfer pricing methods is increasingly complex and costly, on the one hand due to the difficulties of identifying uncontrolled comparable transactions and on the other hand due to the multiple training rules applicable at EU level, which make transfer pricing documentation one of the important tax issues facing companies.

In Romania, the legislation on transfer pricing has existed since 2008, but the obligation to prepare the transfer pricing file was introduced in 2016, and since 2020 National Agency of Fiscal Administration (ANAF) has set up a department that performs risk analysis and deals with the verification of transfer pricing, which that the issue of transfer pricing should get more concern from both companies and state institutions. Because the taxation of multinational groups is a topic of discussion in the Romanian and European public space, the tax authorities check the way in which the companies that are part of these groups comply with the legislation in force. We must also take into account the fact that a policy to prevent and combat a phenomenon is less expensive and much more efficient than the costs generated by the globalization of its consequences [6].

It even makes the risk of transfer pricing exist, it is associated with many more opportunities related to efficient tax planning and management. That is why in this field we can talk about a transfer pricing management that has its advantages and must be applied by companies. However, the adoption of decisions must be done at a global and consistent level so as to allow companies to avoid the different interpretations that exist at the level of national tax authorities, thus avoiding inconsistency. Secondly, a cost efficiency can be ensured in the conditions in which it starts from a global strategic analysis [5]. Third, this global approach will allow companies to better manage the risks that are associated with tax costs. And last but not least, the global analysis also allows the improvement of the performance measurement method.

MATERIALS AND METHODS

The methods that are applied in testing the conformity of transfer prices with the market value principle, and which are also provided in the Fiscal Code, are: price comparison method, resale price method, cost plus method, net margin method, profit sharing method, other methods.

Methods are used both by companies for tax planning purposes, but also for documenting the transfer prices they practice, and tax authorities use them to test the market value of transactions that take place between people and are the basis for determining real profits, that is, those that would have been obtained in the absence of an affiliation relationship between the parties [3].

The method of comparing prices consists in comparing the prices used in transactions between affiliated parties and which are called "controlled prices", with the prices used in transactions between independent parties which are called "uncontrolled prices" and which represent the key factor of this method internal or comparable external.

Internal comparables apply if any of the related parties carries out transactions with independent parties, with the same category of product or services, in economic conditions that are comparable (Figure 1).â

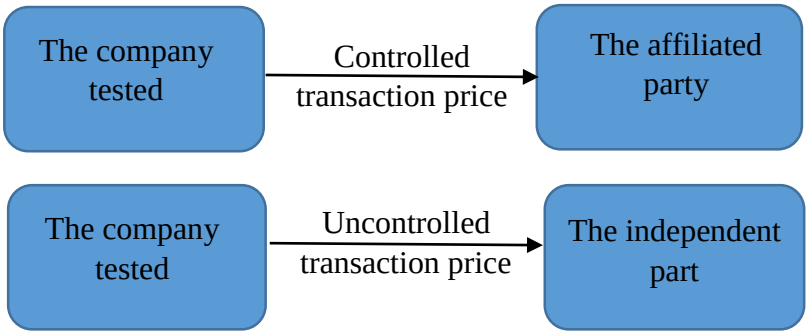

Fig. 1. Internal controllables
Source: own processing.

External comparables apply in situations where we have information on prices charged in transactions that take place between independent, unaffiliated parties that trade the same category of product or service (Figure 2).

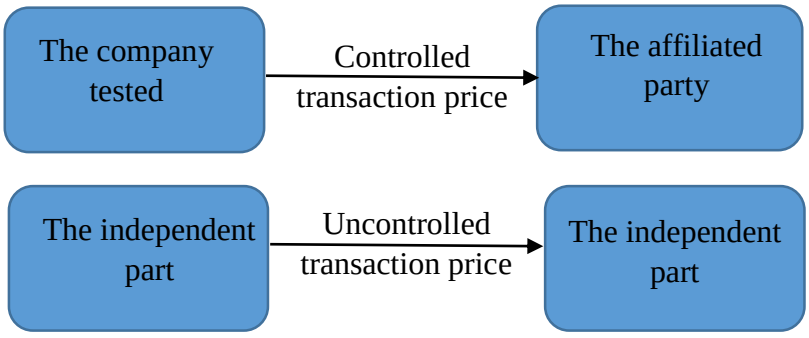

Fig. 2. Externally controllables
Source: own processing.

The cost plus method is a method that applies especially to entities that carry out production or service activities and involves the use of accounting information on production costs and revenues from the sale of products or services. The method involves comparing the gross margins related to the costs obtained by the economic entity in its relationship with related parties, with the gross margins related to uncontrolled transactions, allowing aggregations of homogeneous product categories. It uses the same categories of controllable, internal (Figure 3) and external (Figure 4).

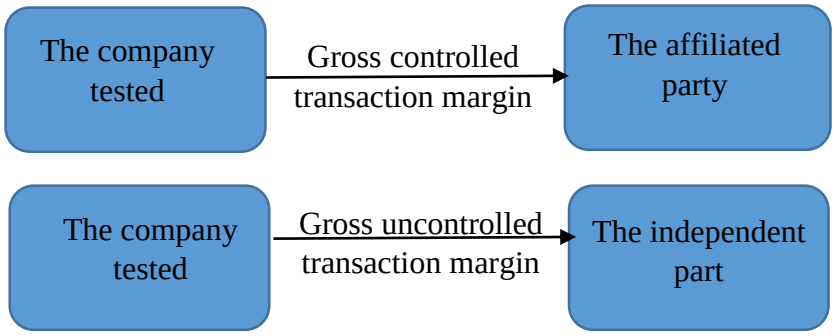

Fig. 3. Internal controllables
Source: own processing

Given that financial statements, even those that meet international financial reporting standards, do not allow an accurate comparison, due to the fact that the determination of gross margin is influenced by the cost categories used in its calculation, the use of external comparables is not used current [4].

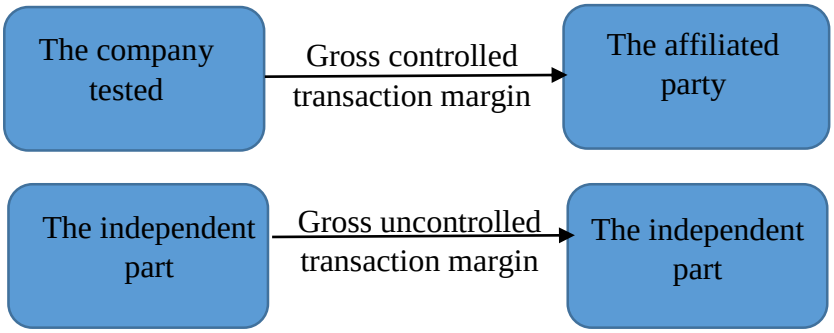

Fig. 4. Externally controllable
Source: own processing.

In the case of using internal comparables, the gross margins can be calculated in the same way as in the case of transactions between the company and the affiliated parties, which makes the method more accessible.

The resale price method is used in resale activities and is used in the case of production activities and services, assuming the observance of the same principle as in the case of the cost plus method. Gross margin is determined based on data from the statutory financial statements, which means that external comparables can be used, and profitability is determined taking into account revenues, not expenses, and profitability indicators are determined at the level of net margin [10]. Given that net margins are used, the selection of comparables is more permissive due to the fact that in addition to differences in the characteristics of products or services, minor differences in the functional profile are allowed.

The profit sharing method is used in the case of interconnected activities that do not allow separate valuation. The method has a high degree of subjectivity because these situations are rarely encountered in practice.

RESULTS AND DISCUSSIONS

In order to exemplify the application of the methods of testing the conformity of transfer prices, the case study involved the analysis of the data provided by the financial statements of some groups of economic entities, as well as the data provided by their management accounting. Alpha is in a relationship with Betha, which is a supplier of goods, and

Ghama, a third-party company, which is also a supplier of goods. Alpha is a distributor of goods for other categories of economic entities, without carrying out market prospecting activities. The analysis will involve: determining the method of compliance of transfer pricing; determining the sales margin, determining the commercial profitability rate. Considering the activity characteristics of the company, the procedure used will be that of internal comparability. In order to determine the Commercial Profitability Rate, that is the profitability of sales, we will start from the management accounting data that are centralized in Table 1.

Table 1. Determining the Commercial Profit Rate

Analyzed quality criteria	Betha	Ghama
Turnover (thousand lei)	6,480	9,720
Expenditure on products (thousand lei)	5,503	7,815
Gross margin (thousand lei)	977	1,905
Transfer price (thousand lei)	5,503	7,815
Commercial profitability rate (%)	15	20

Source: own processing.

Given that the commercial rate of return on transactions between Alpha and Betha is 15% and the rate of commercial return on transactions between Alpha and Ghama was 20%, an adjustment is expected, following a fiscal control, for the rate profitability in the relationship between Alpha and Betha from 15% to 20%. Therefore, the recalculated profit will be 1,296 thousand lei, and the additional profit tax will be 207.36 thousand lei.

The following case study analyzes the situation of transfer prices within the company Avantaj S.A., a start-up founded in 2017.

The company carries out custom production activity, purchasing raw materials from the New Era Company based in France, which delivers the finished products. Some of the products obtained are sold to customers in Romania. The price of the services provided to New Era is calculated on the basis of the tariff/piece. The analysis period is 2018-2019. In Romania, the transfer of goods is made both with transfer of ownership and without transfer of ownership. The data in the Profit and Loss Account are presented in Table 2.

Table 2. Profit and loss account for Avantaj Company

Indicator	2018	2019
Revenue from services rendered (thousand lei)	8,164	7,867
Revenues from the sale of products (thousand lei)	1,170	1,162
Total operational income (thousand lei)	9,334	9,029
Expenditures on raw materials and consumables (thousand lei)	429	356
Energy and water costs (thousand lei)	195	260
Personnel expenses (thousand lei)	1,456	1,703
Depreciation expenses (thousand lei)	4,654	4,990
Other operational expenses (thousand lei)	3,085	1,460
Total operational expenses (thousand lei)	9,793	8,769
Operational result (thousand lei)	-459	260
Result from the financial activity (thousand lei)	126	135
Gross result (thousand lei)	-333	395
Profit tax (thousand lei)	0	66
Net result (thousand lei)	-359	329

Source: own processing.

The statement of income, expenses and operating result is presented in Table 3.

The chosen method will be that of the net margin because the company not providing services to third parties will not be able to find data on transactions between independent entities, therefore the method of price comparison is excluded. Since the

transactions between Avantaj and New Era can be analyzed separately, without the use of these and fixed assets, then we will not be able to use the profit sharing method either. And because there is no perfect comparability between the company's transactions and the transactions of independent entities for comparisons, we did not choose the cost-plus method either. Therefore, the analysis will be performed using the net margin method, which involves determining profitability through Net Cost Plus (NCP).

It is found that the level of operating profit (Net Cost Plus) is 3.11% in 2019, and in 2018 the value is negative, the loss rate being 4.93%.

Furthermore, the level of operational profit is compared with the interquartile range obtained for comparable companies.

Table 3. Profit and loss account for Avantaj Company

Indicator	2018	2019
Operational income (thousand lei)	9,334	9,029
Operational expenses (thousand lei)	9,793	8,769
Operational result (thousand lei)	-459	260
Net cost plus (NCP) (%)	-4.69	2.96

Source: own processing.

The interquartile range is a tool used to eliminate some of the differences between the tested entity and the calculated results. However, neither the fiscal legislation of the European Union nor that of Romania expressly provides for the manner of conducting the comparison made between the results of the analyzed entity and the calculated interquartile range. Therefore, there were no restrictions on the use of data for several years.

Table 4. Comparison of NCP with interquartile range values

	2018	2019
Minim (%)	0.03	0.05
Q1 (%)	2.35	3.44
Median (%)	3.52	4.58
Q3 (%)	5.87	7.63
Maxim (%)	12.45	22.44

Source: own processing.

The minimum is represented by the lowest value of the profit level in the comparison sample used, the median is the middle value of the sample, and the maximum is represented by the highest value in the sample.

The two quartiles, Q1 and Q2 represent the values below which, respectively, above which 25% of the comparison sample falls.

Based on the calculated data, they will identify the risks that may affect the company Avantaj, respectively the highest risk (Table 5), as well as the lowest risk (Table 6).

Table 5. Identifying the highest risk for Avantaj Company

Indicator	2018	2019
Q1 (%)	2.35	3.44
Median (5)	3.52	4.58
Q3 (%)	5.87	7.63
NCP (%)	-4.93	3.11
Difference of result (thousand lei)	343	140

Source: own processing.

In this case, the highest risk for the entity is that of adjusting the rate of return at the level of the median rate, which will lead to the adjustment of expenses and differences in results of 343 thousand lei in 2018 and 140 thousand lei in 2019, which will involve the payment of an additional tax in each of the two years.

Table 6. Identifying the lowest risk for the Avantaj Company

Indicator	2018	2019
Difference of result (thousand lei)	314	117

Source: own processing.

The lowest risk occurs when the company decides to adjust the rate to 3.2% for 2018 and 4.3% for 2019, which brings an adjustment of the tax due, lower than in the first option.

Giving this example, we may consider that in case of agricultural companies, whose profile expose them to the climate factors both the vegetal and animal sector, where productions are uncertain, prices for farm inputs are higher and higher and production costs as well, price level of the agricultural products depends on various factors, first of all on the demand/offer ratio, product quality, contractual risks, and market opportunities. Price/cost ratio is a conditional factor which determines efficiency and profitability at the product level in agriculture.

CONCLUSIONS

Due to the importance of transfer pricing, groups of entities are much more concerned with this issue and have begun to pay much more attention to the management strategy applied to transfer pricing globally, in order to improve performance.

Proper documentation of transfer pricing has the advantage of providing an overview of the market in which the group operates, but also offers the advantage of understanding how a business operates within the group or the specific relationships between the parties affiliated, which will lead to the identification of opportunities related to tax planning of economic entities.

Or this fiscal planning can be reflected by the improvement of cash flows, by the performance indicators and by the possibility of realizing the development plans.

Although the preparation of the transfer pricing file is not an easy task, if the principles of preparation are observed and the appropriate methods of comparison are chosen, transfer pricing can lead to increased efficiency of the activity and even to ensure a commercial advantage over competing companies.

Each of the methods has its advantages and disadvantages, they have certain characteristics that underlie their choice. Thus, the decisive factor in choosing the price comparison method is the similarity of the products that are subject to analysis from the point of view of the transactions made; the cost plus method requires the identification of the categories of expenses that will be the basis for determining the costs; the resale price method is based on and applied in relation to the similarity of functions, risks and contractual terms; the net margin method has the advantage that it is less influenced by the differences that occur at the time of trading and that directly influence the price. At the same time, net margins are less sensitive to some functional differences that occur between controlled and uncontrolled transactions compared to gross profit margins, thus allowing the identification of both uncontrolled transactions and comparable companies.

In conclusion, the choice of the method differs from one company to another, and the opportunity to choose one of the methods is influenced by the characteristics of the analyzed transactions.

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THE IMPACT OF THE COVID-19 CRISIS ON TOURISM AND ITS RECOVER POSSIBILITIES

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Abstract

The Covid Crisis - 19 meant for each of us an experience that we have never lived before and that we saw as a form of isolation from all that means socially, the negative impact on the economy being at the same time an undisputed one. And yet, can't it be the beginning of a new path? Can't it also have positive effects on our lives and on the entire planet? Doesn't it mean sustainability, doesn't it mean reinvention and the beginning of a new road, more modest, more relaxed, less aggressive with the environment? In this paper we aimed to analyze how the Covid - 19 crisis has influenced the tourism industry and how this could contribute to its reinvention, to the promotion of a sustainable tourism, to the finding of new ways to practice tourism. The study is based on the analysis of different bibliographic sources, on the analysis of statistical data, on the experience of some creators of sustainable forms of tourism that could be extended and that could contribute to the good of the planet and ours.

Key words**:** *tourism, sustainability, Covid-19, solutions*

INTRODUCTION

It is true that the Covid-19 crisis had a negative impact on tourism, as well as on the entire economy. It is true that tourism was one of the sectors most affected by the Covid-19 crisis, that the losses in this sector were huge and that talking about reinventing tourism is a controversial topic, but tourists have sought and are looking for solutions that will allow them to still travel, but in risk-free places, to ensure the safety and peace they need. But this is a direction the world is already heading, because the way we spend our free time, vacations, the way we travel, has changed a lot in recent years with the awareness that the resources we benefit are limited and the lack of Reaction from us, the inhabitants of this planet, could have irreparable consequences. At this great moment, some of us are much more educated, more responsible, much more concerned with environmental protection, sustainability, how we can contribute to our own health, but also to the health of the planet. Children grew up in a responsible environment, received a more responsible education, which turned them into young people and adults involved in volunteer activities aimed at the sustainability of the environment in which we live.

And then, maybe in tourism, the time has come to restart, to find solutions to create a quality tourism, a sustainable tourism, a tourism that no longer negatively affects the tourist localities, that no longer creates discomfort, their inhabitants,

The relationship of tourism with the environment is a direct one, the practice of tourism being influenced by the existence of the infrastructure, of the tourist facilities, all these being able to contribute to the destruction of the environment [1]. On the other hand, the incomes obtained from tourism can contribute to the awareness of the practice of an ecological tourism, to the protection of the protected areas or to the financing of some environmental protection projects.

Finding a balance between increasing tourism revenues, creating responsible tourism and respecting the environment is a challenge, but it certainly has solutions [4].

MATERIALS AND METHODS

In this paper, the working methodology included two stages, the first in which a review of the literature on "sustainability in tourism" was carried out, different specialized sites were analyzed that presented information on the effects of the Covid crisis. on tourism, and a second stage which involved analyzes of statistical data provided by Eurostat, UNWTO, INSSE on how the indicators analyzed in the period 2015-2019 have evolved, as well as on their forecasts for the period 2020-2025.

The analyzed indicators referred to: the number of arrivals in international tourism; the share of the labor force in tourism, the share occupied by tourism in the GDP, The situation of world destinations, in relation to travel restrictions. Based on their interpretation, conclusions have been drawn and proposals have been made on how tourism can be restarted, at national and global level.

RESULTS AND DISCUSSIONS

As we show, tourism is an important source of income for millions of people, in many countries it contributes to ensure 20% of GDP and representing in 2019, 7% of global trade [3]. At the level of 2019, tourism represents 11.8% of GDP in Spain, 8.6% of GDP in Iceland and Mexico, 8.0% of GDP in Portugal, 7.4% of GDP in France and 6.8% of GDP in Greece.

According to Eurostat (2020) [3], the direct tourism contribution to Romania's GDP in 2019 was 2.7%. Its contribution to GDP, in the period 2015-2019, as well as the estimates made for the period 2020-2025 are presented in Fig. 1, highlighting both the decrease in 2020 and the optimistic scenario regarding its recovery after the medical crisis started at the end of 2019, as mentioned by OECD [6].

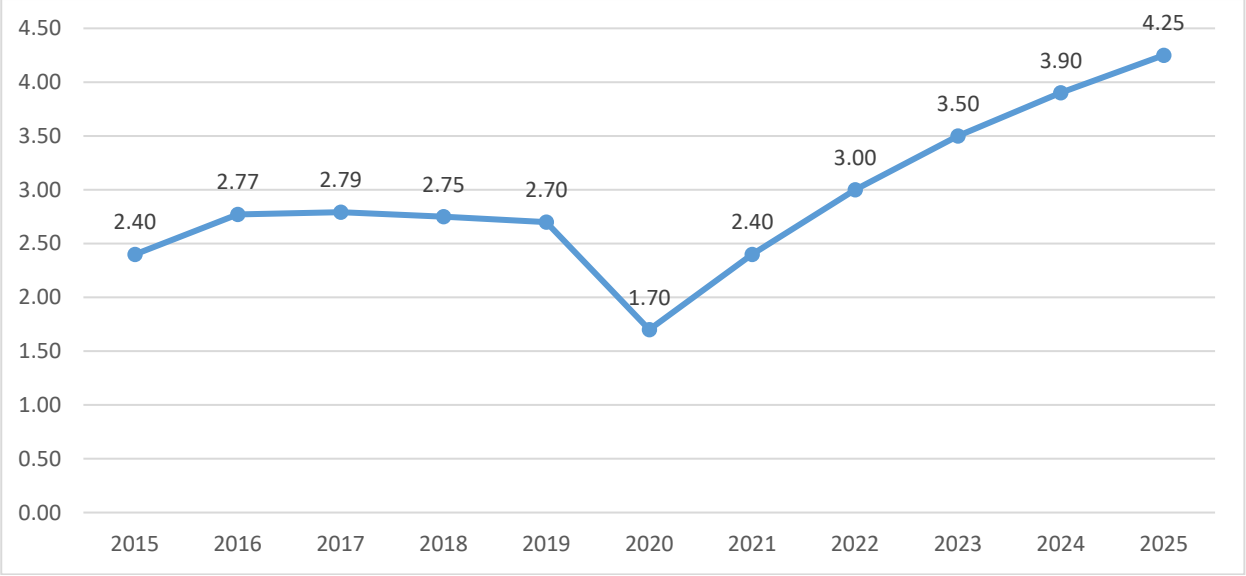

Fig. 1. The contribution of tourism to GDP in Romania (%)
Source: own processing based on Eurostat data [3].

Tourism also occupies an important place in terms of employment, along with economic, social or environmental aspects [8, 9]. Regarding the number of people working in tourism, Eurostat data show that in 2019, a significant share of the workforce is employed in tourism. In the first 10 places at European level are countries such as Greece (26%), Croatia (23%), Portugal and Cyprus (22%), Malta (17%), Austria (16%), Spain, Italy and Estonia (15 %) and Slovenia (13%). Romania has a share of 6% of the labor force in tourism, which places it among the last countries in the European Union, on the same place as Iceland, on the last place being Lithuania and Poland with 5%.

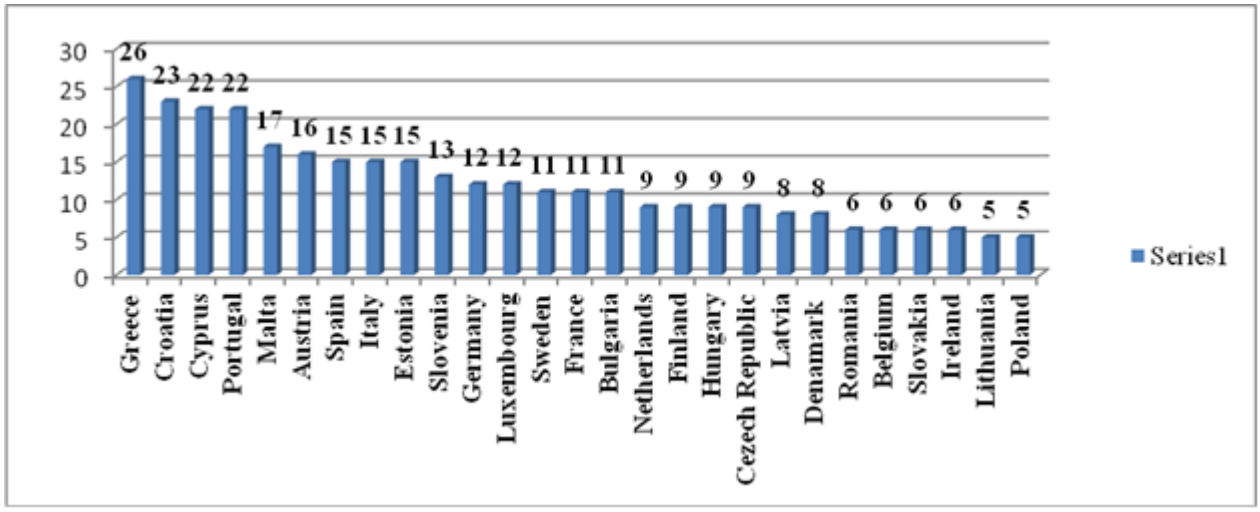

Fig. 2. The share of the labour force employed in tourism in the U.E. in 2019 (%)
Source: own processing based on Eurostat data [3].

In China, in 2019, over 80 million people worked in tourism, of which 35% were directly involved in tourism, and 65% in tourism-related activities. Also, in Thailand, about 4.5 million people worked in tourism, in almost 12% of the workforce of this country. Based on these data, we can measure the impact that the reduction or cessation of tourism-related activities has affected the population, as a result of the Covid crisis, which comes to demonstrate the limits of globalization [2].

The Covid crisis - 19 determined in the first 9 months of 2020 a decrease in tourist arrivals worldwide of 57%, decreases that by the end of the year could reach over 70%, which would determine a decrease in spending by tourists of $ 1.5 trillion and the loss of 100 million jobs directly related to tourism [11]. This is all the more serious as many of these jobs are filled by vulnerable people, which will lead to increased poverty and social inequality. Moreover, the loss of tourism revenues will contribute to the destruction of biodiversity in areas where there are no alternative resources to ensure the existence of inhabitants, in those poor and vulnerable areas [5].

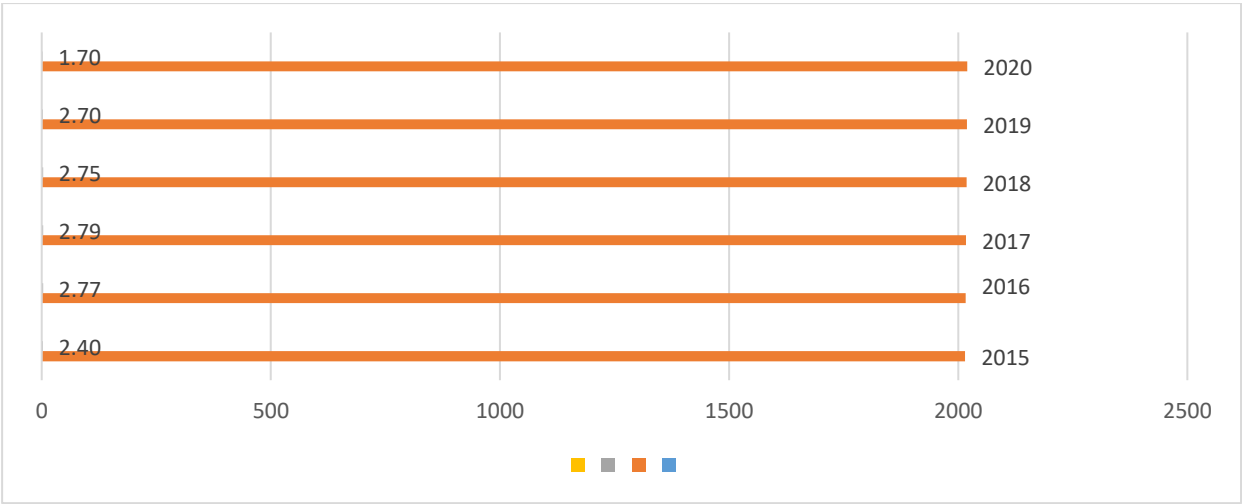

Fig. 3. International tourist arrivals situation in 2020 (%)
Source: own processing after World Tourism Organization [13].

The decrease of the number of tourists had as general cause the Covid crisis in the conditions in which in the previous year there were increases of the tourist arrivals with a catch between 2-7%.

These decreases were due to the imposition of total, partial restrictions, high restrictions or other categories of measures related to traffic in general, as a result of the Covid crisis - 19. These restrictions were imposed progressively, influencing the tourist traffic, as affirmed by UNWTO, giving examples for Italy, Spain, Austria, Malta and Portugal (Fig.4).

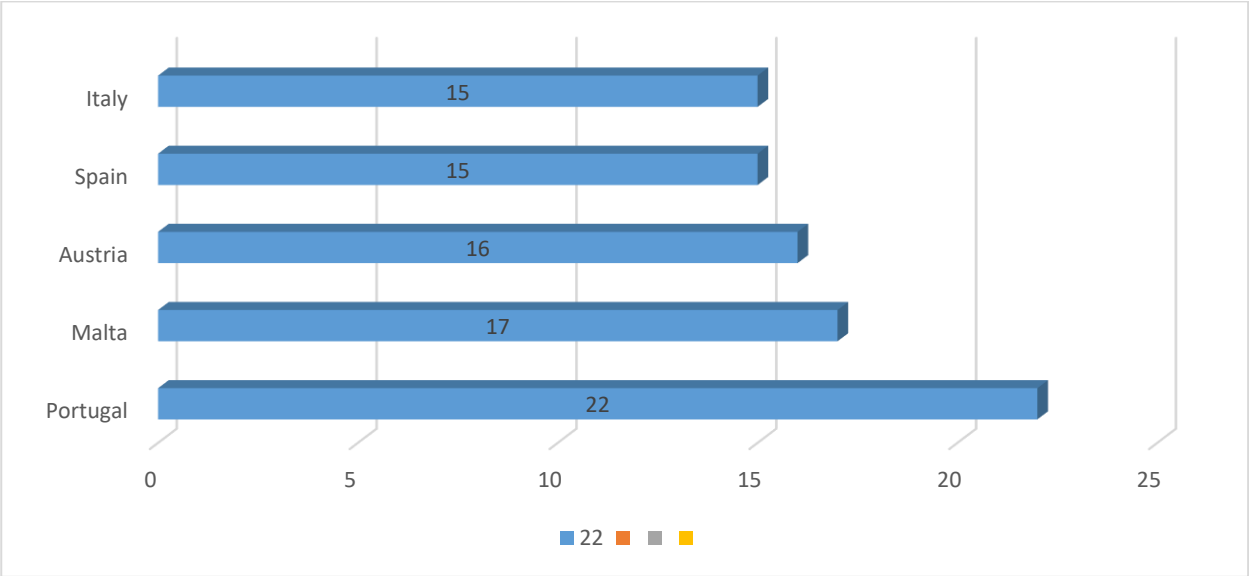

Fig. 4. The situation of world destinations, in relation to travel restrictions
Source: own processing after World Tourism Organization [11].

In the first quarter of 2020, international tourist arrivals had a decrease of 22 % what they were in 2019. In March 2020, arrivals went down by 57%, meaning a loss of 67 million international arrivals and about USD 80 billion in receipts.

The scenarios made by UNWTO [13] in March 2020 reflected "three possible patterns of monthly change in arrivals from April to December 2020 supposing that travel restrictions start to be lifted and national borders opened in early July (Scenario 1: -58%), in early September (Scenario 2: -70%) or in early December (Scenario 3: -78%).

If the urban tourism was catastrophically affected by Covid-19, the rural tourism did not suffered too much, on the contrary, tourists thought that for spending their vacations mainly in summer season it could be less risky to travel in destinations in the middle of nature, and rural, agrotourism, ecotourism have been a safer alternative. In the country side, where the population density is the smallest, it was a good opportunity to benefit if fresh air, admiring the beauty of the landscapes, enjoying visiting the local attractions and tasting the traditional gastronomy. However, even in case of rural tourism, the number of guests was not as high in the previous year [12].

Lifting the measures could mean, as it was mentioned earlier, a new beginning, a way of rethinking tourism, its orientation towards a more environmentally friendly tourism, but also friendly with tourists and city dwellers. People will want to be able to enjoy travel, nature, freedom as much as possible when they can return to a normal life, so that tourism will have to be prepared to respond to these challenges.

The criteria that tourists will take into account when choosing a destination for spending the holidays will be related to their health safety, the choice of unoccupied areas, the quality of services provided, sustainability. The place of vacations spent in traditional, crowded places, began to be taken by the vacations spent in boarding houses and smaller hotels.

Among the measures that could be taken we mention:

• Practicing a quality niche tourism that brings the same incomes, and replacing the mass one

because a larger number of tourists does not mean a sustainable tourism

•Supporting local producers that can contribute to tourism development and revenue growth, precisely because the Covid - 19 crisis has shown that dependence on world markets can bring shortcomings related to supply, transport, etc.

•The development of creativity was one of the positive effects of the Covid crisis, the appeal to the online environment, to the realization of new ways of promotion and business development. The use of mobile data in optimizing visitor flows, using the virtual world, etc. are ways that can in turn contribute to sustainable tourism.

•Awareness of the role that sustainable tourism has not only on the environment, but also on our health, can influence our decisions, so that we move from classic tourism to sustainable tourism. This could also influence tourism policies, which should move towards strategies to promote environmentally friendly tourism, reduce pollution to the detriment of consumer marketing policies.

• Tourism should mean a business model in which people come first, in which local culture is promoted, in which the environment is protected, and all measures should be taken to support these values.

• Assuring tourists about their safety, which requires the use of procedures and safety standards

• Promoting domestic tourism, because it will last until people have the courage and opportunity to make international trips

•Introducing traffic through the use of environmentally friendly means of transport (bicycles, electric scooters) that could also contribute to reducing carbon and other gas emissions from burning fuel

• Expanding pedestrian streets that will both help reduce pollution but help tourists explore the less accessible tourist attractions

• Promoting local products and cuisine, which in addition to authentic experiences offered to visitors can contribute to community development [10]

•Sustainable tourism also means luxury tourism, wellness, but practiced in a responsible and sustainable way

• Staff training, and primarily the training of young people working in tourism, can contribute to the creation of sustainable jobs and the promotion of regional tourism [7].

CONCLUSIONS

The Covid crisis has severely affected the tourism sector, both in terms of business and in terms of tourism workers.

At this moment, it is important that each of the actors involved in tourism activities be aware of the vulnerability of this sector and be prepared to take measures to reduce the shocks of future events that disrupt not only this sector, but the entire economy.

However, this crisis is also a way to rethink tourism management, to promote local resources, to ensure local incomes, to develop quality, sustainable and well-developed services.

Measures have been taken in all countries of the world to support sectors of the economy, including tourism. The use of these funds towards the development of a sustainable tourism could represent a first step in rethinking and relaunching tourism.

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MEDICAL TOURISM - HOW TO INCREASE INCOME IN THE FIELD OF HEALTH AND HOSPITALITY

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Abstract

Medical tourism is a global phenomenon that involves the movement of people outside the country of residence in order to receive medical care, given that the global market is characterized by high medical costs for the treatment of chronic diseases, especially in developed countries. This market is growing, manifesting itself in two directions, on the one hand from developing countries to developed countries that have quality medical services, and on the other hand from developed countries to developing countries, due to the affordable services from the financial point of view, Among the reasons that determine the medical tourism are diseases such as dental, fertility treatment, cosmetic surgery, ophthalmic, orthopedic, cardiovascular treatments, etc. Based on the bibliographic study and the existing data in the statistical databases, we proposed that in this paper to analyze how medical tourism has developed in recent years, and the impact it has on a country's economy.

Key words: *medical tourism, incomes, health expenses, globalization*

INTRODUCTION

Medical tourism is a form of tourism that refers to medical services provided to tourists, spa and wellness tourism, and refers to people who travel in order to improve their health, to heal, relax, prevent or improve well-being theirs.

It appeared in the late twentieth century and began to develop in the early twenty-first century. Over time, different definitions of medical tourism have been given. Thus, in 2007, Bookman et al. they defined medical tourism as "an economic activity that entails trade in services and represents the splicing of at least two sectors: medicine and tourism" [1]. Hopkins et al. they defined medical tourism as referring to "to cross-border health care motivated by lower cost, avoidance of long wait times, or services not available in one's own country" [4]. Musa et al. looked like "all the activities related to travel and hosting a tourist who stays at least one night at the destination region, for the purpose of maintaining, improving or restoring health through medical intervention" define medical tourism [6]. It results that medical tourism is a part of health tourism, the relationship between them being presented in Figure 1.

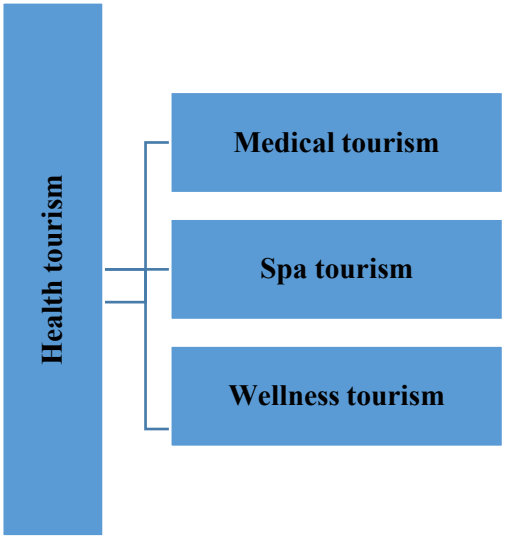

Fig. 1. Health tourism and its components
Source: Own concept.

We are talking about medical tourism, but also internally, because some of the trips and vacations spent by tourists are for medical purposes. Although its definition differs from one country to another, although it is not very well represented being considered an emerging tourism nor very well reflected in statistics, existing data show that the value of medical tourism in 2018 was 75 billion USD, ie 5 % of total tourism, providing up to 0.3% of GDP. Studies show that globally, for the period 2019-2026, this market is estimated to reach 137 billion USD [3], but the Covid crisis has negatively influenced these estimates at least for the years 2020-2021.

The emergence of medical tourism was also influenced by the changes that took place over time, the increase in living standards, the education of the population that began to be more concerned with health care, disease prevention, personal well-being, allocating an income from growing for a healthier lifestyle.

Another important aspect is related to the increase of medical expenses with the increase of life expectancy, which according to studies will determine a doubling of the population aged 60 by 2050, which makes both long-term care expenses and social expenses. to be bigger [5]. Modern technology is in turn a factor in influencing medical tourism.

The modernization of the life we live, the consumption of semi-prepared, excessively processed foods, stress, work rhythm, pollution, all being effects of urbanization have as effect an increase in the incidence of chronic diseases that generate an increase in medical expenses, but also the need to practice a relaxation tourism or a medical tourism.

On the other hand, the field of tourism has adapted to this form of tourism, through the offers it promotes, through the technology offered, through an attempt to bring income in the off-season periods as well. But there is a whole network for medical tourism, from hotel chains, to clinics and hospitals, which offer high quality services and not just complementary services,

At European level, the right to health and the facilitation of medical tourism is supported by Directive 24/2011, according to which EU citizens they are guaranteed the right to cross-border healthcare, which facilitates the settlement of medical services provided at Union level.

MATERIALS AND METHODS

In the present study we proposed an analysis of the situation of medical tourism starting from the bibliographic study of the specialized literature regarding the existing situation at world, European and national level. The study was structured in two parts, on the one hand the definition of medical tourism in various international published works, and on the other hand the collection of statistical data provided by databases, their processing using specific methodology and interpretation of information, based on which - formulated the conclusions, which present the opinions of the authors regarding the medical tourism and its development possibilities.

For Romania, the analysis of medical tourism was made based on data published by National Institute of Statistics for the period 2015-2019, analyzing several indicators: total health and medical expenses incurred by non-residents; expenses incurred by non-residents for the stay; expenses incurred by non-residents for transit; expenses incurred by non-residents for treatment and medical care; expenses incurred by non-residents for shopping; expenses incurred by non-residents for the holiday; expenses incurred by non-residents for business.

RESULTS AND DISCUSSIONS

A report by Oxford Economics and Visa in 2018 shows that annually, the number of tourists traveling for medical purposes is about 11-14 million people [12]. Another study shows that the main exporting areas for tourists traveling for health tourism are Eastern Europe, Latin America, Asia and Africa, while the importing areas for health tourism are Western Europe and North America [16]. Unlike wellness tourism or spa tourism, medical tourism does not imply the existence of a special natural setting or natural

resources that are used in the treatment of various diseases.

There are many reasons that determine the practice of medical tourism, including: the increasing incidence of diseases such as cancer that will cause travel to developed countries with a modern infrastructure. Aesthetic operations, prosthesis replacement operations, fertilization procedures are reasons that will determine people to look for solutions for medical tourism. There are also countries that, due to the legislation they have, do not allow abortion, which makes people choose countries such as Sweden or Spain for this procedure, or different types of transplants (Philippines), euthanasia assistance (Switzerland).

Dental tourism is developing more and more, but it is practiced by the population of developed countries that travel to less developed countries due to the fact that treatments are much lower in these countries (Poland, Romania).

A study published in 2020 by Elflei and Matej Mikulic and which makes a top 10 of the most important countries on the medical tourism market and conducted based on the value of the medical tourism index shows that it has values between 69.8 in India and 76.47 in Canada (Fig. 2).

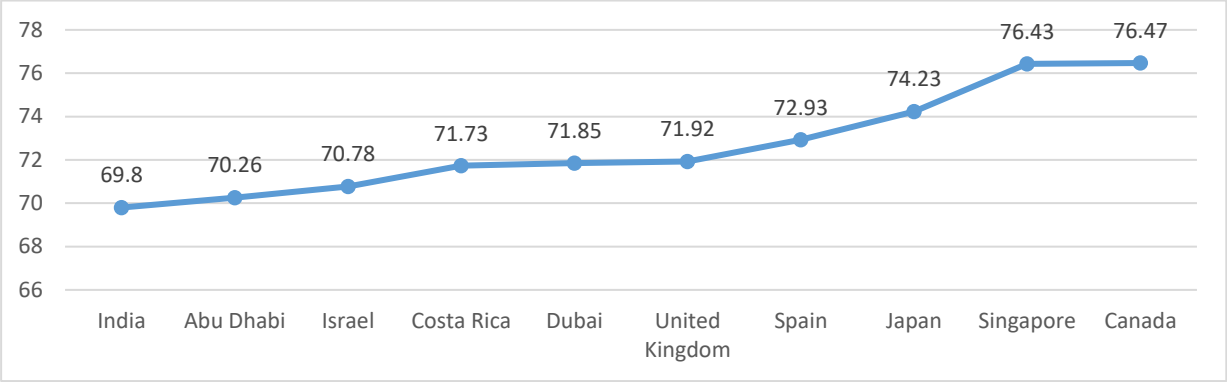

Fig. 2. Top 10 destinations in medical tourism (estimates for 2020)
Source: own processing after [2].

The index evaluates the destination country both from the point of view of the services provided, but also from the point of view of the facilities offered. Among the U.E. In this top are two countries, Spain with an index of almost 73 and the United Kingdom with an index of almost 72 [2].

The world market of medical tourism, at the level of 2016 highlights the fact that on the first place in terms of treated diseases were aesthetic treatments (20%), followed by dental and orthopedic treatments (15%) and cardiovascular and oncological treatments (13%)(Fig.3).

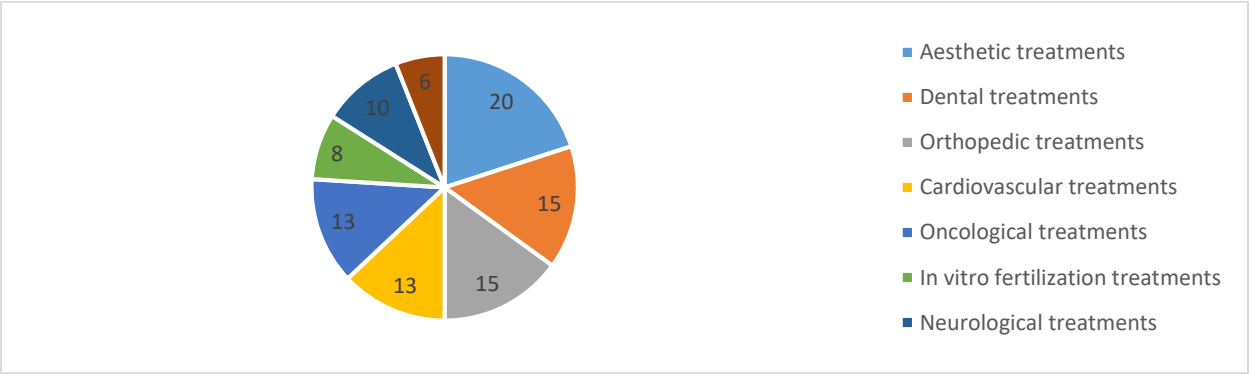

Fig. 3. The structure of the world market of medical treatments, by categories of treatments in 2016 (%)
Source: own processing.

Although there is not much data on medical tourism in Europe, data published in Stewart Conor's study shows that 5% of all U.S. citizens receive medical treatment in other EU countries (Fig.4).

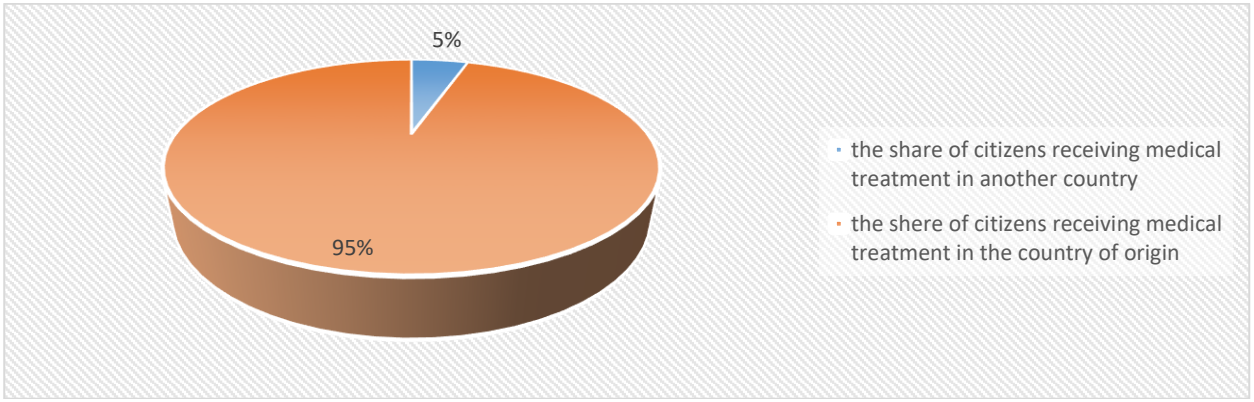

Fig. 4. The share of U.E. citizens receiving medical treatment in other EU countries
Source: own processing [15].

On the other hand, the share of citizens who would be willing to travel to another EU country to receive medical treatment, is 33% as presented in Fig.5.

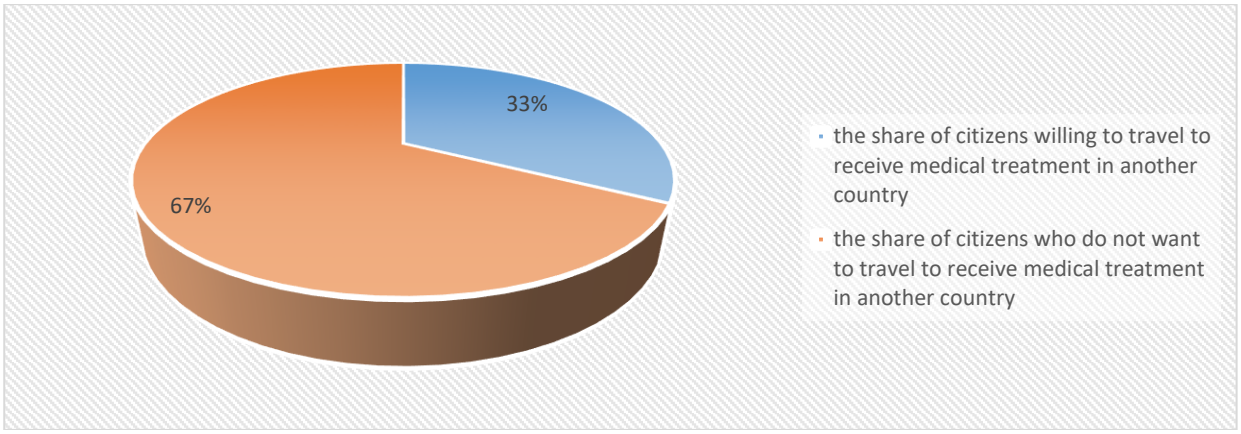

Fig. 5. The share of citizens who would be willing to travel to other EU countries for medical treatment
Source: own processing [15].

On the other hand, the share of citizens who would be willing to travel to another EU country. to receive medical treatment, is 33% (Fig. 6).

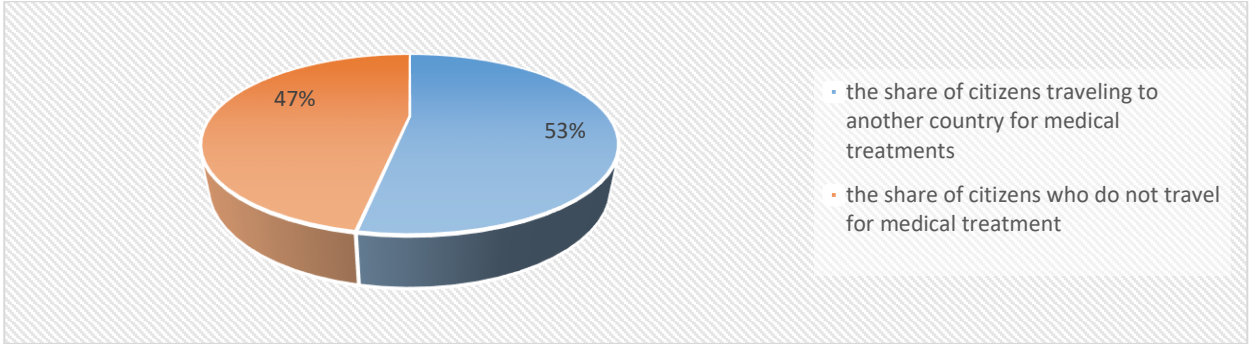

Fig. 6. The share of E.U. citizens traveling to other countries to receive medical treatment
Source: own processing [15].

Based on the data published by INS for the period 2015-2019, we analyzed the evolution of the expenses incurred by non-residents for medical services, as well as of the other expenses that accompany the stay made for this purpose. Thus, it is found that the value of health and medical expenses incurred by non-resentments increased from almost 5 million lei in 2015, to 8.5 million lei in 2017 and 2018. The decrease by 7% of these expenses in 2019 is due to the last quarter, already affected by the Covid crisis (Fig. 7).

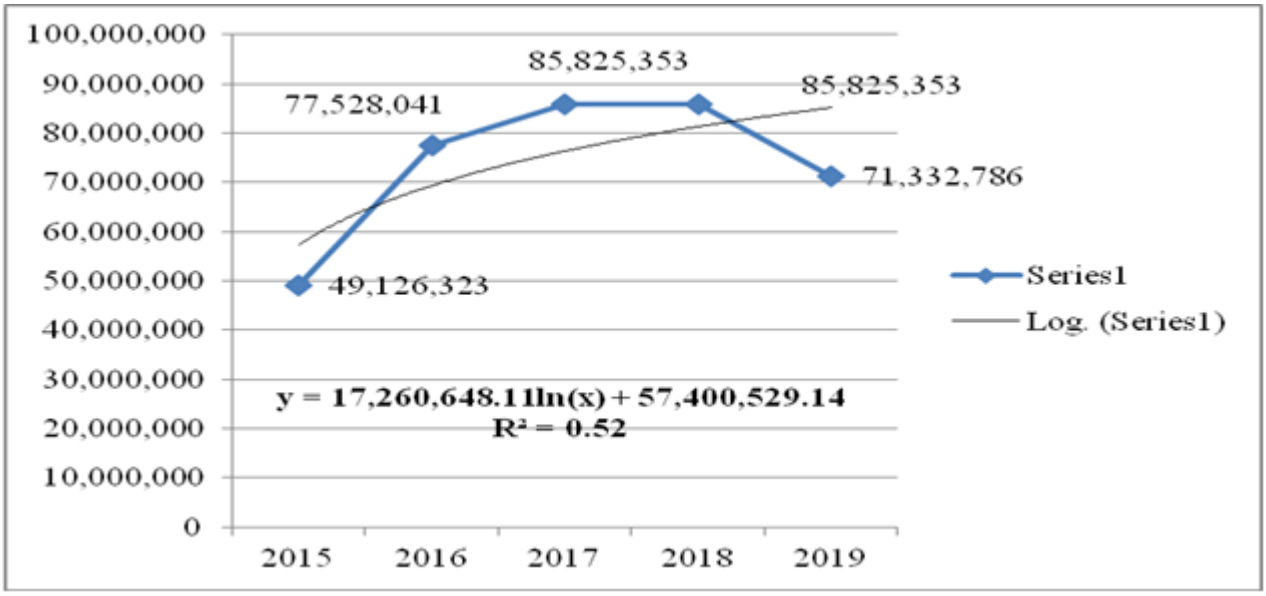

Fig. 7. Total health and medical expenses incurred by non-residents
Source: own processing [15, 7, 6, 9, 10, 11].

For the treatment and medical care of non-residents, their expenses doubled in 2019 compared to 2015, on the one hand due to the increase in the number of people who used medical services, and on the other hand due to the increase in tariffs for these services (Fig.8)

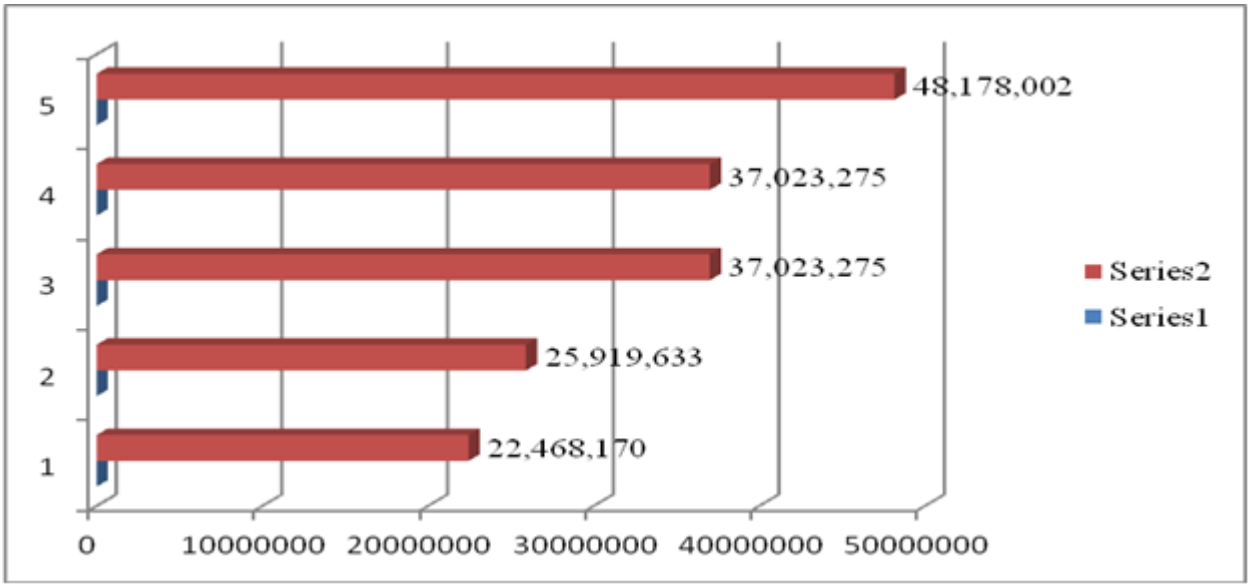

Fig. 8. Expenses incurred by non-residents for treatment and medical care, 2015-2019
Source: own processing [15, 7, 6,9,10, 11].
Note: 1-2015, 2-2016, 3-2017, 4-2018, 5-2019.

In addition to expenses incurred for medical services, non-residents also spent on other services, such as shopping or living expenses. During 2015-2019, expenses for stay

decreased due to the decrease in the number of days spent in Romania, the decrease in 2017, 2018 and 2019 being approximately 70%. The amounts spent on shopping increased from 74 thousand lei in 2015 to 355 thousand lei in 2019 (Fig. 9).

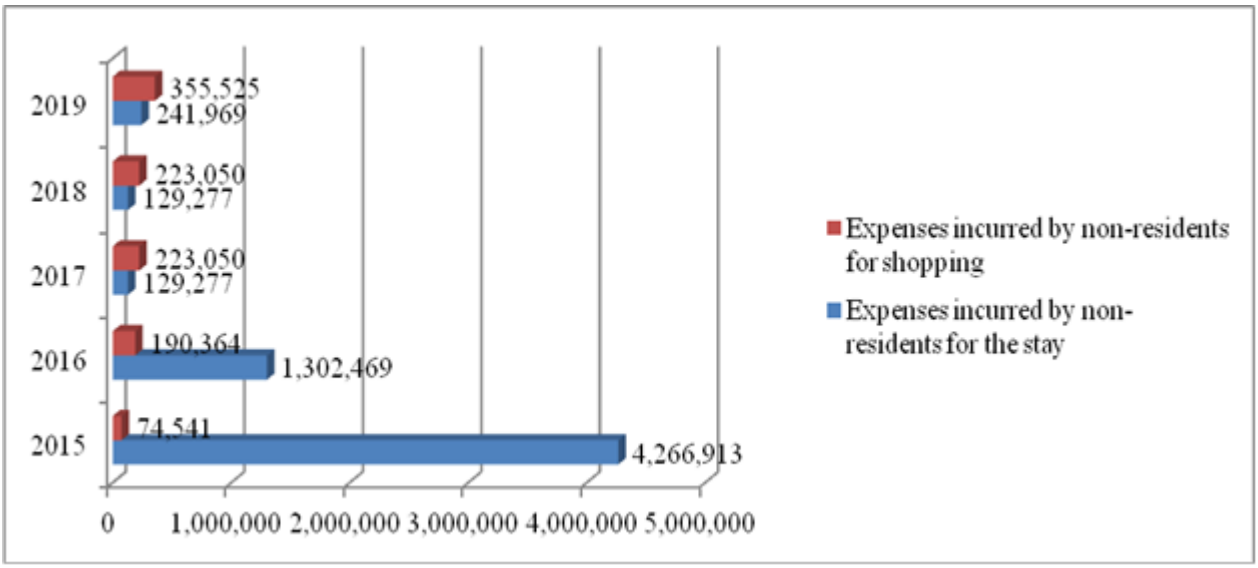

Fig. 9. Other expenses incurred by non-residents who accompanied treatment and medical care
Source: own processing [15, 7, 6,9,10, 11].

Many tourists came to Romania for both medical treatments and holidays, so the amounts spent were almost 17 million RON in 2015, 2017 and 2018. The lowest value of these expenses was recorded in 2016, the decrease compared to 2015 being 29%. In 2019, the amounts spent were 5% lower than the previous year (Fig. 10).

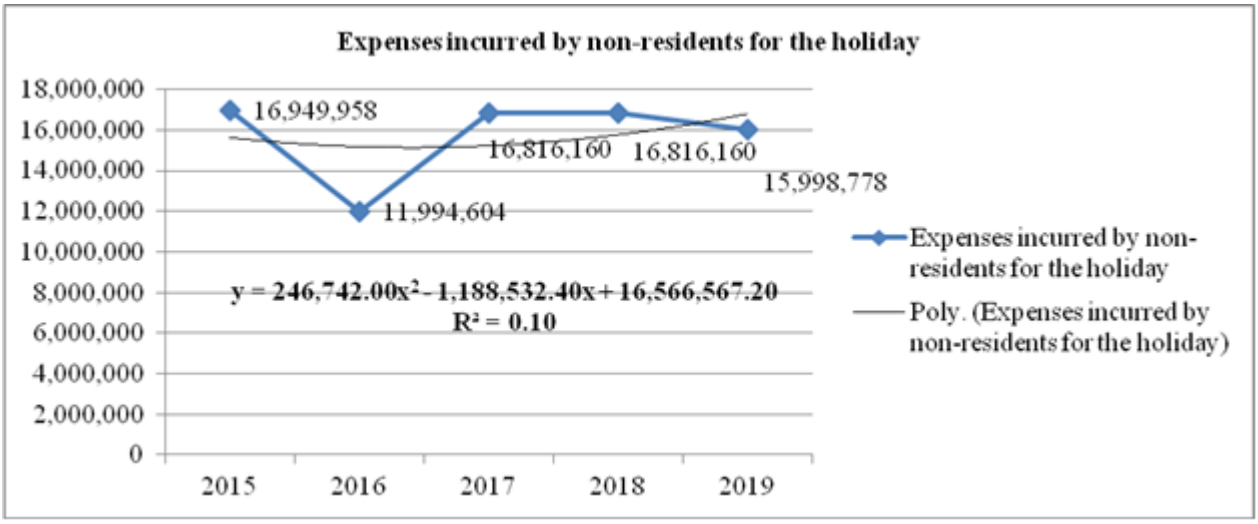

Fig. 10. Evolution of expenses incurred by non-residents for the holiday
Source: own processing [15, 7, 6,9,10, 11].

There are also amounts spent by non-residents who travel to Romania for business purposes to cover health and medical services (Fig. 11). These decreased during the analyzed period. After a slight increase of 2% in 2016 compared to 2015, the decreases in the following years were 19% in 2017 and 2018 compared to 2015 and 44% in 2019 (Fig. 11).

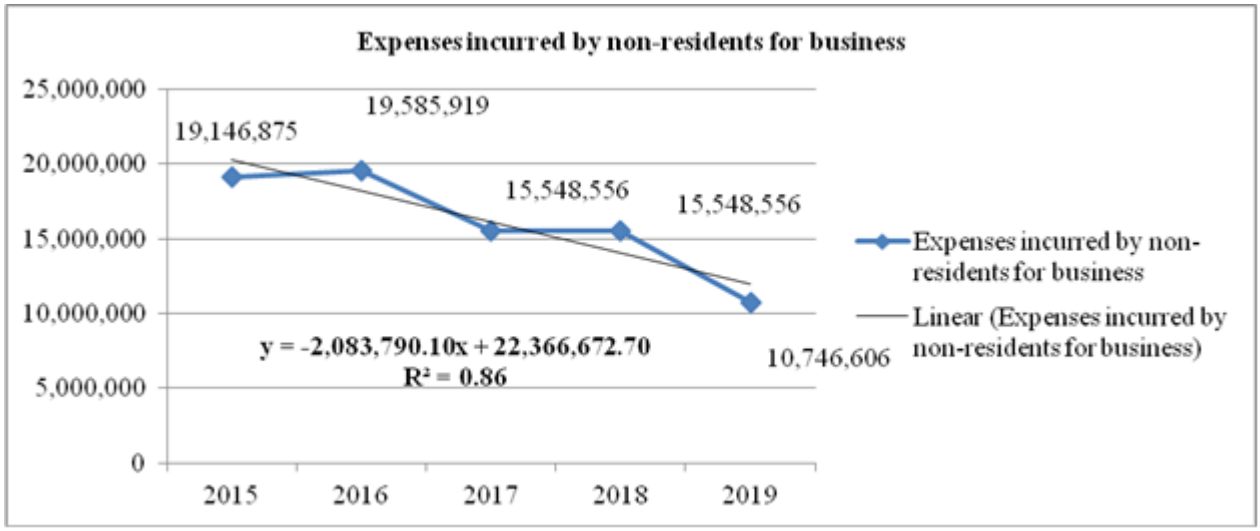

Fig.11. Evolution of expenses incurred by non-residents for business
Source: own processing [15, 7, 6,9,10, 11].

Romania's attraction for tourists coming for medical purposes is due to the much cheaper medical services than in the countries of origin [13]. The number of tourists who visited Romania for medical purposes in 2016 was approximately 11,000, increasing to 50,000 in 2017. The main medical specialties offered to them are dentistry, cosmetic surgery, in vitro fertilization, ophthalmology and orthopedics. An analysis performed in relation to the country of origin shows that the largest share of tourists come from Germany, France, Great Britain, but also from the United States of America.

However, the realization of medical tourism is conditioned by a series of services, namely: consultation by a medial framework specialized in treating the disease; provision of medical services by qualified medical personnel; providing medical care after the procedure; the payment of the service by the patient or the settlement of these services by the insurance services or by the social insurance systems.

CONCLUSIONS

Although the published data on medical tourism are quite few, we tried to outline an image about it based on the information provided in various databases.

We find that medical tourism is an alternative to using a niche area to increase revenues in this sector.

Medical tourism could have a positive influence on health spending, especially on pharmaceutical spending, due to the fact that it will improve the health of people, who will thus spend less on medicines.

The various measures that could be taken by tourism actors and related fields, such as packages and discounts offered by airlines and the companies with which medical patients travel, will increase the number of international travellers. Favorable exchange rates and economic prices, coupled with better hospitality services offered by the health tourism destination will contribute to the accessibility of this category of services, thus stimulating the growth of the medical travel industry.

In Romania, medical tourism has developed a lot in recent years, there is interest in this form of tourism that could be a profitable market, but this involved making investments and thinking of health policies to regulate it.

Also, we must not forget that medical tourism could develop new alternatives such as forest tourism and saline tourism. Medical tourism has also to valorise the high potential of the rural areas.

In the mountain area, the fresh air is more valuable due to the presence of the forests which are named "the lungs of the planet" and Romania has still a large area of forests, which offer an opportunity for walking in fresh air and admiring the beauty of the nature.

It is discussed more and more about Ozone therapy, and the Carpathian Mountains, which are the second largest trunk of mountains in Europe after the Alps, could offer the cleanest air to people who need a natural treatment for respiratory diseases.

Among the well known places for a fresh air with a high Ozone content there are Lapusna, situated in The Gurghiu Valley, Mures County, where it is the thickest Ozone layer of this type in the world. Also, Soveja, Vrancea County well known for the best place for sportsmen training, because of its most Ozoned air in Europe, grace to the forests of firs and pines. Colibita, Bistrita Nasaud County has an Ozone concentration of 90 mg/m^3, higher than the average concentration in Romania which is 72.6 mg/m^3.

Slanic Prahova offers saline air in the Slanic Salt Mountains and Slanic mine, which is the second large salt mine in Europe.

Turda salt mine is also a place for natural cure with salted air in Romania [14].

The existance of large range of the medicinal plants in the spontaneous flora of Romania and forest fruits in its wonderful forests could represent factors for developing natural alternatives for medical tourism in the rural areas.

We consider that an international system would be useful to accredit this form of tourism, as well as the existence of a legislative support that would lead to its development.

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ECONOMIC-FINANCIAL ASPECTS ON THE ACTIVITY OF COMMERCIAL COMPANY S. C. SPRING AGROSERV LLC. MALU MARE, DOLJ COUNTY, ROMANIA (2016-2018)

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Abstract

The purpose of the paper was to analyze the economic and financial aspects within an agricultural commercial company named SC Spring Agroserv LLC Malu Mare, Dolj County, Romania in the period 2016-2018. The unit was established in 2011, having as object of activity "cultivation of cereals (excluding rice), leguminous plants and oilseed plants" - CAEN Code 0111. The company has facilities in the form of: agricultural land (166,752.20 lei), constructions (78,108.71 lei), technological equipment (share of about 90% of the total value of assets - 2,232,362.17 lei), surveillance devices and installations (7,620.93 lei). The inventory value of the fixed capital elements is a considerable one (2,484,844.01 lei). Some of the capital elements were depreciated (value to be depreciated - 1,652,893.97 lei). The unit grew wheat, rye, barley, oats, triticale, corn, sorghum, peas, sunflower and alfalfa. It should be noted that since the unit did not have any financial income and expenses, the operating income and expenses are equivalent to the total income and expenses. At the same time, the operating profit or loss is equal to the gross profit or loss. Regarding the calculation of the profit tax, the unit benefited from certain facilities, in 2016 and 2017 when it reinvested all or part of the realized profit. The unit registers operating profit - 96,551.34 lei and pays a tax of 13,218.07 lei, aspects that lead to a net profit of 83,333.27 lei.

Key words**:** *surface, total production, medium production, income, expenses, profit*

INTRODUCTION

Currently located on the highest bank of the Jiu River, the village of Malu Mare has a history of over 500 years. The first attestation of the settlement appeared in documents from 1494, more precisely in Vlad Călugaru's decision book where the villages of Ghindeni and Birosloveni are registered as being located near the village of Malu Mare.

Over time, the village of Malu Mare grew, developed and later became a commune by uniting with the villages of Ghindeni and Preajba. And so, the commune of Malu Mare appeared for the first time [2].

Malu Mare commune is located in Dolj county, only 10 km away from Craiova Municipality, the administrative center of the county. Crossed by DN 55, which ensures the connection with the other localities in the region, Malu Mare commune benefits from a good infrastructure, having its own railway station, and the nearest airport is only 7 kilometers away.

Malu Mare commune, is made up of Malu Mare localities - the commune's residence, Preajba and Preajba-Selgros, with a population of over 4,000 inhabitants [1].

The unit was established in 2011, having as object of activity "cultivation of cereals (excluding rice), leguminous plants and plants producing oilseeds" - CAEN Code 0111, through the proof of availability no. 49094, from 20.07.2011.

The incorporation of the company was based on the existence of a single shareholder, a Romanian citizen, who constituted a legal entity in the form of a limited liability company (SRL).

The declared headquarters of the company is located in Malu Mare Commune, Preajba village, Dolj County, which can set up branches, according to the legislation in force.

In addition to the main activity, the company may also carry out as a secondary object of activity: the cultivation of various plant species (rice, tobacco, fiber-producing plants, vegetables, etc.); wholesale and retail trade

(various agricultural products); service activities ancillary to agriculture; business consulting and management activities; storage; manipulations etc.

The duration of the company's existence is unlimited, the subscribed share capital was 200 lei (20 shares), the increase and reduction of the capital, as well as its transfer can be done under concrete conditions stipulated in the founding act.

The articles of association also contain provisions regarding: the rights, obligations and attributions of the associates; how to organize; issues related to the administration, activity and control of the company; matters relating to the dissolution, liquidation, merger and division of the company, the company's staff, the preparation of the Balance Sheet and the Profit and Loss Account, the calculation and distribution of profit, litigation and final provisions [7].

Over time, the company has experienced fluctuations in the size of activities, a phenomenon that is related to taxation, so that decisions of a technological and economic nature have been variable [6]. Thus, the practice of rye cultivation was done, given that it has low demands on the soil, capitalizing on sandy soils [3], which are present in the unit.

Aspects related to the performance of a unit's activity can be highlighted by the financial analysis, which can highlight the positive or less convenient aspects of the production process. [5].

MATERIAL AND METHODS

For the this paper, there were determined, according to the recommended methodology, and interpreted the following indicators: cultivated area (ha) and its structure (%); total production (t); average production (kg/ha); income indicators - net turnover, other operating income, operating income (total) - lei; expenditure indicators: expenditure on raw materials and materials, personnel expenses, adjustments to property, plant and equipment and intangible assets, other operating expenses (external benefits, other taxes - fees - payments, compensation for donations, assigned assets), operating expenses (total) - lei; profitability indicators: operating profit or loss (lei), gross profit or loss (lei), profit tax (lei), net profit or loss (lei), gross profit or loss rate (%), net profit or loss rate (%).

The data were collected from the company production and financial evidence, mainly from the Balance Sheet and Profit and Loss Account.

Profit, which is the essential strategic objective of an agricultural unit [4], can also be determined as the difference between the selling price and the cost of production [9], if we refer to the unit of product.

It should be noted that since the unit did not have any financial income and expenses, the operating income and expenses are equivalent to the total income and expenses. At the same time, the operating profit or loss is equal to the gross profit or loss. Regarding the calculation of the profit tax, the unit benefited from certain facilities, in 2016 and 2017 when it reinvested in whole or in part the realized profit [8].

RESULTS AND DISCUSSIONS

The total cultivated area varied from year to year as follows: 245 ha in 2016, 217.94 ha in 2017 (-11.04% - compared to 2016), 263.49 ha in 2018 (+20.90% - compared to the previous year). The average of the period was 242.14 ha.

If we refer to the area at rest, it meant 15.55% of the total area (44.58 ha - average of the period) of 286.72 ha. The indicator evolved fluctuating as follows: 50.81 ha in 2016, 56.18 ha in 2017 (+10.57%), 26.47 ha in 2018 (-51.42%).

The total area registered an amplitude of variation of 21.69 ha (from 274.12 ha in 2017, to 295.81 ha in 2016).

For the average of the period, the following structure of the cultivated area is found (242.14 ha - Fig. 1): 0.09% peas (0.23 ha); 1.40% triticale (3.39 ha); 1.67% corn grain (4.03 ha); 4.77% sorghum (11.55 ha); 5.71% oats (13.83 ha); 9.26% barley (22.43 ha); 12.01% alfalfa (29.09 ha); 16.02% sunflower (38.77 ha); 16.57% rye (40.12 ha); 32.50% wheat (78.70 ha) (Fig. 1).

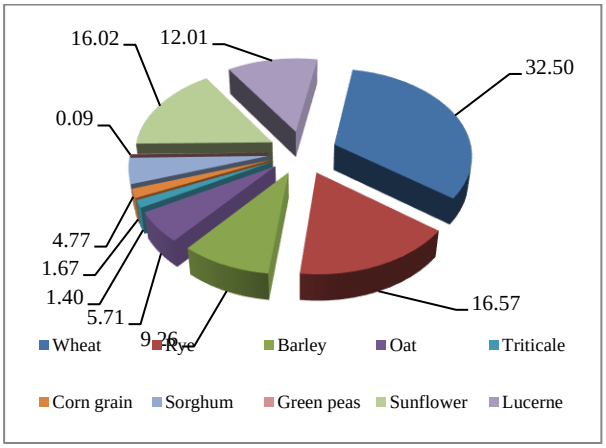

Fig. 1. The structure of the cultivated arable land - the average of the period (%)
Source: Own design and calculations.

The total productions for the average of the period are shown in Figure 2.

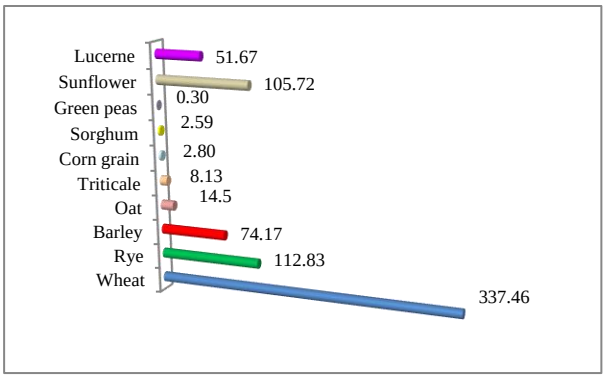

Fig. 2. Total production - average of the period (tons)
Source: Own design and calculations.

The level of production per productive unit is shown in the Figure 3.

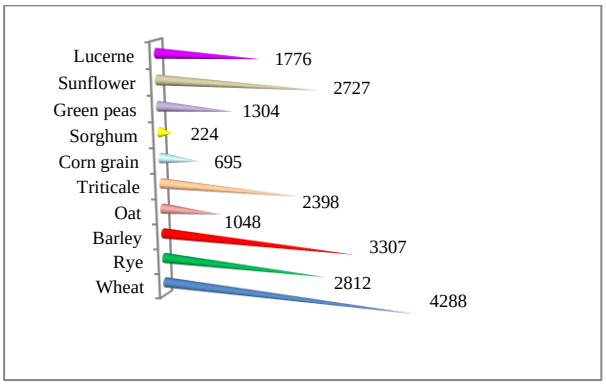

Fig. 3. Production per productive unit - average of the period (kg/ha)
Source: Own design and calculations.

Table 1 contains information on financial indicators.

As the first component of revenues, the net turnover stands out, which varied from 657,371 lei in 2016, to 782,887 lei in 2017, to which adding the value specific to 2018 (639,321 lei) reached an average of period of 693,193 lei (Fig. 4). The indicator evolved unevenly: increases by 19.09% in 2017 compared to the specific situation in 2016, decrease by 18.34% in 2018 compared to the previous term of the dynamic series, increase by 8.43% of the average compared to 2018.

For other incomes, there is an average of 488,773 lei (+36.16 and -25.17% in dynamics), which is based on annual sequential levels of: 358,979 lei in 2016, 454,155 lei in 2017 (1.26 times ahead of the comparison base), 653,185 lei in 2018 (advances of 1.81 and 1.43 times of the terms of reference - Fig. 4).

Operating revenues ranged from 1,016,350 to 1,292,506 lei (2016 and 2018, respectively), and the average for the period reached 1,181,966 lei (Fig. 4). The dynamics of the indicator is strictly ascending, predominating the supra-unitary levels of the component indices - except for those with a mobile base in the case of the average period (91.45%). The advances of the reference bases reached: 1.21 times in 2017, 1.27 and 1.04 times in 2018, 1.16 times for the average of the period.

Expenditures on raw materials and consumables are characterized by an average of 496,715.33 lei (+15.96 and -15.15% compared to the terms of reference), given that the annual sequential levels were: 428,344 lei in 2016, 476,398 lei for the year 2017 (+11.22% in dynamics), 585,404 lei in the case of 2018 (advances of 1.36 and 1.22 times of the reporting bases). We can say that the dynamics of the indicator is strictly increasing (Fig. 5).

Personnel expenses varied from 92,148 lei in 2016, to 120,641 lei in 2018, and the average for the period was 106,035.33 lei (Fig. 5). The indicator has evolved upwards, over time, registering successive annual increases of 14.29 and 14.55% in the case of 2017 and 2018, respectively.

The adjustments regarding the tangible and intangible fixed assets had an average of 252,457 lei, which represented a higher positioning compared to 2016 (142.38%) and a lower positioning compared to 2018 (76.14%

Table 1. Financial indicators

Specification	Year									Period average**		
	2016			2017			2018					
	Eff. (lei, %)*	Dynamics**		Eff. (lei, %)*	Dynamics**		Eff. (lei, %)*	Dynamics**		Eff. (lei, %)	Dynamics	
		Ibf	Ibm		Ibf	Ibm		Ibf	Ibm		Ibf	Ibm
Net turnover	657,371	100	100	782,887	119.09	119.09	639,321	97.25	81.66	693,193	105.45	108.43
Other incomes	358,979	100	100	454,155	126.51	126.51	653,185	181.96	143.82	488,773	136.16	74.83
Operating income	1,016,350	100	100	1,237,042	121.71	121.71	1,292,506	127.17	104.48	1,181,966	116.30	91.45
Expenditure on raw materials and consumables	428,344	100	100	476,398	111.22	111.22	585,404	136.67	122.88	496,715.33	115.96	84.85
Staff expenditure	92,148	100	100	105,317	114.29	114.29	120,641	130.92	114.55	106,035.33	115.07	87.89
Adjustments for property, plant and equipment and intangible assets	177,309	100	100	248,491	140.15	140.15	331,571	187.0	133.43	252,457	142.38	76.14
Other operating expenses	276,734	100	100	185,446	67.01	67.01	228,441	82.55	123.18	230,207	83.19	100.77
Total operating expenses	974,535	100	100	1,015,652	104.22	104.22	1,266,057	129.91	124.65	1,085,414.66	111.38	85.73
Operating profit or loss ***	41,815	100	100	221,390	5.29 times	5.29 times	26,449	63.25	11.95	96,551.34	2.31 times	3.65 times
Tax	-	-	-	35,422.4	100	100	4,231.8	11.95	11.95	13,218.07	37.32	3.12 times
Net profit or loss	41,815	100	100	185,967.6	4.45 times	4.45 times	22,217.2	53.13	11.95	83,333.27	199.29	3.75 times
Operating profit rate	4.29	100	100	21.80	5.08 times	5.08 times	2.09	48.72	9.59	8.90	2.07 times	4.26 times
Net profit rate	4.29	100	100	18.31	4.27 times	4.27 times	1.75	40.79	9.56	8.12	189.28	4.64 times

* data extracted from the Profit and Loss Account (2016 – 2018);
** own calculations;
*** identical to gross profit or loss;
Source: Own calculations.

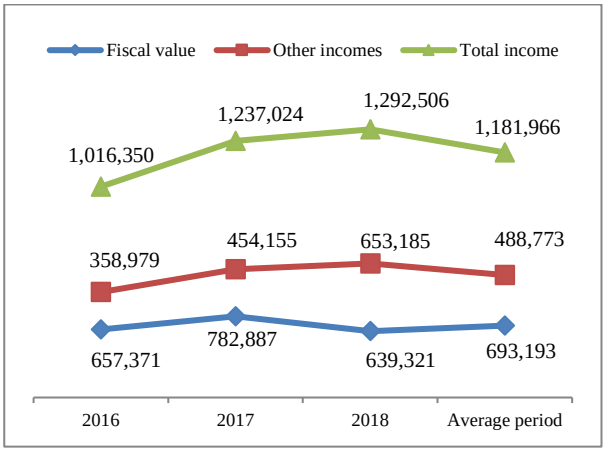

Fig. 4. Income indicators (lei)
Source: Own design and calculations.

This average is based on the following annual situations: 177,309 lei in 2016, 248,491 lei in 2017 (1.40 times ahead of the reference term), 331.571 lei in 2018 (1.87 and 1.33 times ahead of the comparison bases - Fig. 5).

Regarding the situation for other operating expenses, there are extreme levels of 185,446 lei in 2017 and 276,734 lei for 2016, respectively, and the average for the period reached 230,207 lei (Fig. 5). The dynamics of the indicator is uneven: decreases of 32.99% in 2017, increases of 23.18% in 2018 compared to the previous term, increases of 0.77% of the average of the period compared to the specific situation of 2018.

The total operating expenses had an average of 1,085,414.66 lei, as a result of the annual sequential levels of: 974,535 lei in 2016, 1,015,652 lei in 2017, 1,266,057 lei in 2018 (Fig. 5). It can be seen that the indicator has evolved upwards, the dynamics being predominated by the supra-unit levels of the component indices (except for those with a fixed base for the average of the period - 85.73%). The advances of the comparison terms were 1.04 times in 2017, 1.29 and 1.24 times in 2018, 1.11 times for the average of the period.

The operating profit varied from 41,815 lei, in 2016, to 221,390 lei, in 2017, and the average for the period was 96,551.34 lei (Fig. 6).

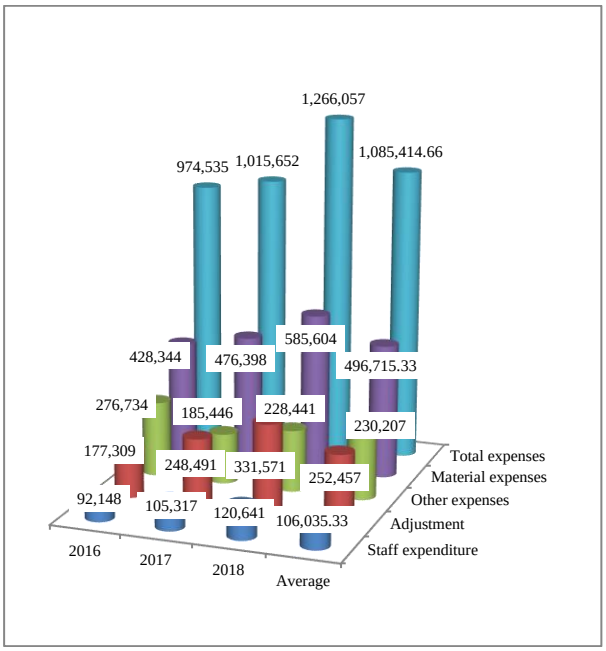

Fig. 5. Expenditure indicators (lei)
Source: Own design and calculations.

An uneven evolution of the indicator can be seen: spectacular overtaking in 2017 compared to 2016 (overtaking 5.29 times), sharp decrease in 2018 compared to the previous term of the dynamic series (-88.05%), increase of 3.65 times the average of the period compared to the state of affairs specific to 2018.

The profit tax appears only in 2017 and 2018 (35,422.4 and 4,231.8 lei), given that the unit benefited from tax-related facilities in 2016, when no reinvested profit tax was paid. The relative decrease of the tax in 2018 compared to 2017 was 88.05%. Under these conditions, the average for the period was 13,218.07 lei (-62.68% compared to 2017 and a 3.12 times advance of the specific situation of the previous year).

The net profit is characterized by an average of 83,333.27 lei, given that the extreme values of the indicator appeared in 2018 - 22,217.2 lei and respectively 2017 - 185,967.6 lei (Fig. 6). The dynamics of the indicator is fluctuating, the advances of the reporting term being 4.45 times in 2017, the decreases compared to the reference bases characterize the year 2018 (-46.87 and -88.05% respectively), and, for the average of the period, there are advances of 1.99 and 3.75 times of the terms of comparison.

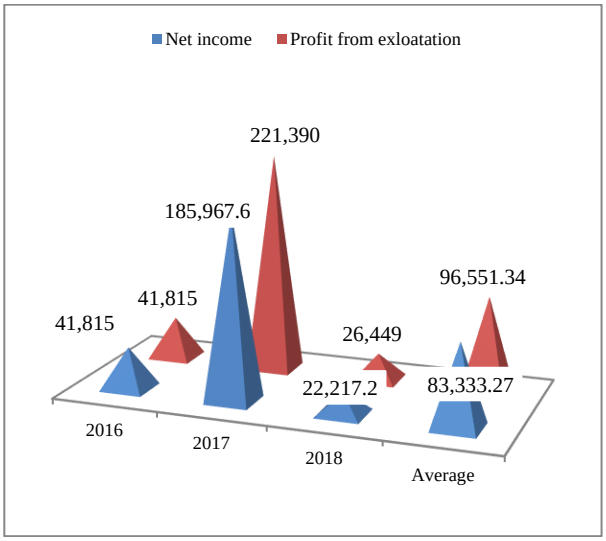

Fig. 6. Operating profit and net profit (lei)
Source: Own design and calculations.

The operating profit rate was 4.29% in 2016, 21.80% for 2017, 2.09% in 2018 and 8.90% for the average period (Fig. 7). The evolution, over time, of the indicator is in the form of a non-uniform trend, the advances of the reference term in 2017 5.08 times, being followed by decreases by 90.41% in the case of 2018.

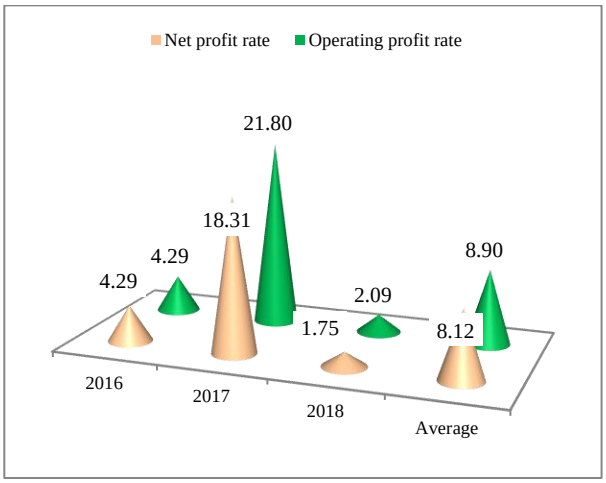

Fig. 7. Operating profit rate and net profit rate (%)
Source: Own design and calculations.

The net profit rate (Fig. 7) registered an average of 8.12% (overtaking 1.89 and 4.64 times the reporting bases), with extreme values of 1.75% in 2018 and 18.31% in 2017. The consequence of this situation, the

dynamics is uneven: there is an advance of 4.27 in 2017 compared to the first term of the dynamic series, and the terms of reference were not reached in 2018 (decreases by 59.21 and 90.44% respectively).

CONCLUSIONS

The levels of total and average productions were also influenced by the degree of qualification of the workers, but also by the climatic conditions specific to the area (sandy soil, precipitation, temperatures, etc.). For certain crops, we can discuss results as convenient as possible, at least in the county context (wheat +3.85%, rye +21.0%, sunflower +9.52%) [10].

In the income structure, the net turnover predominates with 58.65%, other incomes representing 41.35%.

The structure of total expenditures is dominated by expenditures on raw materials and consumables - 45.76%, followed by adjustments on property, plant and equipment and intangible assets - 23.26%, other operating expenses - 21.21%, personnel expenses - 9.77% (Fig. 8).

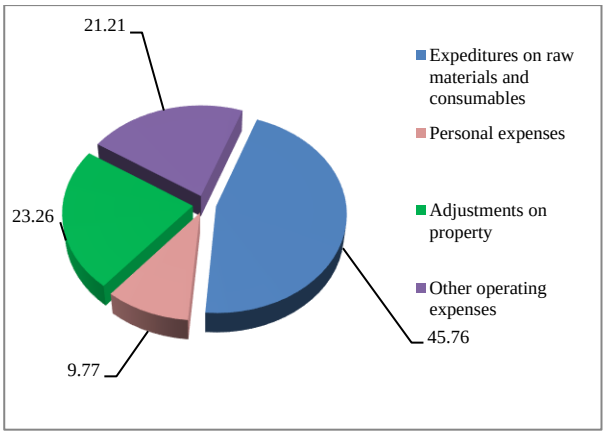

Fig. 8. Structure of total expenditures - average of the period (%)
Source: Own design and calculations.

The unit registers operating profit - 96,551.34 lei and pays a tax of 13,218.07 lei, aspects that lead to a net profit of 83,333.27 lei.

These results are influenced by the specific situations of the three years analyzed (including the tax facilities specific to 2016).

Better management of expenditure elements is needed, the initiative of the entrepreneur to reinvest part of the profit for the development of the unit must be appreciated, but there is also the need for appropriate policies from the state to support the activity of medium-sized companies.

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POLICY IMPACT AND FACTORS OF FARMERS' PARTICIPATION IN AGRI-ENVIRONMENTAL MEASURES

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Abstract

Agricultural sector contributes to water, soil and air degradation, as well as biodiversity loss. Agri-environmental measures are a predominantly voluntary policy instrument that seeks to encourage farmers to implement environmentally friendly practices on their farms. This paper aims at providing an overview of policy drivers, goals and effects discussed in literature, as well as factors affecting farmers' decision to participate in AEM. Most studies geographically belong to Western Europe (United Kingdom, Germany, Sweden, Belgium, Denmark) and there is a disproportionately smaller amount of similar analyzes for Central and Eastern Europe. Connecting AEM's policy impact to understanding farmers' participation motives contributes to comprehending just how complex the concept of policy implementation is now and will be in the future. The effects of AEM mostly depend on the specific measure implemented, phenomenon investigated, and region observed. Farmer's interest to get involved in AEM depends on the potential economic benefit, socio-demographic factors, social connections, personal beliefs and trust in public institutions. Therefore, the policy should adapt to stakeholders' heterogeneity and send straightforward messages to farmers showing clear interrelation between the policy, farmers' uptake and the desired environmental outcome.

Key words**:** *agri-environmental measures, CAP, impact, farmers' participation, policy, review*

INTRODUCTION

Agricultural production is among economic activities which exploit significant amounts of natural resources, put pressure on the environment, lead to soil erosion, water scarcity and pollution, as well as contribute to the loss of wildlife habitat and biodiversity. Moreover, agriculture contributes to climate change through the release of greenhouse gases into the atmosphere, accounting for 10% of EU's overall GHG emissions [10]. Striking a balance between intensive production and the incorporation of environmental care is a challenge for modern agricultural production systems. Environmental targets have been increasingly present in the Common Agricultural Policy (CAP) since 1975, corresponding to EU's attempts of addressing the food surplus problem on the market and reducing the budget burden.

The specific relationship between agriculture and the environment is a stimulating one, with increasing public attention and demanding certain policy responses [24]. Policymakers are faced with difficult decisions; maintaining a resilient and competitive agricultural sector whilst safeguarding the natural capital on which it depends [7]. In order to prevent possible imbalances, agricultural policy provides measures and instruments with an increasingly influential role in making sustainable farming solutions. One such mechanism is the practice of agri-environmental measures (AEM), containing a wider range of practices to address general or specific environmental challenges.

Agri-environmental measures play an explicitly important role in meeting society's demands for environmental outcomes. They

can be designed at a national, regional or local level, allowing for an opportunity to adapt to specific agricultural systems and environmental conditions. In areas of intensive agricultural production, these measures are more focused on reducing environmental risks, such as planting winter cover or reducing fertilization. However, the measures can also be aimed at preserving natural and cultural landscapes, which is more conducive to extensive agricultural areas.

Agri-environmental measures are mostly a voluntary instrument, although in the latest 2014 CAP reform, certain management practices became obligatory for farmers in order to qualify for their basic subsidy. AEM seek to encourage farmers to improve and preserve the environment on their farms by implementing less intensive practices [2] and [28]. By implementing a certain measure, the beneficiary receives payments in accordance with incurred costs or lost income.

Several decades have passed since the introduction of first measures. CAP decision-makers began facing the problem of agriculture's negative impact on the environment in 1970s, after most agricultural products at EU level achieved self-sufficiency. Moreover, encouraging high-intensity production has led to overproduction and, due to the emergence of market surpluses, there has been a public debate about how much budget money is spent on surplus disposal and the consequences such production has on the environment. Concrete moves to reduce the budget burden have caused a change in aid structure and a potential decrease of farmers' incomes. These results are unacceptable since agricultural policy's most important goal is achieving a rational agricultural income. Being the most significant structural change of CAP measures in the 1970s, the sole introduction of support for Less-Favored Areas (LFA) in 1975 can be singled out as an example. The aim of this measure was to prevent land abandonment, preserve the landscape and retain the population. Agri-environmental measures have gained in importance with each subsequent reform. A number of policy changes introduced by the five CAP reforms in this period – the 1992 MacSharry, 1999 Agenda 2000, 2003 Fischler, 2008 Health Check and 2013 CAP reforms – may be considered 'environmental' in its nature in the sense that they either have environmental objectives, or could have positive environmental side effects [1] and [21]. The original purpose was to protect endangered habitats and landscapes, reduce the use of harmful agents and mineral fertilizers, so that over time the prevention of species loss would be in focus.

Farmers' environmental perceptions can play a significant part in the decision-making process [13]. They have to produce more food, adapt to climate change, whilst protecting and improving the environment in which they farm. Farmers are adapting their farming practices to conform to environmental needs and regulations [34]. What used to be a mostly productive activity became an activity with multiple goals, demanding a revision of farmers' behavior and taking land values and environmental protection into consideration [37] and [38]. There are different factors (variables) affecting farmers' decision-making process of voluntary participating in environmental schemes. Most research conclusions state financial and specific socio-demographic factors as important reasons to participate in AEM. Authors [22] have distinguished four categories of participation factors for the uptake of agri-environment schemes: farm factors, farmer factors, informational factors, and social factors. Furthermore, other authors [19] extracted five major categories: economic factors, farm structure, farmer characteristics, farmers' attitudes towards AEM and social capital. Social connectivity among farmers may also be a good driver for increasing farmers' willingness to participate in AEM [6]. Furthermore, farmers' attitudes and behavior towards the adoption of AEM are related to their beliefs [25]. Farmers also make decisions on their farming practice in social and cultural contexts [40]. The greater the credibility of public institutions, the more likely farmers are to participate in AEM [22] and [35].

Farmers are the main bearers in measures' implementation and their willingness to voluntarily take on additional engagement is essential for AEM to achieve environmental objectives. However, sustained participation is even more important, causing great concern to policymakers who are trying to achieve long-term consistency [38]. Hence, this review examines literature that encompasses both the policy impact (drivers, goals and effects) of agri-environmental measures and farmers' motives and drivers to participate in AEM.

MATERIALS AND METHODS

This is a narrative review based on a qualitative analysis, summarizing references selected from extensively reviewed bibliographic databases, such as ISI Web of Science Core Collection, ScienceDirect and Google Scholar, founded on the following sequence of keywords: *agri-environment(al) measures, schemes, Common Agricultural Policy (CAP), effect(s), policy impact, farmer(s), uptake, perception*.

There were more than 1,000 works in total, out of which 100 were scrutinized, but our analysis was focused on 44 studies.

Most literature sources geographically come from Western Europe (e.g., the United Kingdom, Germany, Sweden, Belgium, Denmark), which indicates an imbalance of empirical results and an absence or a significantly smaller number of similar analyzes for Central and Eastern Europe, with predominantly new Member States.

It is extremely important to connect AEM's policy impact to understanding farmers' participation motives in order to learn just how complex is the concept of policy implementation.

A detailed budget performance hasn't been included in this review since this paper's intention is to synthesize and compare the literature discussing policy measures and the willingness of farmers to uptake environment protection measures.

Other references which have also served to paint a picture about the decision-making process and implementation of AEM are not specified here due to the lack of space but are available upon request.

RESULTS AND DISCUSSIONS

Policy impact of agri-environmental measures

Agri-environmental measures have become an increasingly important CAP element since they occupy a significant portion of the budget allocated to rural development.

The CAP evolution is marked by the debate on how much policies contribute to biodiversity and landscape protection, reduction of an adverse environmental impact, as well as the kind of outcome produced by agri-environment measures. Major reforms in 1992 (by *set-aside*) and 2003 (by *cross-compliance*) endeavored to alleviate damage caused by agricultural intensification which has implied an increased application of chemical fertilizers and pesticides, utilization of seed varieties, combined with implementation of best management practices, mechanization, and irrigation [18]. The Agenda 2000 reform separated CAP into two pillars, extending the policy domain to rural development through which farmers could receive payments by voluntary engaging in an agri-environmental scheme. Although it is compulsory for Member States to design and implement AEM, the uptake of AEM by farmers is voluntary [9]. In the 2013 reform, in the CAP pillar one, green payments were introduced as a commitment for predominantly large farms, as well as measures to adapt or combat climate change. Green payments should, in addition to *cross-compliance*, further strengthen the link between direct payments and practices beneficial to the climate and the environment through the obligation to apply crop rotation, preserve permanent pastures and provide at least 5% of their land as seminatural habitats named ecological focus areas.

Pillar two of AEM contains voluntary commitments that cover organic farming, extensification of plant and livestock production, areas facing natural or other specific constraints, reduction of irrigation, crop rotation, action to conserve soil;

management of landscape, pastures and high nature value farmland (HNV); actions of promotion or conservation of biodiversity and genetic resources of local breeds [9].

Besides preventing environmental damage, AEM are needed to respond to increasing societal concerns related to the extent of agriculture's effects on the environment and how it affects the balance between economic, environmental and social needs [18]. As farming ensures the delivery of environmentally related public goods (landscape, environment, biodiversity, food security), farmers receive public subsidies. Moreover, the public-good status of the non-market agricultural outputs leads to market failure which makes it a political element and requires certain legislative framework to please society preferences.

Effects of AEM mostly depend on the specific measure implemented, phenomenon investigated, region observed and farmer's perception [12] and [39]. Aid is too often targeted at already protected areas (high value grasslands or Natura 2000), while it does not deliver significant positive effects to areas of intensive production. Aid targets individual farms instead of coordinated management to promote the expansion of spatial boundaries. Environmental protection cannot be viewed separately for each farm, as it is inherent in production and income policies, since biodiversity, ecosystem and climate change are much more complex goals and surpass the boundaries of one farm [20].

Given the huge expenditure (7% of CAP budget in the 2014-2020 period and more in the future on European AEM, it is important to analyze whether they improve socio-economic or environmental outcomes [19].

The evaluation of agri-environmental policy involves measuring environmental conditions on farms influenced by a particular policy implementation [29]. Studies considered in this review investigate mostly more developed, western regions of the EU and focus on the effects of AEM on biodiversity (farmland birds), followed by grassland vegetation and pollinators. Environmental outcomes of CAP from old Member States are often subject to discourse which calls for a transition towards a more sustainable EU food system [30]. CAP still has a mainly productivist rationale and agriculture is seen as a sector that contributes to an important policy goal: providing a sufficient supply of food [11].

Certain studies from new Member States (Hungary, Poland, Romania) mention benefits for their species richness, area protection in the environmental network Natura 2000 and a raising awareness among farmers as the number of beneficiaries fulfilling the agri-environmental commitments has increased, as well as extensive farming in HNV areas [4], [8], [17] and [23]. Still, a large proportion of small-scale farms, which prevail in CEE countries, are not eligible for AEM, or AEM does not fit to the local or regionally specific ecological and economic circumstances [33].

Farmers' participation in agri-environmental measures

Farmers' behavior plays a key role in the mechanism aimed at providing environmental services [9]. Farmers are adapting their farming practices behavior and attitudes according to the environment they manage. More and more, they conform to regulations required by AEM engagement [34], [38] and [42].

AEM contracts are voluntary-based contracts lasting minimally 5 years. Under these contracts, the farmer has to provide environmental goods that go beyond the minimum requirements of cross-compliance. During that period, they receive a fixed per-hectare payment to compensate for the additional costs and the loss of income linked to these commitments. By adopting certain practices that contribute to mitigating the adverse impact of agriculture on the environment and encourage biodiversity and conservation of genetic resources important for agriculture, increased costs or lost income are significant arguments to get public money compensation [30].

Farmers' willingness to voluntarily take on additional involvement in achieving environmental goals depends on many factors, such as the amount of support, the complexity of administration, the complexity of implementing the measure in practice, age,

education, business results of the farm, etc. Having trust in governmental institutions (local, regional, national), as well as perceiving the objectives of the EU and its legitimacy were found to be important factors in farmers' attitudes to greening measures [43].

Table 1. Discourse analysis of agri-environmental measures covering policy performance and farmers' preferences

Author(s)	Region/Country	Policy impact	Farmers' preferences
Alons, 2017 [1], **Erjavec and Erjavec, 2015** [11].	EU Member States	-incomplete transformation from an exceptionalist agriculture to a post-exceptionalist agriculture policy, -limited integration of environmental goals in agricultural policy -CAP reform decision-making process marked by a mostly productivist discourse	-farmers' economic interests go beyond environmental interests -productivist discourse favored by framers' organizations
Batary et al., 2015 [2], **Früh-Müller et al. 2019** [12].	EU Member States	-support is too often targeted at already protected areas or areas with extensive agriculture (high value grasslands or Natura 2000), while they do not bring significant positive effects to areas of intensive production -supported joint operations of farmers are more efficient	-scheme adoption is linked to utilitarian motivations, such as payment rate and ease of fit within the existing farm practice -those operating in areas with high environmental pressures are more reluctant to participate in schemes as they see a threat to their income
Brodzinska, 2014 [4], **Kubacka, 2016** [18], **Czyżewski et al., 2020,** [8].	Poland	-increase in the number of farms and areas under AEM -local authorities should be mobilized to take responsibility for AEM's implementation -agri-environmental measures generated positive spatial spillovers	-significant part of the AEM beneficiaries have purchased agricultural holdings in order to join the schemes, due to support benefits -experience and education enhance farmers' uptake
Hristov, 2020 [15], **Pe'er et al. 2017,** [28].	EU Member States Germany, Estonia, the Netherlands, Denmark, Austria, Czechia, England, Poland	-2013 CAP "greening" reform has little potential to improve biodiversity and ecosystem services on farms through AEM	-most AEM options that were considered beneficial to biodiversity (buffer stripes and fallow land) had low uptake among farmers perceived as not profitable to for the farm
Mihok et al., 2017, [23], **Toth et al. 2016,** [36].	Hungary	-joining the EU resulted in positive outcomes: the establishment of the Natura 2000, successful conservation of particular habitats and species -implementation of set-aside ensures a higher species richness	-traditional ecological knowledge can contribute to the knowledge-pool of ecosystems
Reif and Vermouzek, 2018 [31], **Suitcliffe et al., 2015,** [33], **Šumrada et al., 2021,** [32], **Guillem and Barnes, 2013** [13].	Slovenia, Czechia Scotland	-farmland birds significantly declined after EU accession -intensification of production, particularly in the beef and dairy sectors are key drivers of the farmland biodiversity loss in Slovenia -majority of AEM have focused on managing water and soil quality, while ecological benefits lag behind	-farmers increased their intensification of production after EU accession due to economic preference of higher CAP direct support -schemes fail to encourage farmers with strong ecologically related attitudes, but also those with production objectives -lack of knowledge on bird habitat requirements limit the uptake
Braito et al., 2020 [3], **Brown et al., 2021** [5], **Coyne et. al., 2021** [7], **Mozzato et al., 2018,** [25].	Austria, Czechia, Finland, Germany, Greece, Hungary, Spain, Sweden and England	-monetary incentives may not be enough to promote sustainable soil management practices -CAP reforms have failed to effectively utilize extensive scientific knowledge about socio-ecological interactions at farm level at the expense of environmental benefits	-plurality of socio-demographic, geographical, informational and farm characteristic factors affecting farmers' decision for uptake makes the policy decision-making process more complex -flexibility, simplicity and compatibility with the farm type and operations are key factors prompting dairy farmers to engage
Hyland et al., 2016 [16], **Pagliacci et al., 2020,** [27], **Van Herzele et al. 2013** [41].	Wales Italy Belgium	-current system of measure targeting is not sufficient to stimulate voluntary involvement in climate change related practices	-difference among early and late adopters -four types of farmers: The Environmentalist with high awareness and The Dejected with the risk perception are most likely to implement measures sooner, still, the lack of knowledge could be an obstacle. The Countryside Steward wants to act pro-environmentally but is lacking in the awareness of climate change. The Productivist is less likely to adopt climate related measures due to self-identity of producing more. -in Belgium, six modes or styles of participation were identified: opportunistic (already implementing practices, money is a bonus, calculating (money is the only motive) compensatory (for a small amount of extra effort they can receive a larger amount), optimizing (report measures for areas where they cannot have a greater economic impact than what has already been achieved), catalyzing (want to achieve a quick positive impact) and engaged (stress the societal value of AEM)

Source: Authors' elaboration based on utilized references.

Farmers are often motivated by both environmental benefit and profit and are unwilling to implement measures that they see as ineffective. Higher levels of education, flexibility in the AEM contract, social connections (unions, organizations) and social capital (advisory service) increase the uptake of agri-environmental and recently introduced climate measures.

In many cases AEM tend to limit agricultural production. This observation strengthens the contradiction between economic goals and environmental goals and limits farmers' motivation to get involved [44]. The most production-oriented farmers are more likely to avoid participation in additional environmentally friendly practices.

Heterogeneity among farms (livestock and crop producers, small-scale and large-scale), different EU countries and distinct views regarding the means of reform discussed in literature [14] and [26] call for differentiation and a wide range of measure adaptation in policy design (e.g., result-based, region-based).

Several studies group farmers in different types, according to reasons for their participation in AEM or by different motives, distinguishing between early or late adopters in order to highlight the importance of adapting the policy measure accordingly.

An additional issue for farmers and policy makers are climate change-related actions.

Although farmers' businesses are directly exposed to climate change, the decision to change their farming practices is still far from obvious [27]. There is still a lack of awareness about climate-related problems as they still haven't fully influenced production and costs. Farmers' personal experience is still rather rare as extreme weather disasters do not occur often enough to alter their actions. This lowers their willingness to implement practices that address climate change. Farmers are more likely to actively react when they are aware of an environmental problem and consider the environmental threat to be real [16].

Policy effects and driving factors of farmers' involvement are the most researched topics in the context of AEM's success. Usually, studies analyze one of mentioned subjects more deeply, however, the two have been connected in our review, which also grouped studies by common elements in policy impact and farmers' preferences (Table 1).

CONCLUSIONS

This paper aims at providing a narrative review of academic literature that thematizes drivers, goals and effects of agricultural policy, as well as motives of farmers' participation in the domain of AEM. Overall, 44 papers providing policy impact and factors determining the farmers' participation have been analyzed. Such studies have been carried out in many Western Europe countries (mostly old Member States) but to a lesser extent in Central and Eastern Europe. The results have often shown that the policy impact and farmers' rationale are locally determined. Furthermore, despite the constant reform process, efforts to improve environmental impact and farmers attitude.

Often measures are compromised by CAP's productivist elements and farmers' productivist attitudes.

On the other side, measures often target already protected areas or areas with extensive agriculture, while areas of intensive production and high environmental pressure can make use of less support. Agricultural policy has a limited positive impact on biodiversity, when implemented in individual areas and paid per farm, while supporting joint operations of farmers is more efficient.

For new Member States, EU membership has resulted in the establishment of the Natura 2000 network and appropriate institutions, as well as in the strengthening of scientific research dealing with agri-environmental relationship. It has also provided access to environmental protection funds, all of which have contributed to the restoration of habitats in general and some restoration of significantly endangered species of plants and animals.

Farmers' behavior, beliefs and values and socio-economic background make monolith policy measures inefficient. Therefore, the policy should adapt to stakeholders'

heterogeneity by being more flexible and less bureaucratic. The policy should also become trustworthy and send straightforward messages to farmers, showing clear interrelation between the policy, farmers' uptake and the desired environmental outcome.

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ECONOMIC ASSESSMENT OF AGRICULTURE DEVELOPMENT AND PROSPECTIVE DIRECTIONS OF AGRARIAN REFORMS IN THE REPUBLIC OF AZERBAIJAN

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Abstract

The paper examines the stages of agricultural development strategies of the Republic of Azerbaijan. Taking into account that, our country is among the developing countries, agriculture is one of the leading sectors in the country after the oil industry. Agriculture plays an important role in the food security of the country and the socio-economic development of the regions. From this point of view, the state has always focused on the development of agriculture. Considering all the things mentioned above, the article has attempted to show the dynamics of development of agriculture in the economy of the country. Also, the article assessed the current state of agriculture in accordance with agrarian reforms carried out in the post-Soviet period and after the independence of the state. In the development of a competitive environment, the owner entities play large role. In the article found a place, development of enterprises in agriculture and their regulation by the state in accordance with the requirements of a market economy. Also, the dynamics of production, productivity and self-sufficiency of the main types of crop and livestock products were analyzed and evaluated on the basis of statistical data of the Azerbaijan Republic. It should be noted, the assessment also examined the impact of agrarian reforms on agricultural development after state independence. During the observation were used, methods of logical history, analysis-synthesis, induction-deduction. Finally, the conclusions and recommendations are based on the provisions obtained from the analysis.

Key words**:** *agriculture, agrarian reform, economic evaluation, transition economies, competitiveness*

INTRODUCTION

Agriculture is of particular importance for its role in social and economic life, especially as a factor contributing to economic development and as a provider of food security.Thus, despite the fact that the share of agriculture in world trade in 2018 is 9.34%, this sector accounts for 63% of world employment.In other words, it is the main source of income for more than 2.5 billion people.High levels of employment in this area are mainly due to developing countries.

According to a new report issued by the Food and Agriculture Organization of the United Nations (FAO), global agri-food trade has more than doubled since 1995, amounting to $1.5 trillion in 2018, with emerging and developing countries' exports on the rise and accounting for over one-third of the world's total. Despite its small relative share to GDP, the economic potential of primary agriculture needs to be properly evaluated and harnessed for growth. However, in an economic structure dominated by services, led by Government Services, followed by Banks and Insurance, Wholesale and Retail Trade, Transport and Hotels and Restaurants, in that order, competition for resources is a continuous challenge. The 2006-2011 Agricultural Development Strategy (ADS) recognized this internal competition for resources as domestic threats to the development of agriculture [3].

Today, most development economists share the consensus that far from playing a passive, supporting role in the process of economic development, the agricultural sector, in particular, and the rural economy, in general, must play an indispensable part in any overall strategy of economic progress, especially for the low-income developing countries [10].

Agricultural production continues to grow, generally keeping pace with population

growth. The global population has almost tripled since 1950. By 2030, there will be an additional 1.7 billion mouths to feed, most of whom from developing countries. To cope with this reality, the world's farmers need to double or even triple food production by 2050. However, farming policies have neglected the critical role which farmers, especially smallholder farmers, must play in making sustainable development a reality [2].

Despite various measures taken to alleviate the world hunger problem, food insecurity and malnutrition remain serious problems in many countries [7]. Ensuring food security has become an issue of key importance to countries with different degrees of economic development, while the agricultural sector plays a strategic role in improving food availability [6].

There are three main stages in the development of agricultural production. The first stage is the pure, low-productivity, mostly subsistence-level traditional (peasant) farm. The second stage is what might be called diversified or mixed family agriculture, where a small part, of the produce is grown for consumption and a significant part for sale to the commercial sector. The third stage represents the modern farm, exclusively engaged in high-productivity, specialized agriculture geared to the commercial market, as in developed countries, and often found in the highly urbanized developing countries [10].

Agriculture in Azerbaijan is currently at the second stage. Azerbaijani agriculture has significant developments over the last two decades with direct effects on the role of the agricultural sector in national income formation and promoting exports. Such developments have also affected farmers' delivery as related to the cropping structure, applied technology, levels of income, and farmers' response to market changes.

Agricultural sector is major part of the Azerbaijan economy, and has been important to the country's economic resilience. Azerbaijan agricultural sector has performed relatively well in recent decades, contributing employment, and poverty reduction. However, the sector's relative contribution to the economy has declined, due in part to the growth of other sectors of the economy, such as industry, mining, and services.

To date, one of the most important tasks for Azerbaijan is to eliminate the oil dependence of the economy and ensure a wider spread of economic development in rural areas.In the economy of Azerbaijan, agriculture is the third largest sector after oil and construction.Food products produced in agriculture and its processing industry cover about 75% of the population's demand for consumer goods.There is a close relationship between agriculture and the industrial sector, especially in the light and food industries.Most of the products of food industry in the country is provided by agricultural products.

MATERIALS AND METHODS

In this paper, in order to assess the evolution of the development of agricultural production there were used logical and historical methods, methods of analysis and synthesis. The analysis of production, yields and self-sufficiency in agricultural products, was based on the data collected from State Statistical Committee of the Republic of Azerbaijan. In the process of working on the paper were used the relevant laws and regulations of the state, such as Law of the Republic of Azerbaijan on the Basics of Agrarian Reform, the Decrees of the President of the Republic of Azerbaijan, the Strategic Road Map for Production and Processing of Agricultural Products in the Republic of Azerbaijan and etc.

RESULTS AND DISCUSSIONS

In this regard, we touch brief chronology of the stages of agricultural development in the economy of Azerbaijan.

One of the main features of the development of agriculture in the Azerbaijan Republic is the climatic conditions of the country.

42% of the territory of the Azerbaijan Republic is mountainous, and 58% are mountainous and lowland. 4,740 thousand ha or 55.1% of the total land fund – 4,769.8 thousand ha are agricultural land, including

30.2% of pastures and hayfields, 31.2% - other lands.

Currently, based on the country's existing hydrographic resources, 1,438 thousand hectares of agricultural land are irrigated, and in total it is estimated that irrigated lands amount to 3,200 thousand acres.In general, the Republic of Azerbaijan is one of the countries with limited land resources.Thus, the country has 0.48 ha of agricultural land per capita, including 0.21 ha of arable land.

The presence of long sunny days, natural heat and other favorable climatic features in the country is a positive factor in rural development.Thus, 9 out of 11 types of climate are typical for the country, with the exception of three types, the rest of which are favorable for the development of various areas of agriculture.

All these factors have led to the specialization of agriculture in Azerbaijan since ancient times.Thus, agricultural products produced in Azerbaijan have become an important object of export not only for the internal market but also for export.Cotton, silk, saffron and many other agricultural products grown in the country were exported to many western and eastern countries along ancient caravan routes. Azerbaijan has become the largest grain, cotton, silk, tobacco and cattle-breeding center in the whole Caucasus.

Assessment of the development of agriculture of the Republic of Azerbaijan in the Soviet Union

A more comprehensive and significant economic growth in Azerbaijan dates back to the Soviet Socialist Republic, which spanned over 70 years in the 20th century. Over the years, most sectors of the Azerbaijani economy developed rapidly and had a strong industrial potential compared to previous periods.This was due to the strong oil potential of Azerbaijan. Azerbaijan was the main oil base of the Soviet Union.

The economy of Azerbaijan in the Soviet Union has reached a high but incorrectly assessed level of development.Thus, the development of the Azerbaijani economy during this period was unstable.For example, the average economic growth in the country in the 1960s and 1970s was 5.2% and increased by 7.4% between 1970-80. In the 1980s and 1990s, this ratio declined sharply.Thus, there was a decline of 4.9% in 1981-85. and 5-6% in 1986-1990.The reason for the decline is the desire of Azerbaijan to obtain political independence in 1989-1991.

As we mentioned, Azerbaijan has historically been specialized in agriculture.In the 1970s, about 80,000 hectares of land was used for wine production. Cotton production in Azerbaijan's agriculture at that time also played a special role.In the 1970s and 1980s, about 1 million tons of cotton was produced annually. During this transition period, the cotton sector also faced serious challenges. There has been a significant decline in cotton production due to falling world cotton prices. In addition, wheat, tobacco, tea, olives, fruits and vegetables were staple products in the agricultural sector. The country had the potential to produce enough grain to support itself.

During the Soviet period grain production was high. In the 1970s and 1980s, annual output increased to 1 million tons. In addition, production per hectare, for example, more than tripled in 1970 compared with 1913. However, at a time when the planned economy dominated, it was dictated by the center, who would produce, what would be produce and how much. The center preferred to replace the production of grain with grape plantations. True, this contributed to the development of the grape industry in the country.

In the period from 1970 to 1975, the growth rate of agricultural production in Azerbaijan increased and reached 34% instead of the expected 30%. Analyzing the experience and new possibilities of thinking about the sustainable development of agriculture in the republic, Heydar Aliyev set the task for the tenth five years (1976-1980) to achieve the rapid development of agriculture by expanding the use of intensive factors and increasing labor productivity and made concrete proposals. As a result of the implementation of these decisions in the republic in 1981-1985, gross agricultural output increased 2.5 times compared to the average of 1966-1970.

In general, in the 70s and the first half of the 80s, the number of specialized areas of crop production in agriculture in Azerbaijan increased. However, it should be noted that, due to the formal nature of commodity production in Soviet times, prices were not formed under the influence of socially necessary value, as well as supply and demand. The requirements of economic laws, including economic laws relating to the production of goods, were not taken into account. Prices for products were set by the state on the basis of political ambitions.At that time, the state was oriented toward the development of industry, especially the military-industrial complex. Economic development was considered secondary in the agricultural sector. Therefore, the price of agricultural products was many times lower than the cost. However, the law of value, which is one of the economic laws of commodity production, requires that the price must be higher than cost, that is, cost, because if the cost is not paid and the income is not received, reproduction will not occur. In a market economy, this is regulated by a market mechanism.That is, if the cost of the goods of the producer (production costs) is higher than the market price, it will go to bankruptcy. Because the ability to organize production is low, it is replaced by a more capable manufacturer who knows the functions of the market. This factor motivates manufacturers to use new, modern equipment and technologies, to modernize the organization of production. In the absence of them in the Soviet system, the Soviet system began to crumble in the mid-1980s, and the agricultural sector was in a deep crisis.With the collapse of the USSR, state farms and collective farms also ceased to exist. It should be noted that the land used by collective farms was called collective-farm cooperative property, but in fact it was state property. Socialist agricultural enterprises used land inefficiently due to the lack of material interests of collective farms and state farms as a result of production, on the other hand, due to the lack of competition law. As a result, a significant part of the arable land was lost.

Agricultural reforms after independence and evaluation of their results

In the transition to a market economy, the emergence of new production structures and the diversity of economic forms, the overall efficiency of agricultural production depends on the ratio of organizational and legal forms, their application to specific economic conditions and the degree of development. This, in turn, will guarantee the competitiveness of products. It should be noted that improving the competitiveness of agricultural products is, in fact, the most important component of ensuring economic security and maintaining food security, but also plays an important role in improving the national competitiveness of the country's economy.

Legal support for the implementation of agricultural reforms in our country consists of the Constitution of the Republic of Azerbaijan, adopted laws on the implementation of reforms in the agricultural sector, decisions on ensuring their implementation, decisions adopted by the state on the development of the agricultural sector. Theoretical and practical guidelines and decisions arising from these laws, decrees and decisions determine the methodological basis for the creation of private farms, the formation and development of entrepreneurship. The main goal of implementing agricultural reforms in our country is to achieve the organization of special forms of economy in accordance with the law of a market economy and the development of entrepreneurship by all means in all areas of the agricultural sector. It should be noted that for the implementation of agrarian reforms, the State Commission on Agrarian Reform has been created in the republic, local and regional commissions on agrarian reform, their rights, functions, duties and rules of procedure pose very important tasks for the commissions created for the implementation of reforms, which are approved in the relevant provisions.

The main directions, goals and objectives of agrarian reform Law of the Republic of Azerbaijan on the Basics of Agrarian Reform was approved by the President of the Republic

of Azerbaijan H. Aliyev on February 18, 1995. The goal of the reform was to bring the agricultural sector out of the crisis, stabilize the economy, improve the socio-economic situation of the population in the regions and ensure food security of the country. For this purpose, the following directions are envisaged for the reform [4]:

- the formation of new property relations in the agricultural sector;
- land reform, land reclamation and water management;
- the creation of different types of farms;
- state support for the agricultural sector.

The main principles of agrarian reform are:

- coordination of agrarian reform with the economic policy of the state;
- ensuring social justice and voluntariness in the implementation of reforms;
- ensuring the complete freedom of producers in the organization of economic activity and the disposal of their products;
- taking into account the agricultural features of the republic;
- compliance with environmental requirements;
- social development of the village and social protection of the population.

The initial stage of the implementation of agricultural reforms in our country falls on the period after independence, and this stage is considered the first stage of deepening agricultural reforms, improving agricultural relations and the formation of the agricultural market.In this case, the following measures were taken:

- legal basis was created in accordance with market relations;
- agrarian reforms were carried out on state and collective farms, their land and property were privatized, and land and property were provided to those who had the right to receive shares;
- the property of processing, procurement, sales and service enterprises was privatized, the state monopoly was abolished;
- on the basis of state and collective farms liquidated at the expense of land and property shares, various economic entities were established on a private basis, entrepreneurship was formed and developed;
- financial, credit, tax, insurance, price, management system was changed, systemic policy was implemented in accordance with market principles;
- customs policy on import-export operations was improved;
- cooperation with international organizations in the field of agriculture (scientific-technical, experimental, economic, etc.) was expanded;
- new integrated relations in the field of production, processing and services were established in international markets;
- obstacles to the development of entrepreneurship in agriculture and interference in their work have been eliminated;
- favorable legal-economic and organizational mechanisms have been created in the development of entrepreneurship, consistent stimulation measures have been implemented in the development of production (taxes, subsidies, loans, etc.);
- land and property owners are completely free to manage their farms, etc.

At the first stage of agrarian reforms, 99.8% of land plots to be transferred to private ownership and 98.9% of property were privatized. About 867,000 families received land shares and owners were created. As a result of favorable conditions created in the agrarian sector, about 842,000 small (family) farms, 36 state farms (limited liability company), more than 79 agricultural production cooperatives, 2,409 agricultural enterprises (joint farms), 2,571 individual entrepreneurs (legal entities) and 220 other agricultural enterprises (research, teaching, practice, etc.).

Developing second stage, it was considered necessary to resolve the following issues:

1.Soil and climatic features, conditions for the development of territories in the country. This is the main distinguishing feature of agricultural relations. Renewal of land relations and creation of various forms of economy;

2.There should be a raw material base for the agricultural processing industry. Cotton, tobacco, and tea are processed, not consumed. 40-50% of some products are sold for processing, the rest are for personal

consumption. Expanding the network of processing and service enterprises, creating new organizational and legal structures;

3.Agriculture is multifaceted. In addition to the main sector, it is possible to develop other areas of agriculture in one economic region. To develop the production of export-oriented products based on the superior development of the industry;

4.In agriculture, market relations require a new relationship of ownership and entrepreneurship in relation to land and property, and this is a key factor. Creation of conditions for the development of entrepreneurship;

5.The formation and development of market relations in the agricultural sector depends on a flexible system of state regulation. That is, to stabilize and develop production, protect producers' incomes, credit, tax, price, insurance, management, etc. pursue a flexible economic policy in connection with;

6.Ensuring state participation in the social development of rural territories and villages in the regulation of social policy in the agricultural sector;

7.The formation of stocks of food and raw materials for state reserves;

8.Efficient use of available land, labor and financial resources;

9.Ensuring the independence of entities working in the agricultural sector, producers, processors, sales and services.

It should be noted that consistent and systematic measures have been taken and are being taken at the state level to form the agricultural market in accordance with these agrarian policy directions.

As a result of the agrarian reforms carried out in the first years of our independence, agriculture emerged from the crisis and entered a new development path based on quality. These reforms were distinguished by their radicalism and speed not only from reforms in other sectors of the economy, but also from similar reforms of the CIS countries. Thus, with a view to the sustainable development of agriculture, has been created a solid legal framework and have been formed new land and property relations. The new land relations that arose as a result of agrarian reforms created a sense of ownership among the owners and made them real controllers of their products. Now the landowners could decide for themselves what to plant, where to sell and at what price. Owners must both provide themselves with the products that they receive from the land, and improve their material well-being, making a profit, selling it on the market. This increases their interest in production. As a result of land reform carried out in the Republic of Azerbaijan on the basis of a market economy, 4.913 million hectares of land were transferred to state ownership, 2.032 million hectares - into municipal ownership and 1.695 million hectares - into private ownership. The most important task of agrarian reforms was the reindustrialization of the Azerbaijani peasantry, the creation and development of multilayer, highly efficient forms of economy in this important sector.

Following the adoption in 1991 of the Constitution "On the State Independence of Azerbaijan", the Law on Private Property was adopted in the same year. Then, on December 15, 1992, the Entrepreneurship Law entered into force. Also in 1993, the Law on the Privatization of State Property was adopted. We know that the main way to attract large groups of people to entrepreneurship is privatization. This leads to the creation of the material base for the formation of small and medium enterprises. The emergence of small and medium-sized businesses accelerated the transition to a market economy. Then, at the beginning of 1993, the law on privatization of small enterprises was adopted. It should be noted that 93.2% of the properties to be privatized in the agricultural sector have been privatized. As a result, since 1997, agricultural and livestock production has increased by 7% per year.

At the same time, as a continuation of the reforms, the state signed a decree in 2011. In addition, the development concept “Azerbaijan 2020: a Vision for the Future” provides for further improvement of scientific support and training in the agricultural sector [5].

By the Decree of the President of the Republic of Azerbaijan dated March 16, 2016 No. 1897 On approval of the main directions

of the strategic roadmap for the national economy and key sectors of the economy, appropriate instructions were given for the preparation of the Strategic Roadmap based on an in-depth analysis of the current state of the economy. Accordingly, the current situation in the field of agricultural production and the processing industry has been systematically and comprehensively analyzed with the participation of the relevant public authorities, research centers and independent experts, a number of discussions and relevant assessments were held and on this basis the Strategic Road Map for Production and Processing of Agricultural Products in the Republic of Azerbaijan was prepared.

In connection with the implementation of the Strategic Roadmap for 2016–2020, based on the principles of sustainable development in the country, it is planned to implement 9 strategic goals to create favorable conditions for achieving the formation of competitive agricultural production and the processing sector. These strategic objectives include strengthening the resilience of food security, building agricultural production capacity in value chains, developing an agricultural resource market and facilitating access to appropriate resources, including finance, improving agricultural science and education, and providing advice and information. developing service systems, developing market infrastructure and facilitating market access for producers, creating mechanisms for the sustainable use of natural resources, improving the business environment in the agricultural sector and improving welfare in rural areas [1].

By the Decree of the President on amendments to the Decree of the President of the Republic of Azerbaijan dated December 19, 2018 "On improving state support for agriculture and leasing activities in the agricultural sector" and to the Decree of the President of the Republic of Azerbaijan No. 571 dated 23 July 2015 "On approving the provisions of some into the structure of the Ministry of Agriculture ", the Agrarian Credit and Development Agency (ACDA)was created, based on the structure of the State Service for Management of Agricultural Projects and Credits under the Ministry of Agriculture of the Azerbaijan Republic. The State Agrarian Trade Company was established under the Ministry of Agriculture by a decree signed on the establishment of the Agrarian Research Center under the Ministry of Agriculture of the Republic of Azerbaijan. In addition, the district and city offices of the ministry were abolished and replaced by the State Agricultural Development Centers (SADC) and the Farmers Council under the Ministry of Agriculture. Also, the Agrarian Advisory Council was established under the Ministry, the Food Supply and Procurement OJSC was liquidated, and the Agrarian Supply and Supply OJSC was established under the Ministry of Agriculture. On the basis of the State Service for Agricultural Projects and Credit Management, the Agrarian Agency for Credit and Development was created, the portfolio of OJSC Agroleasing, as well as the function of selling agricultural machinery and breeding animals at reduced prices was transferred to the new institution.

The Decree of the President of the Republic of Azerbaijan dated June 27, 2019 No. 759 "On the establishment of a new subsidy mechanism in the agricultural sector" was signed to make the provision of subsidies in the agricultural sector more efficient. At present, the fixed financial means used in the calculation of subsidies in the field of crop production is equal to 200 AZN.25% of planting subsidies are used in cash and 75% in non-cash form. 100% of the cost of pesticides and seeds, 70% of the cost of mineral fertilizers and biohumus can be paid by subsidies. Agricultural cooperatives are paid more than 10% of the subsidy for planting on more than 50 hectares of land. In addition, a new mechanism for providing subsidies for crops and seeds is being introduced, which will help improve the financial situation of farmers.

In the livestock sector, the mechanism for providing subsidies for artificial insemination, beekeeping and cocoon production has also been improved.

Economic assessment of agricultural production in 2010-2018

Although agriculture provides about 5-6% of GDP in Azerbaijan, it accounts for 37% of employment. Of course, this disproportion reflects the situation with labor productivity and human capital development in the agricultural sector. The value of gross agricultural output in actual prices in 2010 was 3,877.7 million manat, and in 2018 it was 7,010.0 million manat. As can be seen, in 2018 it was 1.8 times more than in 2010. Thus, in comparable years, the production of livestock increased by 2 times, and crop production by 1.6 times.

The analysis of statistical data on the production and productivity of the main types of crop products in Table 1 [9] shows that in the comparable 2010-2018 there is a significant increase in crop production in general. From this point of view, in 2018, compared to 2010, crop production is 65.4%, productivity is 45%, cotton production is 6 times, productivity is about 39%, vegetable production is 28%, productivity is 14%, hazelnut production is 76,8%, productivity decreased by 0.8%. This is due to unstable weather conditions and heavy rainfall. Due to weather conditions, pollination of trees is not carried out properly. Although fruit and berry production increased by 38.6%, productivity decreased by 3.7%, tea production increased by 54.4% and productivity increased by 18%.

Table 1. Production and productivity of the main types of crop products

	Grain		Cotton		Vegetables		Hazel		Fruit, berries		Tea	
	Production, thousand ton	Productivity, cents / ha	Production, thousand ton	Productivity, cents / ha	Production, thousand ton	Productivity, cents / ha	Production, tons	Productivity, cents / ha	Production, tons	Productivity, cents / ha	Production, tons	Productivity, cents / ha
2010	2,000.5	20.7	38.2	12.7	1,189.5	142	29,454.3	12.9	729,502.4	70.6	544.9	9.4
2011	2,458.4	25.4	66.4	15.5	1,214.8	146	32,922.2	14.1	765,818.0	71.7	534.1	9.8
2012	2,802.2	27.2	57.0	19.5	1,216.3	150	29,623.8	12.4	765,818.0	73.8	567.9	10.5
2013	2,955.3	27.5	45.2	19.3	1,236.3	154	31,201.9	12.5	853,557.2	74.3	567.6	12.0
2014	2,383.3	24.0	41.0	17.9	1,187.7	152	30,039.0	11.8	850,802.9	72.0	474.3	10.1
2015	2,999.4	31.5	35.2	18.8	1,275.3	158	32,576.3	11.8	888,415.8	71.4	579.0	12.4
2016	3,065.1	30.6	89.4	17.3	1,270.6	159	34,270.7	10.7	882,800.0	65.7	1015.7	14.1
2017	2,928.8	29.8	207.5	15.3	1,405.6	155	45,530.4	12.0	954,785.4	68.4	775.2	11.1
2018	3,309.2	30.0	233.6	17.6	1,521.9	162	52,067.3	12.8	1,010,816.3	68.0	868.6	11.1
2018/ 2010 %	165.4	145.0	611.5	138.6	128.0	114.1	176.8	99.2	138.6	96.3	159.4	118.1

Source: The State Statistical Committee of the Republic of Azerbaijan.

Satisfying the demand for cotton products in the country, improving the supply of raw materials for cotton processing enterprises, developing the processing industry, increasing exports of cotton products, strengthening government support for growing cotton in rural areas and stimulating the development of this sector.

At present, against the background of the development of the non-oil sector in the country, increasing hazelnut production is also a priority. On the other hand, the government is working to increase production and provide farmers with hazelnut seeds free of charge, as well as subsidies, grants and soft loans. At the same time, foreign companies are interested in the development of this area. It should be noted that companies from Italy, Turkey, Austria and Poland are interested in investing in this field in Azerbaijan. All this plays a significant role in the development of hazelnut growing, and as a result, Azerbaijan is the third largest exporter of hazelnuts in the

world. One of the most profitable products in the agricultural sector today is hazelnuts.

One of the most lucrative industries in the country since independence has been the breeding of cattle. Livestock is developed to meet the needs of the country. In order to maintain the dynamics of growth in livestock production in the country and to meet the needs of the population in livestock products through domestic production, the necessary measures are being taken to create new farms, improve the breed of existing livestock and other areas. Recently, more than 15 modern livestock farms have been established in the country. On the basis of the project "Creation of modern family farms for the production of meat and dairy products", measures are being taken to improve the living standards of the rural population by creating modern family farms in selected pilot districts of Agjabedi, Barda and Imishli districts.

It should be noted that in the analyzed years, there has been an increase in livestock production and head count. So, in 2010-2018. meat production in cut weight was 33.2%, milk production - 35.46%, egg production - 42.22%, wool production - about 1.3%, cocoon production - 86 times, honey production, while poultry meat increased by 78.9% more than 2.6 times. National buttermilk, dovga, yogurt, curd and other national products processed by dairy enterprises have taken their place in the markets.

Thanks to targeted measures taken to strengthen the country's food security, the level of self-sufficiency in basic food products increased in 2015 (Table 2).

Table 2. Level of self-sufficiency in crop and livestock products

Products	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total grain	56.5	64.8	64.3	63.9	60.6	64.5	63.8	66.3	74.1
wheat	48.9	57.7	56.8	55.9	54.1	54.8	52.9	58.1	64.8
barley	87.7	93.7	95.1	97.8	84.6	95.1	101.7	94.4	103.1
corn	64.5	68.0	67.3	60.0	56.7	54.1	71.1	70.7	82.7
oats	80.6	82.8	84.4	89.3	62.2	93.1	85.7	90.1	89.2
Other types of cereals	1.0	4.0	8.7	2.3	1.1	6.3	32.0	20.4	82.3
legumes	65.8	70.4	71.6	76.6	76.5	69.3	68.4	73.7	72.0
potato	100.5	101.6	98.2	97.6	89.7	89.1	85.5	89.2	90.8
All kinds of vegetables	97.6	95.7	98.9	102.3	103.4	103.4	105.4	115.2	115.0
tomatoes	106.0	106.1	105.4	109.3	112.1	113.7	119.0	130.9	138.0
gourds	100.0	100.2	100.1	100.0	100.4	100.0	100.2	100.2	99.7
Fruits and berries	107.9	116.8	125.7	121.8	120.1	113.7	116.4	122.4	123.2
walnutsand hazelnuts	121.6	139.9	134.4	134.9	151.4	132.5	141.9	152.9	130.0
pomegranate	…	…	106.7	104.7	103.5	103.7	105.2	104.5	106.3
grape	90.4	89.9	94.3	94.8	97.9	93.1	89.2	93.4	92.5
All types of meat of cattle and poultry	87.7	87.7	91.8	92.4	92.4	94.7	87.9	84.7	82.7
beef	95.5	88.0	92.6	86.3	87.7	91.8	93.5	86.3	85.1
mutton	99.7	99.8	98.5	97.7	97.9	99.3	98.7	98.0	98.1
pork	19.7	14.7	25.7	36.0	16.6	17.8	7.0	5.6	5.5
poultry	70.6	79.9	87.8	98.5	98.0	98.6	79.1	79.7	75.9
Milk and dairy products	70.4	70.9	72.5	76.0	76.3	84.3	87.7	86.1	86.7
Egg	97.9	77.4	96.2	100.0	99.7	99.7	98.8	100.5	101.5
Fish and fish products	76.6	73.0	74.7	71.7	72.8	77.6	82.3	81.2	83.1

Source: The State Statistical Committee of the Republic of Azerbaijan.

One of the main challenges is to radically develop the food safety control system, which is one of the important components of food security. At present, the control over the quality and safety of agricultural and food products in Azerbaijan is carried out by eight government agencies. The establishment of proper coordination among these bodies and

the overcoming of existing problems require institutional reforms.

Thus, the total volume of agricultural products in the country in 2010 was 3,877.7 million manat, in 2018 - 7,010.0 million manat. This shows an increase of 3,132.3 million man. in comparable years. It should be noted that the development of the agricultural sector has increased the level of self-sufficiency in some agricultural products. Despite this increase, the level of self-sufficiency has not yet been fully achieved. Thus, the level of self-sufficiency in vegetables, fruits and eggs is slightly more than 100% (Table 2) [8].

Based on official figures, it can be said that in 2018, the level of self-sufficiency in cereals was about 82.4%, fruits and vegetables more than 100%, and the level of self-sufficiency in livestock products was 83%.Feed and feed components account for 70% of farmers' livestock costs. This reduces the production of livestock products. In general, the development of animal husbandry is one of the most important factors for livestock farmers. At the same time, the elimination of manual labor can be solved with the help of strong financial resources, which, in turn, will lead to higher market prices. All this requires the state to protect farmers and take serious steps in the field of market interventions.

CONCLUSIONS

According to our analysis, despite the positive changes in agriculture, there are still many problems in this area that need to be addressed. The e-agriculture system still has a weak base, the privatization of agro-leasing services, and the optimization of breeding and fertilizer support need to be addressed. Among the serious problems we can show that there are many small farms. From this point of view, the mechanism of establishing cooperative relations should be studied and applied in accordance with world experience, that is, a model should be built in this direction. To accelerate cooperation, the agricultural insurance system must be strengthened. In addition, specifically:

- low productivity due to the lack of widespread application of advanced farming methods, the role of extensive factors in the growth of production for most products;

-problems with irrigation water supply to arable lands;

- insufficient development of market infrastructure, including sales and warehousing infrastructure;

- the predominance of family farms based on low ownership of land and the low level of market orientation of these farms;

- the predominance of supply (production) over demand (market) in agrarian policy and the need to improve this policy in general on the basis of the "value chain" approach;

-weak farming partnerships and cooperation in agriculture, including agro-industrial integration;

- poor development of producers' access to financial resources and agrarian insurance system, etc.

In order to solve these problems, important agrarian projects implemented in the field of agriculture in 2019-2020 continue in our country. The reforms carried out by the state in the field of agriculture have entered a new stage. In our opinion, the most needed area for innovation in the country is agriculture. Innovation will stimulate the efficient use of land, as well as agrarian entrepreneurship, which will increase the competitiveness of products and strengthen the scientific and technical potential of the country.

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DYNAMICS OF RED WINES QUALITY OBTAINED WITHIN THE COMPANY S.C. MURFATLAR ROMANIA S.A. IN THE PERIOD 2017-2019

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Abstract

In order to determine the dynamics of the red wines quality produced within S.C. Murfatlar Romania SA, we performed an analysis of the main physical chemical parameters with an essential role in the quality of wines, namely: alcohol concentration %, free sugar g/l, total acidity g/l $C_4H_6O_6$, non-reducing dry extract g/l, total sulphur dioxide g/l. The analysis regarding the main physical, chemical and organoleptic parameters (colour, smell, taste, texture, balance) responsible for the quality of the wine was performed during the last 3 years (2017-2019) for 12 samples of red wine obtained within the company. The main physical chemical parameters responsible for the quality of the wines, respectively the alcoholic strength, and the total acidity recorded a positive evolution for the analyzed red wines. In terms of organoleptic analysis, all four wines proved to be particularly extractive, with a strong bouquet, balanced and with special flavours. All the analyzed parameters were within the limits imposed by the International Organization of Vine and Wine (OIV) during the studied period.

Key words: *alcoholic strength, physical-chemical parameters, quality, red wines, total acidity*

INTRODUCTION

The wine quality is a subjective term, with different meanings, depending on the context in which it is used. The perceived quality is a reflection of the chemical composition of the wine, when it is consumed [1, 5, 11].

The qualitative diversity of wines, determined mainly by the areas where the vines are grown as well as the diversity of varieties, led each wine-growing country to adopt its own wine classification systems. High quality wines are obtained from wine varieties with superior technological properties, cultivated in delimited wine-growing areas [4]. In Romania, the classification criteria are: alcohol content, quality characteristics determined by the physical chemical composition and the obtaining technology, all provided in the Law on Vine and Wine [9]. The highest quality category of wines is that of wines with a controlled origin name and quality steps (DOC) [6].

Specialists in the field unanimously agree that a high quality wine is the wine that best expresses the terroir of which it is part [4]. Terroir is a concept that concentrates all the peculiarities of a wine area, such as soil, climate, environment, geographical position, but also the traditions of that area. Thus, the terroir plays an important role in obtaining a high quality wine, as the wine takes from it unique elements that cannot be duplicated anywhere in the world [12].

MATERIALS AND METHODS

Terroir of Murfatlar vineyard is characterized by arid soils with visibly calcareous sub-layers, by an excessive continental climate, with hot summers and long, sunny autumns, with rich heliothermal resources. The rain regime is deficient (less than 400 l/m2), distributed mainly in spring and autumn, this ensuring a uniform ripening of the grapes, sometimes even their maturation with the help of pathogenic fungi (Botrytis cinerea var-nobilis) which causes an over-concentration of sugar in grapes, essential for obtaining high quality wines [2].

Consequently, the imprint of the rich, generous and unique terroir of Murfatlar vineyard is transmitted to the wines obtained within the company, resulting in the case of

red wines - particularly extractive wines, with intense aromas and colors, by aging developing a strong bouquet.

The assortment structure of the company currently includes about 200 varieties, in proportion of 30% red varieties (Feteasc Neagr, Cabernet Sauvignon, Merlot, Pinot Noir, etc.), 65% white wines (Chardonnay, Sauvignon Blanc, Muscat Ottonel, Riesling Italian, etc.), and 5% pink varieties.

The present study aims to analyze the dynamics of the qualitative parameters of red wines obtained within the company Murfatlar Romania S.A. during the last 3 years.

We performed an analysis of their physical chemical and organoleptic characteristics, during the last 3 years, the analysis being performed based on the data collected from the analysis bulletins provided by the company S.C. Murfatlar S.A. Romania. The 12 samples were: 3 samples of Feteasc Neagr wine from Arezan collection, 3 samples of Merlot wine from Leat 6500 The Origin collection, 3 samples of Cabernet Saugvinon wine from Zestrea Murfatlar collection, 3 samples of Pinot Noir wine ennobled with Merlot from Zestrea Murfatlar collection.

The physical chemical characteristics analyzed for each wine were: alcoholic concentration%, free sugar g/l, total acidity g/l $C_4H_6O_6$, non-reducing extract g/l, total SO_2 mg/l.

The organoleptic characteristics that formed the basis of this analysis were: the color, smell, taste, texture and balance of the wines, based on which we also achieved the olfactory and gustatory profile of the analyzed red wines.

We looked if the qualitative parameters of this type of wine were within the limits imposed by the International Organization of Vine and Wine (OIV) during the studied period.

RESULTS AND DISCUSSIONS

The values of physical-chemical parameters responsible for the quality of red wines showed in the period 2017-2019 the following values [10]:

Table 1. Physical-chemical parameters of red wines produced within S.C. Murfatlar Romania S.A. in the period 2017-2019

No. sample	Year	Physical-chemical parameters				
		Free sugar (g/l)	Alcohol vol (%)	Total acidity (g/l $C_4H_6O_6$)	SO2 total mg/l	Non reducing dry extract (g/l)
Red wine Feteasc Neagr – Collection Leat 6500 The Origin						
1	2017	23.9	12.00	5.48	115	23.50
2	2018	26.2	12.70	6.60	156	30.20
3	2019	22.4	12.50	5.90	179	33.20
Red wine Cabernet Sauvignon –Collection Leat 6500 The Origin						
4	2017	9.70	12.20	5.32	149	26.00
5	2018	9.00	12.50	5.89	151	25.60
6	2019	8.90	12.70	5.32	169	27.30
Red wine Merlot – Collection Zestrea Murfatlar						
7	2017	9.30	12.20	5.39	159	26.00
8	2018	9.00	12.60	5.53	165	25.80
9	2019	11.0	12.40	5.80	158	25.20
Red wine Pinot Noir ennobled with Merlot – Collection Premiat						
10	2017	29.0	11.80	6.10	172	27.10
11	2018	27.2	12.20	6.43	174	28.90
12	2019	29.5	12.20	6.50	136	26.90

Source: The analysis bulletins of S.C. Murfatlar Romania S.A. [10].

From Table 1, we find out that in the period 2017-2019, most physical-chemical parameters of red wines have changed.

The dynamics of sugar free of the 4 red wines is presented in Fig.1.

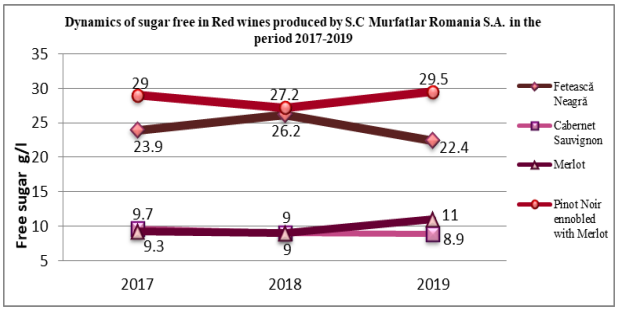

Fig. 1. Dynamics of sugar free in Red wines produced by S.C. Murfatlar România S.A. in the period 2017-2019 [10]

Source: own design [10].

As we can see from Figure 1, the free sugar content varied for each red wine analyzed, as follows: Merlot and Pinot Noir wines ennobled with Merlot recorded in 2019 compared to the first year studied increases by up to 18.27%, respectively 1, 72%, while Cabernet Saugvinon and Feteasc wines had a negative evolution, decreasing by 8.24% and 6.27% respectively.

The increase of the free sugar content in Merlot and Pinot Noir wines ennobled with Merlot is motivated by the use of a modern

vinification technique, opting for the fermentation of wines in egg-shape cement amphorae, these giving the 2 wines superior quality characteristics, compared to Cabernet Saugvinon and Fetească Neagră wines, in which the fermentation took place in steel tanks. Amphorae are made of cement, having an egg shape, among the famous wine producers that use this model of amphorae are Pontet Canet, Chateau Lafite and Chapoutier [1].

Depending on the accumulated free sugar content, the 4 wines analyzed are classified as follows: Cabernet Saugvinon wines, Merlot-semi-dry wines, Fetească Neagră wines, Pinot Noir ennobled with Merlot-semi-sweet wines.

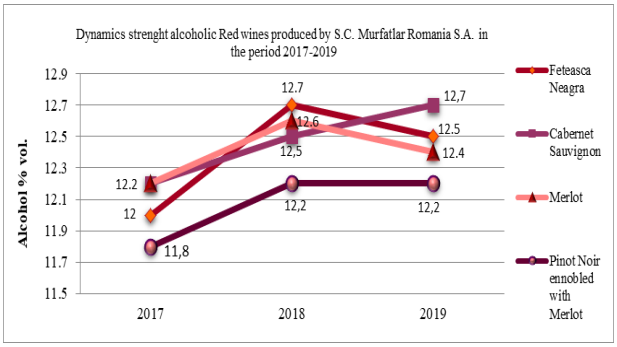

Fig. 2.Dynamics of alcohol strength of red wines produced by S.C. Murfatlar Romania S.A. in the period 2017-2019
Source: own design [10].

We note that in 2019 comparatively to the first year studied, all four analyzed wines recorded a slight increase of alcohol strength, at least over 4%.

The content of sugar and alcohol strength moderates the wines acidity, offering them a balance [7].

As we can see from Figure 3, the total acidity of Merlot and Pinot Noir wines ennobled with Merlot recorded a positive evolution throughout the studied period, with an average annual increase of over 5.9%. The factors that contributed to these increases are the treatment of cement amphorae in which the wines were vinified, with tartaric acid solutions before use, as well as the particularities of Merlot grapes from which both wines were made, which have a higher content of annual tartaric acid.

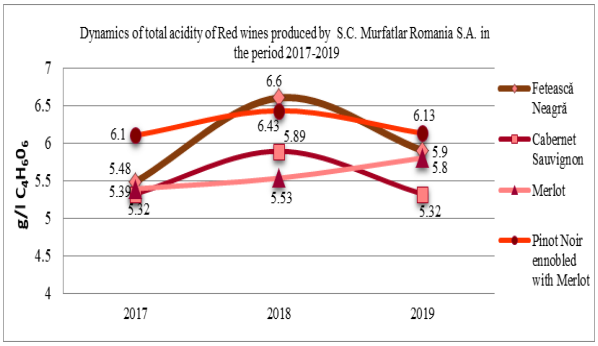

Fig. 3. Dynamics of total acidity of red wined produced by S.C. Murfatlar Romania S.A. in the period 2017-2019
Source: own design [10].

In contrast, in 2019, Cabernet Saugvinon and Fetească Neagră wines recorded a decrease in the value of total acidity by up to 9.68% and 10.6% compared to the values of total acidity in the previous year, as acidity corrections were made by refrigerating the wine, adding K_2HPO_4 solutions as well as SO_2.

Sulphur dioxide prevents the disease of the wine and improves the quality of the wines, keeping their freshness of aromas and color, participating in the formation of the wine bouquet [8].

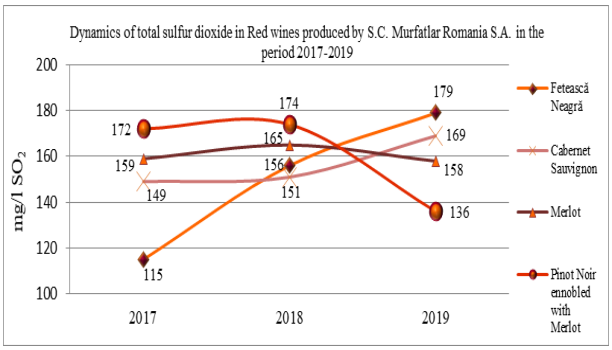

Fig. 4. Dynamics of sulphur dioxide of red wines produced by S.C. Murfatlar Romania S.A. in the period 2017-2019
Source: own design [10].

Regarding the evolution of sulphur dioxide of the 4 wines analyzed, we find that in 2019, compared to the first year studied in the case of Fetească Neagră and Cabernet Saugvinon wines, there were increases of 55.65% and 13.42%, respectively, these increases have as main causes the addition of SO2 in order to correct the acidity of the 2 wines, in the clarification operations but also to prevent possible defects. In the case of Merlot wine, the amount of sulphurous anhydride decreased

slightly by 0.63%, while Pinot Noir wine ennobled with Merlot decreased by up to 20.9% during the same period. These decreases are explained by maintaining the 2 wines at an adequate temperature of 18^0C for both maceration and alcoholic fermentation, by triggering malolactic fermentation with the sowing of selected lactic acid bacteria, and by the use of cement amphorae, as they were made without chemical additives, from washed sand from Loire Valley, gravel, non-chlorinated water and cement, unfinished inside for better antimicrobial and bacteriological control, thus reducing the need for SO_2, in order to treat any defects of the 2 wines.

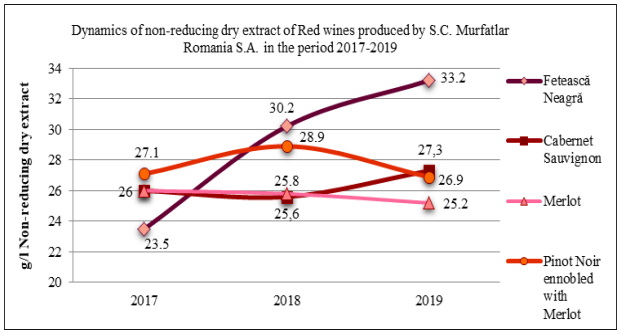

Fig. 5. Dynamics of non-reducing dry extract of red wines produced by S.C. Murfatlar Romania S.A. in the period 2017-2019
Source: own design [10].

The non-reducing dry extract of the 4 red wines showed a positive evolution in 2019 compared to the first year studied for Fetească Neagră and Cabernet Saugvinon wines, which increased by 41.2% and 5%, respectively, due to a long maceration at a temperature of 10^0C, while Merlot and Pinot Noir wines ennobled with Merlot recorded slight decreases, of 0.8%, finding that the use of a modern vinification technology can sometimes have as a side effect a slight decrease of the non-reducing dry extract.
The most extractive of the 4 wines studied were the wines Fetească Neagră and Pinot Noir ennobled with Merlot.
Based on the data provided by the analysis bulletins, we made the taste and olfactory profile for each wine.
The organoleptic characteristics of *Fetească Neagră wine* are presented in Fig.6.

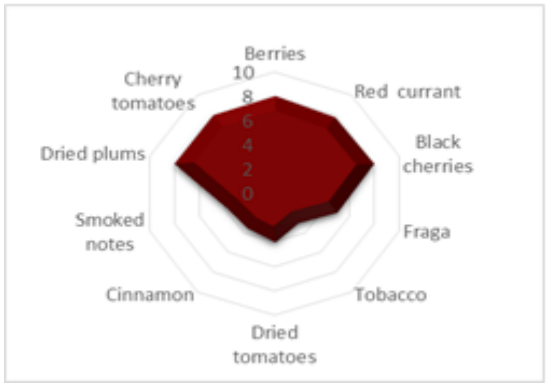

Fig. 6. Olfactory profile of Feteascã Neagrã wine in Arezan collection - S.C. Murfatlar Romania S.A.
Source: own design [10].

Feteasca Neagră wine, with a deep ruby red color, is a wine as expressive as it is soft. Scented with intense and compact aromas, it evolves gently in clean and refined notes represented by a symphony of sensations of red berries, dried plums, black cherries, red and strawberry currants, tobacco, sun-dried tomatoes, cinnamon and smoky notes. Initially shy and tense, it then looks complex and with a remarkable personality, resulting in perfect concordance with the olfactory picture.

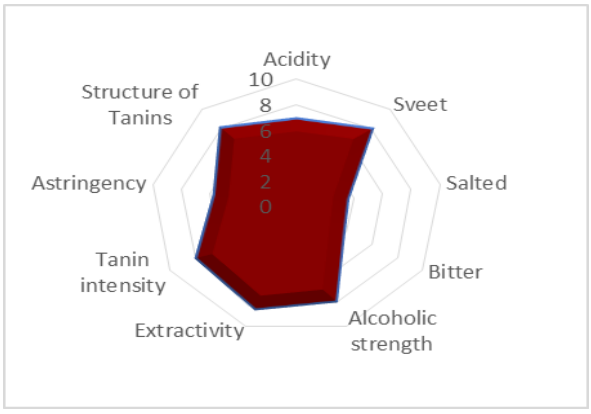

Fig.7. Taste profile of Fetească Neagră wine in Arezan collection - S.C. Murfatlar Romania S.A.
Source: own design [10].

Tasteful, it arouses a true admiration of elegance to its tannins, extremely fine and well defined, along with the generous extraction of fruit and an acidity in perfect harmony with the structure of this wine, woven as if by hand, with a velvety and balanced body accompanied by lively notes of spice and characterized by an optimal

persistence, robbing us for a long time of the thought dedicated to its taste [3].
The organoleptic characteristics *of Cabernet Saugvinon wine* are presented in Fig. 8.

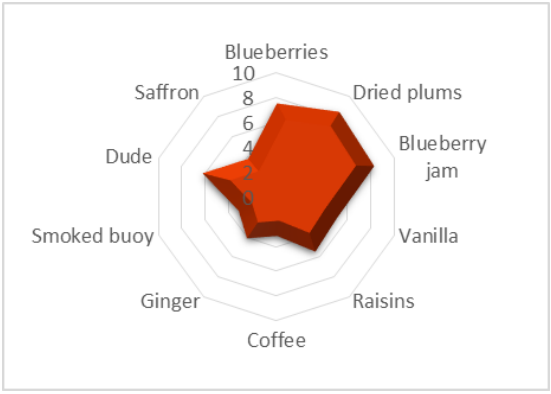

Fig. 8. Olfactory profile of Cabernet Saugvinon wine of Zestrea Murfatlar collection - S.C. Murfatlar Romania S.A.
Source: own design [10].

Saugvinon Cabernet, with an intense, clear and crystalline ruby red color, delights the olives with shades of dried plums, currants, blueberry jam, dudes, vanilla and coffee, ending with spicy notes such as ginger, saffron and smoked paprika.

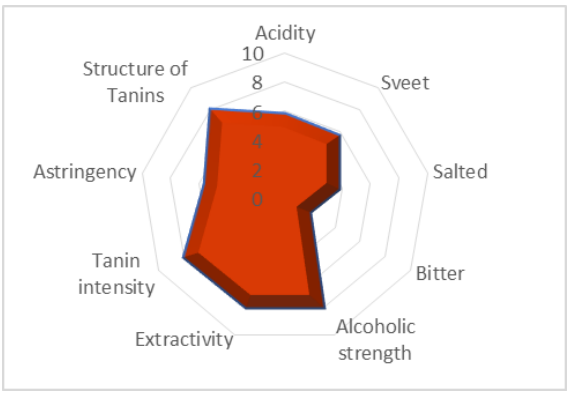

Fig. 9. Taste profile of Cabernet Saugvinon wine of Zestrea Murfatlar collection - S.C. Murfatlar Romania S.A.
Source: own design [10].

Taste, the wine greets us with a feeling of freshness of red fruits, with a wide structure and intensity of tannins and a perfect balance between acidity and alcoholic strength [8].
For *Merlot wine*, the organoleptic characteristics are shown in Fig.10.
Merlot wine is a ruby red wine with violet reflections, olfactory delights with an explosion of aromas of red fruit, bitter chocolate, vanilla, blueberry jam, licorice and burnt wood, following an intense attack of spicy notes such as pepper, green peppers and eucalyptus.

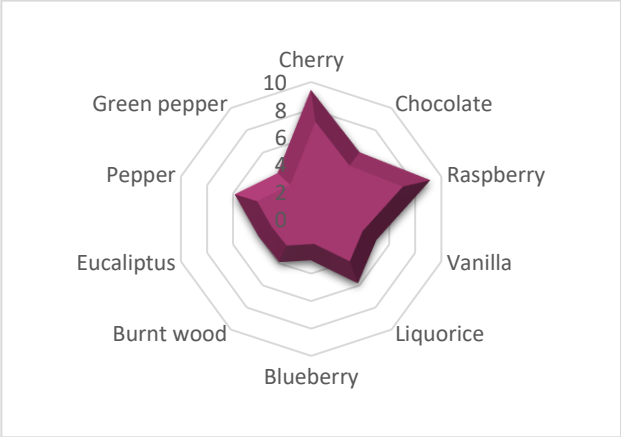

Fig. 10. Olfactory profile of Merlot wine of Leat 6500 collection The Origin - S.C. Murfatlar Romania S.A.
Source: own design [10].

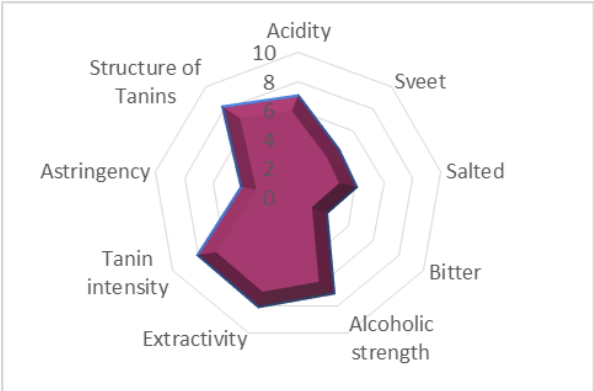

Fig. 11. Taste profile of Merlot wine of Leat 6500 collection The Origin - S.C. Murfatlar Romania S.A.
Source: own design [10].

Tasteful, it is strong, intense, balanced with round tannins, with a noticeable astringency, a medium body with a lasting aftertaste.
For *Pinot Noir wine ennobled with Merlot*, the organoleptic characteristics are illustrated in Fig.12.
Pinot Noir wine ennobled with Merlot is a wine with an expressive red glow and nuances of maturity, clear and crystalline.
Olfactory, it is characterized by a wealth of aromas of red fruit such as raspberries, cherries, currants, cherries and blackberries, in perfect synchrony with notes of cinnamon, truffles, sage, paprika and tobacco.

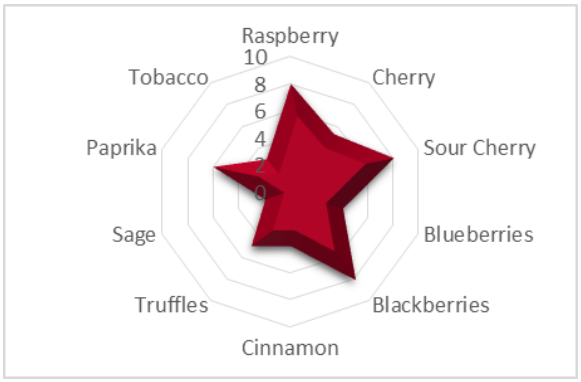

Fig. 12. Olfactory profile of Pinot Noir & Merlot wine of Zestrea Murfatlar collection - S.C. Murfatlar Romania S.A
Source: own design [10].

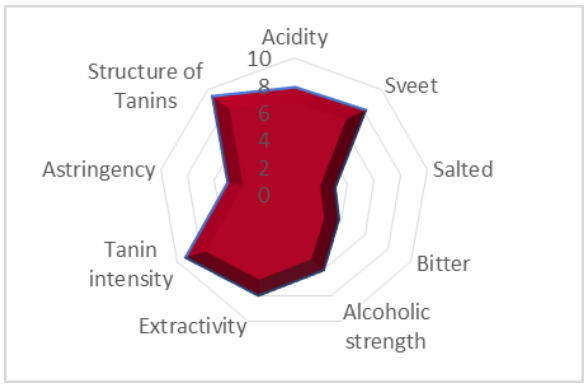

Fig. 13. Taste profile of Pinot Noir & Merlot wine of Zestrea Murfatlar collection - S.C. Murfatlar Romania S.A.
Source: own design [10].

Tasteful, it is strong, balanced, with velvety tannins, having a medium body.

CONCLUSIONS

Based on the study, we can conclude the following:
Feteasca Neagră red wine in terms of physical chemical composition and organoleptic characteristics, throughout the period 2017-2019, corresponded to the quality category DOC CT and the type of wine depending on the sugar content – semi - sweet.
Cabernet Saugvinon red wine corresponded in terms of physical chemical composition and organoleptic characteristics, throughout the period 2017-2019, the quality category DOC CMD and the type of wine depending on the sugar content - semi-dry.
Merlot red wine corresponded in terms of physical chemical composition and organoleptic characteristics, throughout the period 2017-2019, the quality category DOC CT and the type of wine depending on the sugar content - semi-dry.
Pinot Noir red wine ennobled with Merlot corresponded in terms of physical chemical composition and organoleptic characteristics, throughout the period 2017-2019, the DOC CT quality category and the type of wine depending on the sugar content - semi-sweet.
In the category of red wines, in the case of Merlot and Pinot Noir wines ennobled with Merlot, there was a tendency to increase the main physical chemical parameters responsible for wine quality, namely alcoholic strength, free sugar and total acidity.
The qualitative parameters of all wine categories were within the limits imposed by the International Organization of Vine and Wine (OIV).
In the future, we propose a better promotion on the international markets of wines made from Romanian varieties, such as Feteasca Neagră, which enjoys an increased appreciation in international wine competitions.

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EFFECT OF INFORMATION SYSTEM ON RISK ATTITUDES OF RURAL FARMERS IN GORONYO IRRIGATION SCHEME, GORONYO LOCAL GOVERNMENT AREA, SOKOTO STATE, NIGERIA

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Abstract

The study examined the relationship between information systems and attitude of the farmers towards risk in Goronyo Local Government, Sokoto State, Nigeria. A three-stage sampling procedure was used to select one hundred and twenty (120) farmers from three sectors in the irrigation scheme. The data collected were analyzed using descriptive statistics, attitudinal scale approach and multinomial logistic regression. The result of socioeconomic characteristics revealed that the farmers were predominantly male and married with mean age, farm-size and farming experience of 37 years, 0.78ha and 13 years respectively.. Radio was reported to be the major source of agricultural information reported by the farmers. The analysis on Attitudinal Scale Approach (ASA) revealed a slight variation in the classification between the risk averse and risk taking group with only a few in the neutral category. The multinomial analysis confirmed that there exists significant relationship between risk attitude of farmers and information systems, age, years of schooling, and household size. The study further revealed that damage by pests and diseases, high costs of farm inputs, inadequate storage facilities, as well as poor remunerative prices of farm produce are some of the major sources of risk faced by farmers in the study area. It was therefore recommended that extension education be intensified in order to bring to the notice of the farmers on the different means available to getting prompt information as regards their production.

Key words**:** *information systems, risk, attitude, attitudinal scale approach, rural farmer*

INTRODUCTION

Rural dwellers in Nigeria depend on agriculture as their major means of livelihood. Yet, agricultural productivity is low due to use of unimproved agricultural technologies as well as risk associated with weather conditions, pests and diseases, etc. [4, 24]. While farmers have always faced risk, farming has over the years becomes increasingly risky as a result of market liberalization and globalization. Smallholder farming has become especially vulnerable. A casual approach to farming, even if it is for household food consumption, is no longer viable. Farmers need to acquire more professional skills, not only in basic production but also in farm business management.

Risk which investment economists describe as the variation from expected outcomes due to imperfect knowledge of investors in decision making is inherent in every form of enterprise but is more intensive in input – output relation among agribusiness productions. Taking decisions that involve risk and uncertainty naturally varies from farmer to farmer and these variances are used to describe differences in risk attitude. Understanding the economic pattern displayed by individual farmers depends on getting individual risk preference [33]. Obviously, agricultural activities are exposed to greater risk. In fact, agricultural activities are more susceptible to

the physical and natural uncertainties than other enterprises. Agricultural activities entail extensive, direct and continuous contact with the forces of nature and in this part of the world where scientific methods are less developed; predicting nature can be less accurate thus, making the primary role of agriculture as the supplier of food and raw materials to the agro-industrial processing and manufacturing sector ineffective. Potential negative outcomes of risk are being given greater importance by farmers just like many other decision makers, which makes them to generally exhibit willingness to trade-off potential income for either risk or uncertainty avoidance [9, 32].

Information systems provide new approaches for communicating and sharing information, of which agricultural information is not an exception. Using these technologies improve the knowledge and skills of farmers by making available the recent information in achieving optimum yield from the input used. The term information system could be used for multitude of stand including telephone, television, video, voice information systems, and fax [37].

The use of ICT in agriculture for risk management is very important. Use of information and communication technologies have played very effective role in the agriculture development and in the decision making of farmers in different countries [7, 13, 30, 35]. Information and communication technologies have potential to disseminate agricultural information among smallholder farmers. These technologies are integrated with different devices such as computer, internet, mobile phones, television and radio. These facility transfer related and timely information that helps to make decisions to use resources in the most productive and profitable way [10, 29].However, the most common information systems available for the rural farmers are the radio, mobile phones and television.

Fundamental decisions made by farmers such as; what price to sell the produce, where to sell (given the numerous fragmented markets), when to harvest, and when to spray pesticides to save the crop are currently been made easier by ICT in many countries around the world [19] and this had been helping in improving yields and thus stimulating improved food security, trade, and income growth. Could this be attributed to the situation in Nigeria where farmers still depend on the use of traditional method of disseminating and gathering information that is unhealthy for improved agricultural decision making and risk management. It is against this background that the research examined the effect of information system alongside socioeconomic characteristics on the farmers risk attitude with the view to identify solutions to their problems as well as suggest ways on how such solutions can be achieved.

MATERIALS AND METHODS

Study Area

Goronyo is located between latitude 13^0 26' 32 N and longitude 5^0 40'E [20]. It has an area of 1,704km^2 and a population of 182,296 [22]. The annual rainfall is between 500mm to750mm with average monthly temperature ranges from 24^0C and 33^0C [26]. This may vary from season to season. Farming is the major occupation of Goronyo indigenes. Cereal crops (like rice, millet and sorghum), legume crops (such as beans, soya beans, etc) and root crops (such as sweet potatoes and cassava) are produced, although cassava production is relatively low. The major sectors in the local government were farming is predominantly done are: the Falaliya sector, Takume sector, and Mai-Iyali sector.

Sampling Technique

A three-stage sampling procedure was employed in the study. In the first stage, the three sectors (Falaliya, Takakume, and Mai-Iyali) were purposively selected from the local government area due to high level of farming activities in the sectors.

This was followed by random selection of two villages from each sector making a total of six villages. Subsequently, twenty (20) farmers were randomly selected from each village. This makes the sample size to be 120.

Data for this study were obtained from primary source.

This was achieved through a semi-structured questionnaire that was administered to the 120 rural farmers selected for the study.

Analytical Techniques

Descriptive statistics such as frequency, percentages and the likert scale were used in examining the socioeconomic characteristics of the farmers; eliciting the types of information sources used by the farmers as well as the various types of risk faced by the farmers. Attitudinal scale approach (ASA) was used to identify the risk attitude of the farmers and the multinomial logistics was used to evaluate the effect of the information systems on farmers risk attitude.

Attitudinal scale approach (ASA)

Five point Likert scale was used to measure an individual risk attitude. The responses measured on five point scale includes, strongly disagree (SD), which implies the risk aversion attitudes of the farmers. On the other hand, strongly agree (SA) indicates risk taking attitude of the farmers. In between the two extremes i.e. (SD and SA), disagree (D), neutral (N) and agree (A) were also incorporated. Thus, the aggregate score for risk averse individuals was achieved by combining responses from strongly disagree and disagree, the risk neutral category from the responses from Neutral categorization of the Likert scale and strongly agree and agree were also combined to ascertain the aggregate score for risk preference of individuals. This was expressed mathematically as;

$$Attitude = \frac{\sum of\ responses}{total\ question} \qquad (1)$$

The following are the mathematical expression for the three classes of attitude under study;

$$R_{averse} = \frac{\sum(\mathrm{SD} + \mathrm{D})}{total\ question} \qquad (2)$$

where:

R_{averse} = risk averse

SD = strongly disagree

D = disagree

$$R_{neutral} = \frac{\sum(\mathrm{N})}{total\ question} \qquad (3)$$

R_{averse} = risk averse

N = neutral responses

$$R_{takers} = \frac{\sum(\mathrm{SA} + \mathrm{A})}{total\ question} \qquad (4)$$

where:

R_{averse} = risk averse

SA = strongly agree

A = agree

Multinomial Logistics Regression Model

The choice of this method is based on the fact that the risk attitude (dependent variable) is a categorical variable which can take three (3) levels (0, 1, and 2). This classification emanated from the results of the risk attitude eliciting technique of the farmers. For this study, 0 was the risk neutral group; 1 was the risk averse group; and 2, the risk taking group. The risk neutral group was taken as the reference group for which other risk attitudes were compared. The model was utilized to identify the socio-economic characteristics responsible for the risk attitude group a farmer belongs.

The probability that the i^{th} farmer belongs to the j^{th} risk attitude group reduces to:

$$P_{ij} = \frac{e^{\beta_j X_i}}{\sum_{k=j} e^{\beta_k X_i}} \qquad \text{..... (5)}$$

Following [18, 5], the basic model is written as:

$$P_{ij} = \frac{e^{\beta_j X_i}}{\sum_{k=0}^{j} e^{\beta_k X_i}} \qquad \text{..... (6)}$$

where:

i = 1, 2 …..n variables;

k = 0, 1,.. j groups and;

β_j = a vector of parameters that relates X_i's to the probability of being in group j where there are j+1 groups.

In this study, X_1 to X_7 are socioeconomic variables.

Model normalization

The summation of the probability for the three groups must be equal to unity. This calls for a normalization of the equations in the model. The common rule is to set one of the parameter vectors equal to zero [17]. Hence for, k, number of choices, only v-1, distinct

parameters can be identified and estimated. In this study, k is three (3) groups and two distinct parameters were identified and estimated.

Based on equation 5, the probability of being in the reference group (risk neutral) with parameter vectors equal zero is:

$$P_{i0} = \frac{1}{1+\sum_{k=j} e^{\beta_k X_i}} \quad \text{..... (7)}$$

Similarly, the probability of being in each of the other j groups is:

$$P_{ij} = \frac{e^{\beta_j X_i}}{1+\sum_{k=j} e^{\beta_k X_i}} \quad \text{.....(8)}$$

Dividing equation (8) by (7) gives:

$$\frac{P_{ij}}{P_{i0}} = e^{\beta_j X_i} \quad \text{.....(9)}$$

This denotes the relative probability of each group to the probability of the reference group. Hence, the estimated coefficients for each group reflect the effects of X_i' s on the likelihood of the farming household head belonging to that alternative group relative to the reference group. The logarithm of the odd ratio in equation 9 to base e gives the estimating equation.

$$Ln\left[\frac{P_{ij}}{P_{i0}}\right] = \beta_j X_i \quad \text{..... (10)}$$

Equation 10 implies that, j, log odds ratio can be computed [15]. However, following [16], the coefficients of the reference group may be recovered by using the formula:

$$\beta_v = -\left[\beta_1 + \beta_2 + ... + \beta_{v-1}\right] \quad \text{..... (11)}$$

RESULTS AND DISCUSSIONS

Socioeconomic characteristics of the farmers

This section presents and discusses the socioeconomic attributes of the respondents such as age, sex, marital status, educational background, household size, other occupation they engage in apart from farming, farm size and their farming experience. The distribution of farmers according to socioeconomic characteristics is presented in Table 1.

The result reveals that the mean age of the farmers was 37 years. This implies that majority of them are still young, energetic and within the productive age of farming. This tends to play an important role as it informs one's knowledge through experience, thus understanding of the phenomena under study [31]. This corroborates with the findings of [3, 24]. The results also revealed that majority of the respondents (97.5%) were male while 2.5% were female. This could be attributed to the labor intensive nature of farming which may perhaps be hectic and time consuming, especially for females who would have to combine this activity with their domestic chores. The outcome is in line with the work of [11]. The result also revealed that 7.5% of the respondents were single, 88.3% were married, and 3.3% were widowed while 0.8% was divorced.

A household generally comprise of the man, his wife, and children; in some cases dependent if any. It was however observed that the mean household size was ten (10) persons. Large household size has a tendency to to reduce the costs of production likely to be incurred by the farmers with fewer household members. The polygamous nature as well as the family pattern of the area probably will explain the large family size reported. This is contrary to the findings of [27, 25] but in line with work of [24].

Education which plays a key role in creating awareness among farmers and influences the adoption of management strategies and practices was accessed and the result shows that 41.7% had no formal education, 34.2% had primary education, 21.7% had secondary education and 2.5% had tertiary education. Farmers tend to have several secondary occupations as reported. This however, ranged from fishing and trading (50.0%); artisan (10.8%) and handcraft (3.3%). Off- farm activities could therefore be used by farmers as a means of managing risk. The experience of a typical farmer was thirteen years. Experience serves as a measure of management ability thus, indicates the ability

to acquire skills and adopt new innovation. The more experienced a farmer is, the more his/her ability to make a better decision. The years of experience of a typical farmer were practically good.

Table 1. Distribution of farmers according to socioeconomic characteristics

Characteristics	Frequency	Percentage	Mean
Age (years)			
20-27	20	16.67	**37.24**
28-35	44	36.67	
36-43	26	21.67	
44-51	17	14.67	
52-59	8	6.67	
60-67	5	4.17	
Sex			
Male	117	97.50	
Female	3	2.50	
Marital status			
Single	9	7.50	
Married	106	88.30	
Widowed	4	3.30	
Divorced	1	0.80	
Household size			
3-10	51	42.5	**10.67**
11-17	60	50.0	
18 and above	9	7.5	
Education level			
Quranic	50	41.70	
Primary	41	34.20	
Secondary	26	21.70	
Tertiary	3	2.50	
Other occupation			
Fishing	30	25.00	
Trading	30	25.00	
Artisan	13	10.83	
Civil servant	6	5.00	
Handcraft	4	3.33	
No other occupation	37	30.83	
Farm size (hectare)			
0.6-1.1	87	72.50	**0.78**
1.2-1.6	27	22.50	
1.7-2.1	6	5.00	
Farm experience (years)			
2-9	45	37.50	**13**
10-17	38	31.67	
18-25	26	21.67	
26-33	6	5.00	
34-41	5	4.17	

Source: Field Survey, 2018.

The size of the farm is vital to a farmer and the production of output, since the sizes of the farm to some degrees determine the input to be used. The need to increase production requires increase in the hectares of land cultivated as the farmers in the study area cultivate at average of 0.93 hectares of land. However, it can be inferred that the farmers are smallholder farmers that limit their production. This is in line with the works of [36, 3, 24].

Information Sources

This section shows the information sources available to farmers in the study area and the

ones mostly used by them. The distribution of respondents according to source of information used is presented in Table 2.

Table 2. Distribution of farmers according the information sources used

Information source	Frequency	Percentage
Radio	86	71.7
Television	13	10.8
Mobile phone	5	4.2
Extension agent	6	5.0
Others	10	8.3
Total	**120**	**100.0**

Source: Field Survey, 2018.

The result on Table 2 shows that majority of the farmers (71.7%) obtained information via the radio source, 10.8 % reported television as their source, with 4.2 % and 5.0 % get theirs through mobile phones and extension agent respectively. Radio is a multidimensional source of transferring information, particularly in rural areas of developing countries and the impact presented is helpful among different communities of people such as farmers [28, 8]. There is no doubt that modern information about agriculture can be diffused by using the television. However, the findings of the study showed that radio was the best means of information dissemination considering its portability, affordability and easy to access as reported by the majority of the farmers, thus, corroborates with the findings of [6, 1, 2, 21] who reported radio as one of the best sources of diffusing agricultural, technical and scientific information to the farmers. This is contrary to the findings of [12, 34] who reported television as the best channel of sourcing information.

Type of Agricultural Information

The types of agricultural information obtained from various information source helps farmers in making decision as regards their farming activities and marketing of their farm produce. The types of agricultural information obtained from information sources as reported by the sampled farmers are presented in Table 3.

The result reveals that 9.2% of the respondents obtained market information from the information sources, 41.7% obtained climatic information, and 40.8% obtained cultural practices.

Table 3. Distribution of farmers according to the type of agricultural information obtained

Information type	Frequency	Percentage
Market	11	9.2
Climate	50	41.7
Cultural practices	49	40.8
Others	10	8.3
Total	**120**	**100.0**

Source: Field Survey, 2018.

Radio and television have played important roles in enhancing the capacity of farmers by broadcasting different agricultural related programs. However, in the context of Nigeria settings where electricity becomes a factor of concern to the use of some of this means, particularly in the rural area where production is concentrated, farmers mostly depend on radio to meet their information needs on market [14, 8], cultural practices [38, 28] and of course the most widely sourced information as presented by the study, climatic information [38, 23, 8].

Farmers Risk Attitude

The aggregate measurement of farmer's attitude towards risk was analyzed and presented. The risk attitudes of the farmers were categorized into three main groups; risk averse, risk neutral and risk preference. With reference to the methodology applied in the study, the risk averse individuals are those who strongly disagree or disagree with the risk management strategies available.

The risk neutral individuals are those who neither disagree nor agree with the strategies provided and the risk preference individuals are those who strongly agree or agree with the risk management strategies provided. The distribution of respondents according to these categories is presented in Table 4.

The result of attitudinal scale approach (ASA) using Likert scale analysis, as presented in Table 4 showed that almost half (46.7%) of the farmers were categorized as risk averse individuals, lower proportion (7.5%) as risk neutral and almost half (45.8%) of the farmers

were categorized as risk takers (preference) individuals.

Table 4. Distribution of aggregate score measuring risk attitude of the farmers

Risk Strategies (Category)	**Frequency**	**Percentage**
Risk Aversion	56	46.7
Risk Neutral	9	7.5
Risk Taker	55	45.8
Total	**120**	**100.0**

Source: Field Survey, 2018.

Effects of Information System on Risk Attitude

Table 5 identifies the variables that explain the risk attitude of the farmers. The variables of interest are information source, age, gender, marital status, years of schooling, household size and farming experience. With the multinomial logit model, the risk neutral group was used as the reference group for other risk attitude groups. The summary of the result of the analysis are given in the Table

Table 5. Parameter estimates on impact of information systems on farmers risk attitude

	Risk Averse Group		**Risk Loving Group**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.391	1.598 (-1.496)	-1.848	4.888 (-0.378)
Information source	2.423***	0.325 (7.455)	1.669*	1.011 (1.651)
Age	3.167*	1.866 (1.697)	2.144*	1.120 (1.914)
Gender	0.145	0.637 (0.227)	1.786	2.021 (0.883)
Marital status	-1.444	1.651 (-0.874)	-2.528	2.411 (-1.048)
Years of schooling	-17.270***	1.529 (-11.294)	-16.422***	0.910 (-18.046)
Household size	0.268**	0.134 (2.000)	3.568**	1.756 (2.031)
Farming experience	0.058	0.092 (0.630)	1.494	1.203 (1.241)
Log likelihood		58.136		
Likelihood Ratio (λ)		34.44**		
ρ^2		0.282		
N		120		

Note: Figures in parenthesis are the t-ratio of the estimated regression coefficients in their absolute values
* = significant at 10% ** = significant at 5% *** = significant at 1%
Source: Own calculations.

From the result, the likelihood ratio test for the model (λ) is significant at 5%. This indicates that the risk attitude groups in the study area are heterogeneous, thus, confirms the appropriateness of the choice of model (polychotomous) used in the study.

Information source, age and household size are positive and significantly responsible in classifying the farmers into the risk averse and risk taking groups. This implies that the probability of being in these groups relative to the reference group increases as these explanatory variables increases. However, years of schooling is negative and significantly responsible in classifying the farmers into a risk averse and risk taking groups. This implies that the probability of being in these groups is lower relative to being in the reference group as these two explanatory variables increase.

Table 6 shows that majority (63.3%) of the farmers reported damage caused by pests and diseases as very important, 33.3% as important while 3.3% as not very important, thus, ranked as the most important risk type faced by the farmers.

This corroborates with the findings [24] who reported incidence of pests and diseases as the most pressing constraints militating against farmers' production.

This was followed by high costs of inputs, poor remunerative prices of farm produce and inadequate storage facilities as theses were highly reported as an essential risk type and consequently ranked 2nd, 3rd and 4th respectively.

However, the analysis on drought, weather condition, theft and pilfering as well as market availability as an important source of risk was refuted based on the responses

received depicting these factors as not important as far as their production is concerned.

Table 6. Distribution of various types of risk based on their importance

SOURCES	VI	I	U	NVI	NI	WS	MS	RANK
Damage by pests and diseases	76	40	0	4	0	548	4.56	1st
	(63.30)	(33.30)	(0.00)	(3.30)	(0.00)			
High cost of input	44	62	1	13	0	497	4.14	2nd
	(36.70)	(51.70)	(0.80)	(10.80)	(0.00)			
Inadequate storage facilities	35	48	1	36	0	442	3.68	4th
	(29.20)	(40.00)	(0.80)	(30.00)	(0.00)			
Theft/pilfering	3	39	2	65	11	318	2.65	10th
	(2.50)	(32.50)	(1.70)	(54.20)	(9.20)			
Unfavorable weather condition	2	43	2	51	1	291	2.42	11th
	(1.70)	(35.50)	(1.70)	(42.50)	(0.80)			
Drought	0	2	4	83	31	217	1.80	12th
	(0.00)	(1.70)	(3.30)	(69.20)	(25.80)			
High post-harvest losses	23	50	4	42	1	412	3.43	6th
	(19.20)	(41.70)	(3.30)	(35.00)	(0.80)			
Poor market linkage	15	51	2	51	1	388	3.23	8th
	(12.50)	(42.00)	(1.70)	(41.50)	(0.80)			
Lack of market available for farm produce	4	48	1	67	0	349	2.90	9th
	(3.30)	(40.00)	(0.80)	(55.80)	(0.00)			
Lack of market information	18	55	7	40	0	411	3.42	7th
	(15.00)	(45.80)	(5.80)	(33.30)	(0.00)			
Perish ability of produce	10	70	6	34	0	416	3.46	5th
	(8.30)	(58.30)	(5.00)	(28.30)	(0.00)			
Poor remunerative prices of farm produce	35	73	4	8	0	495	4.12	3rd
	(29.20)	(60.80)	(3.30)	(6.70)	(0.00)			

Source: Field Survey, 2018.
VI = Very Important; I = Important; U = Undecided; NVI = Not Very Important; NI = Not Important; WS = Weighted score; MS = Mean score. Figures in parenthesis are in percentages

CONCLUSIONS

The achievement of agricultural development programs in developing countries basically depends on the nature and level of use of mass media channels in mobilization of people for development in general. Of course, with respect to the study, radio among several other information sources turn out to be the most widely used in getting the required information particularly on climate and other cultural practices. In the same vein, no clear distinctive class of attitude was observed as farmers were seen to either be risk averse or taker. The study confirmed significant relationship between information systems, and the farmers risk attitude. In addition, socioeconomic characteristics of the farmers; age years of schooling and household size contribute significantly to the preference of the farmers on risk.

Conversely, it becomes pertinent to note that the highlighted sources of risk to the farmers can be managed by giving priority to the observed ranking. It is therefore recommended that intensification of extension activities in making known to the farmers several types of information sourcing platforms related to their production is key in

any of the programs or policies targeted to the farmers.

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PHENOTYPIC VARIATION OF FRUITS, SEED GERMINATION AND EARLY GROWTH OF *BLIGHA SAPIDA* K.D. KONIG IN SELECTED LOCATIONS OF ONDO STATE, NIGERIA

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Abstract

Tropical forest contains many plant species that are cultivated for food but they are neglected and underutilized despite their importance. This study examined phenotypic variation of trees and fruits of Blighia sapida conducted at (Akure, Owo and Akoko) within Ondo State, Nigeria. Five healthy trees were selected and twenty (20) matured fruits were collected from each tree. Data collected from selected trees were tree growth, fruits and seeds. The result indicates that highest tree height 14.0 m was recorded in Akoko and 8. 00 m was found in Akure B. sapida trees but tree dbh shows that 19. 46 cm, 19.44 cm and 18.34 cm were found for Owo, Akoko and Akure trees while 8. 48 m, 7. 60 m and 7. 12 m were for crown diameter found for Akure, Owo and Akoko tree respectively. But for seed parameter it shows that 1.85, 1. 75 and 1.71 were found for the seed no/fruit for Akoko, Owo and Akure, and 2.14, 2. 03 and 1.99 cm for seed length for Akoko, Akure and Owo respectively. Seed breadth ranged from 1. 67 cm – 1.81 cm and seed weight ranged from 8. 19g -7.61g. Fruit parameters show that highest fruit length was found in Akoko with 4. 90 cm while Owo fruits had least with 3.78 cm, for fruit breadth Akoko had the highest value of 4.08 cm Owo had the last value of 3. 37 cm but for fruit weight Akoko had the highest with 42. 33 g while Akure had the least weight of 42.20 g respectively. The variation in fruit and seed of B. sapida could be due to climatic, edaphic factors and cultural factors.

Key words**:** *phenotypic variation, fruit, seed, Blighia sapida, growth*

INTRODUCTION

Tropical rainforests are the most species rich and diverse terrestrial ecosystems in the World [25]. While occupying about 7% of the world's total land area, tropical forests contain over half of all plant and animal species on the planet [8, 10]. About 40% of the world's 275,000 flowering plants are found in tropical forests [29] in which many contain edible fruits, nuts and vegetables species. The tropical forest ecosystems represents important home of natural resources that helps developing countries and improve their economic wellbeing. More than 1.6 billion people worldwide depend on forest for their livelihood [1]. Tropical forests are full of tree species that people use every day of their lives for their own needs (food, fodder, medicines, building materials, resins, dyes, and flavourings) and these are regarded as Non-Wood Tree Products (NWTPs). Therefore, the people in developed and developing world rely on these forest products, due to the value of wood and non-timber products provide by the forest which is an immeasurable. Forest resources and their roles in livelihood are in many forms [30, 32] which include food supply, income earning, employment, education, medicine and energy. Thus, their contributions to local diets, potential in

ameliorating prevailing food problems and alleviating poverty are enormous [19].

Blighia sapida (K.D. Koenig) belongs to the family Sapindaceae, and it is commonly known as Ackee in English. In Nigeria, the Yoruba calls the plant "Isin". It is a woody perennial multipurpose fruit tree species native to the Guinean forests of West Africa [15, 16]. It is an ever green tree with a dense crown. *B. sapida* occurs naturally from Senegal to Cameroon and Equatorial Guinea, and possibly also in Gabon. It is commonly planted in its natural area of distribution, as fruit tree and ornamental shade tree. It has been introduced in many other tropical countries and in some subtropical regions such as Florida (United States) and is widely cultivated as fruit and ornamental tree in India and tropical America.

Although *B. sapida* tree is largely overlooked by researchers in many region most especially the silvical requirement [22], but the tree is highly valued by farmers and is an important component of traditional agroforestry systems in many part of local villages. Recently, *B. sapida* has emerged as high-priority species for domestication in Benin after a national survey and ranking of Non-Timber Forest Products (NTFPs) [6]. General reasons for domesticating *B. sapida* are income generation, improvement of livelihoods strategies, satisfaction of farm household needs and agroecosystem diversification [7, 11]. Unfortunately, these locally important species are often neglected leading to the erosion of their diversity and usefulness, further restricting development options for the poorest. Research to increase the value of these species and to make them more widely available would broaden the agricultural resource base and increase the livelihood options for rural communities. Though, research into *B. sapida* silvicultural activities have not been well documented, this is reflected in the scarcity of literatures on this species with respect to its silvical requirements. Thus this study therefore investigated the phenotypic variation that occurs in the fruit of *B. sapida* collected from different ecosystems in Ondo State and raised at the nursery under different soil media.

MATERIALS AND METHODS

Study Area

The study was carried out in Ondo State, Nigeria; Ondo State was one of the seven States created on 3rd February, 1976. Hence, the present Ondo State is made up of Akoko, Akure, Okitipupa, Ondo and Owo Divisions. The State lies between latitudes $5^0$45' and $7^0$52'N and longitudes $4^0$20' and $6^0$05'E. Ondo State is bounded on the east by Edo and Delta States, on the west by Ogun and Osun States, on the north by Ekiti and Kogi States and to the south by the Bight of Benin and the Atlantic Ocean. The climate of Ondo is humid tropical with seasonal variation. The mean annual rainfall is about 2,000 mm with double maximum in the months of July and September and a short relatively dry period in August. December through to February constitutes the major dry season while January and February are the driest months with each having less than 30 mm rainfall [20]. The mean monthly relative humidity is about 70%. Ondo State has a temperature which ranges from about 20.6ºC to 33.5ºC. The monthly mean temperature is about 27ºC, a condition that is conducive to the development of tropical rainforest. Ondo State has a total land area of 15,500 km^2. The population of the State according to 2006 census is 3,441,024, with a medium population density of 245 inhabitants per km^2. The natural vegetation is the high forest, composed of many varieties of hardwood timber such as *Melicia excelsa, Antiaris africana, Terminalia superba, Lophira procera* and *Symphonia globulifera*. In the Northern districts, the vegetation consists of woody savanna featuring such tree species as *Blighia sapida* and *Parkia biglobosa.* The swamp flats are the domain of the fresh water swamp forests in the interior and the units of mangrove vegetation near the coast. The sand ridges are characterized by savanna and stunted rain forests. Over most of the State, the natural vegetation has been very much degraded as a result of human activities, particularly the bush fallow system. As a result, the original forest is now restricted to few forest reserves. An important aspect of

the vegetation of the State is the prevalence of tree crops. The soils in Ondo State are predominantly ferruginous tropical soils and are typical of the variety found in the intensively weathered areas of basement complex formations in the rainforest zone of southwest in Nigeria [26]. The soils of Ondo State were derived from the basement complex rocks which are mostly well drained, with a medium texture. The soils, classified as Ondo association, are of high agricultural value for both tree and arable crops. The swamp flats are characterized by swampy organic and flooded organic soils, while the major part consists of decomposed and partly decomposed organic matter; whereas areas affected by tide bear saline soils. The latter soils are mostly useless for agricultural practices.

Methods of data collection

The sampled trees used for this study were selected purposeful from three towns within Ondo State. Selected towns for the study were Akure, Owo and Akoko respectively and they were selected based on division of the State as well as availability of these trees species under study. The study was restricted to these towns alone because of the abundance of *B. sapida* trees. Five trees were selected from each town tree height; crown diameter and diameter at breast height of each tree were measured using Spiegel relaskop, measuring tape and girth diameter tape respectively.

Sample measurements

The sampled trees used for this study were selected purposeful from three towns within Ondo State. Selected towns based on abundant of the trees were Akure, Owo and Akoko. Five trees of the *B. sapida* were selected from each of the selected towns. Selected trees were measured for tree growth characteristics such as tree height, crown diameter and diameter at breast height using Spiegel Relaskope, Metric tape and Girth tape, respectively. Twenty (20) fresh and matured fruits of *B. sapida* were harvested from each tree., Mature and ripe fruits were considered to be those with scurfy brown, woody, fragile shell with brown pulp and blackish-brown, and hard shiny seeds. For the purpose of fruit harvesting, four branches with matured and ripe fruits were collected from the lower, middle and upper parts of the each of the sample tree's canopy. It was ensured that harvested fruits did not have visible insect damage or disease symptoms. Thus, a total of 100 fruits were collected from each town, making a total of 300 fruits for the study. A minimum distance of 100 m was maintained between each selected tree in order to reduce the chances of sampling trees from the same parents (sampling sibling). Fruits collected from the same tree were bulked, kept in a separate bag and labeled for further analysis. Seed characteristics such as number of seeds per fruit, seed length, seed breadth and seed weight were measured using graduated ruler, vernier calipers and electronic balance. The fruit length, fruit breadth and fruit weight collected from each tree were also measured with the aid of graduated ruler and using electronic weigh balance.

Method of data analysis

The experimental design was Completely Randomized Design (CRD) with the three locations selected serving as the treatments. One-way analysis of variance was employed to test for the significant differences in the morphological characteristics of *B. sapida* trees from the three locations as well as the phenotypic variations of the fruits and seeds of the species. Significant means were separated using Duncan's multiple range tests. In addition, the data were also subjected to descriptive statistics. All statistical analyses were performed using Statistical Package for Social Scientists (SPSS 16.0).

RESULTS AND DISCUSSIONS

Phenotypic variation of *Bligha sapida* trees, fruits and seeds

The mean tree growth characteristics from three different locations in Ondo State, Nigeria are shown in Table 1 below. The tree with the highest Dbh was found in Owo with (19.46 cm) and the least was encountered in Akure (18.34 cm). For the crown diameter, the highest value (8.48 m) was recorded in Akure, followed by Owo (7.60 m) and the least value (7.12 m) was recorded in Akoko. The tallest tree (14.00 m) was found in Akoko

while the shortest tree (8.00 m) was found in Akure as presented in Table 1.

Table 1. Variation in tree height, tree Dbh and crown diameter among the selected location

Locations	Height (m)	Tree Dbh (m)	Crown diameter (m)
Akoko	14 ±1.58[a]	19.44±1.74[a]	7.12±0.78[b]
Owo	13.6 ±1.5[a]	19.46±1.11[a]	7.60±0.17[ab]
Akure	8.00 ±0.77[b]	18.34±1.07[a]	8.48±0.34[a]

N B. The values assigned with the same superscript in the same column are not significantly different at 5% level of significant. Mean are followed by the standard error of the mean
Source: Data Analysis, 2019.

The result of seed number per fruit, seed length, seed breadth and seed weight was presented in Table 2 below.
The result revealed that fruits from selected trees from Akoko area of Ondo State had the highest number of seeds per fruit (1.85) while the least value of seed no per fruit was recorded with the fruits collected from Akure area 1.71 respectively. But for the seed length, seed breadth and seed weight from the selected study locations, the results of the study revealed that fruits collected from Akoko area had higher values than others locations. Seed length mean ranged from 1.99 cm to 2.14 cm with the highest value recorded from the Akoko location while the least was found at Akure with 1.99 cm respectively. But for the seed breadth the least was found at Owo fruits location with 1.67 cm and the highest value of 1.81 cm were found at Akoko fruit. The result of seed weight shows that the highest weight was found with the fruit from Akoko and the least weight was revealed with the fruit from Akure with 7.61g respectively. The result of the effect of seed sources on seed no, seed length, seed breadth and seed weight shows that there were no significant different among the location at ($p>0.05$) in Akoko, Akure and Owo respectively.

Table 2. Variation in seed no/fruit, seed length, seed breadth and seed weight among the selected locations

Location	Seed no/ fruit	Seed length (cm)	Seed breadth (cm)	Seed weight (g)
Akoko	1.85±0.07[a]	2.14±0.08[a]	1.81±0.08[a]	8.18±0.40[a]
Akure	1.71±0.07[a]	1.99±0.08[a]	1.69±0.08[a]	7.61±0.37[a]
Owo	1.75±0.07[a]	2.03±0.08[a]	1.67±0.07[a]	7.61±0.38[a]

N B: The values assigned with the same superscript in the same column are not significantly different at 5% level of significant. Mean are followed by the standard error of the mean.
Source: Data Analysis, 2019.

The mean fruit length, breadth and weight from different sources in Ondo State are presented in the Table 3 below. It was discovered that fruits from Akoko had the highest mean of fruit length (4.90 cm), follow by Akure with mean value of (4.57 cm) and the least mean of fruit length (3.78 cm) was recorded on Owo.
More so, it was observed that there was no significant difference between the fruit breadth from Akoko (4.08 cm) and Akure (3.97 cm) but the mean fruit breadth from Owo (3.37 cm) was significantly lower. The result revealed that fruits weight was not significant difference at 5% level of significant across the three locations as shown in Table 3.

Table 3. Variation in fruit length, fruit breadth and fruit weight among the selected locations

Location	Fruit length (m)	Fruit breadth (m)	Fruit weight (g)
Akoko	4.90±0.07[a]	4.08±0.05[a]	42.33±0.14[a]
Akure	4.57±0.06[b]	3.97±0.05[a]	42.20±0.13[a]
Owo	3.78±0.07[c]	3.37±0.08[b]	42.35±0.07[a]

NB: The values assigned with the same superscript in the same column are not significantly different at 5% level of significant. Mean are followed by the standard error of the mean
Source: Data Analysis, 2019.

Cumulative germination rate of *Blighia sapida*

Result of cumulative germination of *Blighia sapida* based on the seed sources and as affected by the sowing media started on the

10th days after sowing for all the sowing media used for this experiment, though the percentage of the germinated seeds differs from one source to the other. The result of seed sown using top soil as sowing media revealed that seeds from different sources start germinating after 10th days after sowing and its germination lasted until 23rd days after sowing. At the end of germination period seeds from Akoko had the highest germinated seeds with the 50% while the seeds sourced from Owo and Akure had 33% germinated seeds respectively. Also, results of cumulative germination percentage of the seeds sown when river sand was used as the sowing medium revealed that seeds sourced from Akoko also had the highest germinated seeds with 63% while seeds from Owo and Akure had the same record of germinated seeds respectively with percentage of 50%. But the result differs when mixture of 50 % of the top soil were mixed with 50% of river sand, at the end of the germination counts, it shows that seeds sourced from Akoko had the highest germination percentage with the value of 50% follow by Akure 47% while Owo had the least germination of 37% respectively (Figure 1).

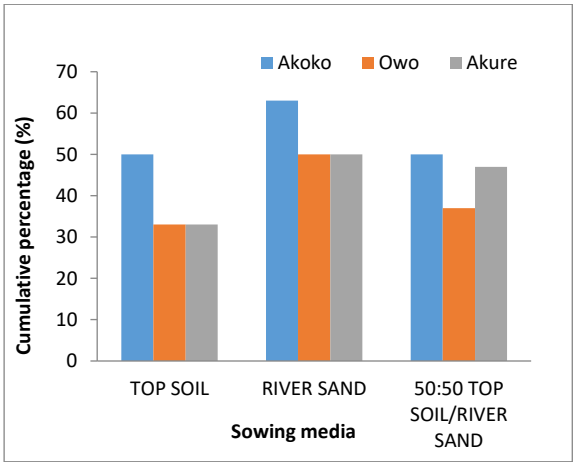

Fig. 1. Effect of seed sources on germination percentage of *Blighia sapida*
Source: Data Analysis, 2019.

At the end of twelve weeks of early growth monitoring, the mean height growth characteristics of *Blighia sapida* seedlings of seeds germinated from the different locations in Ondo State were monitored. The highest plant height was observed with the seedling sourced from Owo, while the least was found with seedlings from Akure with a total height of 16.48 cm with seedlings monitored with top soil as sowing media. But for the seedlings monitored with river sand as sowing media, the height was found with Akure seed sourced with a total height of 19.98 cm while 17.9 cm was the least with seedlings sourced from Owo while the soil that was mixed shows that Akoko seed sourced had the highest plant total height with 19.78 cm as the highest while the least was found with Akure seed sown with the mixed soil respectively. It was discovered that plant height varied significantly from one location to the other at 0.05 level of significant (Figure 2a). The result of no of leaves accumulated by the seedlings was presented in the figure 2b below and it was discovered that no of leaves were not significant from one seed location to the others as shown in Table 4.

The highest no of leaves by seedling was found with seedlings planted in river sand and sourced from Owo, followed by the seedling grown on river sand as sowing media. But the least seedlings with no of leaves were found with seedlings planted with top soil sourced from Owo and Akoko. Collar diameter result was shown in figure 2c and the seedling collar diameters were not significantly different from on sowing media to the other. It was found from the result that seedlings planted and raised with top soil showed that seeds from Owo had 0.50 cm collar diameter and shown the highest collar diameter while Akoko seeds had the lowest but for seeds planted with river sand seeds sourced from Akoko performed better with 0.74 cm collar diameter and the least was recorded with the seed sourced from Akure station. Result of sowing media with mixed soil shows that seeds from Akoko had the highest collar diameter with 0.51 cm and Akure seed had the least collar diameter with 0.47 cm. Number of branchlet produced by each seedlings were counted and it was discovered that seeds sown with top soil shows that Akure seeds were found to have higher number of branchlet followed by Owo seedlings and the least was found with Akoko seedlings with only 4 no of branchlets.

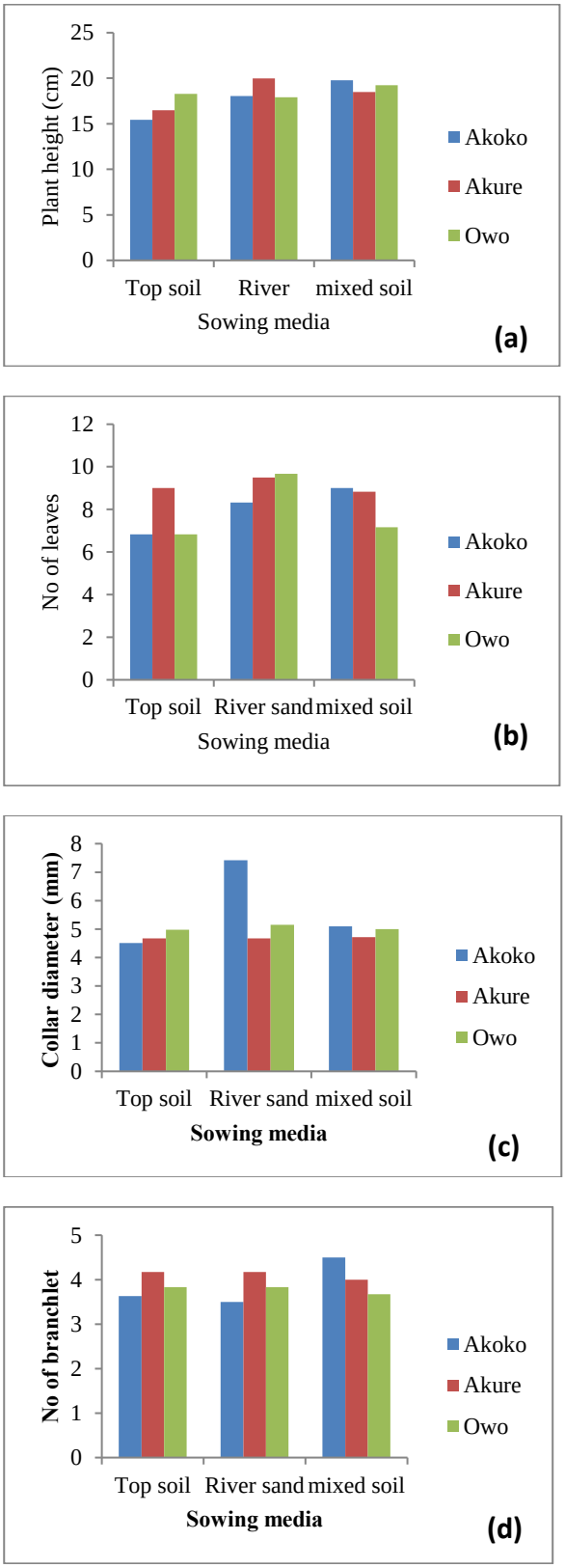

Fig. 2. Effect of sowing media on (a) Plant height (b) no of leaves (c) collar diameter (d) no of branchlet of *Blighia sapida*
Source: Data Analysis, 2019.

River sand seedlings shows that Akure seedlings had the highest no of branchlets with 4 while in the sowing media with mixed soil found that Akoko had the highest no of branchlet with 5 and the least were found with Akoko and Owo with 4 seeds each, also, it was shown that mixed soil was significantly higher than river sand and top soil potting mixture.

Table 4. Summary of Duncan's Multiples Range Test for the Early Growth Parameters of *Blighia sapida* Seedlings

Growth parameters	Treatment	Mean
No of leaf	River sand	9.17[a]
	Top soil	7.56[a]
	Mixed Soil	8.33[a]
Plant height	River sand	18.37[ab]
	Top soil	16.24 [b]
	Mixed soil	19.17[a]
Collar diameter	River sand	5.18[a]
	Top soil	4.69[a]
	Mixed soil	4.85[a]
No of branchlets	River sand	3.83[a]
	Top soil	3.89[a]
	Mixed soil	4.06[a]

Note: Means with the same letters on the same column are not significantly different (P <0.05).
Source: Data Analysis, 2019.

In order to fulfill the goal of meeting the demands of subsistence farmers and product markets, the knowledge of intraspecific diversity of the *B. sapida* trees is fundamental [30]. The participation of farmers in domestication of forest food tree species has been reported by some researchers [17, 18, 9, 19]. Though, *B. sapida* had been classified by [11, 12] among endangered tree species in Nigeria. Thus, these species might go into extinction in the near future except steps are taken to conserve them or increase their population. Some of the reasons why farmers domesticate *B. sapida* were mainly for income generation, improvement of livelihoods strategies, satisfaction of farm household needs and agro-ecosystem diversification. Therefore, the phenotypic variation among the trees, fruits and seeds of the *B. sapida* from different locations of Ondo State was observed, though different locations within Ondo State had a little effect on the variations on the tree, fruits and seed parameters examined. Fruits from Akoko location in

Ondo State had better characteristic than Akure and Owo locations with the respective to highest mean values of weight, length and breadth of fruits. The result of this research was in agreement with the report of [4] who reported variation in morphological and productivity of individual baobabs according to the climatic zones. Also, [23] reported that there are variations in tree growth assessment of *B. sapida* from one State to another and from one ecosystem zone to another. However, the mean differences for most fruits and tree characteristics were comparable between Owo and Akure locations. Among the sampled trees from the three locations, the tree height analysis shows that there were significantly different among the trees sampled for this research, and also there is significant different statistically among the crown diameter of the sampled trees, but the tree diameter at breast height were not statistically different. The differences encountered in tree height and crown diameter of the sampled trees for this research could be due to environmental factors which seem to play an important role in determining the tree characteristic of *B. sapida*. Also, the differences expressed in the tree characteristic of *B. sapida* from the different locations could revealed that it has high genetic differences which is to be exploited [26]. Also, as reported by [15] they reported in their findings that differences among different sites largely attributed to climatic, edaphic, genetic and cultural factors which were in agreement with the findings of this research. Hence, it could be deduce from the result of the research that trees from Akoko had higher height and wider diameter than Owo and Akure trees this may be due to the agro-ecological zones and the soil factor which encourages the production of higher trees and wider diameter at breast height than other trees from other locations. In addition, management regimes within a given environment may also cause morphological variation in fruits and seeds especially for traits targeted by artificial selection [5]. As noted from the report by [14], that variables such as DBH, stem bole height, diameter of and numbers of leaflets, number of seeds and the diameters of fruit pods are highly important in localities from different climatic zones and locations which may also have effect on the tree performance and characteristics which was supported by the result of this findings. In general, sale of fruits is based on size (weight, length, width) [13], with bigger fruits fetching higher prices than smaller once. Thus, tree breeding may target trees with bigger fruits. However, there seems to be no relationship between taste and size of the fruit which complicates the choice of selection criteria.

Blighia sapida is easily established through seed or cutting. The seeds are sown either directly or in a poly pot or in any other containers, without any prior pre-treatment and its germination started. Our germination result shows that germination percentage of *B. sapida* seeds ranged from 33 to 63%. The germination recorded in this study is within the range for some forest seed species [2] for *Chrysophyllum albidum;* [24] for *Chrysophyllum albidum*), but generally lower than what was recorded by [25] for *Moringa oleifera*. The significant effect of potting mixture of *B. sapida* seed germination in this study is in agreement with the report of [3], [25, 7] they reported a significant effect on the germination of forest fruits and potting mixture of *Dacryodes edulis* and *Moringa oleifera* seeds. It was discovered from the result of this study that there was significant difference ($p \leq 0.05$) in germination percentage between different potting mixtures used at 95% probability level. It was indicated from the result of this finding that river sand had the highest germination percentage.

Therefore the results of seedling growth of *B. sapida* revealed that river sand was the best sowing media for germinating *B. sapida* followed by 50:50 topsoil/ river sand and the least was topsoil. This was supported by [6] who reported that effect of sowing media on seed germination and growth of some forest trees, therefore, the results revealed that potting mixture had significant effect on the collar diameter and seedlings height of *Blighia sapida* but does not have significant effect on the number of leaves. The seedlings on river sand showed superior and significant

growth performances in total height, collar diameter compared with seedlings in top soil and 50:50 topsoil/ river sand respectively. Since all seedlings were exposed to similar environmental condition, this difference in vigour among the seedlings can be attributed to environmental adaptation with respect to some traits such as height and diameter increment. The result of this experimental work is in agreement with the findings of [25] who observe superior and significant monthly increment in the height and diameter of *Moringa oleifera*. The work of [28] also indicated the same differential pattern of growth in seedlings progenies of *Parkia biglobosa* collected from different provenances in Nigeria. According to [33] when comparing trees from regions up to one-hundred kilometres apart, particularly regions that differ in climate, general geographical trends in growth are evident. The implication of this general observation is that over similar areas especially where there is little or no climatic variation, little or no geographic trend in growth will occur [33, 28]. This explains why there is no significant difference in the number of leaves, collar diameter and no of branchlet from all the sources. Therefore, current results help to fill the gap of information for *Bligha sapida* phenotypic diversity for fruit characteristics and individual seed traits for use in the domestication and tree improvement process.

CONCLUSIONS

The result of this study had shown that there is significant different in the phenotypic variation of the trees and morphological features of *B. sapida* in Ondo State. Thus, it could be deduce from the result of this research that *B. sapida* from different location under studied revealed a significant variation across the different locations in terms of number tree height, diameter at breast height, fruit length and seed weight. This implies that domestication and conservation of *B. sapida* tree can be encouraged to increase their productivity. It will be important to extensively investigate the spatial genetic structuring in the *B. sapida* in the southwest so that the information could be used in tree domestication, conservation, management and improvement in the whole region. In addition, further molecular studies should be done to assess genetic diversity at large scale (regional) and fine scale (within countries) to complement on the current study.

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REGIONAL PRICE SITUATION FOR SUNFLOWER IN ROMANIA (2014-2018)

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Abstract

The paper addresses an essential aspect, related to the economic efficiency of sunflower production, i.e. the selling price (lei/kg). This situation is determined by the multiple possibilities for the recovery of sunflower seeds, depending on which producers can negotiate different levels of the selling price on the basis of the quantitative and qualitative parameters of the seeds, which may be stipulated in the recovery contracts or which may be taken into account at the time of sale on the open market, to various beneficiaries. It should be noted that Romania is the main grower and producer of sunflowers in the European Union (about 24% of the total area harvested and about 25% of total production respectively). Addressing the subject, aimed to highlight the differences between the 8 development regions existing at national level, in Romania. The price is characterized by a multiannual national average of 1.39 lei/kg, with limits of 0.99 lei/kg for the West Region in 2014 and 1.61 lei/kg for the South Muntenia Region at the level of 2016. If we look at the indicator in the light of its evolution over time, we see the existence of fluctuating trends.

Key words**:** *price, production, amplitude of variation, evolution, sunflower*

INTRODUCTION

Sunflower, is a crop of multivalent importance: industrial, forage, agrotechnical-technological, export and source of profit [5].
For Romania, sunflowers are the most important oil crop [6].
In the context of membership of the European Union, Romania is the main sunflower grower (1,010,215.2 compared to 4,175,246 ha – 24.19%), as well as the main producer (2,396,570.6 vs. 9,229,647.2 t – 25.97%). The level of technological performance is somewhat convenient (2,372 compared to 2,211 kg/ha -107.28%) – multiannual averages for the period 2014 - 2018 [2]. In addition to Romania, in the European Union, other major growers are represented by Bulgaria, Spain, France and Hungary [9].
At the same time, Romania is in line with the European trend of reducing areas cultivated with maize and increasing areas related to sunflower cultivation [11].
The work, is carried out when Romania, recorded during the period 2013-2018, increases by 42.8% in total production, 2.1% for the area harvested and 40.7% for the average production [8].
At national level, it is noted that the South East and South Muntenia development regions are the largest suppliers of sunflowers [1], which can also have consequences for the price level.
Romania is also notable for its surplus trade balance in sunflowers [7]. This is underlined by the fact that Romania is the world's leading exporter of sunflowers [10].

MATERIALS AND METHODS

In order to prepare the paper, it was operated with the selling price (lei / kg) for sunflower seeds, which is presented at national and regional level.
The documentation was based on accessing specialized sites, such as the database of the Romanian National Institute of Statistics [4] and the database of the United Nations Food and Agriculture Organization (FAO).
The analysis was performed both nationally and regionally (eight development regions), presenting the positioning of each region

against the national average price, the absolute variations of the indicator (lei/kg) and the dynamics of the indicator (%). The study was conducted for a period of 5 years (2014-2018), operating with the average period (6 terms). In the case of the regions Center and Bucharest - Ilfov, there are no data for the years 2014 and 2015, as such the dynamic series have only 4 terms (2016-2018 and the average of the period).
For this purpose, the percentage method and the comparison method were performed.

RESULTS AND DISCUSSIONS

Table 1 contains data on the specific situation in terms of sunflower seed prices - national and regional levels.
For 2014, the average price at national level was 1.26 lei/kg, compared to which there were for the region, both supra-unit values and sub-unit levels. Thus, the South East region is characterized by a supra-unitary level: 1.30 lei/kg. Consequently, we are talking about an absolute increase of 0.04 lei/kg, an increase that in relative size was 3.17%. The subunit levels reached: 0.99 lei/kg for the West Region (-0.27 lei/kg and -20.16%), 1.05 lei/kg for the North West and South West Oltenia regions (-0.21 lei/kg and -15.32%), 1.14 lei/kg in the case of the North East Region (-0.12 lei/kg and -9.52%), 1.23 lei/kg for the South Muntenia Region (-0.03 lei/kg and -0.81%).
The year 2015 is characterized by price variation limits of 1.32 lei/kg for the South Muntenia Region (-0.18 lei/kg and -12.0% compared to the national situation) and respectively 1.50 lei/kg in the case of the South East Region (level of equity with the national one). Consequently, we are talking about regions that have registered lower levels, compared to the reporting base (national level of the indicator - 1.50 lei/kg) - 1.34 lei/kg South West Oltenia Region (-0.16 lei/kg and -10.67%), 1.45 lei/kg for the North West and West regions (-0.05 lei/kg and -3.33%), 1.48 lei/kg at the level of the North East Region (-0.02 lei/kg and -1.33%).

Table 1. The situation of the average purchase price at national and regional level (lei/kg)

Specifiction	Year										Average**	
	2014		2015		2016		2017		2018			
	Eff.*	% compared to the national level **	Eff. *	% compared to the national level **	Eff. *	% compared to the national level **	Eff. *	% compared to the national level **	Eff. *	% compared to the national level **	Eff.	% compared to the national level **
National level	1.26	100	1.50	100	1,51	100	1.37	100	1.32	100	1.39	100
North West Region	1.05	83.33	1.45	96.67	1.32	87.42	1.27	92.70	1.19	90.15	1.26	90.65
Central Region	-	-	-	-	1.32	87.42	1.23	89.78	1.18	89.39	1.24	89.21
North East Region	1.14	90.48	1.48	98.67	1.37	90.73	1.16	84.67	1.26	95.45	1.28	92.09
South East Region	1.30	103.17	1.50	100.0	1.48	98.01	1.36	99.27	1.34	101.52	1.40	100.72
Bucharest Ilfov Region	-	-	-	-	1.40	92.72	1.36	99.27	1.32	100.0	1.36	97.84
South Muntenia Region	1.23	99.19	1.32	88.0	1.61	106.62	1.46	106.57	1.37	103.79	1.40	100.72
South West Oltenia Region	1.05	84.68	1.34	89.33	1.40	92.72	1.31	95.62	1.25	94.70	1.27	91.37
West Region	0.99	79.84	1.45	96.67	1.39	92.05	1.39	101.46	1.18	89.39	1.28	92.09

*http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (20.12.2020)
**Own calculation.

If we refer to the specific situation of 2016, there is a national price of 1.51 lei/kg, compared to which the development regions were positioned as follows: -12.52% each

North West and Central regions (-0.19 lei/kg), - 9.27% North East Region (-0.14 lei/kg), -7.95% West Region (-0.12 lei/kg), -7.28% Bucharest Ilfov and South West Oltenia Regions (-0.11 lei/kg), -1.99% South Region East (-0.03 lei/kg), + 6.62% South Muntenia Region (+0.10 lei/kg).

In the case of 2017, it is observed that the price varied from 1.16 lei/kg in the North East Region (-15.33% respectively -0.21 lei/kg compared to the comparison term) to 1.46 lei/kg in the case of the South Muntenia Region (+6.57% respectively +0.09 lei/kg), and the national level of the indicator was 1.37 lei/kg. Exceedances of the national level are found for the West Region (+0.02 lei/kg respectively +1.46% in relative values). There are also decreases compared to the national level: -0.01 lei/kg for the South East and Bucharest Ilfov regions (1.36 lei/kg respectively -0.73%), -0.06 lei/kg South West Oltenia Region (1.31 lei/kg respectively -4.38%), -0.10 lei/kg North West Region (1.27 lei/kg respectively -7.20%), -0.14 lei/kg Central Region (1.23 lei/kg respectively -10.22%).

For 2018, a national level of 1.32 lei/kg of the sale price was registered, with limits of 1.18 lei/kg in the Central and West regions (-10.61% and -0.14 lei/kg compared to the national situation) and of 1.37 lei/kg in the South Muntenia Region (+ 3.79% and +0.05 lei/kg). Below the reference level are: North West Region - 1.19 lei/kg (-0.13 lei kg and -9.85%), South West Oltenia Region - 1.25 lei/kg (-0.07 lei/kg and -5.30%), North Region East - 1.26 lei/kg (-0.06 lei/kg and -4.55%). For the Bucharest Ilfov Region, the price was equal to the national one, and in the case of the South East Region the price was super-unitary (1.34 lei/kg, exceedances by 0.02 lei/kg and 1.52% respectively).

Starting from the annual situations presented above, the average of the period was determined, characterized by a national level of the indicator of 1.39 lei/kg. Compared to this state of affairs, the development regions were positioned as follows (Fig. 1): 89.21% Center Region (effective level 1.24 lei/kg, absolute decrease of 0.15 lei/kg); 90.65% North West Region (1.26 lei/kg effective level, 0.13 lei/kg absolute decrease); 91.37% South West Oltenia Region (effective level 1.27 lei/kg, absolute decrease of 0.12 lei/kg); 92.09% North East and West regions (1.28 lei/kg effective level, 0.11 lei/kg absolute decrease); 97.84% Bucharest Ilfov Region (effective level 1.36 lei/kg, absolute decrease of 0.03 lei/kg); 100.72% South East and South Muntenia regions (1.40 lei/kg effective level, 0.01 lei/kg absolute increase).

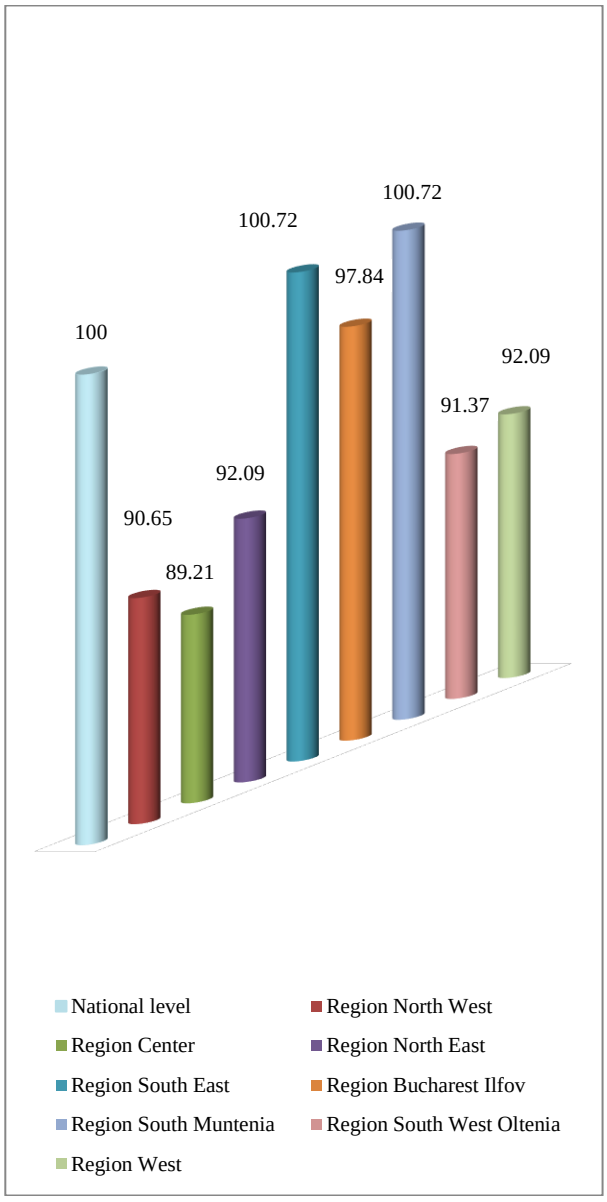

Fig. 1. Positioning of development regions in relation to the national level of the average purchase price (% of the period average)
Source: Own design and calculations.

Table 2 shows the absolute variation of the price (lei/kg), at national and regional level.

Table 2. Absolute variation of the average purchase price at national and regional level (±lei/kg)*

Specificare	±Δ 2015 vs. 2014	±Δ 2016 vs. 2015	±Δ 2017 vs. 2016	±Δ 2018 vs. 2017	±Δ media vs. 2018
National level	+0.24	+0.01	-0.14	-0.05	+0.07
North West Region	+0.40	-0.13	-0.05	-0.08	+0.07
Central Region	-	-	-0.09	-0.05	+0.06
North East Region	+0.34	-0.11	-0.21	+0.10	+0.02
South East Region	+0.20	-0.02	-0.12	-0.02	+0.06
Bucharest Ilfov Region	-	-	-0.04	-0.04	+0.04
South Muntenia Region	+0.09	+0.29	-0.15	-0.09	+0.03
South West Oltenia Region	+0.29	+0.06	-0.09	-0.06	+0.02
West Region	+0.46	-0.06	-	-0.21	+0.10

Source: own calculations.

At national level, there is a fluctuation in the selling price of sunflower, the lowest negative differences being 0.05 lei/kg in 2018 compared to 2017, and the most pronounced reached 0.14 lei/kg for 2017 compared to 2016. There are also increases in 2015 compared to 2014 - 0.24 lei/kg, in the case of 2016 compared to 2015 - 0.01 lei/kg. Under these conditions, the average for the period exceeded the level of 2018 by 0.07 lei/kg (Fig. 2).

For the North West Region, there are decreases in 2016, 2017 and 2018 compared to the reporting bases (-0.13, -0.05 and -0.08 lei/kg), but also their exceedances in 2015 and for the average of the period (+0.40 and respectively +0.07 lei/kg).

In the case of the Central Region, it is found that the indicator showed two decreasing trends (-0.09 and -0.05 lei/kg in 2017 and 2018, respectively) and an increasing trend for the average of the period. (+0.06 lei/kg).

The North East region is characterized by the existence of three situations when the indicator increases, compared to the terms of reference, respectively the year 2015, 2018 and the average of the period (+0.34, +0.10 and +0.02 lei/kg) and by two situations of decreasing level of the indicator - the years 2016 and 2017 (-0.11 and -0.21 lei/kg respectively).

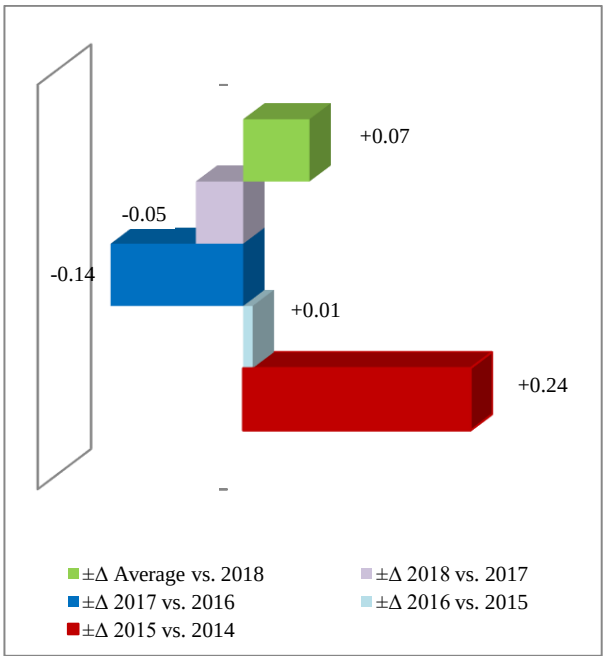

Fig. 2. The absolute variation of the national average purchase price (lei/kg)
Source: own calculations and design.

The South East region presents an evolution characterized by absolute decreases in 2015, 2016 and 2017 (-0.02, -0.12 and -0.02 lei/kg respectively), but also by increases of the indicator in the case of 2015 and for the average of the period (+0.20 and + 0.06 lei/kg).

The Bucharest Ilfov region is characterized by the existence of two subunit levels in the case of 2017 and 2018, respectively (-0.04 lei/kg) and a superunit value for the average of the period (+0.04 lei/kg).

In the case of the South Muntenia Region, there are decreasing trends of the indicator level in 2017 and 2018 (-0.15 and -0.09 lei/kg, respectively) as well as ascending trends in 2015, 2016 and respectively for the average period (+0.09, +0.29 and + 0.03 lei/kg).

South West Oltenia region, shows decreasing trends in 2017 and 2018 (-0.09 and -0.06 lei/kg respectively), as well as increasing trends in 2015, 2016 and for the average period (+0.29, +0.06 and +0.02 lei/kg).

At the level of the West Region, there are two price increase trends (+0.46 lei/kg in 2015 compared to 2014, +0.10 lei/kg for the average of the period compared to 2018), a

stationary trend in 2017 and two trends of decrease (-0.06 and -0.21 lei/kg in the case of 2016 and 2018 respectively).

Regarding the annual amplitudes of variation of the indicator, they were 0.34 lei/kg in 2014, 0.18 lei/kg in 2015, 0.29 lei/kg in the case of 2016, 0.30 lei/kg in 2017, 0.19 lei/kg in 2018 and 0.16 lei/kg for the average of the period (Fig. 3). It can be seen that the highest price uniformity appeared for the average of the period (relative differences of 11.43% between extreme values), and the largest variation is specific to 2014 (relative differences of 23.85% between extreme values - Fig. 3).

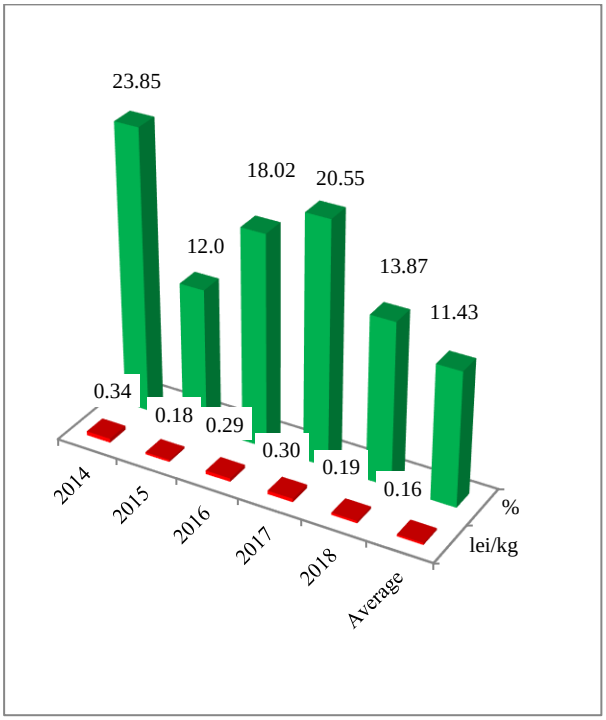

Fig. 3. Annual amplitude of variation of the average purchase price (lei/kg)
Source: own calculations and design.

If we analyze the indicator in terms of the amplitude of variation for each reference level (national and regional), we find the following (Fig. 4): variations of 0.08 lei/kg in the Bucharest Ilfov Region; amplitude of 0.14 lei/kg at the level of the Center Region; changes of 0.20 lei/kg in the case of the South East Region; 0.34 lei/kg for the North East Region; amplitude of variation of 0.25 lei/kg in the case of the national level; variations of 0.35 lei/kg at the level of the South West Oltenia Region; total amplitude of 0.37 lei/kg for the South Muntenia Region; 0.40 lei/kg for the North West Region; changes of 0.46 lei/kg in the Western Region.

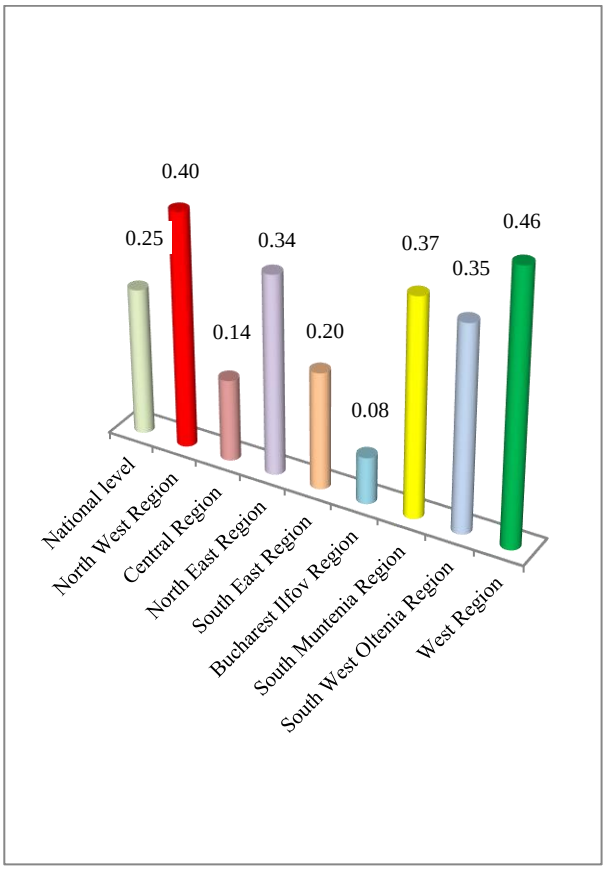

Fig. 4. Amplitude of variation of the average purchase price, at national and regional level (lei/kg)
Source: own calculations and design.

Table 3 shows the price dynamics at national and regional level.

At national level, the dynamics of the indicator contains subunit values in 2017 and 2018 (decreases by 9.28 and 3.65% compared to the previous terms of the dynamic series), but also supraunitary values in the rest (exceedances from 4.76 to 19.84% of the reporting bases). The average of the period is higher than both terms of reference (+10.32 and +5.30% respectively).

The North West region presents a sinuous evolution of the indicator over time. Fixed-base indices range from 113.33% in 2018 to 138.10% in 2015. At the level of mobile-based indices, the variation limits were 91.03 and 138.10% in 2016 and 2015, respectively. Under these conditions, the average period is ahead of 1.20 and 1.05 times the terms of comparison, respectively.

Table 3. Purchase price dynamics (%), at national and regional level

Specification	Year										Average	
	2014		2015		2016		2017		2018			
	Ibf	Ibm	Ibf	Ibm	Ibf	Ibm	Ibf	Ibm	Ibf	Ibm	Ibf	Ibm
National level	100	100	119.05	119.05	119.84	100.67	108.73	90.72	104.76	96.35	110.32	105.30
North West Region	100	100	138.10	138.10	125.71	91.03	120.95	96.21	113.33	93.70	120.0	105.88
Central Region	-	-	-	-	100	100	93.18	93.18	89.39	95.93	93.94	105.08
North East Region	100	100	129.82	129.82	120.18	92.57	101.75	84.67	110.53	108.62	112.28	101.59
South East Region	100	100	115.38	115.38	113.85	98.67	104.62	91.89	103.08	98.53	107.69	104.48
Bucharest Ilfov Region	-	-	-	-	100	100	97.14	97.14	94.29	97.06	97.14	103.03
South Muntenia Region	100	100	107.32	107.32	130.89	121.97	118.70	90.68	111.38	93.84	113.82	102.19
South West Oltenia Region	100	100	127.62	127.62	133.33	104.48	124.76	93.57	119.05	95.42	120.95	101.60
West Region	100	100	146.46	146.46	140.40	95.86	140.40	100.0	119.19	84.89	129.29	108.47

Source: own calculations.

In the case of the Center Region, the indicator decreases in 2017 by 6.82% compared to the first term of the dynamic series, then in 2018 the decreases remain (-10.61 and -4.07% compared to the reporting bases), and the average increases by 5.08% compared to the previous term of the dynamic series.

If we refer to the specific situation of the North East Region, it is found that the first reporting term is exceeded throughout the dynamic series (+29.82, +20.18, +1.75, +10.53 and +12.28% respectively in 2015, 2016, 2017, 2018 and respectively for average of the period). Regarding the indices with mobile base, they are sub-unitary in 2016 and 2017 (92.57 and 84.67%) and super-unitary for the rest of the components of the analyzed period (129.82% in 2015, 108.62% in 2018, 101.59% in the case of the average period).

The South East Region, presents only supra-unitary values of the fixed-base indices (115.38, 113.85, 104.62, 103.08 and 107.69% - 2015, 2016, 2017, 2018 and respectively the average of the period), and the mobile-based indices were sub-unitary in 2016, 2017 and 2018 (98.67, 91.89 and 98.53% respectively) and supra-unitary for 2015 and the average for the period (115.38 and 104.48% respectively).

The Bucharest Ilfov region shows a downward trend of the indicator, a situation highlighted by the fact that the only supra-unit value characterizes indices with a chain base for the average of the period (103.03%). The decreases recorded were 2.86 and 2.94% in 2017 and 2018, respectively, compared to the previous terms of the dynamic series.

The situation of the South Muntenia Region is characterized by the fact that there are increases in 2015, 2016 and for the average of the period (+7.32, +21.97 and +2.19% compared to the previous terms), as well as decreases in 2017 and 2018 respectively (-9.32 and respectively - 6.16% compared to previous years of the dynamic series).

The South West Oltenia Region is characterized by the decrease of the indicator level in 2017 and 2018 by 6.43 and 4.58%, but also by its increase in 2015, 2016 and respectively for the average of the period compared to the previous terms of the dynamic series (+27.62, +4.48 and respectively +1.60%).

For the western region, the evolution trends are uneven, upward in 2015 (+46.46%), downward in 2016 (-4.14%), stationary in 2017, downward in 2018 (-15.11%) - all this compared to previous terms reference. the average is 1.29 and 1.08 times ahead of the comparison bases, respectively.

CONCLUSIONS

The selling price for sunflower registered a national multiannual average of 1.39 lei/kg, with extreme values of 0.99 lei/kg in 2014 for

the West Region and of 1.61 lei/kg in the case of 2016 for the South Muntenia Region (total amplitude variation of 0.62 lei/kg). If we refer to the situation of the European Union, Romania stands at 97.56% of the regional level of the indicator [3].

At national level, the evolution of the indicator is uneven, a phenomenon that is also manifested for the North West, North East, South East, South Muntenia, South West Oltenia and West regions. The Central and Bucharest Ilfov regions are characterized by strictly descending evolutions.

Sunflower producers must be supported by government bodies in order to properly integrate into the product chain in terms of relations with economic actors upstream and downstream.

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CONSIDERATIONS ON COVID 19 IMPACT ON AGRICULTURE AND FOOD SECURITY AND FORWARD-LOOKING STATEMENTS

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Abstract

The COVID 19 pandemic is one of the greatest threats of the 21st century that disturbed whole human`s life and all sectors of the global economy. Due to highly infectious and spreading capacity of SARS-CoV-2 the governments took unprecedented measures worldwide with a great impact on the most vulnerable groups (people affected by chronically hunger, malnourished children and small farmers) and sectors. Agriculture is the most important economic sector that cares the responsibility for food security and human development. The present paper identifies and synthetize relevant literature to provide an integrated overview of the current state-of-knowledge on the economic impact of COVID 19 pandemic on agriculture and food security, including also forward-looking statements on future measures to mitigate the effects on crop production, food demand, agricultural products supply, inputs supply, agricultural products market, farmers` income and rural poverty. The study emphasizes that due to the mobility restrictions, decline in international trade, reduced purchasing power, disturbance in food production and food processing, food insecurity may arise affecting especially the small farmers from the regions already affected by poverty, climate change and conflicts. Therefore, the governments and international organizations should enforce the measures to control the pandemic, with minimum economic losses, without disturbing the food supply chain and re-enforcing the food security of their citizens.

Key words**:** *agriculture, COVID 19, food security, impact, SARS-CoV-2*

INTRODUCTION

As long as plants, animals and humans coexist on Earth, epidemics and pandemics will occur and lead to significant economic losses. World globalization, trade liberalization, international transport of people and commodities, working and studying mobilities across the world are factors that may contribute to pathogens spreading from one place to another, increasing epidemics and pandemics risks.

In plants the organisms with epidemic risk (pathogens, pest and invasive alien plants) are listed starting with early 1970s on the "black" list of specialized international organizations, such as FAO, European and Mediterranean Plant Protection Organization (EPPO A1 List and EPPO A2 List), whose mission is to help countries in preventing the introduction of harmful organisms from different parts of the world and to avoid their spreading in new areas and territories, in order to limit economic losses. These losses can be generated by surveillance, control and eradication, losses of yield, income and employment and losses of trade access [1, 3,11,15,14]. Thus, to evaluate the epidemic potential risk of emerging pests to agriculture, forestry and the environment, EPPO is involved in Pest Risk Analysis (PRA) in order to propose immediately phytosanitary measures to mitigate these risks.

On the other side plant pathogens, pests and weeds are one of the most important drivers of the diversity in plant breeding, new crop management and practices, new methods and

technologies in agriculture and food research and production [4, 5, 6, 7,13, 34, 35, 36].

However, an outbreak of any pest or disease, either plant or animal, has the potential to be widespread in large territories, with subsequent social, economic and environmental impacts.

Beside globally or regional economic impact generated by plants and animals' pathogens, during the time, many human diseases have had their own effects on global economy. For example, the Ebola outbreak occurred in 2015, which affected Guinea, Liberia and Sierra Leone in Western Africa region, resulted in more than $ 500 billion losses [24].

During its history the humankind has been faced different diseases, such as tuberculosis, malaria, leprosy, cholera, smallpox, influenza, Russian flu, Spanish flu, Asian flu, HIV/AIDS, H1N1, Ebola, Zika, MERS, SARS. These diseases have affected humans worldwide by their contagious and often deadly capacity leading to epidemics or even pandemics which have disturbed whole human`s life and global working productivity. [25, 26, 39].

According with [31] a disease is not a pandemic because it spreads all over the world and kills many people, but the most important condition is to be infectious.

Starting with January 2020 the virus SARS-CoV-2 that causes COVID 19 disease, has become a new threat for human's health and for the first time the Chinese city Wuhan came into forced lockdown. Rapidly the new virus has spread all over the world and on March 11, 2020, The World Health Organization announced officially COVID 19 pandemic and in only one year at the end of January 2021 the number of confirmed infected people reached 100,200,107 cases and 2,158,761 confirmed deaths in 223 countries, areas and territories with cases (World Health Organization Report, 2021) [51].

Some factors, especially biological and epidemiological ones, seem to be similar in many countries (SARS-CoV-2 strains virulence, disease symptoms, guidelines for the diagnostic, treatment, safety and prevention protocol against COVID 19), but in fact they vary remarkably between them due to their specific economic and social characteristics (population age, demographic structure, economic performance, income level, healthcare infrastructure, access to healthcare system, societal characteristics, cultural behaviour, education level, life style, vaccination strategies, etc.) [23, 30].

The effects of COVID 19 pandemic are reflected in socio-economy with huge consequences in all economic sectors (primary sectors, secondary sectors and tertiary sectors) due to mobility restrictions, loss of productivity, remarkable costs of medical care and deaths. The restrictions imposed all over the world by governments have led to reduced workforce across all economic sectors and caused many jobs to be lost, sparkling fears of an economic crisis and recession [2, 9, 32, 49]. International Labour Organization (ILO) estimated that 81% (2.7 billion workers) global work force were affected due to totally or partial closure of the work place [28].

How much COVID 19 will cost global economy? It is difficult to estimate both direct and indirect economical costs of COVID 19 pandemic since there are still many uncertainties on the evolution and control of this multifaceted crisis. To date, there is little information in this topic and new studies are needed to offer valuable guidance for interventions, especially in vulnerable sectors.

Agriculture is a vulnerable sector and the outbreak of COVID 19 has been testing its resilience and capacity to offer food in new conditions of protective measures against virus spreading.

The aim of this paper is to present a review of the current studies on the impact of COVID 19 on the agriculture and food security on the new volatile global market and to make some forward-looking statements based on the predictions regarding pandemic evolution.

MATERIALS AND METHODS

The present paper identifies and synthetize relevant literature to provide an integrated overview of the current state-of-knowledge on the article topic, which is of great interest

nowadays. A literature review is a relevant research method when the researchers are looking to evaluate a theory or evidence in a specific area, to examine the validity of a certain theory or to investigate the effect between specific variables [46].

Depending on the goal of the review the research method may vary. To reach the purpose of this paper there were used systematic, semi-systematic and integrative research approaches using an analytic comparation of current literature, papers, studies, reports and statistics in order to offer significant insights based on the article topic and to identify knowledge gaps within literature [43, 44].

Also, it was used text mining method, which is a popular text analytical technique used to extract relationships and knowledge from a large number of textual documents [33].

The literature, papers, studies and reports used in this review are organized into the following sections.

RESULTS AND DISCUSSIONS

The COVID 19 pandemic has changed the lives of 7.8 billion people in the world and put the governments in the front of a hard decision: more investments in public safety or reviving the economy.

Many countries are now turning their attention to recover economy building resilience of business and people who need to continue their activities co-existing with COVID 19.

A report of World Bank (April 2020) stands that Sub-Saharan Africa will be the region the most affected by COVID 19 pandemic and almost 49 million people will be pushed into extreme poverty, most of the farmers from this region being small subsistence farmers

At the country-level the most affected in the number of poor people are estimated to be India (12 million), Nigeria (5 million) and The Republic Democratic of Congo (2 million), while global poverty in 2020 was closed to the level in 2017 [27, 50].

In this new reality the assessment of economic impact of COVID 19 on agriculture and food security should be viewed as a fluid process responding to international and national contexts and evolving over time.

Impact of Covid-19 on agriculture

COVID 19 disease hit agriculture all over the world but the effects are worst in areas affected by climate changes, prolonged droughts, severe flooding, pest invasion and poverty [37, 38].

The lockdown has affected worldwide, the planting of spring crops especially spring wheat, barley, canola, maize, sunflower, vegetables [42].

The new movement restrictions have caused difficulties for farmers to harvest crops or to bring their products to market, especially in areas where farmers used to sell their products directly to the consumers, but the effects are recorded in all agricultural activities. [41] [53]. Thus, the farmers had to face the difficulties to access labor, extension and consulting services and also to provide inputs (seeds, fertilizers, pesticides, fuel) for new cropping seasons due to the impact of the coronavirus on the markets ability to exchange commodities and due to the decision of many companies to reduce their global production, especially in China [45]. This markets ability depends on factors such as pandemic duration, mobility restrictions, market size and elasticity of demand and supply.

Impact of Covid-19 on food security

Previous studies emphasized that when an infectious disease outbreak occurs, hunger and malnutrition increase, putting food security under risk [10, 40].

A recently international organizations report on the State of Food Security and Nutrition in the World showed that the COVID-19 pandemic increased with 130 million the number of people worldwide suffering from chronic hunger in 2020 [21].

Fourth-five countries (thirty-four of them in Africa) continue to be under external assistance for food, accordingly with a recent report published by FAO's Markets and Trade division [18].

A Global Report on Food Crisis estimated that till the end of 2020 about 265 million people from low and middle-income countries (vulnerable groups – Fig.1) were suffering of

acute food insecurity due to COVID 19 pandemic, especially in countries affected by conflict, climate change and economic crisis [22].

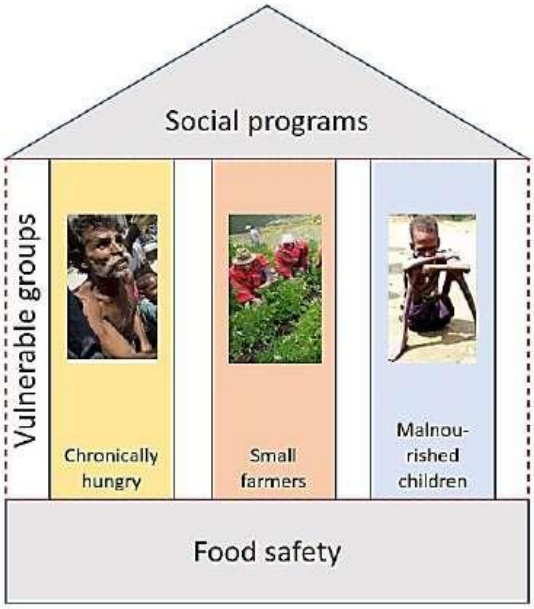

Fig. 1. Vulnerable groups to a food crisis
Source: Raúl Siche, 2020 [41].

Other report of The Food and Agriculture Organization emphasis that COVID 19 affects food security in two significant aspects: the supply and demand for food [17].

All food supply chain network, such as manufacturing, products control, packaging, distribution, storage, was affected by movement restrictions imposed by virus spreading [12].

The closure of many informal local and farmer`s markets in the urban areas has disrupted food supply systems, especially for fresh products such as meat, fruits, vegetables, eggs and milk.

Wang et al. (2020) assessed the impact of COVID 19 pandemic on diary industry in the United States and China and found that for both countries farm gate milk prices decreased, similar difficulties in moving milk along the supply chain, increased production costs, lack of operating capital and shutdown of many dairy processors due to the closing of retail, restaurants, hotels, schools, airlines [48].

At the beginning of COVID 19 pandemic the demand for food increases due to the panic induced by restrictions rules and lockdown, determining people to make shortage of some products despite the fact that governments took all measures to ensure basic food necessities [47].

Because of forced lockdown both on line demand for food and prices for basic food products have increased significantly. For example, the e-commerce in India grew up with 2 billion dollars in 2020 because of the coronavirus [8]. Also, the analytes

[16] showed that the price of the ingredients used to make a traditional chicken dish in India, grew up by 30 to 50% in June 2020 comparatively with January 2020 (Fig. 2.).

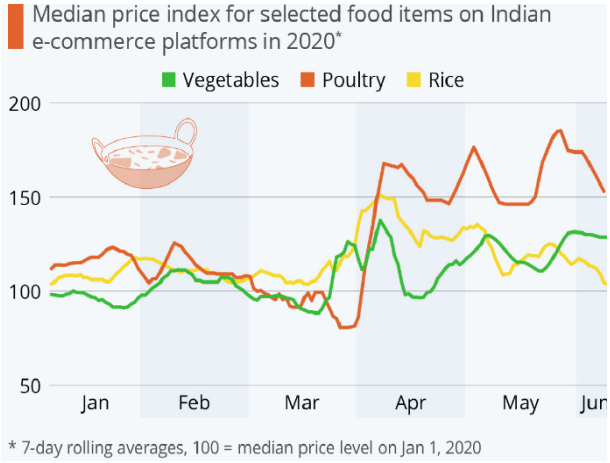

Fig. 2. Price hikes for some grocery deliveries caused by COVID 19
Source: Euromonitor International, 2020 [16].

Once the pandemic has extended the demand for food has decreased slightly due to rosed prices for a basket of food products, reduced income and job losses [19].

However, COVID 19 pandemic has the power to drive up food prices in the current market environment.

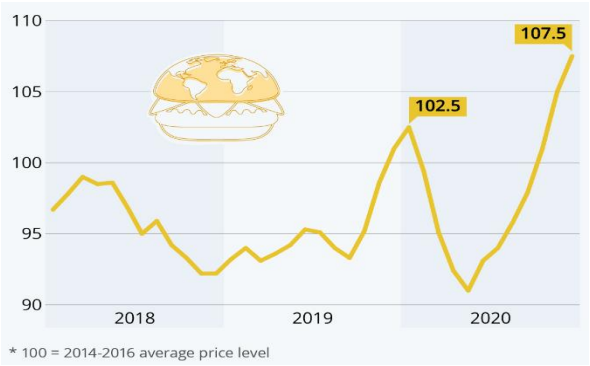

Fig. 3. FAO global food price index 2018-2020
Source: FAO, 2020d [20].

The FAO Food Price Index (FFPI), which measure the monthly variation of international prices of a basket of cereals, oilseeds, sugar, meat and dairy products, averaged 107.5 points in December 2020 versus 102.5 in January 2020 (Fig.3) [20].

Also, for the whole 2020 year the benchmark index averaged 97.9 points recording more than 25% from its highest peak registered in 2011 (131.9 points) (Fig.4).

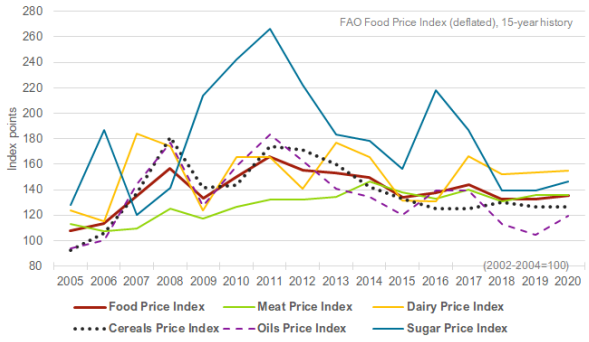

Fig. 4. Evolution of FAO Food Price Index (2005-2020)

Source: McKeany-Flavell, 2020 [29].

The evolution of the values of the FAO Food Price Index for each food products on whole 2020 and between 2002-2020, is presented in Table 1.

The FAO Meat Price Index averaged 94.3 points in December 2020, down 12.3 points (11.6%) from December 2019 and up to 1.6 points (1.7%) from November 2020. December 2020 marked the third consecutive month increase of this index. For the whole year 2020 the FAO Meat Price Index averaged 95.5 points, down 4.5 points (4.5%) from 2019 average.

The FAO Diary Price Index averaged 108.8 points in December 2020 up to 5.3 points (4,9%) from December 2019 and up to 3.4 points (3.2%) from November 2020 marked the seventh consecutive month increase in this index. For the whole 2020 year the FAO Diary Price index averaged 101.8 points, down 1.0 points (1%) from 2019 year.

The FAO Cereal Price Index averaged 115.7 points in December 2020 up to 18.5 points (19%) from December 2019 and up 1.3 points (1.1%) from November 2020, marking the seventh month of consecutive increase. For the whole year 2020 the FAO Cereal Price Index averaged 102.7 points, up 6.4 points (6.6%) from 2019 average and reaching its highest annual average since 2014.

The FAO Vegetable Oil Price Index averaged 127.6 points in December 2020, up 26.1 points (20,5%) from December 2019 and up 5.7 points (4.7%) from November 2020. For the whole 2020 year the FAO Vegetable Oil Price Index averaged 99.1 points, up 15.8 points (18.9%) from 2019.

The FAO Sugar Price Index averaged 87.0 points in December 2020, up 4 points (4.8%) from December 2019 and got down slowly 0.5 points from November 2020. For the whole 2020 year the FAO Sugar Price Index averaged 79.5 points, reaching its lowest annual average since 2008.

Table 1. FAO global food price index for each food category 2002-2020

FAO food price index							
		Food Price Index	**Meat**	**Dairy**	**Cereals**	**Vegetable Oils**	**Sugar**
2002		**53.1**	**55.2**	**46.1**	**55.6**	**55.1**	42.6
2003		**57.8**	**58.3**	**54.5**	**59.4**	**62.6**	43.9
2004		**65.5**	**67.6**	**69.8**	**64.0**	**69.6**	44.3
2005		**67.4**	**71.8**	**77.2**	**60.8**	**64.4**	61.2
2006		**72.6**	**70.5**	**73.1**	**71.2**	**70.5**	91.4
2007		**94.2**	**76.9**	**122.4**	**100.9**	**107.3**	62.4
2008		**117.5**	**90.2**	**132.3**	**137.6**	**141.0**	79.2
2009		**91.7**	**81.2**	**91.4**	**97.2**	**94.4**	112.2
2010		**106.7**	**91.0**	**111.9**	**107.5**	**121.9**	131.7
2011		**131.9**	**105.3**	**129.9**	**142.2**	**156.4**	160.9
2012		**122.8**	**105.0**	**111.7**	**137.4**	**138.3**	133.3
2013		**120.1**	**106.2**	**140.9**	**129.1**	**119.5**	109.5
2014		**115.0**	**112.2**	**130.2**	**115.8**	**110.6**	105.2
2015		**93.1**	**96.7**	**87.1**	**95.9**	**90.0**	83.2
2016		**91.9**	**91.0**	**82.6**	**88.3**	**99.4**	111.6
2017		**98.0**	**97.7**	**108.0**	**91.0**	**101.9**	99.1
2018		**95.9**	**94.9**	**107.3**	**100.6**	**87.8**	77.4
2019		**95.0**	**100.0**	**102.8**	**96.4**	**83.3**	78.6
2020		**97.9**	**95.5**	**101.8**	**102.7**	**99.1**	79.5
2019	December	**101.0**	106.6	103.5	97.2	101.5	83.0
2020	January	**102.5**	103.8	103.8	100.5	108.7	87.5
	February	**99.4**	100.6	102.9	99.4	97.6	91.4
	March	**95.1**	99.5	101.5	97.7	85.5	73.9
	April	**92.4**	96.9	95.8	99.3	81.2	63.2
	May	**91.0**	95.4	94.4	97.5	77.8	67.8
	June	**93.1**	94.8	98.3	96.7	86.6	74.9
	July	**94.0**	92.2	102.0	96.9	93.2	76.0
	August	**95.8**	92.2	102.1	99.0	98.7	81.1
	September	**97.9**	91.5	102.2	104.0	104.6	79.0
	October	**101.2**	91.8	104.3	111.6	106.4	84.7
	November	**105.2**	92.7	105.4	114.4	121.9	87.5
	December	**107.5**	94.3	108.8	115.7	127.6	87.0

Source: FAO, 2020d [20].

Summarizing previous statistics, excepting sugar, the values of the FAO Food Price Index for meat, dairy, cereals, vegetable oils increased in December 2020 comparatively with November 2020. For the whole 2020 year only the FAO Food Price Index for meat and diary decreased slightly comparatively with 2019 year.

Forward looking-statements

The forward-looking statements of COVID 19 impact on agriculture and food security

involve all factors, measures, decisions, risks, policies that may cause future results, performance and achievements in order to mitigate known and unknown effects of this unprecedent pandemic.

These statements are settled to reflect future events that are based on uncertainties, assumption and resilience.

The government from each country must continue monitoring the consequences of the pandemic on agriculture and food security, directing its actions to support especially small and medium-size farms, farmers organizations and cooperatives offering dedicated financial facilities and strengthening social protection measures to enable poor, vulnerable rural households to meet their basic needs.

The key elements to re-enforce agricultural system include keeping global food supply chain active and mitigate the effects of the pandemic across the whole food system by implementing anti-crisis measures [52].

Thus, an important measure is to keep the borders open for the trade of goods and agricultural inputs especially for critical steps in crop management, like providing seeds, fertilizers and crop protection products. Also, a great attention should be paid to phytosanitary measures to avoid the risk of new pathogen and pest outbreaks that may add a supplementary negative impact on agriculture beside the one provided by COVID 19 pandemic. For this it should be taken all measures to assure essential phytosanitary and animal health inspections.

Other measure for the immediate farms re-opening at their full production capacity and to strengthen food supply chain network, such as manufacturing, products control, packaging, distribution, storage, is to guarantee the safe movement of agricultural workers within countries and across borders according with international and national public health guidelines. Any policy which targets reducing virus transmission should ensure the access to goods and agricultural services. Additionally, new policies focused on intensive promoting of agricultural products sale, providing assistance for small poor farmers to cope with rural poverty, providing subsides, guidance in applying new agricultural technologies and field management should be very useful for mitigating pandemic effects.

A great attention should be paid to young agri-entrepreneurs who risk to be more affected by losses and financial burdens than experienced farmers, despite the fact that they are more open to introduce innovations in their business models (for example, on line marketing for agricultural products, especially organic ones).

However, governments and organizations should offer a permanent support for continuous function of local food markets and for mechanization and introduction of new technologies for post-harvest storage and processing, in order to avoid disruption in food supply chain and mitigate food losses.

CONCLUSIONS

The present review emphasizes that the COVID-19 pandemic has the potential to impact almost every facet of the agricultural industry, being an important driver to global food insecurity.

This pandemic has exacerbated and intensified already the pressure on farmers who live in areas affected by climate change, extreme weather events (severe drought, flooding, wind storms), biotic constrainers (pests, pathogens and invasive alien plants) and conflicts, increasing global poverty.

In 2020 global poverty was closed to the level in 2017, setting back by three years the world`s progress to eliminate this human's life threat.

The COVID 19 outbreak affected all crops production, all food supply chain and lead to more expensive food commodities, raising uncertainty on international markets. Higher Food Price Index for basic food basket is due to more difficult access to food products because of lower crop production, lower transactions volume, mobility restrictions, job losses and decreased population income. Also, collateral sectors like tourism, hotels, restaurants, schools, that usually supply agricultural products have been forced to face the reduction of consumers' number.

Various anti-crisis measures taken by governments and international organizations to limit the virus spreading and to mitigate the effects of the pandemic on agriculture and food security will shown up their results in the next future.

Small and medium-size farmers represent one of the most affected categories by the pandemic outbreak and beside credits and government financial support they need stronger agricultural extension and advisory services for rethinking their business models in the new social and economic context.

However, beside its negative effects the COVID 19 crisis open the door to new opportunities and it has accelerated the digital technologies application in the agricultural and food system.

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PROSPECTS FOR STRATEGIC DEVELOPMENT OF VITICULTURAL ENTERPRISES IN BULGARIA

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Abstract

For many years the viticulture and winemaking production in the country mattered of an intensive high-stock and structure-determining industry. The purpose of this paper is to be comparatively analyzed the competitive ability of wine sector and to be pointed ways for its improvement. we use as basic approach the swot-analysis of evaluation of competitive ability of economic sectors – evaluation of factor conditions and strategies of enterprises. Basic approach for enhancement of competitiveness of our wine sector in future is to diversify production. By deriving its competitive advantages and opportunities for sustainable development at the regional level with an emphasis on the development of production and processing facilities. As a result of using the method SWOT-analyse defines strategic goals such as the creation of skills and competencies in the field of strategic planning, cooperation in strategic business planning of small wine companies, diversification of sources of financial risk and maintaining the adaptability of small businesses to market requirements. The achievement of the strategic goals is realized through proposed 6 measures, in the proposed model, aiming at increasing the competitiveness of the enterprises and the sector as a whole.

Key words**:** *competitive advantages, regional development, efficiency, competitiveness, viticulture sub-industry, modeling*

INTRODUCTION

The main priorities in today's European strategy for the development of viticulture are competitiveness, which integrates productivity and competitiveness of production with the requirements of environmental protection and social responsibility. this largely corresponds to the opportunities of countries like Bulgaria to strengthen their focus on regional development in order to bring out the strong capabilities of individual territories. The issue of the competitiveness of the wine sector also corresponds to the European union's vision of developing and strengthening the wine market. in this context, the wine industry in Bulgaria needs a comprehensive analysis in order to determine its potential for its pulling development. it is important to note that viticulture in Bulgaria is formed in the growing role of technology transfer and diffusion of innovations, which lead to the emergence and imposition of new business models, and hence new value chains. The topic of development of the wine products market and price competition is defined as a problem in Bulgaria [4]. This in turn leads to the need to justify the possibility of bringing to the forefront of sustainable competitiveness of the wine sector. In practice, the wine sector creates primary and secondary effects on the socio-economic development of the regions and on their ecological status [2].

In many parts of the country, viticulture is the main or only industry that guarantees employment for the local population and is the engine of regional economic development. Achieving competitive production directly affects employment, profitability and the development of related industries. Secondary effects can be sought on the reduction of

migration flows leading to depopulation of rural areas, attracting investment, development and valuation of the cultural and historical heritage of individual regions in the production and trade of wine [9].

This predetermines our goal to determine the strategic orientation of the wine sector in the direction of increasing the competitiveness of the sub-industry at the regional level in Bulgaria. At the same time to seek assessment and analysis of the competitive level and trends in the development of the wine sector [11].

Through this goal, the authors seek to identify the main factors that influence the development of this business. This mainly includes an analysis of the business environment, determining the capacity and ability of economically active people in the wine industry to develop sustainable production, as well as to generate employment in rural areas of Bulgaria.

MATERIALS AND METHODS

The theoretical model for diagnostics and strategy of competitiveness of the wine-growing sub-sector is constructed on the basis of the use of the method of expert evaluation and the method of swot-analysis which is imposed as a standard way to determine the status of certain economically active persons**.** (Figure. 1).

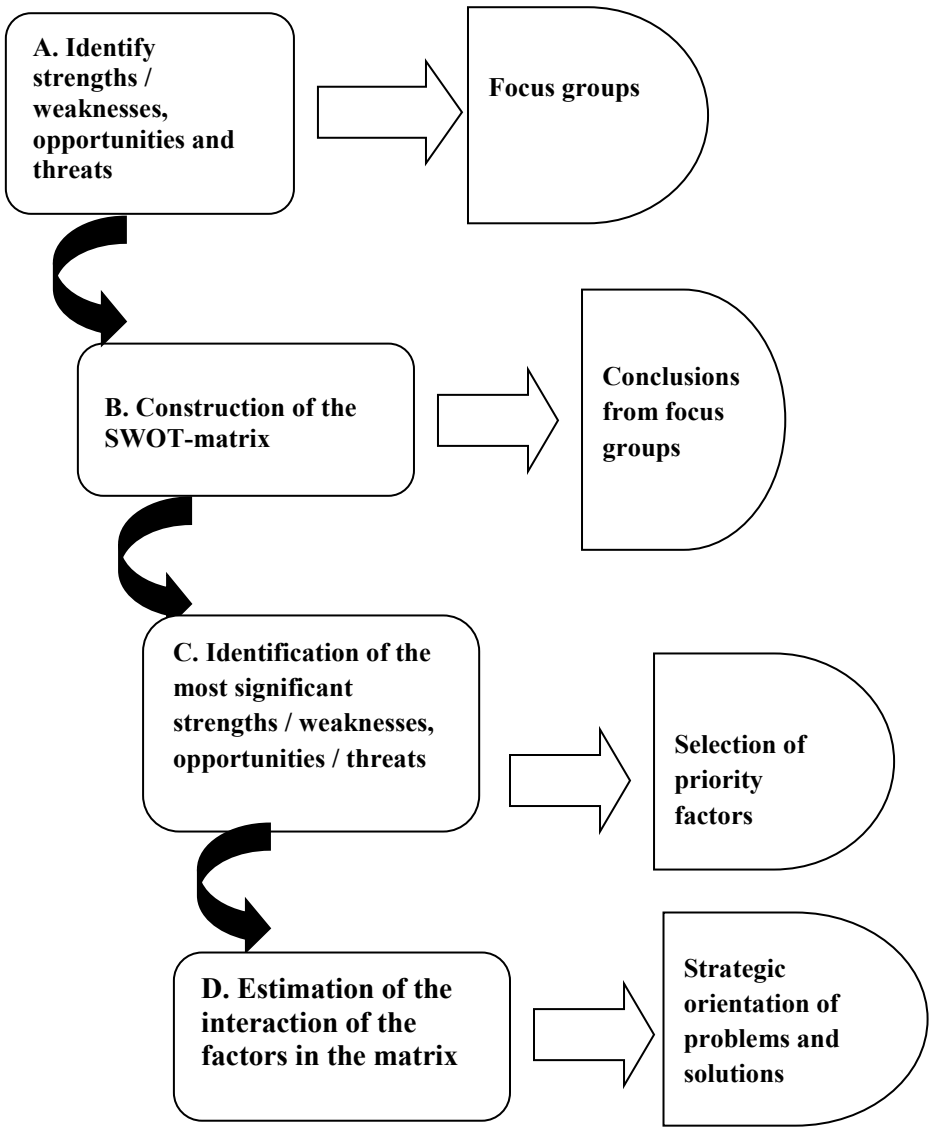

Fig. 1. Methodological approach for strategic orientation of sectoral competitiveness
Source: [3].

In our case, the SWOT analysis is supplemented by knowledge of all specific factors that have a direct and indirect impact on financial management.

This allows us to analyze the details and features of viticulture in order to deduce their specifics.

This approach allows at the level of management and strategic business planning to derive the fullest knowledge of the internal factors of the business environment that determine the future development of economically active people [8].

This approach requires the introduction of the business planning process through SWOT-analysis, which can be supplemented with PEST-analysis and a logical matrix to confirm the set priorities. To a large extent, our SWOT analysis is a sufficiently reliable method to identify strengths and weaknesses. In this sequence, the strengths and weaknesses of the management of the competitiveness of the wine enterprise as well as the opportunities and threats arising from the external environment are determined on the basis of the results of surveys, interviews and statistical analyzes in research [4].

The survey covers mainly enterprises in the wine sector and frames their needs related to their economic behaviour on the national and partly on the international market. We can note that based on the definition of focus groups, the conclusions of the research are the subject of discussion. In this direction, Figure 1 proposes an approach for identifying the needs, problems and potential solutions for the development of competitiveness. In terms of research, we will consider the proposed process of diagnosis and strategic orientation. The first stage (A.) identifies the strengths/ weaknesses as well as the opportunities and threats to the competitiveness of vineyard enterprises. N Through focus groups of managers and specialists in business planning, the strengths and weaknesses and opportunities are discussed and determined and threats to the competitiveness of enterprises as well. During the second stage (B.) the aim is to construct a SWOT-matrix, which is the result of the discussions in the focus groups. The most frequently mentioned strengths/weaknesses as well as opportunities and threats in the derived focus groups find a place in the matrix.

This matrix is subsequently used as a technique to identify two very important elements in the strategic orientation of the competitiveness of the sector, namely: (1) what are the most important strengths, weaknesses, opportunities and threats and (2) what is the interaction of strengths and weaknesses; weaknesses with the indicated opportunities and threats. In the third stage (S.), the most significant factors for the success of the management are sought. The method of expert assessment ranks the most significant strengths, weaknesses, opportunities and threats in a SWOT-matrix. The role of experts in the evaluation of these four building blocks of the SWOT-matrix is played by the managers and specialists from selected vineyards. The expert evaluation organized in this way aims to determine the most significant factors for the success of wine companies from the point of view of their managers.

In the fourth stage (D.) of the application of the SWOT-analysis, the interaction of the factors in the SWOT-matrix is determined. At this stage, the results of the expert evaluation are summarized. The individually completed SWOT-matrices of each respondent are aggregated in one generalized SWOT-matrix, which is a map of the summarized results of the expert assessment. The row "Sum" summarizes the individual scores in the cells by columns of the matrix. This order identifies the most significant opportunities and threats to the future development of enterprises. The higher the amount for the respective opportunity or threat, the more significant it is, according to experts. In the column "Amount" are the individual estimates in the cells by rows in the matrix. This column identifies the most significant strengths and weaknesses that can be used to establish the competitive advantages of enterprises. The higher the amount for the respective strengths or weaknesses, the more significant it is, according to experts. The generalized matrix can be used as a tool to identify the strategic orientation of wine

enterprises in their future development in terms of managing their competitiveness. In other words, the compilation of this matrix achieves two useful effects: (1) determines the direction of future development of enterprises and (2) identifies a set of alternative business strategies for the development of these production structures. The strategic orientation of wine companies is determined by the method of SOR-analysis (abbreviation of three key success factors, which are: strengths, opportunities and obstacles to development, strengths, opportunities and roadblocks). This is a method for defining a business strategy for future development of enterprises, which is based on the principle - attack the most attractive opportunities with the most significant strengths of the organization, by passing obstacles [6].

RESULTS AND DISCUSSIONS

The search for the assessment and analysis of the opportunities for strategic management of viticulture in Bulgaria defines the need to derive the territorial approach in the segmentation of the regions in which it develops and has a real economic impact on regional development. In this respect we can assume that the territory of the Republic of Bulgaria is divided into 4 wine-growing regions.

The northern region covers the lands between the Balkan Mountains and the Danube. The growing season lasts between 180 and 213 days - starting between 5 and 15 April and ending between 15 and 25 October. Temperature sums vary between 3,500 and 3,980˚C. The average temperature during the hottest month is 21-24˚C. In winter it sometimes falls below -18˚C and the vineyards are endangered by frost. The annual amount of precipitation is between 550 and 600 mm, and in September and October it is about 90-100 mm. Within the region there are several dozen neighbourhoods. Conditions are relatively favorable for red varieties - Cabernet Sauvignon and Merlot. Local varieties such as Gamza and Pamid are also grown. Some white varieties also give good wines - Chardonnay, Sauvignon Blanc, Aligote, Riesling. Larger wine centers are Ruse, Svishtov, Pleven, Suhindol, Lyaskovets and Vidin.

The Eastern (Black Sea) region covers Ludogorie, Dobrudja and a 25 ÷ 30 km strip of land on the Southern Black Sea coast. Temperature sums during the vegetation period vary between 3,600 and 4,000˚C. The growing season lasts about 210 days, starting around April 15 and ending around November 10. The average temperature during the warmest month is 21-22˚C. Precipitation is between 469 and 633 mm per year, and during the grape harvest is between 78 and 89 mm. The mild climate is favorable mainly for white varieties. Dimyat, Chardonnay, Sauvignon Blanc, Juni Blanc, Muscat Otonel, Traminer, Aligote, Rkatsiteli and Riesling are grown. Larger wine centers are Targovishte, Preslav, Varna and Pomorie.

The southern region covers the districts of Pazardzhik, Plovdiv, Haskovo, Stara Zagora, Sliven and Yambol. The annual temperature sum during the vegetation period is between 3,700 and 4,000˚C. The vegetation of the vineyards begins in the first week of April and ends in the first week of November. The average temperature during the warmest month is 23-24˚C. Winter frosts are relatively rare. The annual rainfall is between 530 and 650 mm, and during the grape harvest 80-90 mm. The soil and climate are favourable mainly for red varieties such as Cabernet Sauvignon and Merlot. The unique Bulgarian variety Mavrud is also grown on limited areas around Asenovgrad, Pazardzhik and Perushtitsa. Especially popular are the merla from Stambolovo, Lyubimets and Ivaylovgrad, as well as the cabernets from Stara Zagora and Sliven. Pamid, Muscat otonel, Dimyat, Rkatsiteli and other varieties are also grown. More important wine centers are Perushtitsa, Brestovitsa, Asenovgrad, Haskovo, Lyubimets, Stara Zagora and Sliven.

The south-western region covers the lands south of the town of Dupnitsa, along the Struma River. The most favourable is the wine-growing district around Melnik and Sandanski. Due to the relatively high temperatures (above 4,100˚C during the

vegetation period) and the light brown and cinnamon forest soils of volcanic origin, the area is extremely favourable for viticulture. The duration of the vegetation period is between 220 and 230 days, starting in early April and ending in early November. The average temperature during the warmest month is 24-25˚C. The annual rainfall is about 530 mm. The most important variety (about 75% of the vineyards) is Shiroka Melnik vine, which grows only here. Cabernet Sauvignon, Merlot and other varieties are also grown. Larger wine cellars are Damyanitsa, Harsovo, Sandanski and Blagoevgrad.

This predetermines that on the basis of the four regions it is necessary to bring out the number of wine enterprises. The data of the National Vine and Wine Chamber - Sofia, show that 9,280 vineyard enterprises operate on the territory of Bulgaria. For wine-growing enterprises we assume that the revenues from sales of wine and wine-cognac materials form at least 50% of the total revenues from the activity. These enterprises must keep accounts according to the Accounting Act in our country and have vineyards registered with the National Vine and Wine Chamber in Sofia. In practice, there are enterprises that are seasonal in nature, which necessitated for the purposes of our study to make a random sample that includes enterprises that have year-round activity. This approach helped us to make a sample of 155 vineyards, which manage a total of 166,445 acres, which is 4.5% of the registered vineyards in the Republic of Bulgaria. The represented enterprises have a significant role in the development of viticulture in Bulgaria [7].

The analysis of the results of the study shows the factors determining the company and sectoral competitiveness of economically active people in the wine industry.

Table 1 shows the constructed SWOT-matrix showing the state of the sector at the level of summarized results.

Table 1. SWOT - matrix for identifying the factors for increasing the competitiveness of enterprises

STRENGTHS	**OPPORTUNITIES**
Adaptive and motivated to realize sales growth	Creating skills and competencies for strategic planning
Liquid	Cooperation regarding financial and innovation management
Striving to introduce innovations in production	Sharing the financial costs of creating and implementing innovations
They diversify the sources of financial risk	Establishment of mutual financial funds for financing innovations
They have a stable market share	New business models, allowing to increase the company's competitiveness
WEAKNESSES	**THREATS**
High indebtedness	Monopolistic structure of the market
Insufficient working capital	Strong dependence on the credit policy of commercial banks
They do not diversify the sources of market risk	Insufficient supply of experienced specialists on the labour market
Systemic gaps in the implementation of strategic planning activities	Tightening competition, the big ones are becoming more aggressive towards the market share of small market players
They do not have conditions for attracting experienced business strategists / They do not have a separate strategic unit in their management structure	Unequal access to state financial aid and subsidies

Source: Summary of focus group results. (summary of the opinion of 53 experts, divided into 3 focus groups).

Through the analysis of a matrix we are given the opportunity to derive measures to increase the company competitiveness of enterprises in the sector. The important findings are that the

enterprises (micro and small ones) are adaptive and motivated to realize growth in sales and expansion of the vineyards, if they have the financial opportunity to do so. It can be assumed that they have good liquidity, but have problems with branding and presenting the strengths of their production in comparative terms. It is important to take into account that the wine industry needs the introduction of more innovations in production and especially in the storage of products and sales on the market. The study showed that wine companies invest mainly in technological renewal of their production facilities and in the implementation of quality management systems. Enterprises seek to diversify the sources of financial risk by using both equity and borrowed (external) capital for their market development. The industry has a large number of small and medium-sized enterprises with a relatively small market share and a very small number of large enterprises that own more than half of the market. Small businesses have a stable market share (ie they have built a small but loyal group of consumers of their products). In general, the regulatory and regulatory framework does not provide significant obstacles for enterprises in the wine industry, but on the other hand it is necessary to create conditions for the implementation of programs to increase the vineyards in Bulgaria.

Along with the outlined strengths, there are also serious problems in the sub-sector. They are identified as weaknesses in the management of wine enterprises, the participants in the focus groups indicate the following (Table 1). Basically, these are high indebtedness to major suppliers of raw materials and finance. The indebtedness is mainly to financial enterprises. Insufficient working capital to enable them to pay on time and thus improve their solvency. Businesses (mostly small ones) do not diversify their sources of market risk. They work mainly with one or two clients, on whose solvency they are directly dependent. There are systemic gaps in the enterprises in terms of the implemented strategic planning activities. Most of the experts (1/3 of the total number of experts) in the focus groups share that they mainly focus on the activities in the field of strategic business planning, but not in terms of strategic control. Enterprises, mostly small ones, do not have the necessary conditions to attract experienced and capable business strategists to implement strategic planning activities. This task is solved by an external contractor/strategist, who does not know in depth the specifics of the wine sector. The potential of the development sector is significant in terms of built production capacity and fair demand for wine and grapes. These products have a traditional meaning in the menu of the Bulgarian. The existence of potential is not a sufficient condition for market presence and superiority, it is necessary to explore and identify opportunities for realizing this potential [1].

As a result of the discussions and the formulated conclusions of the analytical study, the following opportunities for increasing the competitiveness of wine enterprises have been identified. In this direction it is necessary to create skills and competencies for strategic business planning. Most business managers say that the lack of experienced staff in this area hinders market development. Providing strategic management with experienced specialists will increase the company's competitiveness of enterprises.

Cooperation in terms of strategic planning. This cooperation will not be in full, but only in terms of the implementation of strategic activities and in terms of concentration of capital, thus looking for opportunities to increase the corporate competitiveness of small businesses in the sector. Thus, these businesses will have a greater chance of developing a market dominated by several large players. Sharing the financial costs of creating and implementing innovations. In the course of the research it was found that small wine companies have the desire, but not the opportunity to be innovative and in this line to successfully compete in the market with the big ones. The main limiting factor of the innovation process in these enterprises is the significant amount of costs for financing innovations and innovation activities. In many

other sectors, the financial costs of creating and implementing innovative products are shared. In this way, major competitors in the market cooperate in terms of innovation costs in order to achieve greater market competitiveness [5]. Following this model can be applied to micro, small and medium-sized vineyards, which form clusters for research and development and innovation in partnership with scientific organizations in our country. Establishment of mutual financial funds. Innovations, which are a necessary factor for diversifying the product range, require funding. As already noted, the financing of innovation activities requires significant costs, which are risky and in some cases slowly pay off over time. The creation of financial funds for mutual assistance in the implementation of innovative activities among small and medium enterprises is a significant opportunity to increase their corporate competitiveness. New business models, allowing to increase the competitiveness of both enterprises and the sector as a whole. Very often, innovative solutions in the sector encourage the actors in the value chain to merge and / or integrate in the process of adding value. These strategic alliances present innovative business models to the market that can achieve a sustainable pace of market development and competitiveness.

Threats in the sector are factors that can significantly impair the competitiveness of enterprises. The analysis of the conclusions from the focus group discussions identifies the following significant threats. For example, according to expert assessment, the Bulgarian market has a monopolistic structure. There are few large players that dominate the market. Small and medium-sized market participants operate in conditions of fierce price competition. The expansion of the market share of the big ones is at the expense of pushing the small ones out of the sector. This leads to the seizure of consumer surplus. Strong dependence of enterprises on the credit policy of commercial banks. The survey determined that the enterprises in the sector (regardless of whether they are small or large) have significant indebtedness to the banking sector. In the current economic conditions, when interest rates are still low and credit expansion is underway in the sector, companies are looking for ways to repay old debts to banks through additional bank financing. This dependence in the event of a change in the credit policy of commercial banks in the direction of raising interest rates on investment or business loans will play a bad joke on most companies in the sector. Insufficient supply of experienced business professionals in the labour market. The lack of sufficient specialists in strategic business planning impairs the implementation of strategic activities in enterprises and will increasingly force them to seek salvation in business outsourcing. In this way, important strategic activities will be delegated to external companies. This can have negative consequences on the effectiveness of strategic control in enterprises. The strategic management process will be slower to administer and will be a function of the solvency of the wine companies in relation to the outsourcing service provider [10].

As competition intensifies, the big ones are becoming more aggressive towards the market share of small market players. Significant threat that will lead to market failures and market restructuring into a monopoly structure. Unequal access to state financial aid and subsidies. There is a sense of injustice among managers and owners of small and medium-sized enterprises in the sector regarding the distribution of subsidies.

According to them, larger companies absorb most of the financial support and thus achieve even higher company competitiveness. In these structures there is a strong concentration of financial capital, which allows them to form a strong lobby in the face of the state. The elements formulated in this way in the SWOT matrix determine the critical factors for the development and increase of the company competitiveness of the wine enterprises. The next stage in the process of strategic orientation of the sector's competitiveness is the validation of the success factors and on the basis of this validation to solve two important problems: (1) what will be the strategic goals for the

development of competitiveness at micro and brand level and (2) what management decisions will be implemented to achieve these strategic goals. Once these tasks are solved, the main guidelines for increasing the corporate competitiveness of wine enterprises can be formulated.

Table 2 shows a summary assessment of the interaction of the factors (map of strategic decisions) that determine the company competitiveness of wine companies.

The map of strategic decisions is analyzed in the following aspects:

(1) identification of the most significant strengths and weaknesses in the management of the competitiveness of wine enterprises;

(2)identification of the most significant opportunities and threats to the development of the competitiveness of enterprises;

(3) strategizing the future development of the competitiveness of enterprises by identifying strategic goals and decisions for their achievement.

The map of strategic decisions shows that the experts (participants in the focus groups) determine the predominance of strengths over weaknesses in the surveyed enterprises, the assessment of strengths is 2,503, which is higher than the assessment of weaknesses - 2,396) (Table 2).

Table 2. Map of strategic decisions to increase company competitiveness

SWOT matrix		Creating skills and competence for strategic management	Cooperation in terms of strategic planning	Sharing the financial costs of creating and implementing innovations	New business models, allowing to increase the company's competitiveness	Establishment of mutual financial funds	Monopolistic structure of the market	Strong dependence on the credit policy of commercial banks	Insufficient supply of experienced specialists in strategic planning on the labor market	Tightening competition, the big ones are becoming more aggressive towards the market share of small market players	Unequal access to state financial aid and subsidies	∑ of line estimates	
STRENGTHS	Adaptive and motivated to realize sales growth	66	30	71	79	95	30	33	19	95	33	**551**	2503
	Liquid	33	59	81	30	60	25	91	26	19	11	435	
	Striving to introduce innovations in production	95	55	75	15	55	91	75	57	85	28	**631**	
	They diversify the sources of financial risk	91	99	61	45	45	9	87	8	30	55	530	
	They have a stable market share	80	65	59	12	11	15	65	16	20	13	356	
WEAKNESSES	High indebtedness	60	91	71	44	41	30	99	65	11	15	**527**	2396
	Insufficient working capital	95	33	81	15	19	59	54	11	57	51	475	
	They do not diversify the sources of market risk	15	30	11	19	25	81	77	19	83	77	437	
	Systemic gaps in the implementation of strategic activities	59	79	35	63	51	11	61	71	95	11	**536**	
	They do not have conditions for attracting experienced strategists / They do not have a separate strategic unit	93	31	9	33	33	9	11	85	28	89	421	
	∑ of the grades in the column	**687**	**572**	554	355	435	360	**653**	377	**523**	383		

Source: Summary of focus group results (summary of the opinion of 53 experts, divided into 3 focus groups).

These expert assessment results determine that wine companies have the potential to increase their corporate competitiveness by attacking opportunities with their most significant strengths. As the most significant strengths, the respondents identified the following:

(i)The aspiration of the enterprises to implement innovations in the production (see in figure 3, the respondents give an assessment - 631);

(ii)Small enterprises are adaptive and motivated to achieve sales growth by increasing their market share by differentiating their products (Table 2, the total score of the respondents is 551).

The most significant weaknesses that can hinder the process of increasing the corporate competitiveness of wine companies are:

(1)Systemic gaps in the implementation of strategic planning activities, ensuring company competitiveness. The respondents gave a grade - 536.

(2)The high indebtedness to the banks and the suppliers of resources, providing the activity of the enterprise (see in figure 3, the experts have given an assessment - 527).

In the process of strategic development of the company's competitiveness, the most important elements are the opportunities and threats that arise from the external environment. These are factors that cannot be controlled by the management of enterprises. The map of strategic decisions features the following two attractive opportunities for increasing the competitiveness of wine enterprises:

(1)Creating skills and competencies for strategic planning. This opportunity was assessed with the highest importance by the experts - 687 points;

(2)Cooperation on the strategic planning of wine enterprises. (Table 2, experts give a total estimate of this possibility - 572).

In the next stage of the analysis, the experts identify the most significant threats hindering the process of increasing the company's competitiveness, namely they are:

(1)The strong dependence on the credit policy of banks. Respondents rated this threat at 653;

(2) The intensification of the competition on the market, as more and more the big players prevail. The sum of the evaluations of the individual experts is 523.

In this respect, the reform of the wine sector in the EU, unfortunately, is not going towards its liberalization, but the tightening of controls and regulations. Farmers want more money to be able to modernize their production and compete successfully. It is not recognized that the main problems in the industry come mainly from subsidies and regulations, which deter manufacturers from seeking market solutions for greater efficiency. Against the background of production constraints, subsidies, regulations and distorted incentives in the EU wine sector, it is clear that relying on aid is not a profitable strategy for the industry.The process of assessing the potential of enterprises to increase corporate competitiveness, by using the most significant strengths to take advantage of the most attractive opportunities ends with the definition of strategic goals and management decisions needed to achieve them [9].

The strategic goals need to be adequate to the identified opportunities. In this context, the map of strategic decisions is analyzed in 4 quadrants, assessing the interaction of the elements in the SWOT-matrix. The results of the analysis of the expert assessment are given in Table 3.

Table 3. Evaluation of the interaction of the elements in the SWOT-matrix

Quadrant 1. Assess the interaction of strengths with opportunities S → O **1,467**	**Quadrant 3. Assessment of the interaction of strengths with threats** S → T **1,036**
Quadrant 2. Assessment of the interaction of weaknesses with opportunities W → O **1,136**	**Quadrant 4. Assessment of the interaction of weaknesses with threats** W → T **1,260**

Source: Summary of focus group results (summary of the opinion of 53 experts, divided into 3 focus group.

Strategic goal 1. Creating skills and competencies in the field of strategic planning

In the Strengths-Opportunities quadrant, which has the highest score of the 4 quadrants on the strategic decision map, the highest score (95, Table 2) determines the interaction of the strengths "Creating skills and competencies in the field of strategic planning". The interaction assessment determines the main motives for pursuing the stated strategic goal. The results of the analysis of the expert assessment in the quadrant "Assessment of the interaction of strengths with opportunities" indicate that the training should contribute: first to increase the innovative activity of enterprises and second to the diversification of sources of financial capital. In this context, the training should be aimed at creating knowledge and competencies in financial management of the innovation process and financial risk management [8].

The main obstacles to the realization of the opportunity (strategic goal) is the insufficient working capital available to enterprises (in the quadrant "Assessment of the interaction of weaknesses with opportunities" the relationship of this weak country with the specific opportunity is assessed with the highest total score - 95). Another limiting factor is that a significant part of the enterprises do not have the financial resources to build a strategic unit or to attract a specialist in strategic business planning in their structure. That is why training at these companies is not very important.

Strategic goal 2. Cooperation in terms of strategic business planning of the world and small wine enterprises

Achieving this goal will increase the company's competitiveness both at the sector and at the enterprise level by enabling the diversification of sources of financial capital and by achieving an even more sustainable market share. In other words, cooperation in terms of strategic business planning will avoid the deficit of strategic management capacity of enterprises in the sector (mainly small ones) and will create conditions for reducing indebtedness.

Strategic goal 3. Diversification of sources of financial risk

Achieving this goal will allow wine companies to break away from the strong dependence of financial companies (banking and other financing organizations in the sector) and to create conditions for reducing indebtedness in the sector. Financial diversification will provide an opportunity to diversify the sources of market risk by concluding deals with more new customers.

Strategic goal 4. Maintaining the adaptability of small enterprises to market requirements

This goal will be achieved by creating conditions for increasing the innovation activity of small enterprises by allowing greater access to state aid and other financing alternatives. The main barrier to the realization of this goal are the systemic gaps in the implementation of the strategic planning activities. This necessitates proposing concrete measures to change the status quo for small wine companies.

The achievement of the strategic goals is realized through **proposed 6 measures**, in the proposed model, aiming at increasing the competitiveness of the enterprises and the sector as a whole.

Measure 1. "Training for creating skills and competencies in the field of strategic business planning of company competitiveness". The financing of such training will provide a prerequisite for the construction and development of organizational capacity in enterprises, which will more effectively implement strategic planning activities.

Measure 2. "Establishment of organizational capacity for the implementation of strategic activities in enterprises". The aim of this measure in combination with measure 1 is to increase the efficiency in the implementation of strategic activities in enterprises. The creation of managerial and executive competencies among the staff is the first condition for increasing the efficiency of the application of the activities. It is necessary to identify and build a financial unit or position in the organizational and management structure of enterprises, which will begin to

systematically impose the strategic approach to financial management.

Measure 3. "Creation of tools for strategic management of financial competitiveness". Measuring the effectiveness of the implemented strategic activities is an important aspect in the process of managing the company's competitiveness. The creation of tools for strategic analysis and control will support this process and increase its efficiency**.**

Measure 4. "Creation of macro-structures for strategic management of company competitiveness.". Small enterprises, due to their insufficient financial capital, cannot form a strategic unit to perform strategic business activities. The purpose of this measure is through cooperation, small businesses to build organizational capacity to implement strategic activities.

Measure 5. "Establish a financial system for mutual assistance." The purpose of this system is to support small businesses in the sector by creating alternatives for low-interest financing. This can be done by building a financial system at the sectoral level, centred on a mutual fund.

Measure 6. "Creating financial conditions to promote innovation". The purpose of this measure is to support small enterprises in their innovation activity both in financial terms and in the technological transfer between the nuclear education and wine sector.

The implementation of these 6 measures seeks to achieve a multiplier and synergistic effect on the implementation of each measure will allow to achieve more than one of the set strategic objectives. The implementation of the measures has a significant role in the development of organic production and protection of the components of the environment. This creates conditions for the wine sector of Bulgaria to develop according to the trends for insurance of quality, reliability and efficiency of production [12].

CONCLUSIONS

Strategic planning for the competitiveness of the wine sector requires specific intervention measures to be taken at both macro and global levels. The sustainability of the competitiveness of the wine sub-sector requires diversity. There are many companies in the industry, but this is apparent. Most are in subcontracting relationships with each other, which defines them as highly interdependent. The participants in the network of values in the sector are determined by high indebtedness, which is the reason for their financial instability. This is a result of the lack of a clear long-term strategy for the development of individual enterprises. The variety in the range of wines on the market is great. But this diversity is not based on quality, but on price. The low income of the consumer determines the wine-growing enterprises to compete mainly in price, which also reflects on the quality. In order to cut costs, some companies rely on less good manufacturing practices. Insufficiently applied strategic activities determine the weak interest of wine companies in market requirements. All this determines the wine sector with a low degree of competitiveness and sustainability in the international wine market. Achieving sustainable competitive development of the industry is taking into account the specific factors in the sector such as varietal and age structure of the vineyards, production capacity, product range and adequate marketing for the sale of goods. Market demand is more flexible than supply when the price, income, taste, expectations, etc. change. This determines the higher inertia of the industry in the event of already changed market demand. The construction of the vineyard and the processing facilities is a time-consuming process and once they have become an asset, a weak interest in the products can be established, caused by a new change in the demand from the consumers of grapes and wine. Therefore, the main emphasis is placed on the choice of varietal structure, the diversification of production in the sector and the choice of business strategy adequate to market requirements. The main ways to achieve sustainable competitiveness in the sector, the introduction of the cluster approach, as well as the planting of new and consolidation of vineyards, which will allow

the introduction of production technologies to minimize economic costs in viticulture.

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ESTIMATION OF CATCH PER UNIT EFFORT OF FISHERS: A CASE STUDY IN HILONGOS LEYTE, PHILIPPINES

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Abstract

This study estimates the catch per unit effort (CPUE) among fishers in Hilongos, Leyte, Philippines. The identified efforts included in the study were fishing expenses, the presence of companions in fishing activity, fishing hours in a day, fishing days in a week, membership in fisher's organization and years of involvement in fishing activity. Descriptive statistics and regression analysis were the statistical methods used to facilitate the necessary analysis. Based on the results, fishing expenses, presence of companions in fishing activity, membership of fishers in organization, and fishing days were the significant variables that influences catch rates based on the available data. For future studies, more coastal barangays should be included and there should be a bigger number of fishers as respondents for each coastal barangay.

Key words: *CPUE, fishers, fishing effort, fisheries*

INTRODUCTION

Fish is an important component of the total human food consumption. The demand for fish is expanding rapidly throughout the world because of increasing population and income [8]. Fishers are important participants in the economies of South and Southeast Asia [6]. Over 36 million people are employed directly through fishing [2] and as many as 200 million people derive direct and indirect income from fish [3]. The production of fish requires several inputs, one of which is the fish stock itself. Other key inputs include labor, capacity, technology, and fishing time and many others [1]. Due to this variety of inputs, it is therefore necessary to examine the fishing activity through identifying the efforts that significantly influenced the catch through estimation of the Catch per Unit Effort (CPUE). CPUE is the total fish catch per amount of effort used to harvest the catch [6]**.** This study aims to describe the fishing activity and estimate the catch per unit effort of fishers in Leyte, Philippines. It is a prerequisite to the design and implementation of effective assistance programs. In addition, the results can be used as baseline information in assessing the impact of fishing projects in the selected coastal areas.

MATERIALS AND METHODS

Study site

The study was carried out in the municipality of Hilongos in the province of Leyte. Leyte is located in Eastern Visayas region, Philippines (Figure 1).

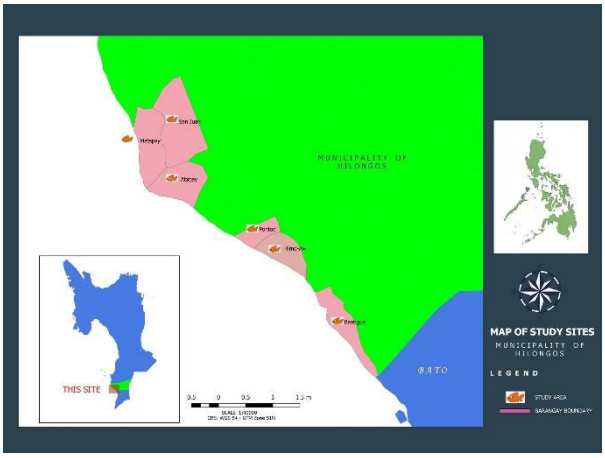

Fig. 1.Map of study site in Hilongos, Leyte, Philippines
Source: [4].

Data Collection

Primary data was gathered through a survey

among selected fishers. The survey instrument aims to describe the fisher's activity and their corresponding fishing efforts. It was pre-tested and further modified based on the results of the pre-test. The fisher respondents were requested to fill up the questionnaires after it was translated into vernacular for easy understanding.

Sampling Design

Stratified random sampling (STRS) was used in this study where the population is partitioned into regions or strata [9] and random samples were taken from each strata. *Barangay* was used as stratifying factor. A *barangay* is the smallest administrative division in thePhilippines and is the native Filipino term for a village, district, or ward [5]. There were six strata are identified for this study.

Establishing the profile of the fishers

Descriptive statistics and parameter estimates were used to establish the profile of the fishers. Age, civil status, household size, number of dependents, and highest educational attainment. Other selected variables related to fishing were also measured.

Estimation of the fishers' Catch per Unit Effort by Regression Analysis

Fish catch function was estimated by the multiple regression analysis technique. The dependent variable was fish catch, measured in kg, while the independent variables were selected fishing efforts namely expenses per fishing trip (in PHP), fishing days, membership in fisher's organization, presence of companions, fishing hours per trip, and number of years in fishing activity. It is anticipated that all identified independent variables displays positive association with fish catch. To capture the catch of fishers, the following model was hypothesized:

$$Y = \beta_0 + \beta_1 expenses + \beta_2 companion + \beta_3 hours + \beta_4 days + \beta_5 member + \beta_6 years + e \quad \text{.....(Equation 1)}$$

where:

Y: average daily catch (in kg)

$expenses$: daily expenses per fishing trip (in PHP)

companion: presence of companion in fishing activity (1= with, 0=without)

$hours$: total number of fishing hours per trip

days: number of fishing days in a week

member: membership in fisher's organization (1=member, 0=not a member)

$years$: years in fishing activity

e: error term.

RESULTS AND DISCUSSIONS

Profile of the fishers

The average age of the fisher respondents is 42 and majority of them were married (83%). Fishers with age ranging from 36 to 45 years old composed the largest percentage (31%) in the distribution. The percentages of respondents who were widowers and separated from their spouses were approximately equal which is about 3% and 2%, respectively. Their average household size consists of five members with three dependents on the average. The educational level of fishers was categorized into four groups. More than half of the total fishers were able to reach elementary level (63.87%). Some reached high school level (31.61%), only few were able to reach college level (2.6%) while only small portion (1.9%) had able to graduate college.

Characteristics of fishing activity

The average fishing years of respondents was 21. Majority has 11 to 20 years of fishing experience (56%). Meanwhile, more than half of the fishers were members of organization for fishers which was about 54% of the entirety. Their membership helps them be more knowledgeable with the various techniques, policies and regulation related to fishing activity in their community. Approximately half of the fishers (51%) catch fish in the morning, meaning they are in the sea catching fish between 7:00 AM until 11:00 AM.

The remaining fishers catch fish in the night, they catch starting 6:00 PM and be back early in the morning around 6 AM.

Table 1. Profile of the fisher respondents

Characteristics	Categories	Frequency	Percent
Age	25 &below	6	3.9
	26-35	39	25.2
	36-45	48	31
	46-55	41	26.5
	56 & above	21	13.5
Total		155	100
Mean = 42			
Civil status	Married	129	83.2
	Single	19	12.3
	Widower	4	2.6
	Separated	3	1.9
Total		155	100
Household size	2 & below	12	7.7
	3-4	56	36.1
	5-6	60	38.7
	7 & above	27	17.4
Total		155	100
Mean = 5			
Dependents	2 & below	80	51.6
	3-4	52	33.5
	5-6	19	12.3
	7 & above	4	2.6
Total		155	100
Mean = 3			
Education	Elementary level	99	63.87
	High school level	49	31.61
	College level	4	2.6
	College graduate	3	1.9
Total		155	100
Membership in fishers' organization	Not member	71	45.8
	Member	84	54.2
	Total	155	100
Fishing time	Morning	79	51
	Evening	76	49
	Total	155	100
Companions in fishing	With companion	118	76
	Without companion	37	24
	Total	155	100
Fishing days in a week	1-3	15	9.7
	4-5	44	28.4
	6-7	96	61.9
	Total	155	100
Mean = 6			
Fishing hours in a day	1-6	57	36.8
	7-12	88	56.8
	13-24	10	6.5
	Total	155	100
Mean = 7.7			
Years of fishing	10 & below	36	23.2
	11-30	90	58.06
	31-50	27	17.42
	51 & above	2	1.29
	Total	155	100
Mean = 21			

Source: Authors' own calculation and analysis based on survey data, 2021.

In terms of presence of companion in fishing activity, more than three-fourths (76%) of the total fishers have companions but this depends on fishing method they are using, some fishing methods requires several labourers while some are light enough to be carried out without involving several people.

The average fishing days in a week was six. There were about 61.9% of the fishers who went to catch fish almost every day or between 6 to 7 days in a week. The average duration of fishing activity I s 7.7 hours. About half spent almost 7 to 12 hours in the sea to catch fish (56.8%).

Fisher's estimated daily catch and income

The estimated mean daily income in fishing activity is PHP 240.87 (USD 5.01) with an estimated standard error of 19.63. The range of the true income at 1% error has a lower limit of PHP 185.91(USD 3.86) and an upper limit of PHP 264.91(USD 5.51). The range of fisher's daily income at 5% error les within PHP 195.34 (USD 4.06) and PHP 255.48 (USD 5.31). On the other hand, the estimated mean catch of a fisher per fishing day was 6.76 kg with the estimated standard error of 0.419. The ranges of the true catch at 1% error have a lower limit of 4.88 kg and an upper limit of 8.64 kg. The ranges of fishers daily catch at 5% error lies within 5.392 kg and 8.19 kg.

Table 2. Descriptive analysis of income and catch

	Income	Catch
Mean	240.8742	6.76
Standard Error	19.63339	0.419
Standard deviation	244.43371	5.216
Variance	59747.836	27.206
95% Confidence Interval	(195.34, 255.48)	(5.392,8.191)
99% Confidence Interval	(185.91, 264.91)	(4.880,8.640)

Source: Authors' own calculation and analysis based on survey data, 2021.

Estimation of catch per unit effort (CPUE) by regression analysis

Table 3 presents the descriptive statistics of the selected fishing efforts identified in the study. Mean, standard deviation, minimum and maximum value were calculated.

Table 3. Descriptive statistics of selected fishing efforts

Fishing effort	Mean	St. Dev.	Min.	Max.
Catch	6.76	5.22	1	50
Daily expenses in fishing (in PHP)	238.64	199.52	0	1,630
Presence of companion in fishing	.75	.44	1	0
Fishing hours per trip	7.70	3.36	2	15
Fishing days	5.67	1.30	2	7
Membership in fisher's organization	.54	.50	0	1
Number of years in fishing	20.98	12.87	1	60

Source: Authors' own calculation and analysis based on survey data, 2021.

By multiple regression analysis, the identified fishing efforts was examined how it significantly influenced the fish catch (in kg). Table 4 shows that daily expenses in fishing activity significantly affects catch at 1% level of significance. This implies that 1 peso (USD) spent for fishing activity would increase catch by .0117715 kg. Presence of companions per fishing period displayed significance at 1% level.

Table 4. Results of regression analysis

Fishing efforts	Coefficient	Standard errors
Daily expenses in fishing	.0117715***	.0018039
Presence of companion in fishing	2.361205***	.8977255
Fishing hours per trip	-.2234367	.1340129
Fishing days	1.3547***	.3324319
Membership in fisher's organization	-1.897715**	.7955791
Number of years in fishing	-.0137957	.0288774
Constant	-2.463057	2.106603
Observations	155	
R-squared	0.3335	

Source: Authors' own calculation and analysis based on survey data, 2021.

Having a companion when fishing resulted to increase of fish catch by 2.361205 kg. Fishing days is significant at 1% which translates that an added day in fishing would increase catch by 1.3547 kg. Membership in fishers' organization would decrease fish catch by 1.897715 kg. Other identified fishing efforts such as fishing hours per trip and number of years in fishing activity have no significant influence to fish catch using the available data.

CONCLUSIONS

Based on the profile of fishers, age, civil status, household size, number of dependents, and highest educational attainment of the fishers showed variation. Fishing time, availability of companions, and the amount spent in fishing activity merely depends on the fishing methods used. In regression model, daily fishing expenses, presence of companions, fishing days, and membership in fisher's organization are the significant efforts that influences catch based on the available data. The concerned official may subsidized their fishing expenses fishing activity to support the living of the fishers. Fishers are encouraged to catch fish with other fishers however this may not possible with fishers having small boats. In this situation, the government must provide assistance to fishers in terms of owning a boat through loans. Membership in fisher's organization has negative influence to fish catch where it was hypothesized to impact catch positively. With this, extension workers have to revise or improve their approach in connecting with the fishers. They must orient the fishers with the appropriate fishing practices. Fishing communities must also encouraged other fishers to be a member of fisher's organization. Concerned officials should conduct livelihood trainings for other members in the family as additional source of income aside from fishing to sustain their living. For further study, more coastal barangays should be included and there should be a bigger number of fishers as respondents for each coastal barangay.

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TRENDS IN THE MILLING AND BAKING INDUSTRY IN THE EU-28 AND ROMANIA IN THE PERIOD 2015-2019

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Abstract

The paper aimed to analyze the trends in milling and baking industry in the EU-28 and Romania. During the period 2015-2019, the production of milling and bakery products increased as the need of the market is much higher. The offer of bakery products has been continuously adapted to consumer's preferences and assured a large range of bakery assortment for satisfying all the market segments. In the EU, the most representative countries operating in baking industry are Germany, France, Italy, Spain, Austria, United Kingdom, Poland and Romania. The milling and bakery products market is dominated by SMEs, and production technologies are more and more industrialized while the traditional bakery is slowing down. In Romania, milling and baking sector is the top sector in food industry. The number of companies has increased, production technologies have been modernized, product quality is increasing, the production volume is higher and higher, productivity, turnover and profit have also an ascending trend and the competitiveness has become more intense in the business environment. This economic sector assures jobs, and creates value added contributing to GDP growth. Bread consumption reached 78kg/capita/year in average in the EU-28 while in Romania is 82 kg/capita, a little bit higher. The top companies in milling and bakery industry in Romania based on their turnover achieved in 2019 are: Vel Pitar, the leader in the field, followed by Oltina, Boromir, Dobrogea, Sapte Spice and GoodMills. Based on the five criteria used in this study, the hierarchy is almost similar: Vel Pitar, Oltina, Boromir, Sapte Spice, Dobrogea, and GoodMills. The milling and bakery industry has to continue to modernize infrastructure, to look for healthier ingredients in the recipes, to diversify production, to keep under control production costs reducing energy expenses, to increase product quality and assure a good ratio between product quality and price.

Key words**:** *milling and baking industry, trends, EU-28, Romania*

INTRODUCTION

Bread is one of the oldest man-made foods, which plays an essential role in human diet and also in religious rituals and secular culture.

It is said that "wheat", one of the most important cereals in the world, in its form of bread, "provides more nutrients to the world population than any other single food source"[18].

This is explained by the fact that bread is a rich source of carbohydrates, fibers, vitamins, minerals and other nutritional factors, which are included in its content depending on the recipe. It is commonly presented in our daily diet in different sorts, shapes, sizes, being prepared either in an industrialized system or in a traditional way.

The types of bread have been improved across the time and nowadays there is a large range of sorts among which it deserves to be mentioned: plain, multi grain, whole wheat, whole grain, high fiber, omega-3, gluten-free, non-allergen, low-fat, sugar-free, oat, bran, oil seeds etc. In addition, bakery industry produces many other sorts like pastries, muffins, cupcakes, biscuits etc, each of them having specific ingredients, nutritive value and benefits [15].

The offer of bakery products have known a large diversification in order to better satisfy consumer's preferences which have changed over the time and modern consumer is willing much more to consume a healthier food. For this purpose, consumers have become more careful in choosing the bread that they consume. They prefer a high quality bread which is made of whole wheat or whole grain flours and has a dense consistence. Many consumers avoid to buy and consume commercial bread which often is made of refined flour and contains additives destined to improve colour, flavour, texture, nutrition, and shelf life.

In general, packed bread and sliced bread are the most required, being purchased from supermarkets and hypermarkets, which means a high development of the industrialized manufacturing, while bread produced in traditional systems looks to slow down [33].

To satisfy better consumers' preferences, bakery industry have to maintain a continuous product innovation keeping pace with the trends in healthcare. Besides of its social and health importance, bakery industry is a key subsector in food industry bringing its contribution to the economic development by creating jobs, value added, assuring revenues flow to the budget. The increased demand of bakery products has led to the growth of the number of milling and bakery companies, to the improvement of production technologies and products quality, the increase of turnover, profit, profitability and competitiveness in this sector.

In 2018, the global grain mill products market size was valued at USD 623.4 billion, in 2019 it was estimated at USD 644.67 billion and in 2020 it is expected to reach USD 667 billion. From 2019 to 2025, it is expected to grow by 3.6% and reach USD 797.27 billion.

In milling industry, wheat, maize, rice, rye, barley and other cereals are supposed to be processed within an entire technological process which means: cutting, grinding, and crushing to produce flours. The new technologies and high demand of non-gelatinized flour will determine the market growth for grain mill products.

Wheat has the largest market share (42%) and the increased demand for binders has produced deep changes on starches and flours varieties used in the production of food products and industrial goods. Nowadays, wheat flours are fortified with additives, micronutrients, and a variety of ingredients [14].

The EU's bakery sector is one of the most dynamic sub sectors of food industry, due to the permanent change in consumer's preferences and innovations in production technologies of high productivity and efficiency and also assuring food safety and security.

Continuous changes are seen in manufacturing technologies, mainly regarding the reduction of energy expenses and production costs, and also in distribution channels, and products prices [12].

Among the most representative producing countries of milling and bakery products in the EU are Germany, France, Italy, Spain, Austria, United Kingdom, Poland and Romania [15].

The average bread consumption in the EU-28 has registered a decline and at present accounts for 78 kg/capita/year, but there are countries where bread is consumed in higher amounts.

In Romania, bread consumption is 82 kg/inhabitant/year, and it still higher compared to other countries, and this has sustained milling and bakery industry to maintain its the top position in the food industry regarding production diversification, turnover and profit.

The development of milling and bakery industry in Romania has been also favored by the large surface cultivated with wheat and maize and the high production performance year by year [17, 20, 26].

In this context, the paper aimed to analyze the main trends in bakery industry in the EU and Romania during the period 2015-2019.

Also, the study pays attention to the key companies operating in the milling and bakery industry, emphasizing on their financial results and profitability.

MATERIALS AND METHODS

This study is on a selection of important articles regarding the development of the milling and bakery industry in the EU and Romania, and also on the balance sheets of the top six companies operating in Romania: Vel Pitar, Boromir, Sapte Spice, Dobrogea, Oltina and GoodMills for the period 2015-2019 provided by Romanian Companies.

The main aspects approached in this study regard: product varieties, manufacturing technologies, the number of companies, production, and consumption.

Financial analysis is based on the firm performance at the end of a financial year emphasizing on turnover, net profit, profit margin, fixed assets turnover, return on fixed assets and equity [19].

The calculations were based on the following formulas:

Fixed Assets Turnover (FAT) = T/FA, where: T= turnover and FA = Fixed Assets.

Return on Fixed Assets (ROFA) = NP/FA, where: NP= Net profit, and FA= Fixed Assets.

Return on Equity (ROE) = NP/E, where: NP= Net profit, and E= Average Shareholders' Equity.

Profit margin (PM)= NP/T x 100, where: NP = Net profit and T = Turnover.

In addition there were used the Points Method and Comparison Method in order to comparatively examine the financial results and profitability indicators of the companies operating on the milling and bakery market in Romania.

The results were tabled and correspondingly commented, and finally there were drawn the pertinent conclusions.

RESULTS AND DISCUSSIONS

Trends in the EU-28 milling and bakery industry

In the EU classification of economic activities, NACE Group C, Class 10, "Manufacture of Food products" includes the activities in food industry, in the year 2012, there were operating 265,699 enterprises, where about 4,096,033 persons are employed and the companies' turnover accounted for Euro 914 Billion, and valued added for Euro 170 Billion. Over 50% of these companies are SMEs and their production value reached Euro 837 Billion.

In NACE Group C, Class 10.61 there are included the activities regarding "Manufacturing of grain mill products" such as: "grain milling: production of flour, groats, meal or pellets of wheat, rye, oats, maize (corn) or other cereal grains, manufacture of cereal breakfast foods, manufacture of flour mixes and prepared blended flour and dough for bread, cakes, biscuits or pancakes etc"[11].

In this field of activity, in the year 2012, there were operating 6,000 enterprises with about 105,852 employees, achieved a turnover of Euro 45,718 Million, and valued added of Euro 7,167 Million. Their production value reached Euro 42,186 Million [10].

In NACE Group 10.7 Manufacturing of bakery and farinaceous products, it is included the production of bakery products, macaroni, noodles and similar products, and in Group 10.71 it is included "Manufacture of bread; manufacture of fresh pastry goods and cakes class" which means: "manufacture of bakery products: bread and rolls (pastry, cakes, pies, tarts, pancakes, waffles, rolls etc.)" [11].

In 2012, in this field of activity, there were 155,219 enterprises with 1,530,972 employees. Their turnover accounted for Euro 114,523 Million, value added Euro 39,524 Million and production value Euro 108,199 Million [10].

Therefore, in food industry of the EU-28, in NACE 10.6 and 10.7. there were operating over 60.6% companies, which assured jobs for 40% people, which produced 17.52 % of turnover, 27.46% of value added and 17.95% of production value (Table 1).

Taking into account the number of enterprises and the number of jobs existing in these sectors, bakery industry is on the top position in the EU-28 food industry.

For the revenue level, these sectors come on the 5th position in the food industry [2].

Table 1. The number of companies, employees, turnover, value added and production value in food industry and in manufacturing of grain mill products and bakery and farinaceous products in the EU-28 in the year 2012

	Number of enterprises	Number of employees	Turnover Euro Billion	Value added Euro Billion	Production Value Euro Billion
NACE 10 Manufacture of food products	265,699	4,096,033	914	170	837
NACE 10.6. Manufacture of grain mill products	6,000	105,852	45.71	7.18	42.18
NACE 10.7 Manufacture of bakery and farinaceous products	155,219	1,530,972	114.52	39.52	108.19
Share of NACE 10.6 in NACE 10 (%)	2.25	2.58	5.00	4.22	5.03
Share of NACE 10.7 in NACE 10 (%)	58.41	37.37	12.52	23.24	12.92

Source: Own calculation based on the data from [10].

In the EU-28, the number of bakery companies varies from a country to another, the most numerous ones being in France and Italy, which together have almost 50% of the total number of enterprises. They are followed by Germany, Spain, Greece, Portugal, Poland, Romania and Belgium, all together having 85% of all the companies existing in the bakery sector.

The hierarchy of the companies is established based on their turnover and not on profit margin, because there are differences between companies regarding operating expenses, productivity and average value added per employee [2].

In 2018, the revenue of the bakery industry in the EU-28 was almost similar with the one performed in 2017, accounting for USD 68.7 Billion [13].

In the EU, more than 80% of the products are based on bread, being of various types, among which the most common are: pre-packed products, fresh products and bake-off products. If in the Eastern European countries, pre-packed breads and also the bake-off products achieved by supermarkets are more required, in the Western European countries consumers prefer much more "ready meals, pizzas, frozen baked goods, instant foods over breads" [15].

In 2016, the consumption of bakery products in the EU-28 reached 40 million tons, of which: 77% bread, 11 % patisserie, 9% viennoiserie and 3% savory pastry. The consumption value accounted for €147.3 billion ($165 billion). The share of various bakery products in sales was: bread 54%, patisserie 24%, viennoiserie 15% and savory pastry 7%.

About 71 % of bakery products is represented by fresh-baked goods, and 24% belong to packaged-to bake products [16].

Bread consumption in the EU-28 increased during the last decade, If in 2010, the average bread consumption per capita was 50 kg/year, in 2018, it accounted for 78 kg/inhabitant, but with large variations from a country to another. While Germans are the top consumers of bread, exceeding the EU average, the British consume less than the EU average.

In 2018, the highest consumption of fresh bread and miscellaneous bakery is in United Kingdom (4.8M tons), Germany (4.6M tons) and Spain (3M tons), representing 44% of the total consumption in the EU, which was 28.17 M tons.

Per inhabitant, in the year 2018, the highest consumption of fresh bread and miscellaneous bakery was registered in Ireland (154 kg), Netherlands (81 kg) and United Kingdom (72 kg).

Also, in 2018, the highest level of market value was carried out by Germany (USD 15.7 Billion), United Kingdom (USD 11.9 Billion) and Italy (USD 9.8 Billion), all together

representing 54% of the total market value which accounted for USD 69.95 Billion.

In the EU, bakery sector is the most industrialized, 80% of bread production being manufactured in industrial companies, and the remaining being obtained in the traditional system.

The main countries where industrial bakery has the highest share in bread production are: United Kingdom 80%, Netherlands 81%, Germany 40%, France 30%, and Spain 19%.

Even though in the EU, the supermarkets and hypermarkets produce their own bakery products, frozen dough and semi-baked products are substantially expanding.

In 2018, the highest production of fresh bread and miscellaneous bakery was achieved by Germany (5.1M tons), United Kingdom (4.3M tons) and Spain (3.1M tons), all these three countries together producing 12.5M tons, that is 44% of the total production of 28.40M tons in the EU. Other important producing countries are; France, Italy, Poland, Netherlands, Romania, Ireland, Czech Republic, Portugal and Belgium, all together achieving other 44% of the total EU output [13].

The increased demand has stimulated not only production but also trade with bakery products, and imports are more and more commonly frequent in many countries and also the import price has substantially raised. In 2018, the EU-28 imported 4.2M tons of fresh bread and miscellaneous bakery [13, 33].

Trends in Romania's milling and bakery industry

Romania is a special case in the EU, being known its geographical position and good soil and climate conditions for producing cereals. In Romania, the most suitable areas for these crops being the South and South Eastern, West and North East [21, 24].

In 2019, Romania produced 30.41 million tons cereals, 1.8 times more than in the year 2010. Maize production accounted for 17.43 million tons, representing 57.3% of the cereals production and being 1.9 times higher than in 2010, while wheat production was 10.29 million tons, 1.77 times higher than in 2010 and representing 33.8% of the total cereal production. Therefore, maize and wheat are the main cereals produced in Romania providing raw material for milling and bakery industry and not only and also for export [20].

The variation of production from a region to another was caused by climate change and especially by severe and long droughts periods which appeared during the last decade. The demand/offer ration had a deep impact on maize and wheat price, which affected producers very much [23].

The high production of maize and wheat grains allows not only to cover the domestic market but also to export these grains in the EU and other extra EU states [25].

The market of milling and bakery products in Romania has taken an unprecedented advance in terms of volume of supply and demand, diversification of product range, their qualities, volume and value of sales and profit of the companies operating in this sector, which currently set the top position in the food industry.

The milling and bakery products market is dominated by SMEs, but at the same time there are still large companies whose business is continuously developing.

The main market segments are: on one side, the industrial sector endowed with a modern infrastructure, having a high number of employees, a large range of production types, and on the other side, it is the traditional manufacturing sector which is represented by small companies which practice classic production technologies [28].

The industrial companies are permanently focused on the increase of production capacity and the improvement of processing technologies, on the creation of new recipes, on the diversification of products portfolio to satisfy better consumer's preferences, on the increase of the value added and product quality, on the improvement of distribution channels and on keeping costs under control, on the growth of turnover and profit, efficiency, profitability and to cope better with the fierce competition in the business environment.

The companies operating in milling and bakery sector have a high contribution to the employment and revenue flow in Romania.

Romania produces 1.5 Million tons bread and the turnover of the mill and bakery industry reached Euro 3 Billion, which places this sub sector of the food industry on the top position. However, besides the official statistical data, there are other 500 thousand tons bread which are missing from the official data, reflecting fiscal evasion, despite of the measures taken by Government to reduce VAT to 5% [29].

Bakery industry is focused on the high demand of conventional bread which is "the white bagel", the top product consumed in Romania. However, young generation and the persons with higher income working and living in the urban areas have become more oriented to the new products compiling with a healthier life style and with a high satisfaction assured by the quality/price ratio.

Consumption habits in the urban areas have become more oriented to whole bread, rye bread or gluten-free bread, bread with seeds and Omega-3, or high-fiber bread.

Romanians are high bread consumers compared to other Europeans. But, if in 2010 bread consumption accounted for 92 kg/inhabitant/year, in 2018 it declined by 10 kg, and reached 82 kg/capita, being still by 4 kg higher than the EU-28 average of 78 kg/capita.

Consumption of white flour, maize flour and bread declined with a few percentages, while the consumption of biscuits and cakes increased.

Bread consumption differs from a region to another in the territory and also among various social categories depending on their income, education level, age, profession, preferences, habits.

The highest bread consumption in Romania is the South East Oltenia, South Muntenia, North East, where bread price is the lowest, compared to the Central region where bread price is higher.

Bread is bought especially in supermarkets and hypermarkets, but also from the small traditional bakeries situated in the house proximity from where people is accustomed to purchase rapidly [1].

Profitability in the top milling and baking companies in Romania

In Romania there are over 4,500 companies operating the field of milling and baking industry, among them the most well known are: Vel Pitar, Boromir, Dobrogea, GoodMills, Oltina, Titan, Pam Bac, Pan Grup, Croco and Rom Pak [27].

From these companies, there were selected in this study only six, which are the top companies based on their sales in 2019. They are: Vel Pitar SA, Oltina Impex Prod Com SRL, Boromir Ind SRL, Dobrogea Grup SA Constanta, Sapte Spice SA, and GoodMills Romania SRL.

Vel Pitar SA

The company is the leader in the field of bakery production and distribution in the market. Since its foundation in 2001, the company has expended its activities by joining the capital with other companies, so that at present it has 12 production units and over 2,500 employees. Its products are based on traditional recipes, the ingredients are carefully selected and of high quality, the products are packed to preserve freshness, savour and taste for a longer period of time. This was possible due to the investments in modern technologies, and products continuous improvement.

Its products are required both on the internal market by more than 1 million consumers which appreciate both the bread and pastry assortments. The company delivers bakery products every day in more than 7,000 shops which belong either to the modern retail network including supermarkets and hypermarkets and also in the traditional retail. Many of its bakery and pastry products are competitive for export [31].

However, the company is facing with the competition created by bakery products which are made of frozen bread and are commercialized on the Romanian market [32].

The sales of the company increased by +44.69% from Euro 73.63 Million in 2015 to Euro 106.54 in 2019. Net profit also increased 153 times from Euro 0.06 Million in 2015 to Euro 9.19 Million in 2019. Profit margin grew

up 153 times from Euro 0.08% in 2015 to 8.62% in 2019.
Fixed assets turnover increased from 2.83 in 2015 to 3.91 in 2019, Return on fixed assets from 0.22 in 2015 to 0.337 in 2019 with a peak of 0.438 in 2018, and Return on equity raised from 0.004 in 2015 to 0.289 in 2019 with a peak of 0.455 in 2018 (Table 2).

Table 2. Financial results and profitability of Vel Pitar SA, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	106.54	94.75	85.11	78.67	73.63
2	Net profit (NP)	Euro Million	9.19	11.98	3.38	2.18	0.06
3	Profit margin (PM)	%	8.62	12.64	3.97	2.77	0.08
4	Fixed assets turnover (FAT)	-	3.91	3.46	3.26	3.35	2.83
5	Return on fixed assets (ROFA)	-	0.337	0.438	0.130	0.092	0.220
6	Return on equity (ROE)	-	0.289	0.455	0.207	0.147	0.04

Source: Own calculations based on [8].

Oltina Impex Prod Com SRL is another successful company in the field of milling and baking industry in the year 2019, reaching a high turnover of Euro 89.33 Million, a high profit profit of Euro 3.3 Million and a high profit margin accounting for 3.69%.
Its products of bakery are very well appreciated on the domestic market and also are exported in some European countries [9].
Oltina had one of the best the best dynamics of the sales during the last five years, increasing from Euro 30.02 Million in 2015 to Euro 89.33 Million in 2019.
Its net profit also raised by 855 from Euro 1.8 Million in 2015 to Euro 3.33 Million in 2019. As a result, profit margin was the highest in the Romanian bakery industry accounting for 5.99 in 2015 and 3.72% in 2019, with variations from a year to another.
Fixed assets turnover increased from 2.61 in 2015 to 4.06 in 2018, meaning + 55%.
Return on fixed assets registered a decline from 0/156 in 2015 to 0.019 in 2017, but then it recovered and reached 0.151 in 2019.
Return on equity varied from a year to another, but the general trend was an ascending one from 0.169 in 2015 to 0.222 in 2019, meaning +31.3% (Table 3).

Table 3. Financial results and profitability of Oltina Impex Prod Com SRL, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	89.33	50.83	33.12	32.57	30.02
2	Net profit (NP)	Euro Million	3.33	2.13	0.28	1.60	1.80
3	Profit margin (PM)	%	3.72	4.20	0.83	4.92	5.99
4	Fixed assets turnover (FAT)	-	4.06	3.28	2.39	1.92	2.61
5	Return on fixed assets (ROFA)	-	0.151	0.137	0.019	0.095	0.156
6	Return on equity (ROE)	-	0.222	0.169	0.026	0.141	0.169

Source: Own calculations based on [6].

Boromir Ind SRL is a Romanian company founded in 1994, and which has been continuously developing, at present having many firms of milling and baking in various regions of the country and also specialized shops. The company invested Euro 5 Million in silos for increasing storage capacity and also Euro 3 Million for increasing the production capacity. Its portfolio of products includes: flours of various cereal grains, mainly of wheat and maize, bread cakes, biscuits etc [9, 28].
Boromir registered a continuous increase of turnover from Euro 52.21 Million in 2015 to Euro 65.69 Million in 2019, meaning by 25.81 more. Its net profit also increased from

Euro 1.43 Million to Euro 2.12 Million in the same period, meaning cy +48/25% in the last five years. Profit margin grew up from 2.72% in 2015 to 3.24 in 2019. Fixed assets turnover, return on fixed assets and return on equity declined due to the investment made in modernizing infrastructure for enlarging production and storage capacity (Table 4).

Table 4. Financial results and profitability of Boromir Ind SRL, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	65.69	57.41	54/68	50.95	52.21
2	Net profit (NP)	Euro Million	2.12	1.29	1.54	2,11	1.43
3	Profit margin (PM)	%	3.24	2.25	2.82	4.14	2.74
4	Fixed assets turnover (FAT)	-	1.44	1.69	1.67	1.57	2.52
5	Return on fixed assets (ROFA)	-	0.046	0.038	0.047	0.065	0.069
6	Return on equity (ROE)	-	0.069	0.067	0.077	0.102	0.126

Source: Own calculations based on [3].

Dobrogea Grup SA is also a Romanian company with a high business operating mainly in Constanta, Mangalia, Eforie, but also in Medgidia. Its business is profiled on various sorts of flours, over 100 bread varieties and bakery specialities [28].

The company turnover has slightly increased by only 2.81% from Euro 34.45 Million in 2015 to Euro 35.42 Million in 2019.

Net profit was negative in 2015, accounting for Euro -1.29 Million and after a positive value of Euro 1.33 Million in 2016, the highest net profit during the last five years, it declined to Euro -6.67 Million in 2017, the lowest level. Then, the net profit became again positive and reached Euro 0.29 Million in 2019.

Profit margin had a negative value in 2015 and 2017, and recovered at 0.82% in 2019, but much lower than in 2016, when it had the highest value of 3.85%.

Fixed assets turnover had negative values in 2015 and 2017, but then it recovered and reached 0.27 in 2019, but being by 55% lower than in 2016. Return on equity registered a similar trend, being negative in 2015 and mainly in 2017, but in 2019 it became 0.023, by 65.7% smaller than in 2016 (Table 5).

Table 5. Financial results and profitability of Dobrogea Group SA, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	35.42	35.41	35.12	34.41	34.45
2	Net profit (NP)	Euro Million	0.29	0.25	-6.67	1.33	-1.29
3	Profit margin (PM)	%	0.82	0.70	-19.00	3.85	-3.74
4	Fixed assets turnover (FAT)	-	3.33	3.06	2.90	1.55	1.49
5	Return on fixed assets (ROFA)	-	0.027	0.022	-0.552	0.060	-0.056
6	Return on equity (ROE)	-	0.023	0.020	-0.529	0.067	-0.069

Source: Own calculations based on [4].

Sapte Spice SA is profiled on milling activity, owning four mills of high capacity and its production is specialized on various types of flours (wheat, rye etc), complete mixtures for baking and pastry, but also it produce specialized products according to the clients' specifications.

The company turnover increased by 7.87% from Euro 50.91 Million in 2015 to Euro 54.92 Million in 2019. The net profit declined from Euro 0.54 Million in 2016, the peak value, to Euro -1.14 Million in 2018. As a result, profit margin accounted for 1.18% in 2016 and -2.21% in 2018, the lowest level.

Fixed assets turnover declined from5.79 in 2015 to 4.88 in 2019. Return on fixed assets

decreased from 0.061 in 2015 to -0.108 in 2018. Return on equity also decreased from 0.047 in 2016 to -0.111 in 2018 (Table 6).

Table 6. Financial results and profitability of Sapte Spice SA, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	54.92	47.08	45.86	46.13	50.91
2	Net profit (NP)	Euro Million	0.19	-1.04	0.53	0.54	0.53
3	Profit margin (PM)	%	0.35	-2.21	1.15	1.18	1.06
4	Fixed assets turnover (FAT)	-	4.88	4.89	4.93	4.51	5.79
5	Return on fixed assets (ROFA)	-	0.017	-0.108	0.057	0.053	0.061
6	Return on equity (ROE)	-	0.021	-0.111	0.051	0.047	0.046

Source: Own calculations based on [7].

GoodMills Romania SRL is a subsidiary of the Austrian company, one of the largest groups of milling industry in Europe.

It is a Romanian bakery and a flour mill, but also the company commercialises its milling and baking products. Iits origin is in the company Mopan Mures SA in Tirgu Mures City, Central Romania and which was founded in 1991. Then, in 1999, it was acquired by the Greek company Loulis SA, in 2007 it becomes the company Titan SA, after being acquired by Euromills AG, in 2012, GoodMills Group acquires 97.85% shares in the company and in 2014, the company name becomes GoodMills Romania [30]. It has two factories for milling and baking and it is a leader in producing cereals flours: wheat flour, maize flour, gray, breadcrumbs etc [28].

The company turnover was higher in 2015 and 2016, but then in 2017 it declined from Euro 69.56 Million in 2015 to Euro 44.98 Million, meaning by -35.4% less than in 2015. Then, the company recovered its sales in 2018 and in 2019 reached Euro 53.39 Million, but by -25.25% lower than the level performed in 2015. Net profit has also declined from Euro 1.42 Million in 2015 to -10.04 in 2016, the lowest loss. Profit margin ranged between 2.04% in 2015, the highest level and -15.21%, the lowest one in 2016. Fixed assets turnover increased from 1.46 to 2.58 in the interval 2015-2019. Return on fixed assets declined from 0.031 in 2017 to -0.513 in 2016. Return on equity was much more negative reflecting the lack of efficiency in using the shareholders' equity (Table 7).

Table 7. Financial results and profitability of GoodMills Romania SRL, 2015-2019

Crt. No.	Indicators	MU	2019	2018	2017	2016	2015
1	Turnover (T)	Euro Million	53.39	52.26	44.98	66.04	69.56
2	Net profit (NP)	Euro Million	-0.41	-0.18	0.66	-10.04	1.42
3	Profit margin (PM)	%	-0.76	-0.34	1.47	-15.21	2.04
4	Fixed assets turnover (FAT)	-	2.58	2.46	2.11	3.37	1.46
5	Return on fixed assets (ROFA)	-	-0.019	-0.008	0.031	-0.513	0.029
6	Return on equity (ROE)	-	-0.032	-0.013	0.048	-0.760	0.063

Source: Own calculations based on [5].

Using the results obtained by each company for each criterion, and using the point method, Vel Pitar cumulated 8 points, Oltina cumulated 12 points, Boromir 21 points, Dobrogea 26 points, Sapte Spice 25 points and GoodMills 34 points.

Therefore, the hierarchy of these companies based on the lowest number of points carried out for their profitability in 2019 is the

following one: Vel Pitar, the leader in the field, followed by Oltina, Boromir, Sapte Spice, Dobrogea, and GoodMills (Tabel 8).

Table 8. Classification of the six companies in 2019 based on the selected criteria, using Point Method

	Vel Pitar	Oltina	Boromir	Dobrogea	Sapte Spice	GoodMills
Turnover	106.54	89.33	65.69	35.42	54.92	53.39
Points	1	2	3	6	4	5
Net profit	9.19	3.33	2.12	0.29	0.19	-0.41
Points	1	2	3	4	5	6
Profit Margin	8.62	3.72	3.24	0.82	0.35	-0.76
Points	1	2	3	4	5	6
FAT	3.91	4.06	1.44	3.33	4.88	2.58
Points	3	2	6	4	1	5
ROFA	0.337	0.151	0.046	0.027	0.017	-0.019
Points	1	2	3	4	5	6
ROE	0.289	0.222	0.068	0.023	0.021	-0.032
Points	1	2	3	4	5	6
Total points	8	12	21	26	25	34
Final classification	**1**	**2**	**3**	**5**	**4**	**6**

Source: Own calculation.

CONCLUSIONS

The offer of bakery products have known a large diversification in order to better satisfy modern consumer's preferences which are more oriented to healthier bread and other bakery products.

Bakery industry is a key subsector in food industry in Romania being the top sector based on its turnover and contribution to the economic development by creating jobs, value added, assuring revenues flow to the budget.

The increased demand of bakery products has led to the growth of the number of milling and bakery companies, to the improvement of production technologies in order to increase production and product quality, productivity, turnover and profit and also the competitiveness of their products in the market.

Among the most representative producing countries of milling and bakery products in the EU are Germany, France, Italy, Spain, Austria, United Kingdom, Poland and Romania.

Bread consumption increased in the EU reaching 78kg/capita/year and in Romania is 82 kg/capita, a little bit higher, despite that during the last decade it declined from 92 kg in 2010. In Ireland and Netherlands bread consumption is the highest in the EU.

The milling and bakery products market is dominated by SMEs, but at the same time there are still large companies whose business is continuously developing.

Traditional milling and baking system are replaces year by year by industrialized technologies of production which produce a higher production which could better satisfy the demand.

In Romania's milling and baking industry are operating over 4,500 enterprises, whose turnover exceeded Euro 3 Billion.

The top companies in milling and bakery industry in Romania based on their turnover achieved in 2019 are: Vel Pitar, the leader in the field, followed by Oltina, Boromir, Dobrogea, Sapte Spice and GoodMills.

Based on the five criteria used in this study, the hierarchy is almost similar: Vel Pitar, Oltina, Boromir, Sapte Spice, Dobrogea, and GoodMills.

The milling and bakery industry has to continue to modernize infrastructure, to look for healthier ingredients in the recipes, to diversify production, to keep under control production costs reducing energy expenses, to increase product quality and assure a good ratio between product quality and price.

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DEMAND AND OFFER IN BALNEARY TOURISM OF ROMANIA IN THE PERIOD 2010-2019

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Abstract

The paper aimed to analyze the demand and offer in Romania's balneary (spa) tourism in the decade 2010-2019 in order to identify the main trends and correlations and the aspects which have to be improved for increasing spa tourism contribution in the economy and to people's health and relaxation. The data provided by National Institute of Statistics were processed using usual methods for dynamic analysis, trend equation, regressions and correlations, and determination coefficient. In 2019, Romania's offer in spa tourism was represented by 37 balneary resorts, 620 units with reception function for tourist accommodation, and 35,643 places, while the demand consisted of 1.33 million tourist arrivals and 4.81 million overnight stays. All this figures represent much more than in 2010, except the number of places which declined by 2.3%. Romanian spa tourism keeps 7.1% of the number of tourist accommodation units, 10% of the number of places, 8.5% of tourist arrivals, and 16% overnight stays. A positive and strong connection was found between the number of tourist arrivals and overnight stays, but also an unbalanced ratio between overnight stays and number of places as well as between tourist arrivals and number of places. Therefore, balneary tourism has to be much more sustained to become a strong branch of Romania's tourism. A new strategy is required to better valorize the richness of natural resources, to continue investing in infrastructure, to diversify spa services, and to promote more intensively Romania's spa tourism abroad.

Key words**:** *balneary tourism, demand, offer, dynamics***,** *trends, correlations, Romania*

INTRODUCTION

Tourism is one of the most dynamic branch of the global economy which assure jobs, receipt flows, and the development both directly, indirectly and induced, and creates bridges between continents, people, cultures, and civilizations [25, 37, 39].

Health tourism has become more and more important in the travel and hospitality industry, as people has a permanent need of health care, besides adopting a healthy stile of living and consuming a healthier food [7, 15, 19].

At present, about 5% of the EU-28 tourism belongs to health tourism whose contribution to the EU economy is 0.3% [6, 15].

Health tourism includes three forms of tourism: medical tourism, balneary tourism (spa tourism) and wellness tourism, but between them there is a close relationship and interference due to the complexity of the measures and procedures needed to maintain humans' health [7, 15].

Spa tourism differs from medical tourism, because it is destined to prevent diseases and contribute to the rehabilitation of health status by less invasive procedures, based on the use of natural factors [5].

Balneary tourism has developed across the centuries starting from the antiquity as proved by the archeological excavations. Nowadays, balneary tourism has become more and more important in human life taking into account the high pressure of the stressing work, over-industrialized food, urban stressing civilization, and the ageing of the population. Therefore, it plays an important role in the recovery of our body energy, metabolism and physical condition, in keeping clear our mind and spirit, in maintaining health status, in

preventing the appearance of various diseases and treating the ill people [1, 12, 13].

The development of balneary tourism has been sustained by the progress in balneology, by the existence of a large range of natural resources such as springs of mineral waters for drinking and bathing, springs of thermal waters for baths and treatment, therapeutic and healing sludges and gases, salt mines, medicinal plants, climate factors etc with a benefic effect in various diseases and for improving humans' health, by the existence and continuous development of the balneary resorts where people could find a large diversity of facilities of accommodation in specialized balneary complexes and centers, endowed with adequate infrastructure for cure and treatment, specialized medical staff able to apply modern and effective procedures, and also catering, entertainment, sport and other activities to satisfy better tourists' desires [1, 5, 16, 18].

But we also must highlight the role of internet and e-commerce which has led to tourism globalization, and allowed tourists to chose their preferred cultural, historical, religious but also health, spa and wellness destinations, which are more intensively promoted eliminating the existence of distribution networks such as tour operators, travel agencies, etc. [4].

An important role in the development of spa tourism, and in tourism in general, it is the balance between demand and offer. Sometimes the demand is higher than the offer, but in case of spa tourism the existence of the natural sources exceeds the demand so that in this field it is still a box for improvement [8].

Balneary resorts are a more complex destination as besides accommodation, board, curative and treatment procedures, they could offer a pleasant ambiance for walks in fresh air, occasions to admire the beauty of wonderful landscapes, for visits to tourist attractions, cultural events, for recreation and rest [1, 40].

Besides the well known health destinations like United Kingdom, France, Germany, Italy, Spain, health tourism has also got a new orientation to the Central and Eastern European countries such as: Hungary, Slovenia, Croatia, Czechia, Romania, Poland, Serbia which have become preferred destinations for the West Europeans [2, 6, 14, 26, 27, 28, 29].

Romania's tourism is in a continuous development as proved by the high growth rate of tourist arrivals. More and more visitors both Romanians and foreigners are interested to discover the treasures of the nature, historical and cultural heritage, and to have unforgettable memories about travels and hospitality in this country. Besides other economic branches, tourism plays an important role in Romania's economy contributing to employment and GDP [22, 23, 24, 31, 33].

Balneary tourism is an important branch of Romania's tourism, grace to the existence of a large variety of mineral and thermal waters, which account for 33% of Europe's reserves [3, 37].

Unfortunately, only 10% of springs is utilized, a reason to think that Romania has a high potential for developing balneary tourism at a higher level than at present.

From this point of view, Romania has a high competitive advantage compared to other countries, advantage which has to be used so that balneary tourism to increase its contribution to Romania's tourism industry and economy by creating jobs, assuring a continuous tourist and receipt flow across the year and, at the same time, helping the people to maintain the health [20, 21].

More than this, balneary tourism and tourism in general are aligned to the sustainable development which have to assure a balance between the social, economic and environmental aspects and the use of the actual natural resources [9, 10].

In this context, the paper aimed to analyze balneary tourism in Romania in its dynamics during the last decade, 2010-2019, regarding offer and demand, in order to identify the main trends and relationships, and also to estimate the role played by this form of tourism in the national tourism.

MATERIALS AND METHODS

This study is based on literature review and also on statistical data collected from National Institute of Statistics for the period 2010-2019.

The main indicators studied within this research are the following ones:

- for tourism offer: the number of units offering balneary services and the number of places available in these units;
- for tourism demand: the number of tourist arrivals in units with balneary role, the number of overnight stays, and the average length of stay.

The methodology applied to process data includes usual modern techniques and procedures such as: fixed basis index, trend equations (linear, polinomial), regression equations, correlations and coefficient of determination.

The results obtained from this study were displayed in tables and illustrated in graphics, finally the right conclusions being drawn.

RESULTS AND DISCUSSIONS

Balneary resorts of Romania

Romania has a large variety of natural resources which are used in balneo-therapy, among which the most important ones being: mineral and thermal waters, salted lakes, salt mines, sludges and gases good for treatments, medicinal plants and climate factors, which should be better valorized.

Map.1. Romania's balneary resorts
Source: [36].

The net of balneary resorts reflects their distribution in Romania's territory, the most important resorts being: Felix Baths, Herculane Baths, Sovata, Tusnad, Vatra Dornei, Techirghiol, Mangalia, Calimanesti-Caciulata, Olanesti, Govora Baths etc. [2, 11, 34, 35].

The balneary resorts offer a large variety of facilities for various cure and treatment procedures for various diseases among which the most important are: "rheumatic, cardiovascular, respiratory, digestive, renal, gynecological, dermatological, neurological, endocrine, metabolic and nutritional diseases etc."

The balneary services are numerous and definitely of a high diversity and high quality due to the modern endowment and high professionalism staff. The main spa services offered in Romanian resorts are: "physiotherapy, electrotherapy, kinetic-therapy, hydro-therapy, thermo-therapy, aerosols, aero-heliotherapy, sulfurous and carbonated baths, medical gymnastics exercises, massage etc" [3].

Balneary tourism offer

The number of units with tourist reception function in the balneary resorts has continuously increased in Romania, due to the higher and higher demand of balneary services.

In 2020, Romania had 620 units with role in tourist accommodation, by 60% more than in the year 2010. Besides the old units which have been restored and endowed with modern facilities and equipment, new other units have been built to better cover the requirements (Fig. 1).

The investments made in infrastructure, especially in the modernization of the balneary accommodation units and also in setting up new modern complexes and centers of cure and treatment, relaxation locations, thermal pools, aqua parks, and also the holiday vouchers have strengthen the desire of the people to apply for spending time for recovering their health in balneary resorts.

The share of the number of units with function for tourist reception in the balneary resorts in the total number of units with accommodation function in Romania's

tourism was 7.4% in the year 2010 and 7.1 % in the year 2020, reflecting a slight declining trend. The explain is the fact that the number of accommodation units at the national level has a higher growth rate compared to the increase rate in balneary tourism.

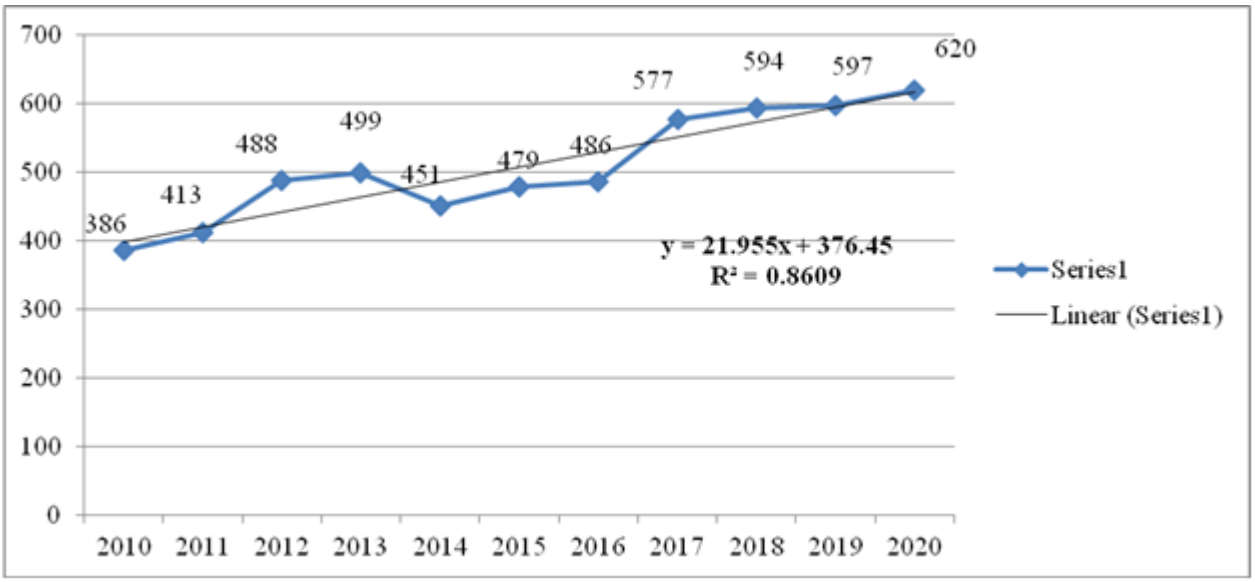

Fig. 1. Dynamics of the number of units with function of tourist reception in the balneary resorts, Romania, 2010-2020
Source: Own design based on the data from [17].

Accommodation capacity in balneary resorts

The number of places offered by the accommodation units in the balneary resorts has registered a variation from a year to another. In 2019, there were 35,643 places in the balneary resorts, by 2.9% less than in 2010. However, across the years, the number of places registered an increase from the year 2010 to the year 2013, when it reached a peak of 39,953 places. Then, it was noticed a deep decline to 33,576 places in the year 2014, by 16 % less than in the previous year. Since 2015, the number of places registered a continuous growth with a peak in the year 2017, accounting for 36,631 places and after this year it started to decline again (Fig. 2).

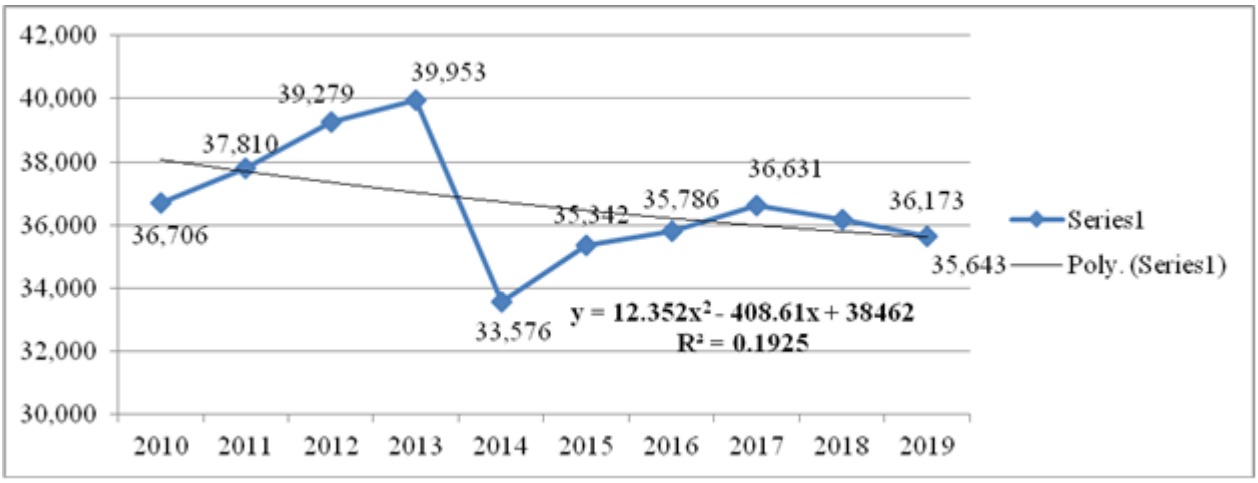

Fig. 2. Dynamics of the number of places in the units with function of tourist reception in the balneary resorts, Romania, 2010-2020
Source: Own design based on the data from [17].

The share of the number of places (beds) in the balneary tourism in the total number of places existing in Romania's tourism recorded a decreasing trend from 11.8% in the year

2010 to 10% in 2019, because at the national level the number of places is increasing.

Tourism demand in balneary resorts

Number of tourist arrivals in the units with reception function

In the analyzed interval, it was noticed a higher and higher number of tourists who are interested to arrive in balneary resorts for spending their time in an useful manner either for cure or treatment, either for enjoying the thermal baths, or visiting the main tourist attractions, walking through the resorts and admiring the landscapes in the their surroundings.

In the year 2019, the balneary resorts registered 1,133,359 tourist arrivals, a figure almost double compared to the year 2010 (Fig. 3).

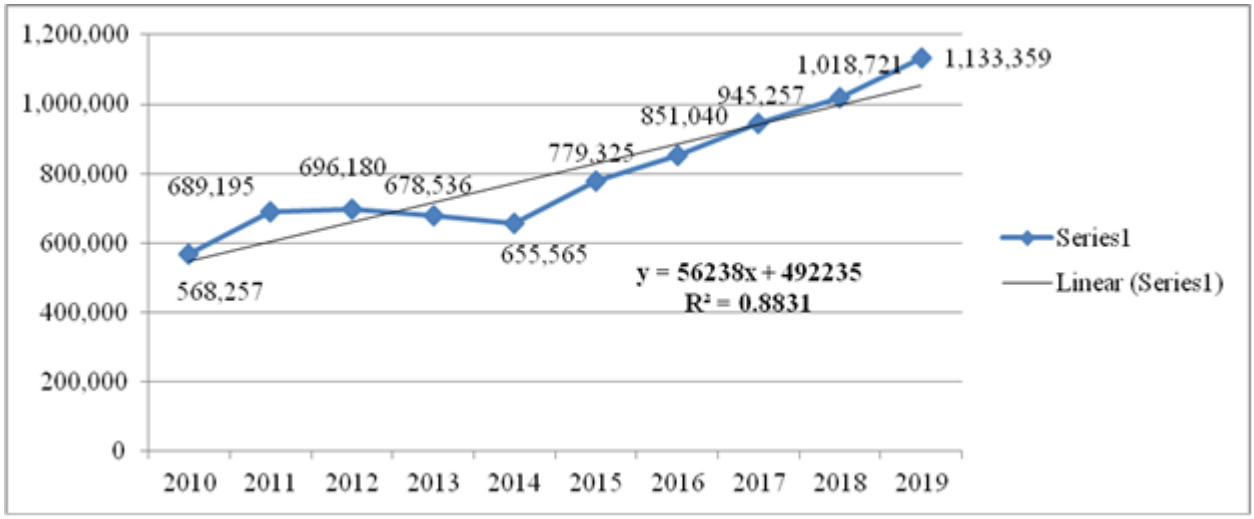

Fig. 3. Dynamics of tourist arrivals in the units with accommodation function in the balneary resorts, Romania, 2010-2019

Source: Own design based on the data from [17].

Taking into account the tourist arrivals in Romania's tourism, the share of the tourist arrivals in balneary resorts has registered a decline from 9.3% in 2010 to 8.5% in 2019, and this is due to the fact that the number of tourists arrivals at the country level has a higher growth rate.

Romanians are dominant in the number of tourists arrivals, with a share whose level has slightly increased from 96.1 % in 2010 to 96.9% in 2019.

Foreign tourists are not so many in Romania's balneary tourism, but their number it is possible to raise in the coming year because the cure and treatment services are of high quality and for sure the tourists are interested to enjoy visiting the country, to admire its beautiful scenery, tourist attractions, to discover history, folk traditions and gastronomy, to take part to cultural events.

Balneary tourist packages include in general high quality services regarding accommodation in the balneary centers, all inclusive board facilities, a large range of cure and treatment programmes, to beneficiaries' satisfaction and that is why the number of tourists arrivals and overnight stays increased year by year.

The countries of origin for the foreign tourists are mainly Hungary, Republic of Moldova, Germany, Israel, Austria, France and Poland.

Despite that the balneary services are of high quality in Romania, their are also cheaper than in other countries, which is another reason why foreign tourists apply for cure and treatment in the Romanian balneary centers.

Number of overnight stays in the balneary resorts

The number of overnight stays in the balneary resorts increased in the analyzed period by 22.88%, from 3,810,309 in the year 2010 to 4,805,188 stays in the year 2019 (Fig. 4).

The share of the number of overnight stays in balneary resorts in the total number of overnight stays in Romania's tourism has

registered a decline from 24.4% in 2010 to 16% in the year 2019.

The share of the Romanians in the total number of overnight stays in the balneary resorts is 97.6% a little bit lower than 97.7% in the year 2010. But the figures reflects that the stays of the Romanians are dominant.

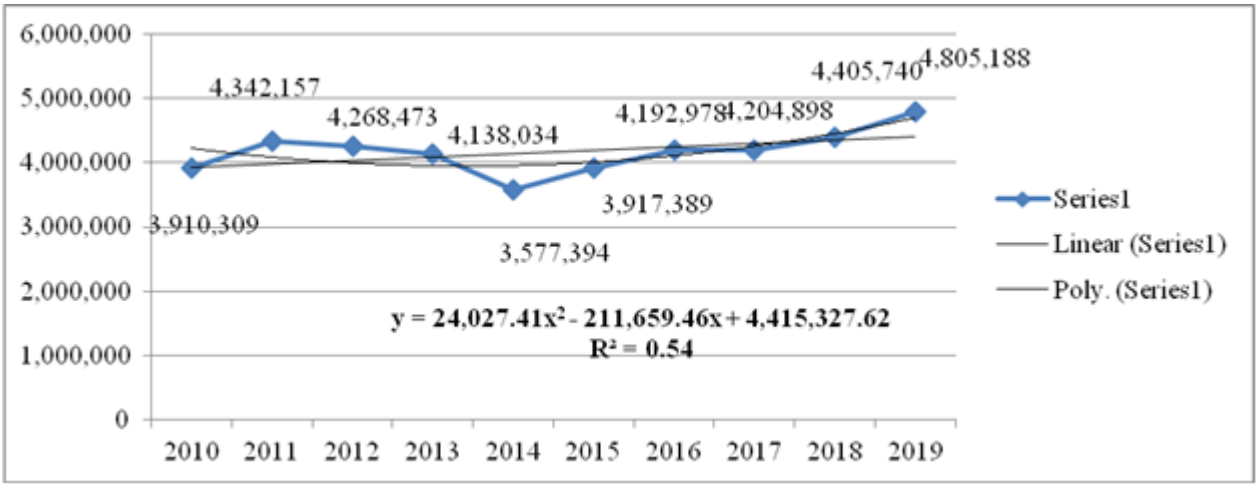

Fig. 4. Dynamics of overnight stays in the units with accommodation function in the balneary resorts, Romania, 2010-2019

Source: Own design based on the data from [17].

Average length of stay in the balneary resorts has followed a decreasing trend from 6.9 days in the year 2010 to 4.3 days in the year 2019, meaning by 37.7 % less than in the first year of the analyzed interval (Fig. 5).

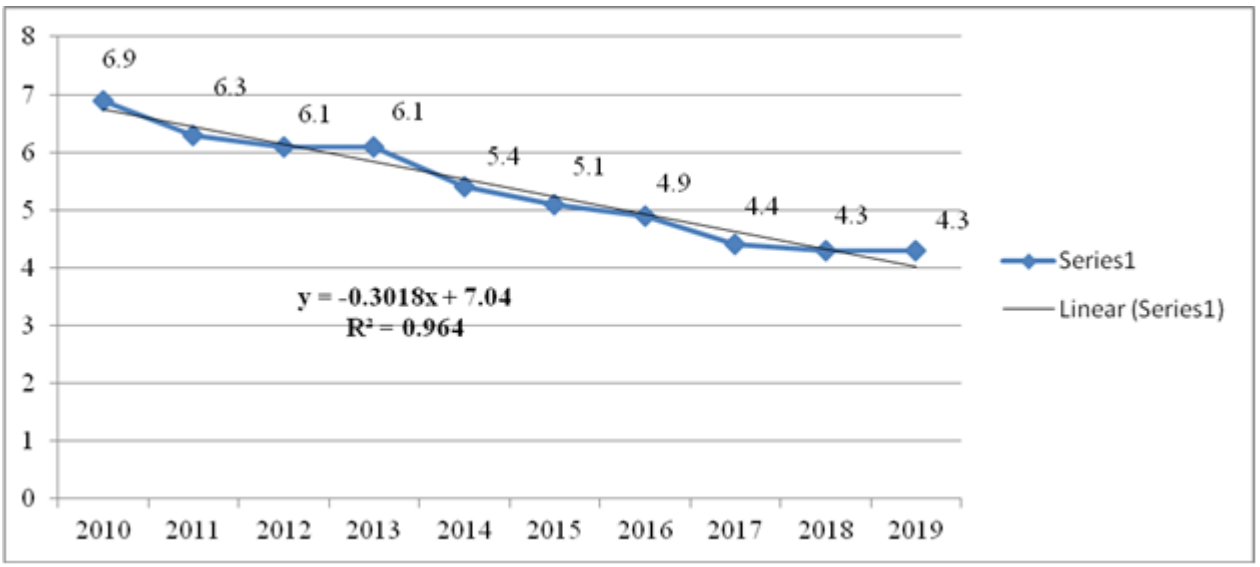

Fig. 5. Dynamics of average length of stay in the units with accommodation function in the balneary resorts, Romania, 2010-2019

Source: Own design based on the data from [17].

Demand/Offer ratio in balneary tourism

The regression of overnight stays depending on tourists' arrivals is presented in Fig. 6. The regression equation, Y= 1.34x + 3,104,553.33 shows that for an increase of 1,000 tourists arrivals the accommodation demand in terms of overnight stays will go up by 1,340. Taking into account the t value and the significance threshold P-value, this coefficient is statistically significant.

The value of the determination coefficient, R^2 = 0.54, is a positive and moderate strong, reflecting a good relationship between these two indicators (Fig. 6).

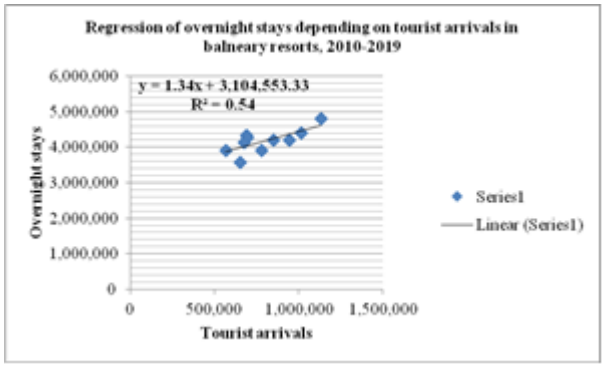

Fig. 6. Regression of overnight stays depending on tourist arrivals in the units with accommodation function in the balneary resorts, Romania, 2010-2019
Source: Own design based on the data from [17].

The regression of overnight stays depending on the accommodation capacity in operation in terms of places is presented in Fig. 7. In this case, the regression equation, Y = 53.10x + 2,227,839.09 reflects that for increase of the accommodation offer by 1,000 places, the overnight stays with determine increase by 53,100. The coefficient of determination R^2 = 0.09 reflects that only 9 % of the variation of overnight stays will be determined by the variation of the number of places (Fig. 7).

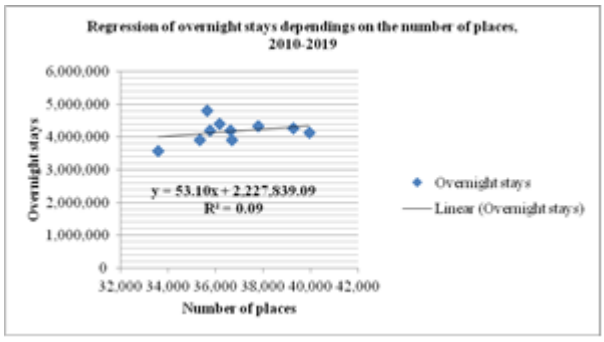

Fig. 7. Regression of overnight stays depending on tourist arrivals in the units with accommodation function in the balneary resorts, Romania, 2010-2019
Source: Own design based on the data from [17].

The regression of the number of beds depending on tourists' arrivals is presented in Fig. 8. The regression equation, Y= -0.028x + 38,947 shows that if tourist arrivals will increase by 1,000, the accommodation capacity will decline by 28 places, which confirms that between accommodation capacity in terms of places and the tourist arrivals is not a balanced ratio.

The coefficient of determination, R^2 = 0.0725 reflects that just 7.25 % of the variation of the accommodation capacity in terms of places is a result of the variation in the number of tourists' arrivals (Fig. 8).

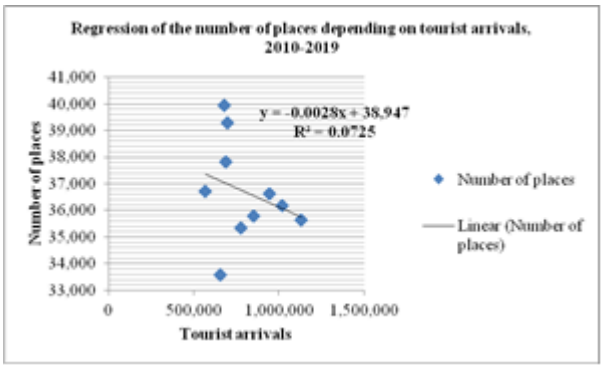

Fig. 8. Regression of the number of places depending on tourist arrivals in the units with accommodation function in the balneary resorts, Romania, 2010-2019
Source: Own design based on the data from [17].

The discrepancy between demand and offer in balneary tourism is not singular in Romania's tourism, because it was also noticed in the seaside tourism at the Black Sea and in other tourism forms [8, 30, 32, 34, 38].

How rural areas could support balneary tourism in Romania? The case of Persani Commune and Persani Baths, Brasov County.

Rural areas could offer opportunities for the development of balneary tourism in the benefit of the local communities.

A notorious example is given by Persani Baths, situated in the proximity of Persani Commne on the road which links Brasov and Fagaras cities.

Here, the rich treasure of the baths is the existence of namol care are proprietati la fel de valoaroase cu cel de la Techirghiol, Constanta County. Acest namol este indicat pentru cura persoanelor care au afectiuni ale aparatului locomotor de natura reumatica, care necesita relaxare musculo-articulara si tratament de curatire si tonifiere a epidermei!

Persani Baths are in fact a small balneary resort care ofera bai cu ape sarate, ce provin din izvoare naturale sarate, ape clorurate, bicarbonate, sodice, si hipotone. Infrastructura bailor permite aductiunea acostor ape in bazinele statiunii.

Aceste bai s-a modernizat in ultimii ani devenind un adevart complex care ofera si alte facilitati cum ar fi: cazare, restaurant, bar, terase, camping. Capacitatea de cazare este relativ modesta constand din 5 camere complet utilate, 21 casute de lemn cu 2 si 4 locuri, dar s-a dezvoltat foarte mult in ultimii ani fiind o sansa pentru dezvoltarea turismului balnear de week-end.

CONCLUSIONS

Balneary tourism is continuously developing in Romania being an important branch of the national tourism.

In 2019 compared to 2010, Romania has 37 balneary resorts, 620 units with reception function for tourist accommodation by +60% more, 35,643 places but by -2.9% less, 1.33 million tourist arrivals meaning 2 times more, 4.81 million overnight stays by + 22.9% more.

In Romania's tourism, spa tourism keeps 7.1% of the number of tourist accommodation units, 10% of the number of places, 8.5% of tourist arrivals, and 16% overnight stays.

Also, the results proved that it is a close and positive relationship between number of tourist arrivals and overnight stays, but an unbalanced ratio between overnight stays and number of places as well as between tourist arrivals and number of places.

Therefore, balneary tourism has to be much more sustained to become a strong branch of Romania's tourism as long as it could contribute to the development of sustainability in the field.

The tourism authorities should develop new strategies which have to valorize much better the richness of natural resources existing in the country, to continue to invest in infrastructure, to diversify balneary offer, to promote more intensively Romania's spa tourism abroad

The main strategical directions to whom the authorities with responsibilities in the field of tourism development must to pay attention are:

(i)the improvement and modernization of infrastructure in the balneary resorts, complexes and centers by investments in new and hightech equipment;

(ii)a better marketing meaning: the identification of foreign markets which could supply potential tourists in balneary resorts, the promotion of Romania's spa resources and high quality services, setting up complete balneary touristic packages including both spa and health care services, tours to touristic attractions, air tickets, tickets to museums etc;

(iii)the increase the quality of spa services and assure the best ratio between service quality and price;

(iv)to increase the number of medical staff specialized on balneology.

Romania has a competitive advantage compared to other countries due to its large variety of natural resources which is an opportunity and a niche which could bring more tourists in the country to have contact and appreciate the achievements in the field of balneology, but also the beautiful landscapes, cultural and historical treasures, traditions and people hospitality.

Romania's spa tourism must offer high quality services, fitting the international standards and certifications, assuring a corresponding management of the balneary units and the patient security and safety as well as an efficient marketing.

The increased tourist flows will sustain tourism receipts which could improve the payment balance and supply financial resources to the private units to continue their development.

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TRENDS IN ROMANIA'S TOURISM DEMAND AND OFFER IN THE MOUNTAIN RESORTS DURING THE PERIOD 2010-2019

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Abstract

The paper analyzed the dynamics of tourist demand and offer in Romania's mountain resorts in the period 2010-2019 using the statistical data collected from National Institute of Statistics in order to identify the main trends and suggest solutions for enhancing this sector of the national tourism. Fixed basis index, structural index and comparison method have been used for data processing. Romania has more than 100 mountain resorts, with a wonderful scenery and breathtaking splendors and treasure which must be discovered. More than 95 resorts are suitable for skiing. The most attractive mountain resorts are Poiana Brasov, Sinaia, Busteni, Predeal, Azuga, Paltinis, Vatra Dornei, Ranca and Transalpina. Over 2.3 million tourists spent their vacations in Romania's mountain resorts in 2019, being 2.8 times more then 2010 and accounting for 17.2% of total Romania's visitors. Romanians are dominant with a share of 91%. Not only the number of Romanians is growing up, but also the foreign visitors number which reached over 196 thousand in 2019, that is 2.2 times more than in 2010. The overnight stays increased 2.8 times, accounting for 4.42 million in 2019. In the mountain resorts there are 2,370 units for tourists accommodation, of which about 70% were represented by tourist and agro-tourist guesthouses, 8.7% tourist villas, 7.9% hotels and 6.2% chalets etc. Their number represent 27.5% of Romania's tourism accommodation units. In 2019, the offer of places (beds) was 63,943, by 80.4% more than in 2010 and representing 17.8% of the total offer in Romania's tourism. The beauty of the natural mountain landscapes, biodiversity, local economy, humans, cultural and historical heritage have to be better valorized, developed and promoted to enhance mountain tourism to increase its efficiency and competitiveness. Mountain skiing resorts have to continue their efforts to improve the access roads, buildings, equipments, installations, facilities, to enlarge the range of activities and to offer to tourists unforgettable vacations and to entirely cover their expectations.

Key words**:** *mountain resorts, tourism, demand, offer, trends, Romania*

INTRODUCTION

Tourism is the most dynamic branch of the world economy. In 2019, it reached 1.5 international tourist arrivals by +6% more than in 2018. In 2018, world tourism receipts accounted for USD 1.7 trillion [63, 64].

The continuous growth in international tourist flow has sustained the increase of income in the field of travel and tourism year by year, reflecting a strong positive correlation between these two key indicators [26]. More than this, this means an increased contribution of tourism and travel to the global GDP and each country where tourism is well developed [38].

The increased number of tourists' arrivals on various regions of the globe reflects a higher and higher demand which had to receive a positive feed-back from the offer side, in terms of accommodation capacity and other facilities, boarding, and a large variety of activities, service quality to satisfy visitors' expectations [24, 29, 33, 35].

Many countries, especially the top destination countries are engaged in developing effective tourism strategies destined to face much better to the high competitiveness in tourism and travel industry [36].

Mountains are of high attraction among tourists' destinations and contributes by 15-20% to tourism industry turnover at the global level.

The attractiveness of the mountains in tourists' preferences is justified by the

beautiful natural landscapes, the majesty of the mountain peaks, the charming valleys, the clean, fresh and cool air, the unique biodiversity, the variety of topography and climates, the large ranges of activities which could be practiced, the chance for meeting local culture, history, and traditions, a chance for "charging the batteries" and recover health, for escaping from the urbanized life, improving health and wellness, a chance for contemplation and meditation [1, 9].

Mountains have a complex functionality and offer a large range of activities which could be practiced. Among them the most important are: walking, leisure, recreation, animation, heath recovery (climate treatment, hydrotherapy, spa therapy etc), hiking, trekking, climbing, winter sports (sleighing, skiing, snowboarding, skating), adventure and extreme sports (bungee jumping, paragliding, mountaineering), water sports (swimming, diving, river rafting, canyoning, canoeing), hunting and fishery, scientific tourism (speleological tourism, caving, visiting the national parks, the biosphere mountain reservations), bird watching, photo-safari, cultural tourism (visiting cities, villages, enjoying meeting history, cultural traditions, customs, gastronomy etc), rural tourism, agro-tourism and eco tourism [1, 7, 9, 10, 16].

The higher and higher growth in tourist flow to the mountain areas mainly in winter and summer seasons, but also in any other season and week-ends has contributed to the economic and social development and to the awareness that the values and treasures of the mountains must be protected and preserved.

Europe and especially the European Union is the most visited part of the world by tourists. In 2018, total international arrivals in Europe accounted for 710 million, accounting for 51% of the global tourists.

Mountains cover 19% European continent (Russian Federation and Caucasus states excluded), and their share is 24% in Eastern and Southern Europe and 15% in the Northern and Western Europe [44].

Austria, Switzerland, France, Spain, Italy, Norway, are countries with a high developed mountain tourism industry. Austria is well-known for tourism contribution to GDP (4%) and for 75% contribution of alpine tourism to national tourism receipts.

The Alps and their mountain resorts offer the best facilities and the highest quality services as alpine tourism is strictly regulated and controlled to satisfy tourists the beat and at the same time to preserve the environment quality and biodiversity.

At the global level, there are 475 mountains, which have 475 protected areas in 65 countries, 140 mountain regions are designated as biosphere reserves and protected areas include national parks [1].

Mountain resorts are well spread all over the world and many of them offer a multiple range of opportunities for spending holidays grace to the enhanced promotion made by multimedia websites. IT facilities help tourists to search the desired destinations forming them a visual impression about what to expect when they will arrive there and how to plan their trip booking in advance transportation tickets, and accommodation reservation. This new tools of information and the new tourist behavior have enabled tourism and travel industry to improve its strategy and management and to benefit of the competitive advantages and build benchmarks and mountain brands of high attraction for the future clients [62].

Snow sports industry has a special place within the mountain tourism industry. In 67 countries, winter sports are the main attraction and more than 2,084 ski resorts all together have an accommodation capacity of 6 million places (beds). Globally, each year about 130 million skiers visit these countries to enjoy practicing snow sports. A number of 1,600 ski resorts receive annually about 80% of the skiers. And about 44% skiers' visits are in the Alps skiing resorts [14].

However, at the global level, 100 countries are able to offer ski lovers the chance to practice snow sports either outdoor (85%) or indoor (15%). Of the 2,084 ski resorts existing in the world, 37% are situated in the Alps, 11% in Western Europe, other 11% in Eastern part of Europe and Central Asia, 21 % in America and 19% in Asia and Pacific [65].

Among the Eastern European countries, Romania has become well known for its mountain resorts where skiing is the main attraction for many Romanian and also for foreigners who affirmed that the facilities for accommodation and skiing are cheaper compared to other countries. Romania registers in average about 1.2 million skier visits annually and their number is growing, the most preferred mountain resorts being; Poiana Brasov, Sinaia, Busteni, Predeal, Azuga, Paltinis, Birsa, Vatra Dornei and Transalpina [65].

In this context, the present study is destined to analyze the main mountain resorts, tourist demand and offer in this area of Romania in the period 2010-2019 in order to identify the main trends and in what measure mountain industry is developing and strengthening.

MATERIALS AND METHODS

Data collection

The data utilized in this study were picked up from Tempo Online data base of the National Institute of Statistics and also from other sources which are mentioned as references.

The following specific indicators used in this study have been the following ones: (i) number of mountain resorts; (ii) tourists' preferences for mountain resorts and their motivations; (iii) number of tourist accommodation units in mountain resorts; (iv) number of places (beds) in mountain resorts; (v) tourists' arrivals in mountain resorts; (vi) overnight stays in mountain resorts.

Methodological aspects

In this study, there were used the following methods:

Index method, based on Fixed basis Index, $I_{t/t0} = (X_t/X_0)100$, where X_t is the level of the indicator X in the last year of the analysis, 2019, and X_0 is the level of the same indicator X in the first year of the analysis, 2010.

The structural index (SI%), reflecting the share of tourism indicators carried out in mountain resorts in the national tourism data.

The trend method based mainly on linear regression model, $Y = bx + a$.

The comparison method was destined to estimate de differences between the level of the indicators at the end of the analyzed period and the their level at the beginning of the studied decade.

The results were explained and commented and presented in graphics and tables. The main ideas resulted from this research were presented at conclusions.

RESULTS AND DISCUSSIONS

Romania - an attractive tourist destination

Romania has become a more and more attractive destination during the last decade, as proved by the increased number of tourist arrivals which reached 13,374,943 in the year 2019, being 2.2 times higher than in 2010. The number of international tourists' arrivals accounted for 2,683,748 in the year 2019 compared to 1,346,343 tourists in the year 2010, meaning 1.99 times more. The share of foreign tourists increased from 17.23% in 2010 to 20% in 2019 [42].

The total number of overnight stays in Romania reached 30 million in the year 2019, being by 87.4 % higher than in the year 2010. The overnight stays belonging to foreign tourists accounted for 5.29 million in 2019, being by 91.2% higher than in the year 2010. The share of foreigners' stays in the total overnight stays in Romania's tourism was 17.58% in 2019, a little bit higher than in 2010.

Tourist flows in Romania are oriented to many destinations among which the most important are: Bucharest, the capital of Romania, Transilvania region with its beautiful medieval cities like Brasov, Sibiu and Clu-Napoca, fortresses, castles, mountains and hills, Bucovina region with its mountains, old monasteries and traditions, Maramures region with its charming attractions, the Danube Delta, a biosphere reservation with its treasures of flora and fauna, the mountain areas with their majestic peaks, magnificent landscapes, wonderful skiing slopes, the seaside resorts at the Black Sea [20, 22, 27, 30, 34, 39, 40, 41, 43].

Tourism has been permanently adapted to the demand growth and has become a more and more better developed sector in the economy, creating jobs, assuring a high professionalism

employees, improving the infrastructure, enlarging the offer of accommodation units and places, increasing service quality and assuring a better correlation between price and service quality and facilities. As a result, tourism turnover in Romania registered an ascending and in 2019 accounted for Euro 5 Billion, the highest performance during the last 30 years. Therefore, efficiency in tourism industry has also raised [8, 23, 25, 28, 32, 37].

Romania's mountain areas

About 23% of Romania' surface of 238,397 km^2 is represented by mountains. After the Alps, the Carpathian Mountains comes on the 2nd position as the largest mountains in Europe. The arc of the Carpathians extends over 1,000 kilometers through the center of the country, covering an area of 71,000 square kilometers. They are low to medium altitude and are no wider than 100 kilometers.

They are characterized by the longitudinal and transverse fragmentation in valleys, many summits which could reach up to 2,256 meters and many settlements located at over 1,200 m altitude. The highest peak is Moldoveanu has 2,544 m altitude and is situated in The Fagaras Mountains in the Southern Carpathians.

Snow layer varies from a mountain area to another, but it lasts from the end of November till the end of March and sometimes in April [67].

Romania's main mountain resorts

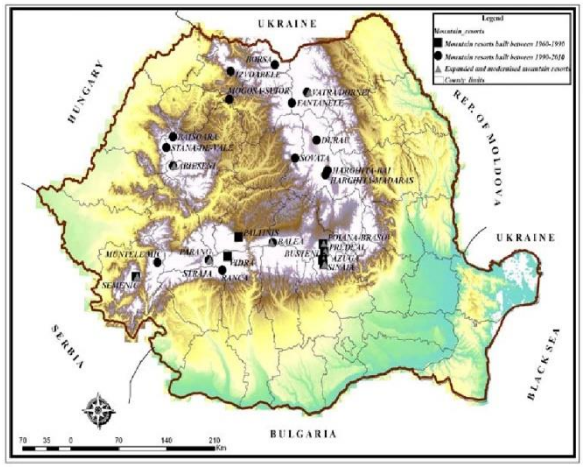
Romania has 95 ski resorts, summing 211 kilometers of slopes and 151 ski lifts. Many of them have lightening installations allowing night skiing and telecars and telechairs, installations for artificial snow [56].

About 588,000 skiers of which 5% foreigners are every year in Romanian mountain resorts and their total visits accounts for 1.2 million [65].

The most known mountain resort is Poiana Brasov, at about 14 km upward from the beautiful medieval city of Brasov.

The Prahova Valley is also well known for its long and valuable necklace of mountain resorts and localities, among which the most important are: Sinaia, Predeal, Busteni, and Azuga situated at about 122 -134 km distance from Bucharest, the capital of Romania.

Other importance mountain resorts are: Straja, in Hunedoara County, Paltinis, in Sibiu County, Borsa and Vatra Dornei in the North part of Romania.



Map 1. The main mountain resorts in Romania
Source: [15].

Poiana Brasov resort, nick named the Glade of the Sun is situated at the altitude of 1,030 m, at the foot of the Postavaru Mountain, in the Southern Carpathians. It is the most luxury mountain resort, especially assaulted by lovers of winter sports. Here, it is the largest place for skiing, there are 12 skiing slopes (Olympic, downhill ski slopes, slopes for huge slalom, trampoline), a cable car, gondola lift, seven ski lifts and artificial snow cannons.

It is the resort with the longest length of the skiing slopes accounting for 13.7 km, 5 km ski routes, 10 lifts for the guests' transportation. The winter sports could be practiced between 941m and 1,783m.

Also, it is a lake, a skating ring, and enough place for sleighing and horse-drawn sleigh ride. The hotels and restaurants serve traditional and international dishes.

Poiana Brasov is preferred by British tourists which affirm that it is the cheapest luxury mountain destination in Europe.

From the peak of the Postavaru Mountain, situated at the altitude of 1,799 meters, tourists could admire the beauty of the mountain scenery [4, 51].

Tourists have also the opportunity to visit the City of Brasov, named Kronstadt in the old times, due to the German population, the old center of the city in the Council Square, the Black Church built in the 14th century in a gothic style, with its high value collection of over 400 Persian carpets and the old German organ, listen an organ concert, the Saint Nicholas Church where it was founded the first Romanian School and Diaconu Coresi founded the first printing press, to see the old manuscripts and the library, the Art Museum where many masterpieces of the Romanian and foreign artists could be admired, to attend performances at the Brasov Opera House, to listen concerts played by "Gheorghe Dima" Philharmonic Orchestra of Brasov, in September to attend the well known "The Golden Deer" International Music Festival, to admire the fortification and the walls and towers of the old medieval fortress and the beautiful architecture of the houses built in various styles (romanic, gothic, classic, baroque, rococo, renaissance styles.

The cultural treasures of the City of Brasov is just a part of the rich cultural and historical heritage of Transilvania [19, 21, 68].

Tourists could find various accommodation alternatives such as hotels, hostels, villas, and also many tourist and agro-tourist guesthouses in the City of Brasov or in its surroundings [11, 12].

Sinaia resort is situated at 122 km North from Bucharest, at the altitude of 850 m and at the foot of the Bucegi Mountains. It is named the Pearl of the Prahova Valley due to its beautiful landscapes, mountain sceneries, fresh air, elegant hotels and villas, cultural and historical past. Its name comes from Mountain Sinai and it is a city related with the locality Aosta from Italy.

Sinaia is full of tourists almost all the year, the main attractions are: The Royal Peles Castle built for King Carol I of Romania in a neo-renaissance architectural style between 1973 and 1914, in its beautiful interior the visitors could admire the elegant furniture, chandeliers, carpets, and paintings; Pelisor Castle, Foisorul Hunting Lodge, Sinaia Monastery built in the 17th century with its wonderful frescos, Ialomicioara Cave, George Enescu, the greatest Romanian composer's Memorial House, the Sinaia Casino from "Dimitrie Ghica" Park, Franz Josef Rock Poiana Stanii situated at 1,300 m altitude, Omu Peak, for which tourists have to trek up to 2,505 m, Bolboci Lake, an artificial lake, created by damming Ialomita's waters at 1,460 m, heigh-end skiing, carp track is one of the most popular tracks for skiers from all over the world. In Sinaia there's a slope for everyone, Valea Dorului being a great great choice for beginners. The cable car brings the tourists on the Bucegi Mountains plateau in a few minutes.

For skiing, there are 17.9 km of slopes and 5 km ski routes, 10 lifts are available for guests' transportation. The winter sports could be practiced at the altitude of 1,006 and 2,090 m [4, 45, 46, 52].

Predeal resort is located in Brașov County**,** and has the highest altitude for an urban locality in Romania, 1,110 m over the sea level. It is situated at the foot of the Bucegi Mountains in their North East side. In Predeal, tourists may find 5,000 places for accommodation in hotels, hostels, villas, guesthouses, 2 skating rings, 8 ski slopes, a tramboline for ski jumpings, the main slope Clabucet is endowed with installations for night skiing and also with installations for artificial snow. The mountain scenery is breathtaking in all the seasons, climate is pleasant, in summers is mild, but in winters is cold. About 7.4 km of slopes are available for skiing and snowboarding and also 0.6 km ski routes. 2 lifts are available for tourists' transportation. The winter sports are practiced usually at the altitude of 1,040 and 1,451 meters [4, 53].

Busteni resort is also situated in the Prahova Valley at the altitude of 850-900 m. It is bordered to the west by the Bucegi (Omu Peak 2,507m) and to the east by the Baiu Mountains (Neamţu Peak - 1,923 m). The main tourists' attractions are: Cantacuzino Palace, the Royal Church, the Cezar Petrescu Museum, the Urlătoarea waterfall, Babele and the Sfinx rocks formed by wind, the Elders Group Hermes, Altarul (The Altar), Porumbelul (The pigeon), the Bucegi National Park, the Cross Glade, the Kalinderul Glade.

The ski slopes have 2.9 km and 2 lifts are available for tourists' transportation. The winter sports could be practiced at the altitude of 1,000-1,295.

Busteni is one of the most preferred resorts in the Prahova Valley by many tourists their flow being higher and higher year by year [4, 5, 13, 60].

Azuga resort is also situated in the Prahova Valley, at the altitude of 850-950 m, and lies at the confluence with the river Azuga, at the foothills of Bucegi and Baiului Mounatins, in the vicinity of the peaks Sorica and Cazacu. It is a climaterical and tourist resort, being known mainly for winter sports. The main tourists' attractions are: the Trinity Church built in 1902, the Monument of the Heroes, the Rhein Wine Cellars, The Secular Beech, the Mamut Tree, the White Tree, the Daffodil Glade, the Turk Valley and the Cazacu Valley.

In Azuga there are 8 km slopes for skiing and snowborading and 6 lifts for guests' transportation. The winter sport are practiced at the elevations of 978 and 1,539 meters [3, 49].

Paltinis resort is situated in Sibiu County**,** at 32 km distance from Sibiu City, and at the altitude of 1,440 m. Due to its location at the food of the Cindrel Mountains, it has fresh air, and numerous hiking routs. Across the time, since its foundation in 1894 as the first resort in Romania, it has been developing and constitutes a high attraction for many visitors.

The most important objectives for tourists are: the historical heritage which consists of The House of the Tourists (1894), (The House of the Doctors (1895), Monaco Hall (1898), Constantin Noica's tomb at Schit Church. Also, the ski and snowboard slopes are available for a long period of time and are well endowed with telechair, a teleski, and a baby - lift, and also a ski school assures high quality training to the ones who want to get skiing skills. There are separately two slopes for beginners and many other activities.

The skiing slopes have 1.6 km and 2 lifts are available for tourists' transportation. The winter sports area is situated at the altitude of 1,400 and 1,667 m [4, 18, 50].

In Paltinis resort, tourists could benefit of high quality accommodation in hotels, chalets, villas. Also, in Sibiu county, there are many tourist and agro-tourist guesthouses where accommodation tariffs could be cheaper than in the resort. Restaurants offer a large variety of dishes [31].

Vatra Dornei resort is situated in Suceava County, and it is well known as a spa resort, being nick named as the Pearl of Bucovina due to its richness in mineral waters such as: Poiana Negri and Floreni and thermal waters. Winter sports are practice at the altitude of 816-1,251 m on 5.5 km skiing slopes and 5 lifts assure tourists transportation. Also, river rafting on the Bistrita river and paragliding are other tourists' attractions [4, 55].

Cheia resort is situated at the altitude of 871m, at the foot of the Ciucas Mountains, at 60 km distance from Ploiesti, Prahova County. Tourists could apply for various mountain routes, hikking and climbing the Red Mountain, the Zaganu Peak, visiting the Beer Valley, or to visit the Museum of Mine Flowers, Cheia Monastery painted by Gheorghe Tatarascu in 1837. The fresh air, the low atmospheric pressure, and the availability of sleighing and skiing slopes of low altitude attract many tourists year by year [4].

Arieseni resort is situated in Alba County, in the heart of the Apuseni Mountains. It is a beautiful resort with exceptional surroundings. Visitors will be delighted to enjoy the visit to Scarisoara Glacier, Focul Viu and Cetatile Ponorului Caves, the canyons of the Aries river. Also, they could visit the Bears' Cave. The 3 skiing slopes are named Piatra Graitoare, Vartop 1 and 2, and they are endowed with skilifts. The skiing area is situated at the altitude of 1,200m. Vartop ski area is found within Arieseni Resort, in the Bihorului Muntains, subdivision of the Apuseni Mountains. Vartop tourist area is found near the border of Apuseni Natural Park [2, 4, 61].

Ranca resort is located in Gorj County, at 67 km from the City of Tg. Jiu, at the foot of Paring Mountains, at the altitude of 1,650m, its has beautiful mountain routes, 3 skiing slopes endowed with installation for artificial

snow and lightening for night skiing. The resort is the center of hiking, recreation, rest and winter sports in the Parang Mountains. It is also a favored destination for week-ends and winter vacations.For skiing and snowboarding there are 3.4 km slopes on Cornesu Mountain and Papusa Peak and 0.3 km ski routes, as well as 6 lifts for guests' transportation and installation for night skiing. The skiing area is at the altitude 1,580-1,918m.

The resort has many facilities among which the most important are: hotels, chalets, restaurants, sports equipment rentals, guides, skiing instructors etc [4, 47].

Straja resort is situated at the altitude of 1,440m in the Valcan Mountains, in the Jiu Valley, Hunedoara County. It is a new resort which was certified in 2002, and it is a very modern resort, with the largest skiing area. The 12 skiing slopes totalize 33 km, the longest slope having 8.1 km, 6 teleski, 12 cable cars are available for tourists' transportation, and winter sport could be practiced between the altitude of 1,130m and 1,868m. There are equipments for lightening of the slopes for practicing night skiing, also a gondola, two new chair-elevators. Among the all slopes, Straja slope is the longest one having 3.8 km. The ski resort Straja is the top resort for skiing in Romania at present with 3 out of 5 stars.

Hunedoara County offer many alternatives for tourists' accommodation: hotels, hostels, chalets and also tourist guesthouses and agro-tourist guesthouse with a good correlation between price and service quality [6, 54, 69].

Borsa resort is situated in the Eastern Maramures County, in the Valley of the Viseu River and near the Prislop Pass. It is located at the foot of the Rodna Mountains and Maramures Mountains. The highest peak Pietrosul has 2,303 m belonging to the Rodna Mountains, which have a National Park whose surface is 463 km^2. It is a well known resort for its baths and also for winter sports. It has a 50m high natural ski jumping hill, 2 lifts and 5 trails, the winter season lasting from December to April [48, 66].

Table 1. The main ski resorts in Romania's mountains and their features

	Resort name	Altitude (m)	Length of skiing slopes and routes (km)	Altitude of skiing (m)	Number of lifts	Night skiing installations	Artificial snow installation
1	Poiana Brasov	1,030	13.7 km slopes, 5 km routes	941-1,783	10	yes	yes
2	Sinaia	850	17.9 slopes and 5 km routs	1,006-2,090	10	Yes	Yes
3	Predeal	1,110	7.4 km slopes and 0.6 km routes	1,040-1,451	2	Yes	Yes
4	Busteni	950-900	2.9 km slopes	1,000-1,295	1	Yes	Yes
5	Azuga	850-950	8 km slopes	978-1,539	6	Yes	Yes
6	Paltinis	1,440	1.6 km slopes	1,400-1,667	2	Yes	Yes
7	Vatra Dornei	795	5.5 km slopes	816-1,251	5	Yes	Yes
8	Ranca	1,650	3.4 km slopes and 0.3 km routes	1,580-1,918	6	Yes	Yes
9	Straja	1,440	33 km slopes	1,130-1,868	12	Yes	Yes
10	Transalpina	1,320	6.1 km	1,320-1,940	5	Yes	Yes

Source: Own synthesis based on the data from [56].

Transalpina-Vidra/Voineasa resort is locatedat the altitude of 1,320m in the North West Valcea County. It is continuously developing, and since 2012 the Vidra Lake zone, Obirsia Lotrului , Voineasa has become an important tourist attraction due its new skiing slope. The length of skiing slope is 6.1 km and there also 5 lifts for guests' transportation. Winter sport could be practiced at the altitude of 1,320 and 1,940m. From the basis of the slope, a telegondola brings the tourists up tp the altitude of 1,800m, from where a teleski continue to

transport them on the Bora Peak at the altitude of 2,000m [57, 58].

Romanians' most preferred mountain resorts for skiing

Based on the results obtained in a of a field survey OLX company regarding Romanians' preferences for mountain resorts, there were selected the top six for resorts for skiing: Poiana Brasov, Sinaia, Predeal, Busteni, Vatra Dornei and Ranca.

For each selected resort, there were taken into consideration the results for the following criteria:

(a)degree of attractiveness, (b) accessibility to the skiing slopes and their quality, (c) quality of the services, (d) price/service quality ratio, (e) the attractiveness for young people.

Then, it was applied the Point Method, rating each resort in a scale 1 point to 6 points, where 1 is the highest rate for the highest obtained percentage and 6 is the lowest one for the lowest percentage.

After summing the points achieved by each resort, it was made the final classification, taking into account the smallest number of points for the top position (Table 2).

Table 2. Top mountain resorts in Romanians' preferences for skiing in 2019

Criterion	Poiana Brasov	Sinaia	Predeal	Busteni	Vatra Dornei	Ranca
Degree of attractiveness	25%	11%	9%	6%	6%	5%
Points	1	2	3	4	4	5
Accessibility to the skiing slopes and theirs quality	20%	9%	14%	6%	5%	5%
Points	1	3	2	4	5	5
Quality of the services	22%	10%	8%	6%	8%	6%
Points	1	2	3	4	3	4
Price/service quality ratio	14%	9%	8%	8%	7%	6%
Points	1	2	3	3	4	5
Attractiveness for young people	26%	10%	12%	7%	4%	4%
Points	1	3	2	4	5	5
Total points	6	14	16	22	24	28
Ranking	1	2	3	4	5	6

Source: Own calculations based on the data from [59].

Tourism offer in terms of accommodation capacity in the mountain resorts of Romania

The number of accommodation units

The higher and higher interest of tourists to spend their vacations in the mountain resort was an incentive for modernizing the existing infrastructure in terms of units with function for tourist accommodation and to built new units. This trends has become more visible during the last two decades.

In the analyzed period, 2010-2020, the number of units for tourist accommodation increased 2.28 times from 1,038 units in 2010 to 2,370 units in the year 2020. In the total number of accommodation units existing in Romania's tourism, the weight of the units existing in the mountain resorts increased from 19.87% in 2010 to 27.52% in 2020, which reflects that the mountain areas are developing their infrastructure for visitors' accommodation in a faster rate than at the national level (Fig. 1).

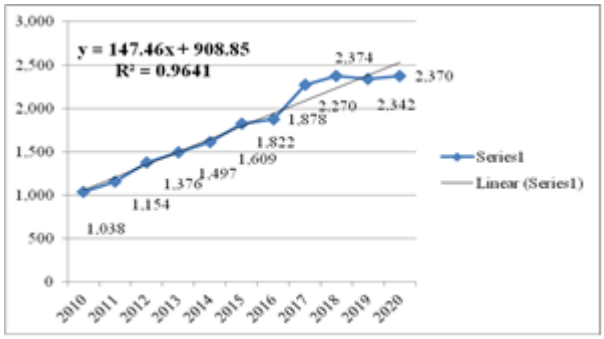


Fig. 1. Dynamics of accommodation units in the mountain resorts, Romania, 2010-2020
Source: Own design and calculations based on [17].

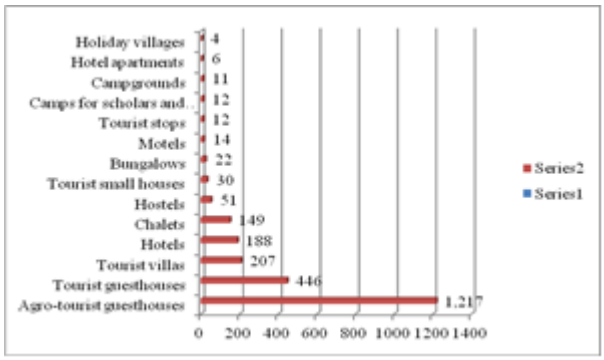


Fig. 2. Structure of accommodation units in the mountain resorts in 2020, Romania
Source: Own design based on [17].

In 2020, within the 2,370 units of accommodation in the mountain resorts, agro-tourism guest houses accounted for 1,217 units, representing 51.3%, being followed on the second position by tourist guest houses whose number was 446 (18.8%), on the 3rd position came tourist villas 207 (8.7%), hotels 188 (7.9%), chalets 149 (6.2%), hostels 51 (2.1%), tourist small houses 30 (1.2%) and the rest other forms of accommodation (Fig. 2).

The number of accommodation units in 2020 in the mountain resorts represent 27.52% of the total number of accommodation units existing in Romania's tourism. The fact that agro-tourist guesthouses and tourist guest houses represent 70% reflect the development of small business in mountain tourism, a good ratio between price and accommodation and board services, a lower price compared to hotels, and these are the reasons why most of the tourists prefer to stay in these types of units. Tourist villas came on the third position and they a little bit expensive compared to guesthouses and are preferred mainly by families. The hotels came on the fourth position and even though they have different number of stars, the most preferred are the three stars hotels and also the luxury hotels, depending on the income per family.

The number of places has also registered an ascending trend during the last decade.

If in 2010, in the mountain resorts there were 35,426 places (beds) in the accommodation units with tourist function, in 2020, their number reached 63,943, being by 80.49% higher than in the first year of the study (Fig. 3).

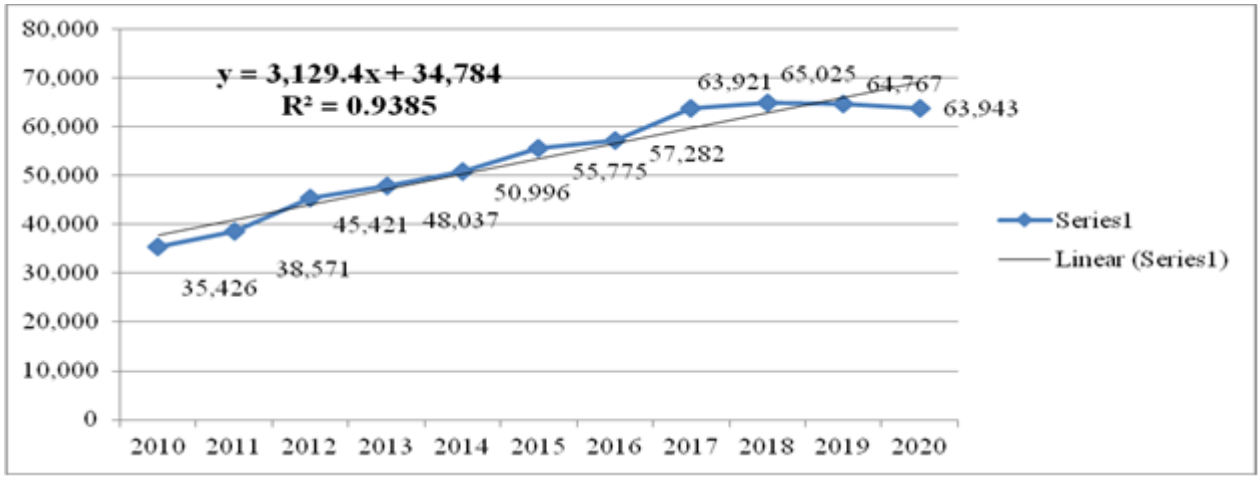


Fig. 3. Dynamics of the number of places in accommodation units in the mountain resorts, Romania, 2010-2020
Source: Own design and calculations based on [17].

The share of the places in the mountain resorts in the total number of places existing in Romania's tourism increased from 11.36% in the year 2010 to 17.85% in the year 2020.

Tourism demand in the mountain resorts

Number of tourist arrivals increased year by year, reflecting visitors' preferences for spending their vacations in the mountain areas either in summer season, in winter season and in any season of the year and even in week-ends. In fact, week-ends have become a common moment for short holidays in many families and also for young people.

In the mountain resorts, the number of tourists arrivals reached 2,305,517 in the year 2019, being by 2.82 times higher than in the year 2010, when it accounted for only 814,973 arrivals (Fig. 4).

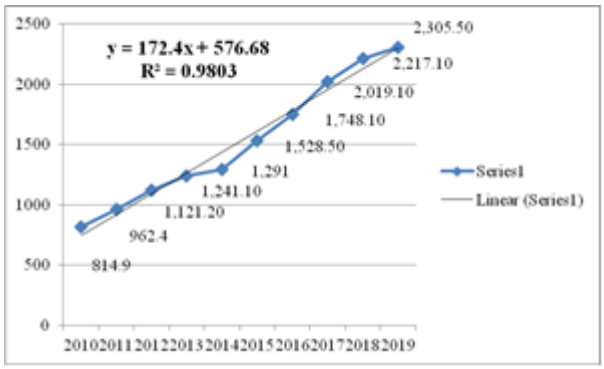


Fig. 4. Dynamics of tourist arrivals in the mountain resorts, Romania, 2010-2019 (Thousands)
Source: Own design and calculations based on [17].

The share of the total tourist arrivals in the mountain resorts in the total number of arrivals in Romania's tourism raised from 13.42% in 2010 to 17.23 % in 2019.

Romanians are the main category of tourists who prefer to spend their holidays in the mountain resorts of Romania and their number increase year by year from 726,320 in 2010 to 2,109,379 in 2019, when it was 2.89 times higher (Fig. 5).

The share of the Romanians in tourist arrivals in the mountain resorts increased from 89.36% in 2010 to 91.49% in 2019.

Despite that international arrivals have smaller figures, their number also raised from 86,653 in the year 2010 to 196,138 in 2019, meaning + 126.34%.

This is explained by the fact that Romania has beautiful landscapes in the mountains, accommodation and board services satisfy foreign tourists' desires and prices are lower than in other countries.

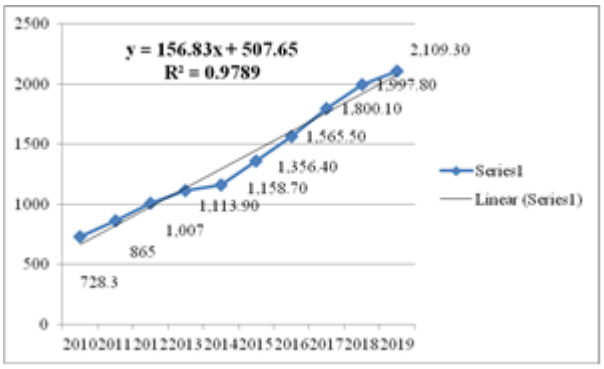


Fig. 5. Dynamics of Romanian tourists' arrivals in the mountain resorts, Romania, 2010-2019 (Thousands)
Source: Own design and calculations based on [17].

Number of overnight stays also registered an ascending trend. If in the mountain resorts, in 2010, it was recorded a number of 1,772,859 overnight stays, in 2019, it was achieved 4,810,148 stays, that is 2.71 times more than in the beginning of the analyzed decade (Fig. 6).

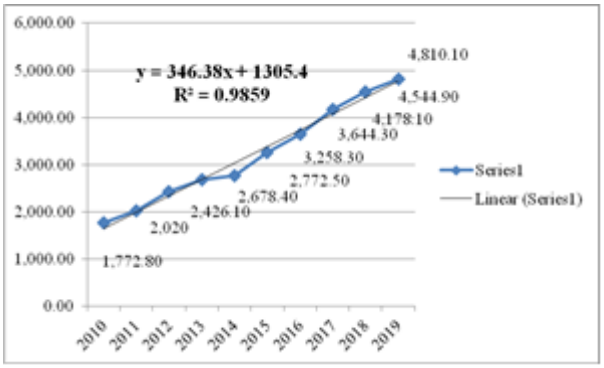


Fig. 6. Dynamics of overnight stays in the mountain resorts, Romania, 2010-2019 (Thousands)
Source: Own design and calculations based on [17].

The overnight stays carried out by Romanian visitors in the mountain resorts increased 2.8 times in the same interval, from 1,578,441 stays in 2010 to 4,421,424 stays in 2019.

As a result, the share of overnight stays of the Romanians in total overnight stays in the mountain resorts increased from 89.03% in 2010 to 91.91% in 2019.

Analyzing the importance of mountain resorts in Romania's tourism based on the criterion

number of overnight stays, we may affirm that if in 2010 the share of stays in the mountain resorts accounted for only 11.04%, in 2019, their weight was 15.98%.

CONCLUSIONS

The study pointed out the increased importance of the mountain resorts in Romania's tourism. The beautiful landscapes in any season, the large range of activities which could be practiced, the offer of accommodation opportunities of high quality and various prices, the facilities for practicing winter sports especially skiing have contributed to the continuous growth of tourist flows and overnight stays, to the increase of the efficiency in mountain tourism, creating jobs and a higher income flow.

Romania has more than 100 mountain resorts and also hundreds of localities situated in the mountain areas, with a wonderful scenery and breathtaking splendors and treasure which must be discovered.

More than 95 resorts are suitable for skiing and during the last decade they have been modernized to satisfy better ski lovers expectations.

The most attractive mountain resorts are Poiana Brasov, the leader in the field, situated close to the medieval City of Brasov, followed by the necklace of charming resorts from the Prahova Valley: Sinaia, Busteni, Predeal, Azuga, continuing with Paltinis resort close to the marvelous medieval Sibiu city, Vatra Dornei, the pearl resort of Bucovina, Transalpine which has appeared recently on the map of ski resorts and which is in a continuous development.

Tourist arrivals reached 2.3 million in the mountain resorts in 2019, being 2.8 times more than in 2010. They represent 17.2% of total Romania's visitors. Romanians represent 91% of the total number of tourists, and their number and foreign tourist number is continuously increasing.

In 2019, in the mountain resorts of Romania, a number of over 196 thousand foreign tourists spent their holidays, which means 2.2 times more than in 2010.

Also, the number of overnight stays increased 2.8 times, accounting for 4.42 million in 2019.

The offer of accommodation units and places has responded to the high demand, and in 2019, the mountain resorts had 2,370 units, of which about 70% were represented by tourist and agro-tourist guesthouses, 8.7% tourist villas, 7.9% hotels and 6.2% chalets etc. Their number represent 27.5% of Romania's tourism accommodation units.

The number of places also increased by 80.4%, reaching 63,943 in 2019, accounting for 17.8% of the total places existing in Romania's tourism.

Mountain area resources in terms of natural landscapes, biodiversity, local economy, humans, cultural and historical heritage have to be better valorized, developed and promoted to attract more tourists, increase income of the local communities, living standard of the population and also to satisfy much better tourists desires.

Mountain resorts for skiing have to continue their efforts to improve infrastructure in terms of access roads, buildings, equipments, installations, facilities, to enlarge the range of activities to offer the tourists unforgettable vacations and their expectations to be entirely covered

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PORK CRISIS IN ROMANIA IN THE CONDITIONS OF AFRICAN SWINE FEVER IN THE PERIOD 2017-2019

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Abstract

The paper aimed to analyze the status of pork market during the period 2017-2019 under the impact of African Swine Fever (ASF) in order to assess the consequences on pig livestock, pork production, trade, and price compared to the period 2014-2016. Using the data provided by Faostat and National Institute of Statistics, and the usual methods specific to such an analysis: fixed index, trend line, regression equations and determination coefficient, the obtained results have pointed out that in the interval 2017-2019 versus 2014-2016, of pig livestock, ASF has amplified the decline of pig livestock, slaughtered pigs and their live weight, and pork production. The higher demand than offer on the domestic market increased imports to assure food security and increased pork price. Farmers are discouraged to grow pigs due to the lack of biological material, high price for piglets and feedstuff, high production cost and the high risk that their business to fail, as long as subsidies and aids are missing in pig farming. In consequence, it is needed a new strategy which has to be adapted to the actual situation at the European level destined to counteract the spread of ASF by using efficient measures of traceability and biosecurity along the pork chain. Veterinary authorities have to join their forces to eradicate this disease and produce a vaccine for saving pig livestock. Subsidies and aids are required to sustain pig growing in Romania, where pork is a strategic food.

Key words**:** *pork crisis, livestock, production, trade, price, African Swine Fever, Romania*

INTRODUCTION

Pork continue to be a preferred meat at the global level as it is an important source of animal protein. The demand is expected to grow stimulating the increase of pork price and international trade [21, 31].

However, the outbreak of African Swine Fever (ASF) has produced disruptions in pig livestock, pork production in many countries and continue to have a deep negative impact in the international pork market.

Starting in the Asian countries, mainly in China, ASF was spread in Europe were produced important damages in pork sector of almost all the countries. Romania, Poland, Hungary, the Nordic countries, Belgium, Slovakia, Slovenia, Italy have suffered in various ways and proportions due to ASF [4, 18].

In 2019, ASF has expended progressively to the South West of the EU. But, the actual situation varies from a country to another depending of many factors such as: pig farm structure and mainly the share of backyard holdings, geographical conditions and the status of wild boar population [5].

In Romania, ASF arrived in 2017, the virus being brought by the wild boars coming from Ukraine and invaded the South Eastern and South Muntenia regions which have been seriously affected compared to other regions like West, Center, and North East [9, 16, 29].

The disease was spread rapidly in Romania due to the existence of a high number of wild boars attracted by the cultivated crops, the huge number of backyard pig farms situated close to each other, indirect transmission by people having contact with the infected animals and farms, contaminated vehicles, etc [2].

In Romania there are 1,220 ASF outbreaks in 28 counties. About 13 outbreaks have appeared in commercial companies. Over

600,000 pigs are already killed from the beginning of the epidemic. And the effect of these aspects was noticed along the whole production chain [20].

For Romania, ASF was an additional risk factor for pork market in a critical moment when it was in decline, despite that the country is among the most important pig growing member states of the EU coming on the 10th position for its swine livestock [27, 30].

Romania is a special case in the EU taking into account the high number of pig farms, dominated by small sized holdings raising 1-10 pigs and the low percentage of the commercial industrialized companies, and also growing a high number of pigs [10, 12, 17].

The sector is passing through a real crisis caused by the high farm input price especially for piglets and feedstuff, lack of biological material, high production cost, low profitability, lack of subsidies. In consequence, a few farmers failed and other are in danger of bankruptcy and this led to the decline of pig livestock and pork production, the internal output could not cover the domestic market requirements and pork imports increased, affecting local producers [23, 24, 25]. However, pork is and continues to be a traditional meat consumed in Romania, a reason to be considered" a strategic food" which have to determine the public authorities to offer a financial support to pig breeders [22, 26].

In this context, the paper aimed to analyze pork market during the period 2017-2019 under the impact of ASF in order to evaluate the consequences on pig livestock, pork production, trade, and price compared to the period 2014-2016.

MATERIALS AND METHODS

This study is based on FAOSTAT and National Institute of Statistics data for the period 2014-2019.

The main indicators studied within this research are the following ones:

-pig livestock, number of pigs slaughtered for consumption, total live weight at slaughter, average live weight at slaughter, pork production, average acquisition price per kg live weight at farm gate, pork carcass price;

- pork export and import quantity, the value of pork export, import and trade balance, and export FOB price and import CIS price.

The methodology applied to process data includes usual modern techniques and procedures such as: fixed basis index, trend equations and coefficient of determination.

The results obtained from this study were illustrated in graphics and tables, and the corresponding comments were added. Finally, the main conclusions resulting from this research were drawn.

RESULTS AND DISCUSSIONS

Pig livestock

Romania is a country raising a high number of pigs, coming on the 10th position after Germany, Spain, France, Poland, Denmark, Netherlands, Belgium, Austria, and Hungary.

The evolution of pig livestock in Romania is a decreasing one, similar to the general trend in the EU, except a few countries where the pig number increased [27].

In the period 2014-2019, pig livestock declined in Romania by 76% from 5,041,788 heads in 2014 to 3,834,136 heads in 2019 (Fig.1).

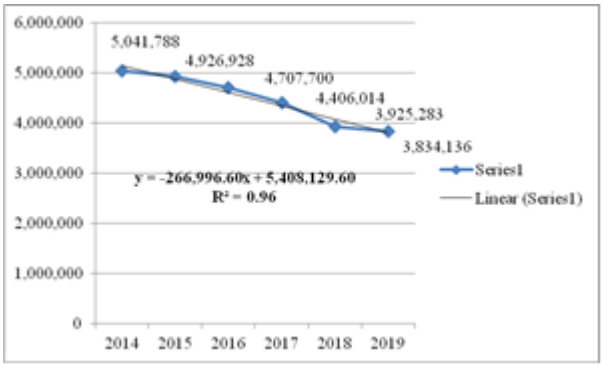

Fig. 1. Pig livestock in the period 2014-2019, Romania (heads)

Source: Own design based on the data from [7].

This decrease was caused by the following factors among which the most important ones are: the lack of piglets in the country in close relationship with the reduction of the number of sows, the high price for purchasing piglets

from other countries which has a deep impact on production cost, in which the share of the biological material is over 50%. Also, the lack of subsidies for swine sector discourages farmers to continue their business in pig fattening, the low price at farm gate per kg of pig live weight, being not enough to cover piglets and feedstuff and other costs [33].

The high share of over 60% of the small farms growing 1-10 pigs does not allow the increase of productivity and efficiency in pig farming and the number of farms growing over 400 pigs represents a small proportion, just 33% [10, 11, 13].

Despite that Romania keeps more than 50% of the number of pig farms of the EU, only the commercial holdings are able to increase performance and reach profitability.

However, the numerous small farms should be not ignored, as they cover the family and relatives needs.

Pigs are raised in the whole Romania, and the decreasing order of the micro-regions based on the number of pigs is: West (22.7%), South Muntenia (15.4%), North West (14.9%), South West Oltenia (13.2%), North East (11.7%), South East (11.6%), Centre (9.7%) and Bucharest-Ilfov (0.8%) [1].

The outbreak of ASF in 2017 changed the dispersion of the number of pigs in the territory as shown in Table 1, from which it is easy to identify that the most affected regions were South East and South Muntenia, whose share in the total number of pigs decreased from 14.4% in 2016 to 11.6% and, respectively, from 16.25 to 15.4% in 2019.

In this year, Romania lost 848,408 pigs compared to the year 2016, when it had 4,574,690 heads, before the outbreak of ASF. Of course, the decline in pig number was intensified by ASF besides the actions of the other restraining factors as mentioned above.

Table 1. Changes in the distribution of pig livestock in the territory in 2018 versus 2016, the year before the ASF outbreak in Romania (heads)

	2016 (heads)	2019 (heads)	2019-2016 (heads)	2019/2016 (%)	Share of the region (%)	
					in 2016	in 2019
N East	489,985	436,573	-53,412	89.0	10.7	11.7
S East	657,258	434,503	-222,755	66.0	14.4	11.6
S Muntenia	743,468	574,530	-168,938	77.0	16.2	15.4
S W Oltenia	569,940	494,051	-75,889	86.6	12.4	13.2
West	959,956	846,880	-113,076	88.2	20.9	22.7
N West	669,586	558,025	-111,561	83.3	14.6	14.9
Centre	465,904	362,751	-103,153	77.8	10.1	9.7
Bucharest-Ilfov	18,593	18,969	+378	102.0	0.7	0.8
Total	4,574,690	3,726,282	-848,408	81.4	100.0	100.0

Source: Own calculation based on the data from [15].

If we take into account that in the period 2014-2016 Romania raised in average 4,892,139 pigs per year and in the period of ASF, it had only 4,055,144 pigs per year, this means a difference of 836,995 pigs that is by 17.115 less (Table 2).

Number of slaughtered pigs for consumption

The decline in pig livestock has led to the decrease of the number of slaughtered pigs. In the last three years when ASF has operated, Romania slaughtered 15,032,240 pigs for consumption, by 2,379,760 less than in the period 2014-2016, meaning - 13.67% (Table 2).

Table 2. Pig livestock and the number of pigs slaughtered for consumption (heads)

	Average pig livestock (heads/year)	Number of slaughtered pigs for consumption (heads)
(a) 2014-2016	4,892,139	17,412,000
(b) 2017-2019	4,055,144	15,032,240
(b)- (a)	-836,995	-2,379,760
(b)/(a)*100 (%)	82.89	86.33

Source: Own calculation based on the data from [7, 15].

The decline in the number of slaughtered pigs was registered not only in Romania, but also

in Greece, Germany, Poland, Denmark However, in other countries like Lithuania, Slovakia, Bulgaria, Estonia, Slovenia were it was slaughtered a higher number of pigs. But, at the EU level, the slaughtered pigs were by 1.3% less numerous than before [8].

The live weight of slaughtered pigs has also declined in Romania in the last six years. In the period 2017-2019, it accounted for 1,645,444 tonnes live weight, being by 39,642 tonnes smaller that in the period 2014-2016 (Table 3).

Table 3. Live weight of slaughtered pigs and pork production

	Total live weight of slaughtered pigs (tonnes)	Average pig live weight at slaughter (kg/head)	Pig meat production (tonnes)
(a) 2014-2016	1,685,086	96.7	1,430,588
(b) 2017-2019	1,645,444	110.3	1,317,626
(b)- (a)	-39,642	+13.6	-112,962
(b)/(a)*100 (%)	97.64%	114.06	92.10

Source: Own calculation based on the data from [7, 15].

The average pig live weight at slaughter was influenced not only by the number of slaughtered pigs and their live weight, but also by the average live weight at slaughter, which is an important indicator reflecting pig fattening efficiency and meat quality. It depends on the technology applied in pig fattening, breeds and hybrids used, feeding, daily gain and other technological factors [24, 25, 32].

If in the period 2014-2016, the average live weight at slaughter was 96.7 kg/head, in the next three years, 2017-2019, it reached 110.3 kg, which is a positive aspect, meaning by + 14.06% more, the level of about 110 kg assuring a high carcass quality related to the thickness of fat layer (Table 3).

Pork production followed a decline caused by the decrease of the number of pigs, slaughtered pigs and total live weight at slaughter.

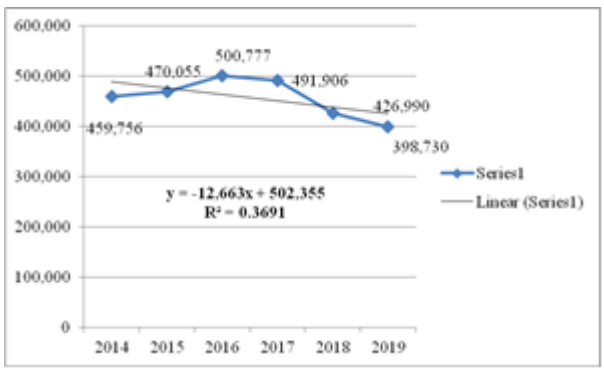

Fig. 2. Pork production, Romania, 2014-2019 (Tonnes)
Source: Own design based on the data from [7].

In 2019, Romania produced 398,730 tonnes pork by 13.3 % less than in 2014, when it carried out 459,756 tonnes (Fig.2).

Taking into account pig meat production in the period 2017-2019 under the ASF, the loss of production accounted for 112,962 tonnes compared to the performance achieved in the period 2014-2016 (Table 3) [28].

Pork consumption

Pork is the most consumed meat sort by Romanians, the average annual consumption accounting for 38.5 kg/inhabitant in 2019, representing 50% of the total meat consumption of 77 kg/year/capita. On the second position comes poultry meat, a Romanian consuming 27 kg per year [14].

Despite that pork consumption in Romania was a little smaller in Romania compared to the EU average, in 2019 it exceeded the EU average. However, it is still lower compared to the average consumption in Spain, Poland, Austria, Germany, Czech Republic, Portugal, Italy and Netherlands, therefore, from this point of view, Romania comes on the 9th position [12].

Pork trade

Pork import and export amounts

Due to the decline in pig live stock, and also due to the ASF which imposed as more than 560,000 pigs to be killed, with a negative impact on the production chain, the losses registered by farmers who have been discouraged to deal with pig farming, the high risk of the extend of the ASF with a high pressure not only in Romania, but also in all

the Eastern European countries, Romania was obliged to cover the domestic market requirements and assure food security of the population and for this reasons it has become more and more dependent on import [20].
In 2019, Romania imported 122,009 tonnes pork, by 37.19% more than in 2014. At the same time, the amount of exported pork varied from a year to another during the last six years, but in 2019, it registered the lowest level, accounting for only 5,687 tonnes, being by 43% lower than in 2014 (Fig. 3).

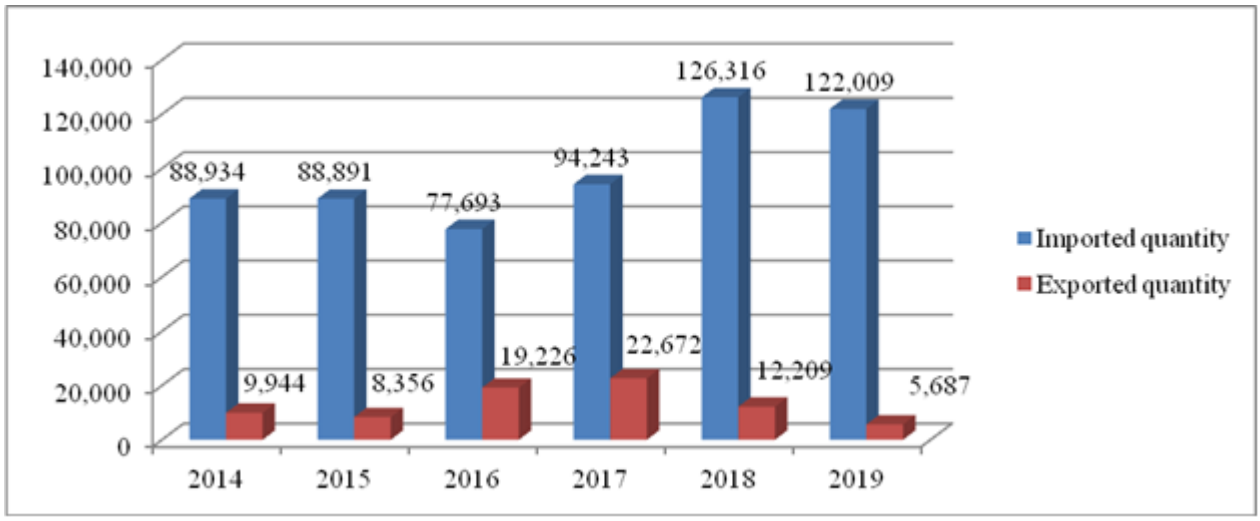

Fig.3. The amount of imported and exported pork (Tons)
Source: Own design based on the data from [7].

The figures show huge discrepancies between the pork export and import amount every year. Taking into consideration the period 2017-2019, when ASF had an additional influence on the quantitative trade with pork, we may notice that in this interval Romania imported 342,568 tonnes pork, by 87,000 tonns, that is by +34% more than in the period 2014-2016.
In the interval 2017-2019, Romania exported 40,568 tonnes pork, by 8.15% more than in the period 2014-2016 (Table 4).

Table 4. Imported and exported pig meat (tonnes)

	Imported pig meat (Tonnes)	Exported pig meat (Tonnes)	Import/Export ratio
(a) 2014-2016	255,518	37,526	6.8/1
(b) 2017-2019	342,568	40,568	8.4/1
(b)- (a)	+87,050	+3,042	+1.6
(b)/(a)*100 (%)	134.00	109.10	123.5

Source: Own calculation based on the data from [7].

The value of pig meat import and export has also showed huge differences year by year resulting a higher and higher negative trade balance (Fig. 4). While pork import value increased from USD 203.1 Million in 2014 to USD 291.8 Million in 2019, meaning by 43.67% higher, the pork export value declined from USD 23.4 Million in 2014 to USD 6.3 Million in 2019, being by 73.1% smaller than in the first year of the analyzed period.
As a consequence, the negative balance increased by 59.4% from USD -179.1 Million in 2014 to USD 285.5 Million in 2019.
Taking into account the influence of ASF, we may notice that in the period 2017-2019 compared to the interval 2014-2016, pork import value increased by 46.9%, while export value decreased by 13% (Table 5).

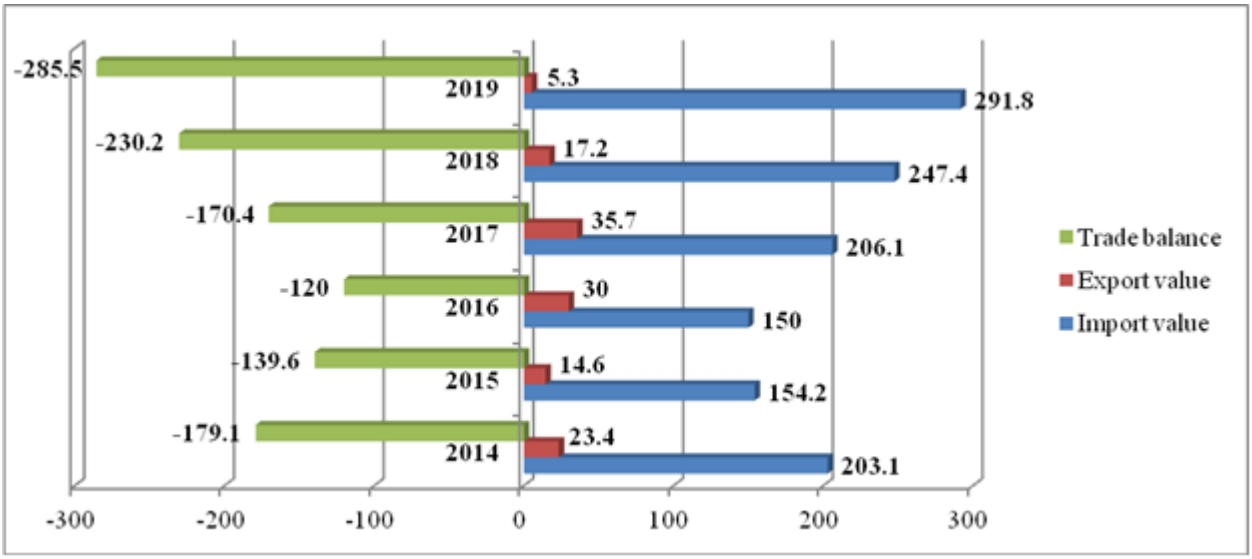

Fig. 4. The value of pork export, import and trade balance, Romania, 2014-2019 (USD Million)
Source: Own design based on the data from [7].

Table 5. Pig meat export value, import value and trade balance (USD Million)

	Import value	Export value	Trade balance
(a) 2014-2016	507.3	68	-439.3
(b) 2017-2019	745.3	59.2	-686.1
(b)- (a)	+238	-8.8	+229.2
(b)/(a)*100 (%)	146.9	87.00	156.18

Source: Own calculations based on the data from [7].

Pork price

The average acquisition price at farm gate per kg live weight varied between Lei 5.81 in 2014 and Lei 6.2 in 2019, when it was by only 6.7% higher than in the first year of the studied period.

But, we have to mention that in the month of December, when it was a high demand for pork, as the traditional meals for Christmas in Romania are prepared of pork, the price per kg live weight raised and reached Lei 8 per kg at the end of the month (Fig. 5).

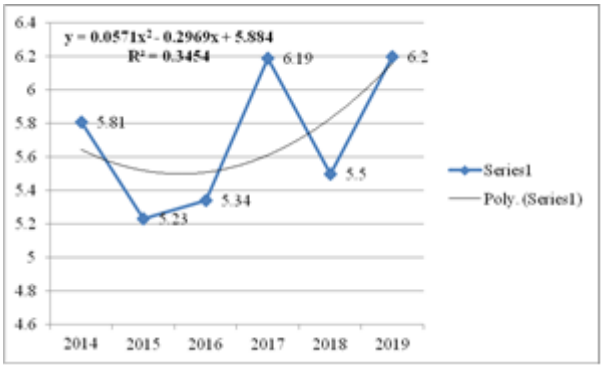

Fig. 5. Average acquisition price per kg live weight at farm gate (Lei/kg)
Source: Own design based on the data from [15].

Also, the variation of average monthly acquisition price in 2019 is exposed in Fig.6, from which we may easily notice that the price has continuously increased since the month of January to the month of December.

In 2019, due to the pork crisis in the international market caused by the high demand of pork on the Asian market, where ASF killed million of pigs, pork carcass price registered a high increase which started from the month of April.

The EU which was one of the main suppliers of pork in the Asian market, especially on Chinese market which is the largest importer, benefited of this advantage intensifying its export and pork carcass price increased.

Due to pork crisis in the international market it is expected as pork price to reach the highest level during the last 15 years [3].

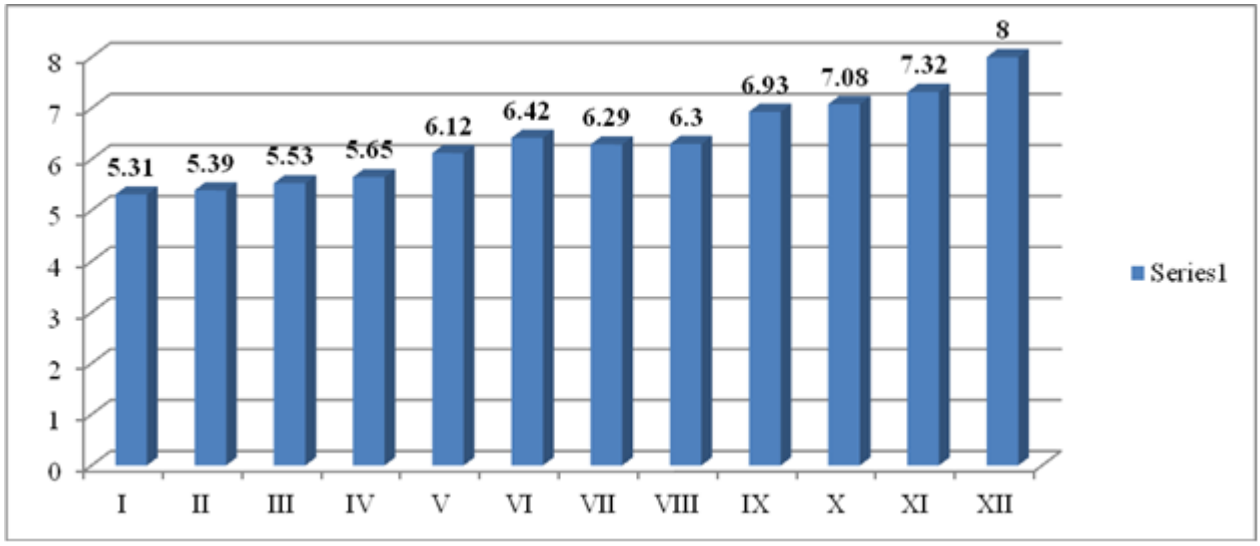

Fig. 6. The monthly dynamics of average acquisition price per kg live weight in 2019 (Lei/kg)
Source: Own design based on the data from [15].

Pork carcass price

The same tendency was noticed in Romania, where the average pork E class carcass price had a general ascending trend, starting from the 3rd week of the year 2019, when it registered the lowest level of Euro 105.09 per 100 kg, and then, it has continuously grown reaching the maximum level of Euro 223.28 per 100 kg in the 52nd week of the year.

In the weeks 1-16, Romania had a lower price than the EU average price, but, then, the price of pork carcass increased in a faster way than in the EU average, but starting from the week 17 and ended the year 2019 at the level Euro 223.28 per 100 kg compared to the EU average price of Euro 193.68 (Fig. 7).

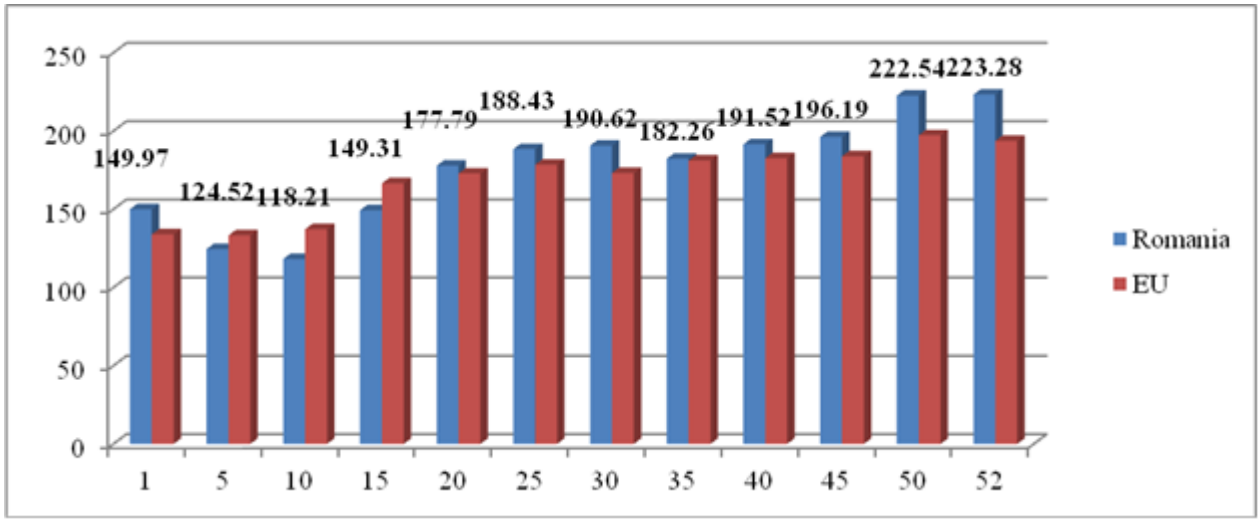

Fig. 7. Comparison concerning the dynamics of average pork Class E carcass Price in Romania and the EU in 2019 (Euro/100 kg)
Source: Own design based on the data from [6].

The higher carcass price is justified by the higher demand, the lack of sufficient offer, the high price for farm inputs especially for piglets and feedstuff. In 2019, average class S- E carcass price increased by 43.6% and the piglets price by 65% [8].

The increase of pork price at the international level has a deep impact on import price, as Romania has to assure food security of the population by imports, and this will led to the growth of pork price in supermarkets [3].

In the period 2014-2019, Romania's average pork export and import price showed important differences. In 2014 and 2015, export price was higher than import price, while in the period 2016-2019, during the interval when ASF operated, import price became higher than export price.

While export price declined by 52.53% from USD 2,357 per tonne in 2014 to USD 1,119 per tonne in 2019, import price increased by 4.72% from USD 2,284 to USD 2,392 (Table 5).

Table 5. Romania's average pork export and import price, 2014-2019 (USD per tonne)

	Average pork export price	Average pork import price	Differences (Export price - Import price)
2014	2,357	2,284	+73
2015	1,747	1,735	+12
2016	1,563	1,931	- 368
2017	1,575	2,187	-612
2018	1,412	1,959	-547
2019	1,119	2,392	-273
2019/2014 (%)	43.47	104.72	-

Source: Own calculation based on the data from [7].

Not to forget that raw material accounts for over 50% in the final price of the products obtained in meat industry. The lack of raw material in the internal market obliged the processors to buy pork, pork carcasses and even live animals to continue their activity, and this with the risk of paying a higher import price. The main suppliers of fresh, refrigerated and frozen pork are Germany, Spain, Belgium, Hungary and Denmark. The high import price has resulted in higher prices for pork and pork preparations at consumer level [20].

The imports of pork have continued in the year 2020, as long as internal production is still able to cover only 30% of the consumption needs. Most of the imported pork comes from intra-EU trade and continue to grow the deficit of pork trade balance [19, 34].

CONCLUSIONS

The study proved that in the period 2016-2019, the outbreak of AFS has intensified the pork crisis in Romania characterized by the decline in pig livestock, pig number delivered to slaughterhouses, pork production, lack of raw material, increased production cost, and pork price.

The main causes are related to the invasion of the wild boars, the high number of small farms situated close to each other, the regulations regarding the compliance of the bioprotection measures which have not been entirely respected, the traffic of people, vehicles and products in the areas with outbreaks, the lack of consciousness from people's part how severe is this disease, the lack of treatments and of a vaccine against ASF.

As a result, the demand/offer ratio was not balance, and about 70% of the internal market needs had to be covered by imports at a high price.

Farmers are in a critical situation, with a lower livestock of pigs, lacked of raw biological materials (piglets, soybean cake and other feedstuff etc), obliged to pay more money for farms inputs, to raise production costs, and get a low price per kg live weight at the farm gate. Industry is also in crisis being obliged to buy raw material from abroad at a high price with a deep impact of the final price at consumer level.

However, pork consumption remains at a high level as pork is the traditional meat in Romania.

The analysis allowed to mention a few solutions to stop the extend of ASF and diminish pork crisis which are presented below:

- to respect the provisions of the combat program against ASF supported by the EU in a proportion of 75%;
- the veterinary authorities to permanently check the persons, vehicles, animal and meat traffic in the active outbreaks of swine fever;
- conducting epidemiological investigations on non-commercial farms, which represent 90% of the ASF outbreaks, in order to identify the infected live animals and contaminated products and take the corresponding measures to eliminate them for not spreading the disease;
-efficient measures of traceability and biosecurity for transported live pigs and pork products have to be taken;
- the increase of the consciousness degree regarding the best practices of biosecurity which could be applied by pork breeders, slaughterhouses, merchants and transporters in order to counteract the spread of ASF;
- the disease eradication must be seen as an European problem as 75% of the pigs are raised in the population households; in this context, the legislation in force has to be improve and better adapted to the actual situation which imposes severe measures for the combat of outbreaks and disease eradication, and the legal provisions have to be entirely respected by all the member states;
- efforts have to continue to be made for producing a vaccine against ASF as soon as possible to stop the spread of this disease;
- Ministry of Agriculture has to develop a new strategy to sustain the development of internal pork production by offering support to pig breeders for making investments in pig farming, assuring the reproduction animals, piglets, soybean cake from internal production by increasing the cultivated surface with soy bean, because the import price of soybean cake is very high, allotting a financial aid for reproduction and each pig delivered to the slaughterhouse, the supermarkets to buy pork especially from the Romanian producers.

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TRENDS IN GOATS' LIVESTOCK AND GOAT MILK, MEAT AND CHEESE PRODUCTION IN THE WORLD IN THE PERIOD 1990-2019- A STATISTICAL APPROACH

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Abstract

The paper aimed to analyze the main trends in goat livestock and milk, meat, cheese and butter production at the world level during the last 30 years, more exactly since 1990 till present. The data collected from Faostat have been processed using fixed basis index, regression equations and coefficient of determination. The results proved that goats are important in the agriculture of many countries. They play a more and more important role in food security and safety, milk, meat, cheese, butter, yoghourt being called to complete dairy products offer and satisfy better consumers' demand. In 2019, the goat livestock reached the peak of the last three decades, accounting for 1,093.7 million heads, milk production was 19.91 million tonnes, meat production 6.25 million tonnes, cheese production 564 thousand tonnes and 7,427 tonnes butter. The highest number of goats is in Asia (54%) and Africa (38%), the highest meat production is also in Asia (73%) and Africa (23%), and the largest milk production is obtained also in Asia (54%), Africa (25%) and Europe (15%). Cheese production has the highest level in Africa (44%), followed by Europe (38%) and Asia (13.6%). Goat breeders are encouraged to continue their business raising goats due to the higher and higher demand for the goat products. The great challenges for goat producers are market fluctuations, price volatility, climate change which could affect forage resources. In this respect, goat breeders associations will play an important role in supporting the farmers with technical services and effective policies to sustain them to benefit from the demand growth.

Key words**:** *goats, production, milk, meat, cheese, trends, world, EU-28*

INTRODUCTION

Goats are among the first animals which have sustained human life across its evolution from the old times till present. After their domestication, they played a more and more important role in supplying milk, meat and other products for the globe population [1, 8, 17, 25].

More than 60% of the world goats are grown especially in the tropical and arid regions where the globe population is facing a deficit of food and has a low income per family. Here, goat milk is the basic food, the primary food resource which maintains life [32].

Goats are not appreciated only in the developing countries, but also in the developed ones in Europe and Americas, where, despite that goats livestock is less numerous, the productivity in milk production is higher, as long as the intensive and semi-intensive rearing systems are successfully applied, processing technologies are well developed, transforming raw milk in high value added products like cheese, yoghourts and butter etc, and consumers are willing to pay more for these products compared to dairy products obtained from cow milk [4, 9, 11, 31].

Goat milk has not only a high nutritive value, but is also considered a real medicine and a protective food, being recommended to be consumed by the people allergic to cow milk or suffering of lung and digestive diseases [11, 14, 20, 22, 25].

Goats are important from an economic, social and environment point of view. First, because, goats products are an important source of protein, amino-acids and other essential nutrients for human body [21, 23, 24, 28].

Secondly, because goats farming is easy to be practiced, requiring low investments compared to cow rearing, goats are not pretentious about food, forage resources are easily to find, in many countries there are pastures and meadows were grazing is a common practice and goats do not compete with humans for cereals. or use the land destined to agricultural crops. Also, goats assures organic manure which favors soil fertilization [3, 10, 19].

Goats raising is a pleasant and accessible activity for the population living in the rural areas, being a job and income source [20, 25, 26].

Goats and sheep are a common presence in the landscapes of many countries, where they contribute to the maintenance of their beautiful sceneries and biodiversity. In other countries like in the Balkan region, goats and sheep contribute to the maintenance of transhumance, the traditional pastoral system which involves extensive grazing, environment protection, landscape conservation and stimulate organic agriculture [29].

That is why goat rearing have to continue to assure the conservation of genetic resources, food security of the population, to avoid poverty, to contribute to the sustainable development of agriculture, to improve productivity and efficiency in this economic sector [2, 6, 12, 15, 25].

In this context, the paper aimed to analyze the trends in global goats livestock and milk, meat, and cheese production during the last 30 years, more exactly between 1990 and 2019. Also, the top 10 countries with high contribution to the development of goat sector have been highlighted.

MATERIALS AND METHODS

This study is based on FAOSTAT data collected for the period 1990-2019 regarding the following indicators: goat livestock, milk production, meat production, cheese and butter production. The market share of each continent and the top 10 countries in each goat production have been calculated.

Fixed basis index, trend equations and coefficient of determination have been the main methodological procedures applied in this study to show the important aspects which deserved to be respond to the approached topic.

The results were illustrated in graphics and tables, and the corresponding comments were done. In the end, the main ideas resulting from this research were highlighted at conclusions.

RESULTS AND DISCUSSIONS

World goats livestock

Across the time, goats' role in human diet has continuously increased due to the high nutritive value of milk and meat, increased demand, importance of goats rearing for the rural population living especially in the developing countries where the opportunities for finding a job are limited and income level per family is low.

In the last 30 years, the number of goats has continuously grown so that in 2019, it exceeded 1,093,732,777 heads, being by 85.75% higher than in 1990, when it counted for 588,796,759 heads [27] (Fig. 1).

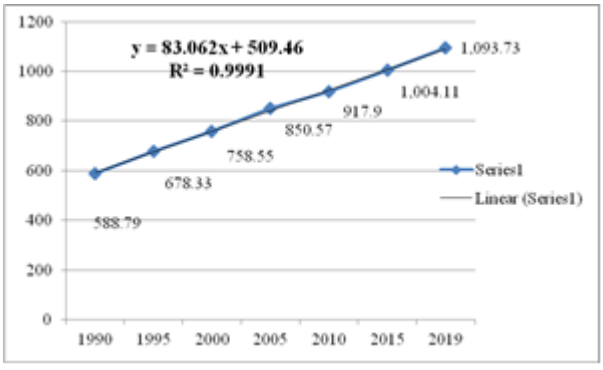

Fig. 1. Trends in goats' livestock in the world, 1990-2019 (Million heads)
Source: Own design based on the data from [7].

Goats are reared mainly in Asia and Africa, and in a lower proportion on the other continents. Therefore, the distribution of goats on the globe is different from a continent to another and from a country to another depending on soil and climate conditions, forage availability, tradition in goats growing and milk and meat consumption, the

opportunities for jobs in the rural areas, the need to preserve biodiversity and genetic resources, the requirements of animal protein in human diet if other sources are not sufficient.

About 54% of the total goats population existing in the world is raised in Asia, 39% in Africa, 3.5% in Europe, 3.4% in Americas and 0.1% in Oceania [13, 31].

The top 10 countries where the number of goats was the highest in 2019, in the decreasing order, are: India (13.61%), China (12.56%), Nigeria (7.49%), Pakistan (6.96%), Bangladesh (5.59%), Chad (3.55%), Kenya (3.22%), Ethiopia (3.11%), Sudan (2.93%) and Mongolia (2.68), all together keeping 674,701,285 goats, that is 61.7% of the global goats livestock (Fig. 2).

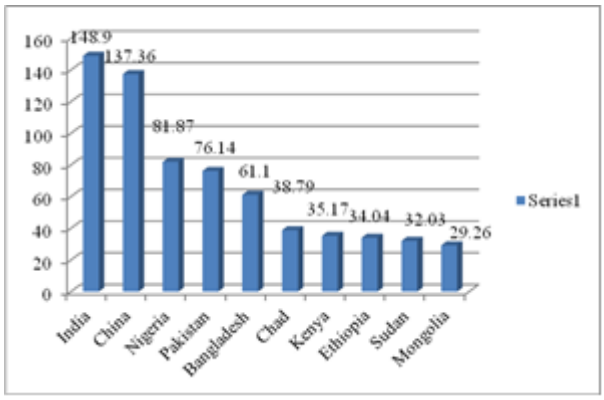

Fig. 2. The top 10 countries with the highest goats population in the world in the year 2019 (Million heads)
Source: Own design based on the data from [7].

Europe comes on the third position regarding the number of goats, but it is on the top position in the world for its industrialized sector and most organized market for goat products [13].

In the EU-28, goats livestock has registered a general decreasing trend, but in a few countries the number of goats increased. The main countries growing goats are: Greece (30%), Spain 922%), Romania (14%), France (10%), Italy (9%), Netherlands (5%), and Portugal (2.8%) [5].

World goat meat production

In general, goats are raised especially for milk and meat, but also for cheese, butter, hair etc. However, the purpose for which they are grown depends from a country to another.

Most of the goats belong to the double-purpose breeds, that is for milk and meat, but there are also breeds specialized only for milk production.

Goat meat is an important source of protein and other chemical compounds for a large part of the globe population and in the countries where consumption is traditional [18, 27].

During the last 30 years, the world goat meat production has also increased, from 2,665.8 thousand tonnes in 1990 to 6,252.5 thousand tonnes in 2019, meaning as level 2.34 times higher than in the 1st year of the period (Fig. 3).

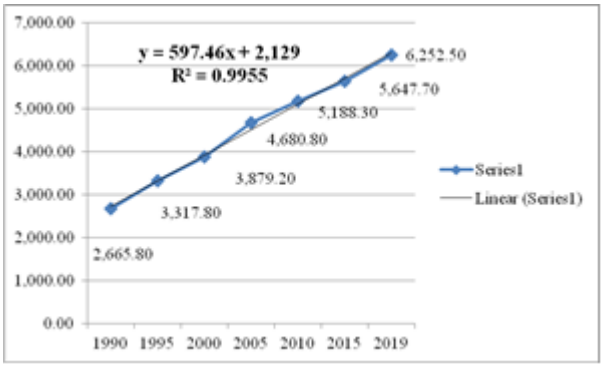

Fig. 3. Trends in the world goats' meat production, 1990-2019 (Thousand tonnes)
Source: Own design based on the data from [7].

Goat meat is mainly produced in Asia which in 2019 accounted for 72.7% in the global production, being followed by Africa with 23.46%, Americas with 2.2%, Europe with 1.28% and Oceania with 0.36%.

The top 10 countries producing goat meat worldwide in 2019, in the decreasing order of their market share, were: China (37.73%), India (8.85%), Pakistan (7.85%), Nigeria (4.26%), Bangladesh (3.62%), Myanmar (2.06%), Chad (2.01%), Sudan (1.92%), Mali (1.77%) and Ethiopia (1.54%0. The meat production achieved by these countries accounted for 4,478,009 tonnes, representing 71.61% of the global goat meat output (Fig. 4).

In Europe, goat meat production is not so important, but it deserve to be mentioned Greece, Soain, France, Romania, Italy, Netherlands, Bulgaria and Portugal which produce the highest goat meat output [7].

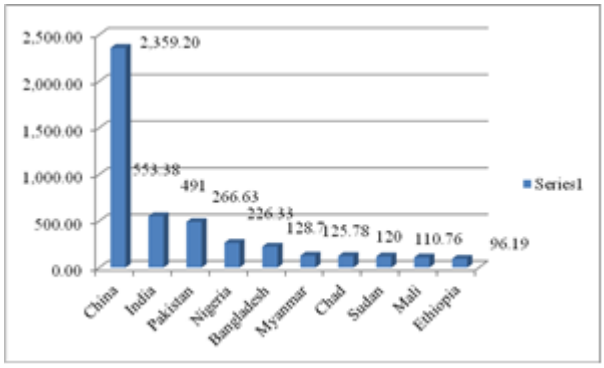

Fig. 4. The top 10 countries producing goat meat in the world in the year 2019 (Thousand Tonnes)
Source: Own design based on the data from [7].

World goat milk production

Due to the expanding demand, goats are primarily reared for milk production, milk being considered a "basic food' and being consumed as fresh milk or processed in various dairy products among which the most common are cheese, yoghourt, and rarely butter.

During the last 30 years, the world goat milk production has doubled its level, registering a continuous ascending trend from 10.16 million tonnes in 1990 to 19.91 million tonnes in 2019 (Fig. 5).

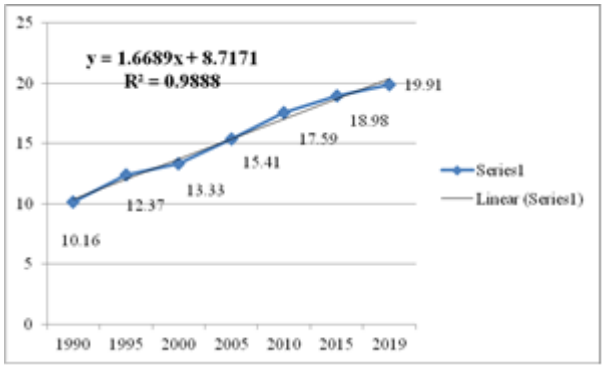

Fig. 5. Trends in the world goat milk production, 1990-2019 (Million tonnes)
Source: Own design based on the data from [7].

Of the total goat livestock, more than 250 million heads represent the dairy livestock, which accounts for 25%.

Goat milk production is by 47% higher than sheep milk production at the global level [31].

The highest contribution to the global goat milk output is given by the Asian countries (54.3%), and the African countries (25%), being followed by the European countries (15.8%), Americas (4.5%) and Oceania (0.4%) [13, 31].

The top 10 goat milk producing countries in the world in 2019, in the decreasing order of their contribution to the global goat production, were; India (27.12%), Bangladesh (13.81%), Sudan (5.82%), Pakistan (4.72%), France (3.30%), Turkey 92.90%), Spain (2.69%), South Sudan (2.31%), Netherlands (1.94%), and Somalia (1.88%), all together carrying out 66.48% of the global goat milk (Fig. 6).

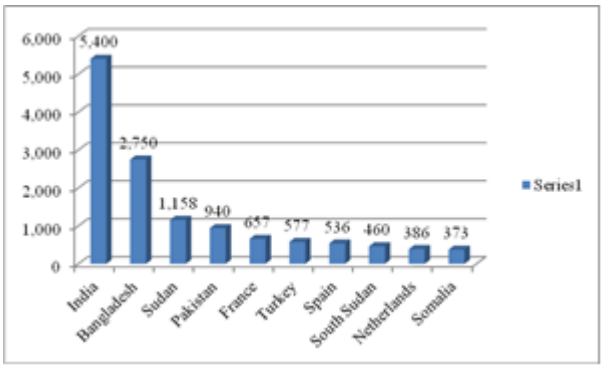

Fig. 6. The top 10 countries producing goat milk in the world in the year 2019 (Thousand Tonnes)
Source: Own design based on the data from [7].

Therefore, the highest milk production is coming from the goats raised in Asia, the most representative countries being India, Bangladesh and Pakistan, and then from Africa, where Sudan, South Sudan and Somalia are the main producers.

Europe comes on the 3rd position with almost 16% contribution to the global goat milk, the Americas are ranked the 4th with 4.5% market share and Oceania is the last with a negligible contribution.

Goats produced more milk than sheep, even though their livestock is less numerous than sheep population [31].

This is explained by the higher milk yield performance in case of goats, which are able to produce more than 75.3 liters per head compared to only 41.5 liters in case of sheep, as world average yield.

Yield level varies from a country to another depending on the breeds genetic potential, specialization profile, the applied growing

systems, feeding assurance and the development of milk processing industry.

The highest milk yield performance is achieved in Europe, where dairy goat sector is highly developed in France, Spain, Greece, Italy, Netherlands, but also in Romania, and Portugal.

Europe is on the top position for its industrialized dairy goat sector and very well organized market for dairy products, like fresh milk, cheese, yoghourt, butter etc. [16, 17, 20, 30].

Goats farming is practiced mainly in the intensive and semi-extensive systems with a high productivity assured by specialized breeds in milk production.

Milk processing technologies are highly industrialized, but also the main producing countries continue to preserve traditional on-farm manufacturing [13].

In Americas, goat dairy products are achieved in many countries playing an important economic, social and environmental role, the most important producers being Mexico, USA, Canada and Brazil [11].

World goat cheese production

The consumer preference for goat cheese is increasing and this has determine production growth.

In 2018, at the world level, there were produced 564,075 tonnes goat cheese, by 63.64% more than in the year 1990, when production accounted for only 344,707 tonnes (Fig. 7).

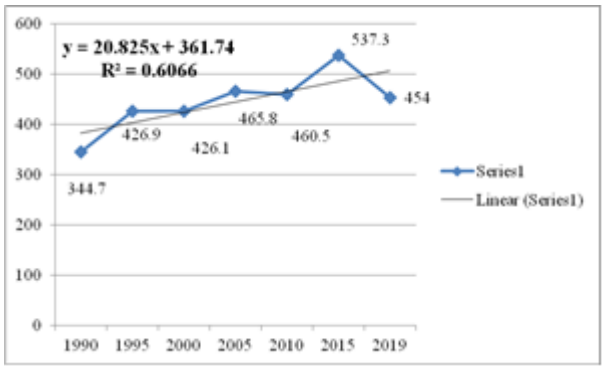

Fig. 7. Trends in the world goat cheese production, 1990-2019 (Thousand tonnes)
Source: Own design based on the data from [7].

Goat cheese is produced in about 35 countries in the world, mainly in Africa and Europe and also in in Asia and Americas. In 2018, the distribution of goat cheese output by continent was: Africa 44.07%, Europe 38.03%, Asia 13.65% and America 4.23%.

The top 10 countries producing goat cheese and their market share was the following one in 2018: South Sudan 19.89%, France 17.66%, Sudan 16.17%, Spain 8.31%, Greece 7.31%, Niger 7%, Iran (Islamic) 6.03%, Mexico 2,99%, Tajikistan 2.48% and Afganistan 1.85%, all these countries together achieving 505.93 thousand tonnes, representing 89.69% of the global goat cheese output (Fig. 8).

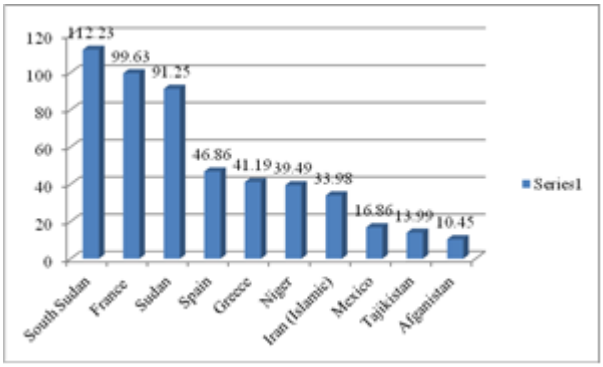

Fig. 8. The top 10 countries producing goat cheese in the world in the year 2019 (Thousand Tonnes)
Source: Own design based on the data from [7].

In Europe, mainly in the EU-28, goat cheese production is well developed in France, Spain, Greece and also in Italy, Bulgaria and Portugal.

The industrialized cheese making and also the traditional on-farm cheese manufacturing and selling is very common in these European countries.

Many sorts of cheese are of high quality and are Protected Designated Origin (PDO) products like in France, Spain, Greece, Italy, Netherlands and Portugal [13].

Goat milk butter production

Butter is rarely produced from goat milk. However, at the world level Spain is recognized as the main producer. In the year 2018 it carried out 7,427 tonnes butter, 2.34 times more than by 3,162 tonnes in the year 2015.

CONCLUSIONS

The statistical study confirmed that goats sector has become more and more important in the agriculture of many countries due to its importance for assuring milk, meat, cheese and even butter for consumers as their demand is higher and higher.

At the global level, the year 2019 registered the peaks of goat livestock: 1,093.7 million goats, milk production 19.91 million tonnes, meat production 6.25 million tonnes, cheese production 564 thousand tonnes and 7,427 tonnes butter.

The most numerous goat livestock is in Asia (54%) and Africa (38%), the highest meat production is also in Asia (73%) and Africa (23%), and the largest milk production is obtained also in Asia (54%), Africa (25%) and Europe (15%).

Cheese production has the highest level in Africa (44%), followed by Europe (38%) and Asia (13.6%).

The higher and higher demand for the goat products encourages breeders and processors to produce more and of a higher quality.

The great challenges for goat producers are market fluctuations, price volatility, climate change which could affect forage resources. In this respect, goat breeders associations will play an important role in assuring technical services and policies to support them to benefit from the demand growth.

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THE IMPACT OF COVID-19 PANDEMIC ON ROMANIA'S TOURIST FLOWS IN THE YEAR 2020

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Abstract

The paper aimed to analyze in what measure the Covid-19 pandemic has influenced tourist flows in Romania's tourism in the year 2020 comparatively with the year 2019 and the 2020 forecast. The main indicators taken into consideration have been tourist arrivals, overnight stays and travels abroad. The data provided by the National Institute of Statistics have been processed using the annual average growth for setting up the 2020 forecast, and the index method allowed to quantify the percentage differences carried out in 2020 versus 2019 and the forecast level. In 2020, in Romania, tourism arrivals declined by 53%, but less compared to Europe 70 % or 74% at the global level. Romanians represents 93% of total arrivals, but their number decreased by 45% compared to 2019. Also, overnight stays declined by 51.65% and the residents' travels abroad by 58.8%. A critical situation was in case of foreign tourists' flow which diminished by 83.2% and the number of overnight stays by 81.1%. The most difficult period for tourism in the year 2020 was March-June, but in July-September, it was noticed a recovery. However, tourism industry was also affected regarding its receipts, turnover, personnel, and tourism units, many of them being closed and a few of them failed due to the imposed restrictions by authorities to diminish the spread of the pandemic. Romanians saved tourism rediscovering the beauty of the natural, cultural and historical treasures of their own country, spending their vacations at the seaside, in the mountains and in the rural areas, and, in general, preferring accommodation in small hotels and tourist and agri-tourist guesthouses. Rural tourism was a niche which offered safer stays, more activities in nature and benefiting of hospitality suitable for families and small groups of friends. Romania's tourism has to be more flexible in the year 2021 and the coming years in adapting the development strategy paying attention to the increased demand for domestic tourism including offers and experiences in open-air, nature-based and slow travel destinations. At international level Romania has to be promoted as a rural destination which is able to offer a high quality hospitality and the beauty of the country.

Key words**:** *tourist flows, Covid-19 pandemic, impact, Romania*

INTRODUCTION

Since January 2020 when the World Health Organization mentioned the first time the high risk of the spread of the new SARS-CoV 2 virus from China, the whole world was facing with a huge Covid-19 pandemic which has affected almost all the countries from a health, economic, social and cultural point of view as never before!

On Feb 13, 2021, the WHO statistics showed that, since the beginning of the pandemic, at the global level there were confirmed almost 108 million cases of Covid-19, of which over 2.4 million deaths [48].

The authorities in each country have been obliged to take specific policy measures to protect the health of the population, to reduce the pressure on the medical system, to diminish the effects of the pandemic. However, the imposed restrictions increased the fear, anxiousness, troubled people behavior and changed the life style, obliging them to stay home, to work from home or to lose their jobs and income.

The economy of all the countries was affected more or less, and depending on the expand of the pandemic, the Governments tried to set up strategies to gradually return to a normal life.

Tourism which has proved to be one of the most dynamic branch of the world economy during the last decades has been deeply affected [8, 9, 10].

Compared to the year 2019, when the international arrivals reached the peak of 1.46 billion tourist arrivals, USD 1,481 billion

tourist receipts, generated USD 1.7 trillion exports from international tourism and had an important contribution of about 10% to the global GDP and of about 320 million jobs, in 2020, due to the pandemic, tourism has deeply declined due to the fear of the people to travel, the imposed movement restrictions, the close of the borders to tourists in many countries [9, 21, 42, 44, 45, 46].

According to UNWTO, in the year 2020, due to the wider spread of the novel corona virus, tourism industry lost approximately 1.1 billion international tourist arrivals, USD 910 to 1.1 trillion receipts and 100-200 million jobs, many of them in small and medium sized enterprises

Also, about USD 1.3 Trillion were lost in export revenues - more than 11 times the loss recorded during the 2009 global economic crisis [40, 42, 43, 44, 45].

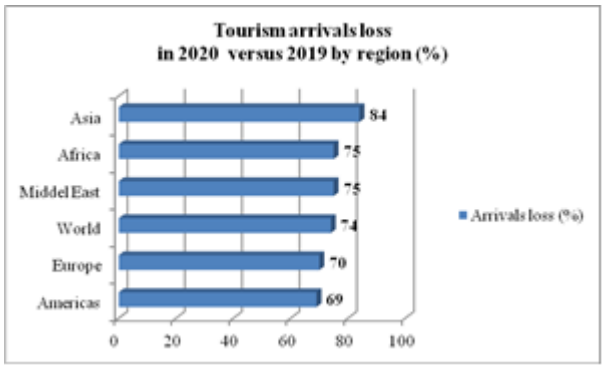

Fig. 1. Decline in tourist arrivals at the global level in 2020 by region (%)

Source: Own design based on the data from UNWTO, 2021 [47, 48].

Because of the decisions taken by Governments to limit the expand of the virus such as: social distancing, self-isolation, travel restrictions (mandatory testing, quarantines, closure of borders etc), movement limitations, lockdown, confinement, closure of hotels, restaurants, bars, clubs, shops, museums, cancellation of cultural and sport events etc and other social and economical reasons, tourist behavior changed during the year 2020 and especially in the period of vacations during Summer and Autumn 2020.

The measure in which tourism was affected in each country depends on the spread of the virus and the dependence of the economic development of the country on tourism compared to other sectors of the economy [2, 39].

Europe which is the top destination in the world registered the deepest decline in international tourist arrivals of over 500 million in the year 2020, meaning by 70% less than in 2019 [44].

UNWTO (2020) has found that 93% of destinations in Europe have fully closed the border for international tourism. Many of them being in the top visited countries of Europe such as France, Spain, Italy, Germany, United Kingdom, Austria, Portugal, Greece, Netherlands, Belgium, Czech Republic, Poland etc. [8, 24, 28, 30, 31].

Since the end of December 2020, the vaccination campaign which started is many countries has become a hope which could "restore traveller confidence, contribute to the easing travel restrictions and pass to a relatively normalized travel in 2021 and especially in 2022 as it is expected [44].

Romania is a country with a tourism in a continuous development mainly during the last decade, and it is not yet a destination of high attraction for international visitors, but it is a good offer for residents to learn more about their own country and discover its natural, historical, cultural values.

The tourist demand in terms of arrivals and overnight stays raised in close relationship with offer regarding the number of units for tourists accommodation and the number of places [19, 22, 25, 29, 32, 37].

In Romania, tourism has become more and more important sector for creating jobs and providing its contribution to GDP, its turnover accounting for about 5 billion Euro in 2019 and also it efficiency has become more evident [4, 20, 23, 33].

Like in other countries, Romania's tourism has been affected from all the points of view by the covid-19 pandemic in the year 2020.

In this context, the paper aimed to quantify the impact the Covid-19 pandemic on tourist flows in Romania in the year 2020 comparatively with the year 2019 and the 2020 forecast. Tourist demand was appreciated based on the statistical data provided by the National Institute of statistics

and refers to tourist arrivals, overnight stays and travels abroad.

MATERIALS AND METHODS

For setting up this study, the main indicators taken into consideration to characterize tourist flows have been the following ones:
(i)tourist arrivals in the units with function for tourist accommodation (total, Romanians, foreigners);
(ii)foreign visitors' arrivals at the frontiers of the country;
(iii) tourist arrivals in the units with function for tourist accommodation in the most attractive destinations in the country;
(iv)tourist overnight stays in units with function for tourist accommodation (total, Romanians, foreigners);
(v)Romanian tourists' travels abroad.
The empirical data have been provided by the National Institute of Statistics.
The years of reference taken into consideration were 2010, 2019, and 2020.
From a methodological point of view, in the study have been used:
- The average annual growth in the period 2010-2019, $\bar{\Delta}$ AAG, which was determined using the formula:

$$\bar{\Delta} \text{ AAG} = (\bar{X}_n - \bar{X}_1)/(n - 1)$$

- Forecast for the year 2020, F_{2020} was established based on the formula:

$$F_{2020} = \bar{X}_{2019} + \bar{\Delta} \text{ AAG}$$

- Fixed basis index method, $I_{FB\%}$, was determined according to the formula:

$$I_{FB\%} = (X_t/X_0)*100$$

where: X_t is the level of the indicator X in the year t, in this case in 2020, and X_0 is the level of the same indicator X in the year 2019 and, respectively, the forecast level for the year 2020.
- The structural index (SI%), reflecting the tourist arrivals and tourist overnight stays structure taking into account their geographical areas of origin.
The graphical representations and the tabled results have been accompanied by the corresponding comments destined to characterize the main trends and identify the aspects related to covid-19 impact on tourism indicators in 2020.
At the end of the study, the main ideas resulting from this research were highlighted an included in the conclusions.

RESULTS AND DISCUSSIONS

Tourist arrivals

The year 2020 was an atypical year for tourism in Romania as in many other countries worldwide. The evolution of the pandemic imposed a large range of restrictions in the period of alert or emergency, and in the period of relaxation, which varied from a month to another.
This determined tourists to change their behaviour with a deep impact on tourism business.
Till May 15, most of the tourists cancelled their reservations for spending their vacations mainly for Easter and 1st May, but starting with May 15 and especially with June 1st, when the restrictions became more relaxed, the Romanians returned to their wish to travel and enjoy their holydays in summer season [1]. This was a chance for tourism industry to recover, mainly in July and August, when the Romanians invaded the sea side, and then the Danube Delta, the mountain areas, rediscovering the beautiful landscapes, fresh air and new attractions in safe places in Romania. Therefore, 2020 was the year of changes and challenges for tourism industry, tourists' preferences and habits.
However, less than 50% of potential tourists have avoided to travel, staying home as they were scared, worried and anxious about their holidays [5].
The rest of tourists choose destinations either close to their home or in isolated places and areas, preferring accommodation in smaller units, hotels or mainly guest-houses, apartments and holiday villas.

The holyday vouchers saved the domestic tourism and tourism agencies offer was diversified with new packages adapted to the imposed measures of hygiene and social distance to assure tourist and personnel protection and diminish the spread of the pandemic.

The statistics showed that in 2020, tourist arrivals accounted for 6.33 million in Romania, being by 52.64% smaller than in 2019 and by 55.35% lower than the expected forecast level for 2020, estimated based on the average annual growth recorded in the last decade 2010-2019.

From total arrivals, Romanian tourists' arrivals accounted for 5.88 million representing 55.51% of their arrivals in 2019 and 52.28% of the 2020 forecast. Therefore, Romanians were the dominant source of tourists with a share of 92.84% in total arrivals.

The year 2020 did not favour incoming tourism, due to the restrictions imposed in various countries related to the pandemic. The number of foreign tourists' arrivals was just 453.1 thousands, representing only 16.88% of the 2019 level and 15.99% of the 2020 forecast (Table 1).

Table 1. Tourist arrivals in the units with function for tourist accommodation, Romania in 2010, 2019 and 2020 (Thousands)

	Arrivals- Total	Romanians' arrivals	Foreigners' arrivals
2010	6,073	4,726	1,346
2019	13,375	10,597.1	2,684
$\bar{\Delta}$ AAG	811.3	652.3	148.6
2020 forecast	14,186.3	11,249.4	2,832.6
2020	6,335.4	5,882.3	453.1
2020/2019%	47.36	55.51	16.88
2020/2020 forecast %	44.65	52.28	15.99

Source: Own calculation based on the data from [12].

The monthly evolution of total tourists' arrivals reflects that the most critical months in Romania's tourism were April, May, and also March and June. After the implementation of the relaxation measures in May and June, tourist arrivals started to grow from July to the end of September.

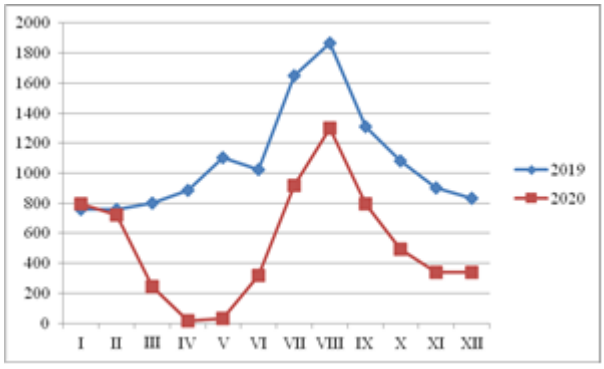

Fig. 2. Total tourist arrivals in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

The peak of arrivals was 1,301.4 thousand registered in August, but representing about 70% of the level in the same month in 2019.

After a decline in October and November, a slight increase was noticed in December on the occasion of Christmas and New Year's Eve celebration and also for winter vacation which have been the main reasons to encourage the growth of arrivals (Fig.2).

In case of the Romanian tourists' arrivals, the dynamics was almost similar with a deep decline in April and May, also in March and June, and with a peak of 1,269.1 thousand arrivals in August, followed by July and September (Fig. 3).

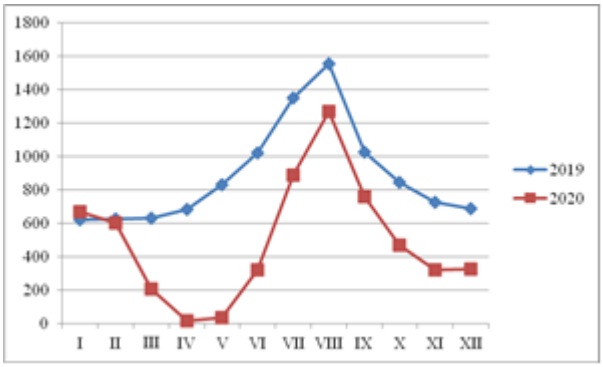

Fig. 3. Romanian tourists' arrivals in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

The arrivals of foreign tourists registered the worst situation due to the fear to travel abroad

and restrictions imposed by their countries regarding covid-testing, quarantine or isolation imposed by the destination country or the country of origin at their return.

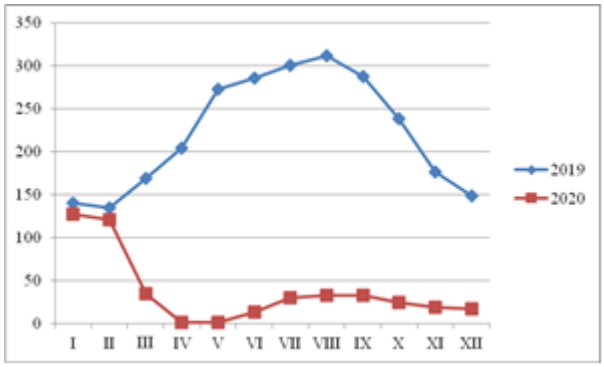

Fig. 4. Foreign tourists' arrivals in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

All the months registered a very low number of foreign tourists starting from March and continuing till the end of the year 2020 compared to the figures recorded in 2019 (Fig.4).

This situation is also presented in Table 2, where there are shown the percentage differences in total number of tourist arrivals, for Romanians' arrivals and foreign tourists' arrivals in 2020 compared to the level performed in the year 2019.

Regarding the region of origin, most of the foreigners who visited Romania in the year 2020 came from Europe.

Table 2 . Percentage differences of tourist arrivals in 2020 versus 2019 by month (%)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Total arrivals	105	95.5	30.2	1.9	3.1	31.4	55.3	69.6	74.3	45.6	37.5	41
Romanian arrivals	108	96.7	32.9	2.2	4.0	31.3	65.7	81.5	74.3	55.5	44.0	47.4
Foreign arrivals	91.2	89.5	20.2	0/7	0.5	4.5	9.9	10.3	11.4	10.3	10.6	11.0

Source: Own calculations based on the data from [12].

They accounted for 78.38% of the total number of foreigners arrivals. The tourists who came from the EU-27 (United Kingdom excepted) registered 58.15% in total arrivals of the foreign tourists. A smaller proportion was represented by tourists coming from Asia, 10%, and from North America 5.58% (Table 3).

Table 3. Foreign tourists' arrivals in the units with accommodation function, by geographical area of origin

	2020 (Thousands)	2020/2019%	Structure by origin area, %	
			2019	2020
Total arrivals	453.1	16.8	100.00	100.00
-Europe	355.3	17.9	74.23	78.38
-EU-27 (UK excepted)	263.6	17.2	57.31	58.15
Asia	45.6	12.6	13.50	10.05
North America	25.3	13.5	6.97	5.58
South America	3.2	14.8	0.81	0.70
Africa	4.7	23.5	0.74	1.03
Others	19.0	19.0	3.75	4.26

Source: Own calculations based on the data from [12].

The number of foreign visitors recorded at the frontier points accounted for 5,022.7 thousand in 2020, representing only 39.25% of the 2019 level.

If in the months of April and May, it was registered the lowest number of visitors, the highest level of about 490-494 thousands was achieved in July and August (Fig. 5).

Like usual, during the Summer season, the most attractive destinations in 2020 for the Romanian tourists were the Black Sea shore resorts and other small localities.

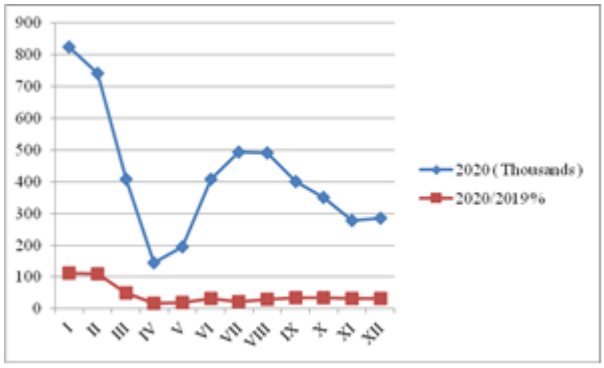

Fig. 5. Foreign visitors' arrivals at the frontier points of Romania in 2020
Source: Own design based on the data from [12].

Starting from June and mainly in July and August, and in a few measure in September, as the month had a wonderful weather and the tariffs were discounted, the seaside was full of tourists [38]. Also, the mountain areas and resorts came on the 2nd position during summer season, but also at the end of the year.

Bucharest and other important cities have relatively maintained their shares among the preferred destinations, despite that in the summer season, they registered the lowest weights in total arrivals, as the Romanians desired to spend their vacations in safer places, in the middle of nature, in isolated areas where to discover new attractions, like in the mountain and rural areas, applying for accommodation mainly in tourist and agri-tourist guest houses, or wishing to rent a guest house for family or a small group of friends [3, 7, 13, 14, 15, 16].

The worst situation was registered by the balneary resorts in the period of restrictions, but then the situation went well as a part of people needed to recover their health (Table 4).

Table 4. The share of tourist arrivals in accommodation units in the most attractive destinations of Romania in 2020 versus 2019 by month (%)

	Bucharest and other cities		**Mountain resorts**		**Other localities and tourist tours**		**Balneary resorts**		**Seaside resorts (Constanta city excepted)**	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
I	41.0	41.4	28.1	27.0	19.0	18.3	10.8	11.7	0.8	1.2
II	46.4	44.7	23.7	24.3	18.4	18.5	9.8	11.1	1.2	1.00
III	48.3	49.2	19.2	9.9	20.0	21.5	10.7	9.9	1.3	1.7
IV	46.3	65.7	19.4	2.3	20.8	28.2	10.9	1.9	1.8	1.1
V	45.5	64.4	17.9	10.2	20.4	20.9	11.4	1.2	3.0	2.3
VI	37.0	33.0	16.9	16.9	17.9	17.1	9.8	5.0	16.5	24.2
VII	29.7	22.7	16.7	15.9	16.5	14.8	9.7	9.0	25.5	34.6
VIII	28.5	22.7	17.6	18.8	16.3	15.5	9.3	11.0	26.0	29.1
IX	38.1	31.8	18.6	20.2	18.9	18.5	10.8	11.8	11.4	14.6
X	45.7	40.6	19.8	23.8	20.6	20.6	11.5	11.8	1.3	1.8
XI	47.9	41.9	19.9	24.8	19.6	21.7	10.9	9.6	1.2	1.3
XII	46.9	42.1	24.9	29.9	18.9	19.7	8.8	7.3	1.0	0.5

Source: [12].

Tourist overnight stays

In the year 2020, the number of overnight stays was closely related as usual to the number of arrivals and the length of stay in various accommodation units preferred by tourists.

Compared to 29.87 million overnight stays in 2019, in 2020 it was registered only 14.44 million, representing 48.35% of the previous year and 45.99% of the 2020 forecast, calculated based on the average annual growth in the decade 2010-2019.

The Romanian tourists registered 13.44 million overnight stays, having a share of 93.1% in the total overnight stays.

However, their stays represented about 55% of the 2019 level and 52% of the 2020 forecast.

The worst situation was noticed in case of the overnight stays performed by foreigners, which accounted for 995.8 thousand, representing 18.9% of the figure achieved in 2019 and 17.95% of the 2020 forecast (Table 5).

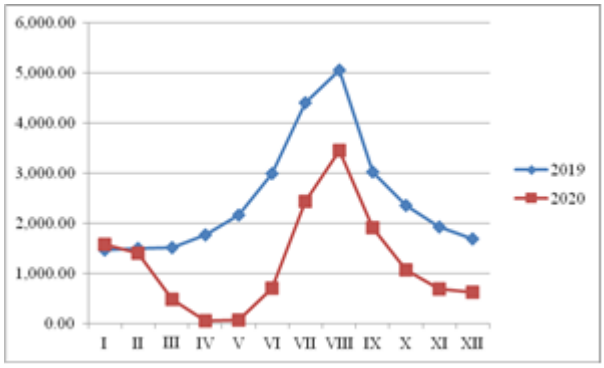

Fig. 6. Total tourists' overnight stays in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

The evolution of total overnight stays by month in the year 2020 reflects that the lowest levels were registered in April, May and also in March and June, and a better situation in the pandemic was carried out in July and August when tourists spent their summer vacation (Fig. 6).

A similar trend was noticed regarding the overnight stays belonging to the Romanian tourist who are the dominant category of visitors. In July, August and September, their stays recorded the highest level in 2020 compared to 2019 level, respectively: 62.2%, 75.8% and 73.8% (Fig. 7).

Table 5. Tourist overnight stays in the units with function for tourist accommodation, Romania in 2010, 2019 and 2020 (Thousands)

	Overnight stays- Total	Romanians' overnight stays	Foreigners' overnight stays
2010	16,051	13,284	2,767
2019	29,870.4	24,603.4	5,267
$\bar{\Delta}$ AAG	1,535.4	1,257.7	277.7
2020 forecast	31,405.8	25,861.1	5,544.7
2020	14,444.7	13,448.9	995.8
2020/2019%	48.35	54.60	18.90
2020/2020 forecast %	45.99	52.00	17.95

Source: Own calculation based on the data from [12].

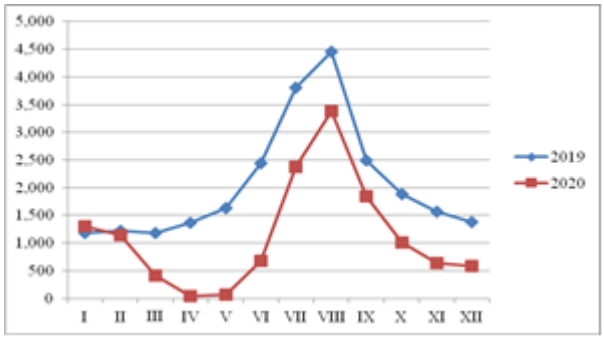

Fig. 7. Romanian tourists' overnight stays in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

The worst situation was carried out in case of foreign tourists whose stays recorded the lowest level in general, and especially in April, May and June, but with a slight recover in July, August, September, October, November and December (Fig. 8).

The synthesis of the increase or decline of overnight stays in 2020 versus 2019 in percentages is presented in Table 6.

Taking into account the region of origin, the overnight stays belonging to foreign visitors accommodated in tourist units reflected that the highest share, 77.2%, belonged to the European tourists and, of course, 56.38% to the EU-27 citizens, followed by Asian tourists with 11.42%, and North Americans with 5.71% (Table 7).

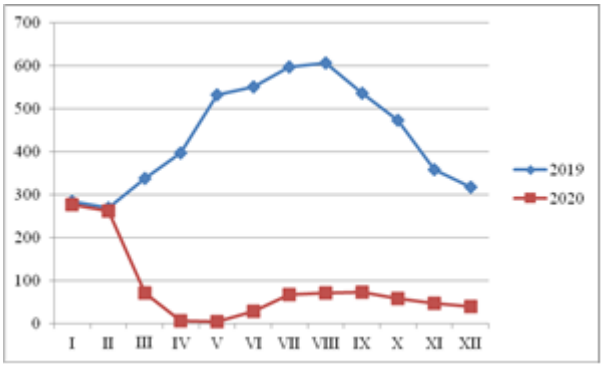

Fig. 8. Foreign tourists' overnight stays in Romania in 2020 versus 2019 by month (Thousands)
Source: Own design based on the data from [12].

Table 6. Percentage differences of tourist overnight stays in 2020 versus 2019 by month (%)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Total overnight stays	106.9	93.8	31.8	2.5	3.0	23.5	55.2	68.1	63.1	45.2	35.3	36.9
Romanian overnight stays	109.3	93.2	34.9	2.9	3.7	27.7	62.2	75.8	73.8	53.5	40.4	42.7
Foreign overnight stays	97.0	96.7	20.8	1.3	0.7	4.9	11.1	11.5	13.5	12.2	12.7	12.1

Source: Own calculations based on the data from [12].

Table 7. Foreign tourists' overnight stays in the units with accommodation function, by geographical area of origin

	2020 (Thousands)	2020/2019%	Structure by origin area, %	
			2019	2020
Total overnight stays	995.8	18.9	100.00	100.00
-Europe	768.9	20.26	72.05	77.20
-EU-27 (UK excepted)	561.5	19.29	55.24	56.38
Asia	113.8	14.05	15.37	11.42
North America	56.9	14.68	7.35	5.71
South America	7.5	16.62	0.85	0.75
Africa	11.4	27.87	0.77	1.14
Others	37.3	19.75	3.61	3.78

Source: Own calculations based on the data from [12].

Romanians' travels abroad accounted for 9,510.1 thousands in 2020, representing only 41.2 % of the 2019 level, when it was registered 23 million travels [12].

If in the last years, outgoing tourism exceeded the incoming tourism, in 2020, Romanians rediscovered their beautiful country full of splendours and unforgettable vacations.

However for the Romanians who travelled abroad in 2020, the most desired destinations were Bulgaria, Greece, Turkey in the period when the restrictions have been partially reduced [1].

Then, at the end of the year, due to the critical situation of the pandemic in the European countries and the imposed restrictions, Romanians preferred to spend the New Year's Eve and also the vacations in January 2021 in exotic destinations such as Maldive Islands and Zanzibar, and even in Dubai and Egypt [1].

In general, the external trips booked in advance for the period of Spring were cancelled or postponed for other periods, and this has affected very much the travel agencies regarding their activity, incomes, staff and salaries.

Rural tourism in the pandemic

The pandemic has changed tourists' behaviour, desires and demand regarding the choice of destinations.

Tourists looked to be more interested to travel and spend week-ends or vacations far away of the crowded cities, in a natural environment, in rural areas, in attractive villages, where landscapes, traditions and rural civilization are well preserved and assure a safe stay.

They preferred to be accommodatea in small units, especially in tourist and agro-tourist guesthouses with a small number of rooms, which could assure a safe stay for a family or a small group of friends, to be a pleasant and cleaned accommodation, to assure a large range of activities in fresh air (walking, hiking or cycling on specific routes to discover unknown places, to enjoy new experiences, fishing, bird watching, walking through the forests, learning about the rural life, local gastronomy, tasting wines, visiting memorial houses, old churches, natural monuments, getting knowledge about various occupations of the rural artisans, playing with the animals, riding the horses, participating to hay, fruit or egg harvesting, picking up mushrooms, medicinal plants or forest fruit, buying local

products naturally manufactured based on traditional recipes, learning to cook traditional local dishes, getting more information about folk traditions (songs, dances, suits, weddings etc).

Rural tourism was in 2020 and will continue to be in 2021 an alternative for many Romanians to spend the week-ends and also their vacations for more days than before.

If in the month of Spring 2020, rural tourism was affected very much during the imposed restrictions, and the reservations made in advance for Easter and May 1st were cancelled, the owners of guesthouses could not get any income.

However, in the period of relaxation measures, rural tourism has become the most attractive form of tourism in Romania.

Tourists became more oriented to guesthouses with large gardens, terraces, enough space for staying outdoor, and wonderful surroundings where to benefit of fresh air and feel well in the middle of nature.

Other tourists applied to experience individual tourism with the family in camping, having a camping van, or moving their tent from a place to another in their route hiking or climbing the mountains, or preferring to visit and to be accommodated in monasteries.

During the last decade 2010-2019, the number of tourist guest houses and agro-tourist guesthouse has enormously increased so that it exceeds 5,000 at present [18, 26, 27, 34, 35, 36].

They represent a proud of the small business run in the rural and mountain areas of Romania. They valorise the natural, human, material resources of the country and offer a chance to their guests to learn about hospitality of high quality, and the owners of the guest houses to get incomes and improve their living standard and contribute to the development of the local communities.

The guest houses have been adapted rapidly by their owners to the imposed measures, assuring a permanent disinfected environment, social distance, personnel route, masks, gloves, disinfectants for staff and guests. Also, the owners offered individualized packages and diversified the activities to better satisfy tourists' requirements.

Among the most attractive destinations where tourist and agri-tourist guesthouses have become well known and the most preferred type of accommodation units are: Bucovina, Maramures, Sibiu surroundings, Rucar Bran-Fundata-Sirnea, the Sub-Carpathian Oltenia, the Danube Delta. Also, the small localities with guest houses situated close to the National Parks like in the Retezat, Ceahlau, and Piatra Craiului Mountains are also of high interest [6, 7, 11, 17, 19, 20, 31, 32, 39, 40, 41].

The beautiful landscapes, the rural houses and guest houses which preserved their specific local architecture and traditions or were modernized, the hospitality of the owners and the delicious traditional meals have made "Magura, Pestera, Cheia, Sohodol, Sirnea, Fundatica, Balvanyos, Berca, Bisoca etc" to be among the most attractive villages [41].

However, in the rural tourism, local authorities and communities have to be much more involved in the sustainable development of all the forms of rural tourism and to promote Romania as a rural country which should face much better to the pandemic [6].

CONCLUSIONS

In Romania, compared to other countries from Europe, tourism has been affected in a smaller proportion in 2020 compared to 2019, the main aspects being:

-the number of arrivals decreased by about 53% instead of 74% at the world level and 70% in Europe;

-the number of Romanian tourists dominated the domestic tourism with a share of 93%; their number was by 45% smaller compared to 2019;

-the number of overnight stays was by 51.65% lower than in 2019;

-the number of the Romanians' travels abroad was diminished by 58.8% compared to 2019;

-the most critical situation was in case of incoming tourism, which brings foreign currency; the number of foreign tourist arrivals declined by 83.2% compared to 2019

and the number of overnight stays was by 81,1% lower;
-the most critical periods for tourism in 2020 were March, April, May and a part of June, but July, August and even September contributed to the recovery of this economic sector.
-the restrictions imposed in the pandemic affected very much hotels and restaurant industry in the months specified above and also in the periods when the restaurants and bars were closed. This led to a loss of personnel, incomes, salaries, a part of the units were closed or failed.
-the most attractive destinations in the pandemic were the sea side, the mountain areas and resorts, rural areas and isolated places;
-the most preferred accommodation units were hotels and tourist and agri-tourist guesthouses;
-rural tourism was the most preferred alternative due to the safe geographical position, beautiful natural sceneries, charming villages, safe offer of accommodation, rural facilities, outdoor activities, hospitality suitable for family and small groups;
-the decline of the classical tourism in the main cities.
As a final conclusion, Romania's tourism has learnt what it was good and bad during the pandemic of the year 2020 and has to be more flexible in the year 2021 and the coming years in adapting the strategy both at the national and local level, having in mind the new trend in customers' demand, to create incentives for potential tourists to travel.
We must be aware that tourism crisis is far from over, as the pandemic will continue in 2021 and in the next years.
Travel risk reduction measures taken step by step, regarding travel testing, tracing, vaccination certificates or passports have to be the result of a coordinated harmonized policy based on international digitalization of the pandemic situation in the destination countries. They are the key for recovering tourist confidence in a safe travel and of tourism industry in the coming years.
At the global level, it is expected to continue the new trends regarding the increasing demand for more tourism activities and experiences in "open-air, nature-based and slow travel destinations, and especially in the field of domestic tourism".

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SILKWORM REARING PRACTICES IN RURAL PAKISTAN

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Abstract

Silkworm rearing practices can play an important role in the well-being of deprived rural populations and boost the growth of economy. It is a simple and short tenure process and contains a sensitive series of activities. Silkworm rearing practices made marvellous progress in early eras of liberation. Currently, however, this industry is almost obsolete. The present study explores the silkworm rearing process, practiced by Pakistani farmers. This study is purely based on primary data and was also supported by secondary data from literature. Results of the study indicate that although Pakistani silk farmers have sufficient knowledge and experience but they need a proper support and assistance from state department to convert the sericulture industry into a profitable industry.

Key words**:** *silkworm rearing, rural development, sericulture, employment activities*

INTRODUCTION

Sericulture has been practiced as a cottage industry in Pakistan since its independence in 1947. It was firstly practiced in Punjab in 1947, in fact Punjab was the first province to start sericulture instantly after independence. Then later on sericulture department was established in Khyber Pakhtunkhwa (KPK) in 1952, in Baluchistan in 1959 and in Sindh in 1975 [10].

Sericulture industry revolves around silkworm rearing and it is an exercise of around 40 days. During this short series of procedure, fulfilment of several technical aspects is an essential requisition [7]. For optimum and healthy production regarding sericulture relevant factors are 'good quality silk seed, well equipped rearing rooms, well trained farmers and backup support of state sericulture department [9].

Standard silkworm rearing process contains; disinfection of rearing rooms, uniform hatching, cleanliness, maintenance of temperature, humidity, light, ventilation, spacing, feeding patrons, care during mounting, molting and cocoon collection stages, precautionary measures against diseases and coping strategies against rapid changes in climate [10].

In silk advanced countries, massive importance is given to these factors. All these technical factors have equal importance and negligence in any of them may cause a serious and negative impact on quality and yield of silk cocoons [6]. Regarding adoption and fulfilment of these technical aspects several types of irregularities are being observed in Pakistan. Due to these irregularities, Pakistan is far behind in silk worm rearing practices and its average cocoon yield has been abridged up to zero. Pakistan's sericulture industry is a spectator of very outstanding past. But now days it has lost its attraction. Major reasons of downfall of this industry are 'ignorance about real potential of sericulture industry, absence of serious backup support of government department and substandard methods of silkworm rearing [1].

In silk advanced countries, several governmental and non-governmental organizations (NGOs) are performing their duties with professional attitude for sericulture promotion but in Pakistan, government sericulture department is just a name of formality and wastage of capital in the name of heavy salaries of un-visionary officials [10].

For progress of Pakistan's sericulture industry, relevant experts recommend that it is

high time to increase the quality and availability of silk seed, increase in mulberry cultivation, application of standard rearing technology, provision of proper assistance to farmers, close coordination between government and NGO's with a visionary and corruption free administration [5].

The main objective of the study is to explore the silkworm rearing practices in Pakistan. Pakistan is a country where unemployment rate is high on the other hand, this industry is providing millions of jobs in Bangladesh, China and India but currently in Pakistan only few hundred families are practicing it as a part time occupation. Unfortunately, Pakistan is far behind from its neighbouring countries in terms of generating employment from sericulture.

In Pakistan large numbers of rural communities are living below the poverty line. Due to more suitable climate, demographic and geographical conditions, Pakistan has a great scope and potential of rural development but there are many obstacles in the way of sustainable rural development in Pakistan [1].

MATERIALS AND METHODS

The present study is both qualitative and descriptive where primary data was composed through an arranged questionnaire by key informant interviews (KIIs) in 2017. These KIIs were led with sericulture officials, silkworm rearing experts and farmers currently linked with silkworm rearing practices. Several sessions were conducted with relevant stakeholders of sericulture industry including silkworm rearing experts, officials and farmers involved in the sericulture. Primary data collection of KIIs was collected and is shown in Table 1.

Table 1. Respondents of primary data

Respondents	KII's
Silkworm rearing experts	10
Sericulture officials	20
Farmers currently involved in sericulture	80
Total	110

Source: MS thesis of the author, Muhammad Farooq Hyder.

In this study, ten KIIs were conducted with silkworm rearing experts and twenty with relevant sericulture officials. These KII's were conducted from six localities of Pakistan including Muzafarabad (Azad Jammu and Kashmir, AJK), Peshawar, Lahore, Changa Manga, Sarai Alamgir and Faisalabad. 80 KIIs were also conducted with the farmers currently involved in silkworm rearing activities. Due to least availability of farmers, from 80 questionnaires, 40 interviews were conducted from Changa Manga, 15 from Faisalabad, 10 from Mandi Bahauddin, 5 from Sarai Alamgir and 10 from Muzafarabad (Azad Jammu and Kashmir, AJK).

RESULTS AND DISCUSSIONS

Silkworm Rearing Process

To understand the importance and impacts of factors involved in silkworm rearing process a brief overview of silkworm life cycle and cocoon production is described below. Mulberry silk is produced by silkworm specie named *Bombyx mori*. Silkworm life consists of five stages i.e., ova, larvae, pupa, imago and adult moth. After hatching from eggs, fresh mulberry leaves are served to silkworms. Silkworms grow rapidly and their hunger increase day by day. During life, a silkworm takes four sleeps and after each sleep it removes its old skin and produce larger one. Before final sleep, silkworm spins a cocoon around it and emerges as an adult moth. After emergence male and female moths met with each other and female moth lays about 300-500 eggs [14].

Technical Aspects: Steps taken in Pakistan

The present study is about to explore the silkworm rearing practices in Pakistan and also to examine the technical aspects of silkworm rearing process. Standard silkworm rearing process contains; 'disinfection of rearing rooms, uniform hatching, cleanliness, maintenance of temperature, humidity, light, ventilation, spacing, feeding patrons, care during mounting, molting and cocoon collection stages, precautionary measures against diseases and coping strategies against rapid changes in climate [10].

During research it is observed that in Pakistan most of the farmers know about the importance of above mentioned factors but due to several reasons they are not capable to maintain these standards and it is also observed that sincerity of officials of government sericulture department is just with their heavy salaries and not with their responsibilities.

Rearing Rooms

Rooms fulfilling the standard conditions for silkworm rearing are one of the basic pre requisitions for silkworm rearing. Generally, in world, silk worm rearing is practiced at home level and in silk advanced countries with collaboration of relevant departments farmers construct such standard rooms which are capable for silkworm rearing as well as other income generating activities during out season [3].

In Pakistan, farmers do not have such standard rearing rooms and during rearing season they spare any domestic room at home, fully or partially. During research it was observed that 92 percent of those rooms were not up to the standard. Climate of AJK, KPK and Baluchistan is more intensive and there is also a great difference between day and night conditions during rearing season, that's why proper rearing room arrangements are most important and critically required in those regions.

A standard silkworm rearing room requires that it should be capable to maintain the temperature and humidity, having proper light and ventilation windows. Roof of room should be high up to 10 feet and design of room should be in such manner that fluctuation in external environment cannot affect internal conditions.

Table 2. Rearing Rooms

Standard Rearing Rooms	Tarries or Open Type	Close Rooms having less facilities of Light and Ventilation
17 %	28 %	55 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

In fact, fulfilment of such ideal conditions is not a difficult task and this could be done by using effective and low cost tactics i.e., special mud rooms which have very low cost and are most effective to maintain the internal conditions.

Currently, Sericulture is a part time activity in Pakistan, due to low productivity; most of the farmers do not rear the worms with keen interest.

These farmers are poor and do not have sufficient and proper rearing space. Results of the study show that only 17 percent farmers have standard rooms for rearing, 28 percent use their tarries or open ended rooms having less control over rapid changes in climate and 55 percent have close rooms but have not proper arrangements of ventilation or light and direct sunlight on rooms increases the internal temperature of such close rooms made with concrete.

Disinfection of Rearing Rooms

Diseases are serious issue and in silkworm rearing, it is easier to prevent the occurrence than trying to cure them when they occur.

So, before starting the rearing of worms, disinfection of rearing room is essential. For effective disinfection, all rearing appliances should be kept inside the rearing room.

Walls, doors, windows and appliances should be sprayed with 2 percent formalin solution. After spray, room should be air tightened for 24 hours and then should be opened with full ventilation of air for 24 hours [13].

Table 3. Rearing Room Disinfection

Proper Disinfection	Partially Apply	In Some Extent	Do not Apply
14 %	37 %	40 %	9 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

In Pakistan, most of sericulture farmers know about disinfection but are not much aware about the benefits of disinfection and only 14 percent farmers properly disinfect their rooms, 37 percent of farmers partially disinfect the rooms and appliances, 40 percent apply in some extent and 9 percent do not apply any method of disinfection before rearing.

Hatching

After preparation of rearing rooms, hatching of silkworm eggs is the next step. For high production, maximum and uniform hatching is necessary. Ideal temperature for hatching is 24C°- 27C° [4]. Although farmers do not have standard rearing rooms to maintain the required temperature but results of the study reveal that they are well aware about the importance of hatching process. To maintain the temperature during hatching process, farmers use different techniques. Most of the farmers put silk seed packets in cotton envelops and these cotton envelops are a good tool for ideal hatching.

Table 4. Hatching Table

Maximum Hatching	Good Hatching	Average hatching
92 %	6 %	2 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

Results of the table show that 92 percent farmers are able to get maximum hatching, 6 percent farmers responded that they are able to get good hatching results and only 2 percent claims about average hatching.

Rearing Beds and Spacing

Silkworms grow rapidly and for moving and eating, each requires proper space. In silkworm rearing, overcrowding effects inadequately and spacing from day first to till end is compulsory. For one packet of 40,000 silk seeds, required space starts from two squared feet and at the end required area is about 360 square feet [6]. With rearing stands this space could be arranged easily in a 12×12 feet room.

Table 5. Rearing Bed Types

Bamboo Stands	Charpoy	Tables	Iron Stands
55 %	38 %	6 %	1 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

In Pakistan, 55 percent farmers make bamboo stands having three or four racks and these stands are effective for maximum utilization of room space, 38 percent use the charpoys putting them one onto other, 6 percent use tables and only 1 percent use iron stands. Results reveal that majority of farmers try to adjust more worms in less space.

Cleaning

Whole process of silkworm rearing requires a continuous cleaning of rearing rooms, beds and trays. Cleaning of wastage of worms and mulberry leaves is not a complex task because silkworms automatically transfer to fresh mulberry twigs which could be shifted to already clean trays. This fact reveals that cleaning could be done more conveniently if farmers have reserve space in their rearing rooms. Results show that farmers are conscious about cleaning and try their best but it is also observed that farmers, who have less space availability in their rearing rooms, face difficulties and unable to fulfil the measures of merit.

Table 6. Cleaning

Consecutive cleaning	Cleaning after 1 day	Cleaning after 2 days	Cleaning after 3 days
12 %	47 %	38 %	3 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

For healthy growth of silkworms, consecutive cleaning is a key but only 12 percent of farmers are able to fulfil this condition, 47 percent clean their rearing beds completely after one day and 38 percent clean after two days but they remained in touch with partial cleaning. More old waste is not good for silkworms and there are only 3 percent farmers who delayed the complete cleaning process for third day.

Maintenance of Internal Conditions

Maintenance of internal conditions of rearing rooms like temperature, humidity, ventilation and light are necessary and rapid changes in these may cause bad impact on health and growth of silk worms. Ideal temperature for silkworm rearing is $24C^0$ - $27C^0$ and required humidity is about 70 - 85 % [3]. Normally silkworms are reared in spring season and it is a blessing of nature that spring season circulates in different localities of Pakistan throughout the year. Although during spring season natural conditions are supportive for silkworm rearing yet proper arrangements for maintenance of such conditions are also

essential. Pakistan is situated in sub-tropical region where temperature and climate vary from place to place. Fluctuations in temperature may also be due to rotation of day and night, due to wind, rain and direct sunlight on rearing room. It is also a fact that in northern areas of Pakistan, at night time temperature drops below $20C^0$ and in southern areas, at day time temperature increases to above $30C^0$.

Maintenance of rearing room climate is a serious issue in Pakistan. Farmers apply different techniques to maintain these conditions. Although these techniques are effective but due to unavailability of proper rearing rooms these techniques brought fewer impacts.

Table 7. Maintenance of Internal Conditions

Full Capability	Good Capability	Average Capability	Low Capability
19 %	22 %	52 %	7 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

Results indicate that only 19 percent farmers have full control and capability to maintain the required climatic conditions, 22 percent have good capability to maintain these conditions, 52 percent have average capability and 7 percent have low capability to maintain the standard climatic conditions of their rearing room.

Moulting

During larval growth phase silkworm moults four times. After achieving the maximum growth in one stage, worm stops to eat and takes a 20 to 30 hour sleep.

After awaking worm removes his existing skin and put on a new and elastic skin which allows him for further growth.

Before moulting, cleaning and drying the bed is important so that worms could settle uniformly and conveniently.

During moulting worms should not be disturbed and feed should be given when more than 90 percent worms come out from moult [2].

Table 8.Moulting

Fully Aware	Sufficient Knowledge and Experience	Less Knowledge and Experience
81 %	13 %	6 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

Results from the above table show that in Pakistan 81 percent farmers are well aware about moulting, 13 percent have sufficient knowledge and experience about moulting while, 6 percent have less knowledge and experience about moulting.

Mounting

After fourth moult, silkworms stop feeding and get ready for mounting. In mounting, silkworms seek some specific frames to settle for cocoon spinning. For mounting, timely support of worms is a key of healthy cocoons. Mounting requires specific branch frames having space of 40-50 worms per square feet. Silkworms spin cocoons in 2-3 days and these cocoons should be collected efficiently [12].

Table 9. Mounting

Fully Aware	Sufficient Knowledge and Experience	Less Knowledge and Experience
76 %	17 %	7%

Source: MS thesis of the author, Muhammad Farooq Hyder.

Results of the study reveal that 76 % farmers are fully and well aware about mounting, 17 percent have sufficient knowledge and experience and 7 percent have less experience about mounting techniques.

Mortality

In silkworm rearing mortality ratio of worms is a critical factor. Low or normal mortality is considerable but in Pakistan mortality ratio is very high. Although availability of insufficient rearing rooms is also an issue but main reason of mortality is poor quality of silk seed.

Cocoon Production

The main Purpose of all previous mentioned efforts is to achieve the good cocoon production. Findings of study indicate that in Pakistan, cocoon production results are very poor and disappointing. Although, lack of standardized conditions have also a role but

main reason behind low productivity is low quality of silk seed.

Currently, in Pakistan there are two government departments where silk seeds are prepared and distributed i.e., department of sericulture, Punjab and directorate of sericulture, AJK. Production result of both silk seed providers are mentioned in separate tables.

Productivity of Punjab Silk Seed

Including other factors, main reason of low cocoon productivity in Pakistan is its lack of advancement in silk seed varieties. Currently, Punjab's sericulture department does not have any reliable silk seed variety and productivity of Punjab silk seed varieties are almost zero. During observations, rather responding on cocoon production, sericulture farmers responded about mortality of worms.

Table 10. Mortality

100 % Mortality	95 % Mortality	90% Mortality
90 %	7 %	3%

Source: MS thesis of the author, Muhammad Farooq Hyder.

About all farmers responded that silk seed packets distributed by Punjab's sericulture department were very poor in quality. They claimed that during first four stages i.e., from hatching to fourth instars their silkworms remained healthy and grew well but at final stage worms started to change their color and swelling appeared on their body, after this, silkworms started to die. About 90 percent farmers claimed that before reaching the mounting stage, almost 100 percent worms died, 7 percent responded that they lost about 95 percent and 3 percent responded that their 90 percent worms died and they got small and low quality yield.

During an interview, Shakeel Khan, senior research officer, Punjab department of sericulture conferred that Punjab silk seed has damaged and remained not capable to produce further. So there is a great need to generate some new and reliable silk seed varieties. He also claimed that Punjab sericulture department is trying to import some reliable foreign silk seed varieties which would be used in further research and development of new varieties.

Productivity of AJK Silk Seed

Productivity of AJK silk seed varieties are comparatively better than Punjab silk seed. AJK silk seed packets are mostly distributed in AJK localities. Some farmers from Punjab who are still engaged in sericulture with enthusiasm and they also have good rearing room arrangements, responded that for silk worm rearing they only prefer AJK silk seed. Most of AJK farmers responded that in past, AJK silk seed was more productive then present. They also argued that currently resistance of AJK silk seed against severe climatic conditions is decreased many times.

Table 11. Cocoon Production of AJK Silk Seed

0-5 Kg	5-10 Kg	10-15 Kg	15-20 Kg
12 %	47 %	32 %	9 %

Source: MS thesis of the author, Muhammad Farooq Hyder.

From the above mentioned results, it is clear that 12 percent farmers obtained 0 to 5 kg of cocoons, 47 percent farmers produced five to ten kg cocoons, 32 percent produced ten to fifteen kg and 9 percent got the production of fifteen to twenty kilograms cocoons. During an interview, Sardar Muhammad Shafiq Khan, Director General of AJK Directorate of Sericulture, assured that in standardized rearing conditions, AJK silk seed is capable to produce up to twenty five kilograms of silk cocoons. He also accepted that due to lack of advancement in innovation and technology, production results of AJK silk seed varieties have decreased but still these varieties have capability of advancement and further research could make them more productive.

Silkworm Feed

Mulberry leaves are the feed of silkworms and they eat them with eagerness and their hunger never ends. Ideally one packet of 40,000 silkworms requires about 800-1,000 kilo grams of mulberry leaves [6]. In Pakistan rearing activities are mostly performed near forest localities. In past, those forests were filled with huge number of mulberry and other trees but massive cutting demolished these forests badly [8]. For promotion of sericulture, enhancement in mulberry forest

areas is equally important as provision of quality silk seed and standard rearing conditions.

State and NGOs Support

Various countries of the world had made a significant improvement in silk production. In those countries, state sericulture departments and NGOs have a strong collaboration and they are facilitating the farmers through different schemes and programs [11].

During survey almost 100 percent farmers and sericulture staff responded that since a long time, not even a single promotional program is initiated by state and there is not even a single NGO which is interested to promote sericulture in Pakistan.

CONCLUSIONS

Results show that Pakistan's sericulture industry is near to end and the main reason behind this is negligence of the state. Results of the study also indicate that although Pakistani silk farmers have sufficient knowledge and experience but they need a proper support and assistance from state department to convert the sericulture industry into a profitable industry. The present study suggests that it is need of the hour to explore and promote sericulture industry by improving silkworm rearing practices in Pakistan in a better way hence employment opportunities can be created for a large number of poor and deprived rural populations.

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REGIONAL DISPARITIES IN SLOVAK AGRICULTURE

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Abstract

Regional disparities can be perceived as a cross-cutting category of many disciplines, but most often they can be perceived as economic differences of regions' level of maturity. Regional disparities in business are addressed mainly by Asian countries. In European countries, research on regional disparities in agriculture is paying less attention. The article focuses its attention on the research of regional disparities in the field of agriculture. The analysis of the series of production and economic indicators showed that, instead of the expected convergence of the development of agriculture in the individual regions of Slovakia, the regions diverged in the monitored period. What is contrary to the European Union's endeavor to ensure convergence of regions under the regional and cohesion policy for 2014-2020.

Key words: r*egional disparities, regions, convergence, production and economic indicators*

INTRODUCTION

The concept of regional disparities is defined as a measure of variation in the expression of the intensity of the economic phenomenon observed within the regions of a given country and with slight modification [23, 24]. The OECD definition focuses only on economic phenomena through which differences in the level of develepment of regions are most often perceived [19]. However, there are more comprehensive definitions of regional disparities. Regional disparities represent the existence of a number of regional disparities, which are ultimately reflected on the level of human development conditions of living in the region [1]. Regional disparities can be seen as differences in the quality of life, wealth, standard of living of people living and working in different regions [8]. Regional disparities can be understood as deviations from some imaginary division reference characters that are considered relevant to the different spatial levels of scale (boundary region) [31]. Regional disparities distances between regions can be considered in abstract metric space, which can be described either by one selected descriptive indicator of the region or by a set of these indicators, not only statically but also dynamically [10]. Disparities can be measured by lack of cohesion, which is also the basis for European Union policies [21].

Regional disparities can be defined as differences or inequalities of features, phenomena or processes that have a clear territorial location (can be allocated within a defined territorial structure) and that occur in at least two entities of this territorial structure [18]. Regional disparities as the difference between regional development and the critical value of selected economic, social and territorial indicators, while the critical value is defined as the median value of the indicator for the whole country with ± 5% tolerance limit [9].

Disparity is often seen as a negative phenomenon, which should be eliminated. However, not all disparities are undesirable phenomena, e.g. regional disparities can be seen as positive in terms of comparative advantages of a particular region, but also negative as unjustified differences in the level of economic, social and environmental development of regions [14]. Negative disparities are often referred in SWOT analyzes as weaknesses of the monitored object and positive disparities, which can be

described as strengths of the examined object. Several authors point out that examining the causes of regional disparities requires a multidimensional approach [18, 30, 12, 13].

Development disparities are the result of development differentiation of social systems, while the effectiveness of their regulation is determined by the degree of respect for the laws of their socio-geographical and socio-economic organization [30]. The causes of regional disparities can be seen in different natural-geographical conditions, the extent and quality of the socio-economic potential of regions, as well as the impact of diverse historical and socio-economic factors [6]. According to them, the individual regions due to different historical, geographical, socio-economic and social conditions have different starting capital, the quality of human capital, infrastructure and adequate to this progress their growth and development is beeing realized.

For the causes of disparities can be regarded the inability of the regions to adapt to economic and social transformation that may be due to the nature of the productive structure, accessibility and remoteness of the region from markets, poor transport and infrastructure, weak public administration, poor structure of labor supply, unfavorable demographic profile and absence of regional policy [4]. The main causes of regional disparities in Slovakia are the primary potential of the territory, the structure of the settlement network, the attractiveness of macro-positions, the economic specialization of regions, the impact of globalization, EU support, public administration and internal resources [16]. Some studies pointed out the importance of the EU membership on regional development from the enterprise point of view [15, 22]. Despite a large number of empirical studies, the results of investigating the causes of regional disparities are not clear [11].

Regional disparities in business are mainly researched by the authors of Asian countries, mostly from India and Nepal [2, 3, 26, 27]. In European countries, to the research on regional disparities in agriculture is paid less attention. While it is true that tertiary and secondary sectors are the key sectors of regional development, agriculture still plays an important role in the development of rural areas. This is also evidenced by the EU Common Agricultural Policy, which has been a key policy of the European Union since the creation of the European Communities. Therefore article focuses its attention on the research of regional disparities in the field of agriculture, which has its importance in the European countries, especially in their rural areas.

MATERIALS AND METHODS

The article uses data from the Statdat and Datacube databases of the Statistical Office of the Slovak Republic. The first partial objective is to assess the current state of Slovak agriculture through a series of production-economic indicators (gross agricultural output, gross value added, sales of agricultural production, the average number of employees in agriculture, the number of natural and legal persons in agriculture and average monthly wage in agriculture) transformed for the need of comparability for the period 2001 to 2016 measured in individual regions of Slovakia (NUTS III). The following regions (Fig.1) were evaluated: Bratislava region (BA), Trnava region (TT), Trenčín region (TN), Nitra region (NR), Žilina region (ZA), Banská Bystrica region (BB), Prešov region (PO) and Košice region (KE).

Fig. 1. Map of NUTS III region in Slovak Republic
Source: Ministry of Agriculture and Rural developlemnt of Slovak Republic [20].

In the second sub-objective, we have compiled a model based on sixteen consecutive cluster analyzes, which monitor

the development of regional disparities in agriculture in individual regions of Slovakia for the period from 2001 to 2016. The identification variable of the cluster analyzes were eight regions of Slovakia; the homogeneous homogeneity and the individual indicators that entered the model did not show any significant correlation between them. The cluster analysis was realized with the use of Statistical Analysis System software.

We have based the research on six transformed indicators, namely gross agricultural output per 1 ha of agricultural land in EUR (GAO), the share of agriculture in total gross value added per 1 ha of agricultural land as a percentage (GVA), number of natural persons per 1,000 ha of agricultural land. land, number of legal persons per 1,000 ha of agricultural land, average monthly nominal wage in agriculture in EUR (Wage) and number of employees in agriculture per 1,000 ha of agricultural land.

RESULTS AND DISCUSSIONS

Development of regional disparities in the agricultural sector in Slovakia

One of the basic indicators of the series of production-economic indicators is agricultural production, whose status can be quantitatively evaluated on the basis of gross agricultural output (GAO in current prices in thousands of euros). In our research we have independently monitored gross agricultural output in crop and livestock production between 2001 and 2016.

The level of gross agricultural output in Slovakia (Fig. 2) reaches a value oscillating around EUR 2 billion per year, whereas the largest gross agricultural output fluctuation occured during the economic crisis after 2008 and have been stabilized in the year 2011.

More interesting, however, is a concrete analyses of livestock and crop gross agricultural output, where it can be seen that since 2007, crop gross agricultural output has had a greater impact on overall gross agricultural output. In the short term, this trend prevailed in 2004, when crop gross agricultural output exceeded livestock gross agricultural output by almost EUR 30 million.

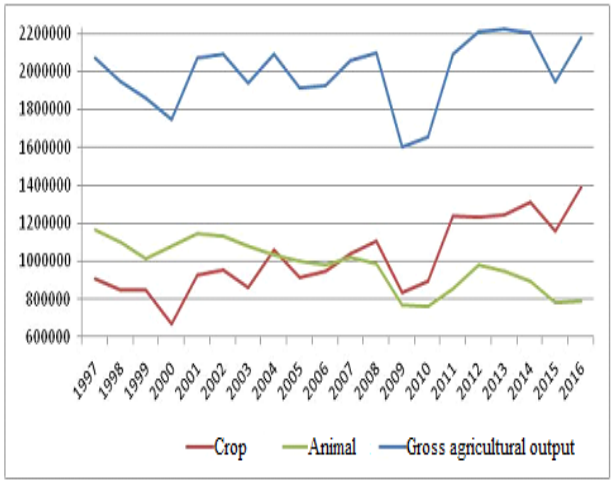

Fig. 2. Gross agricultural output at current prices in thousands of euros
Source: Own calculations based on Statdat data [28].

For better comparability of regions, we have calculated gross agricultural output per hectare of agricultural land in the given region and we have separately monitored crop and livestock gross agricultural production. Crop production as an essential part of agriculture is considered as a limiting factor in the development of livestock and crop production at all. The total production of crop products depends on harvested areas and hectare crops, which fluctuate in individual years. The key crop production sector with the greatest importance in the nutrition of the population is the cereals industry, which belongs to the group of crops with signs of lower costs per unit area. Wheat, barley and corn have the most important position in crop rotation in Slovakia [17].

Crop gross agricultural output (Fig. 3) in the observed period shows an increase in all regions of the Slovak Republic, but especially in the Bratislava region, where crop gross agricultural output increased almost 2.5 times and in the Trenčín, Žilina, and Košice regions, where it increased by more than 40% compared to 2007. However, the largest share in the total increase in gross agricultural output was observed in the Bratislava, Trnava and Nitra regions, which have a significant position in this area. The above figure shows that the differences in gross crop production in the observed period between individual regions deepen.

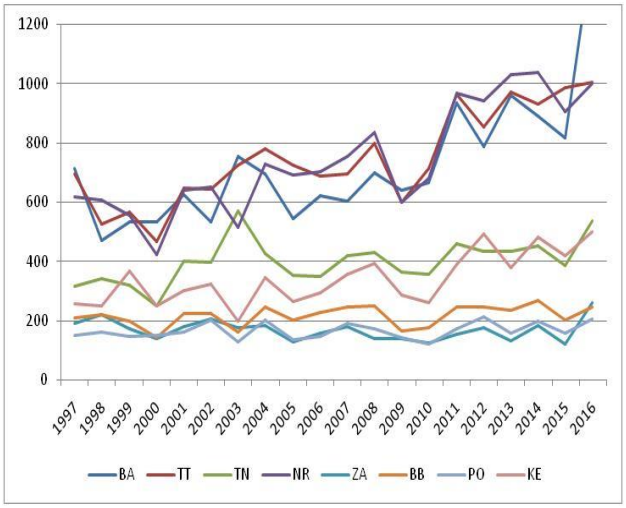

Fig. 3. Gross agricultural output in crop production in EUR per ha of agriculatural land
Source: Own calculations based on Statdat data [28].

Individual products of animal origin have significantly different input requirements. This is influenced on the one hand by the biologically determined ability to use the energy of feed, but also by the different level of breeding and intensity of productivity. The main reserves for streamlining animal production are in the rational intensification of efficiency (reduction of costs per unit of production) and in the optimization of the species structure of animal according to available feed sources [5]. Livestock gross agricultural output (Fig. 4) shows a decrease in 2016 compared to 2007 in six regions of the Slovak Republic, with the exception of two, where livestock gross agricultural output increased by 67% in the Bratislava region and by 17% in the Prešov region. However, the largest contributors to the overall decrease in livestock gross agricultural output were the Trenčín region, where the decrease in livestock gross agricultural output was 44%, the Trnava region with a decrease of 23% and the Nitra region with a decrease of 36% in 2016 compared to 2007 and the Trnava region. The Košice region had a small impact on the changes with a decrease of 38.5%, but due to a longer period of time, compared to 2001. Differences in gross livestock production between the regions deepened during the observed period and from 2013 onwards these differences are starting to narrow, although they have still not reached the minimum value of the 2001 standard deviation.

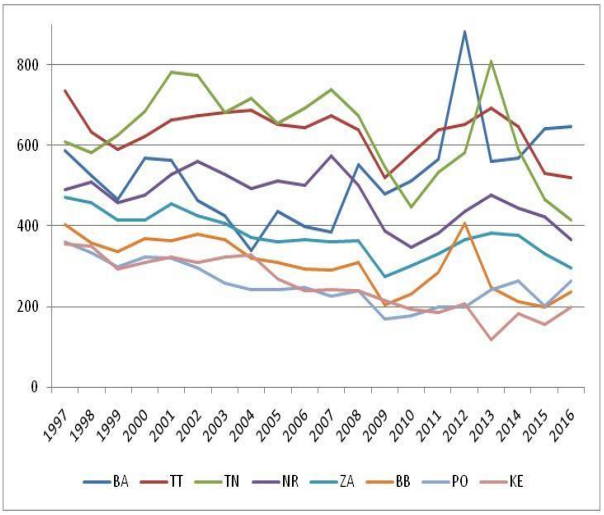

Fig. 4. Gross agricultural output in livestock production in EUR per ha of agricultural land
Source: Own calculations based on Statdat data [28].

The value added of the agricultural sector is the result of its production activity per calendar year, it is used to measure the performance of agriculture and is calculated as the difference between the resources created (value of total production) and consumption (production consumption, so-called intermediate consumption). This is gross value added in agriculture. After subsequent deduction of consumption of fixed capital we receive net value added [17].
In order to evaluate the overall level of Slovak agriculture in individual regions, we chose as another indicator the share of gross value added in agriculture in the region in the total gross value added of the region in terms of 1 ha of agricultural land for the period 2001 to 2016. In general, we can state (Fig. 5) that the share of agriculture in the total gross value added per 1 ha of agricultural land has declining trend in most regions. The most radical decrease in this share can be seen on the curve of the Trnava region, where the share of agriculture in the total gross value added per 1 ha of agricultural land decreased by up to 46%. The smallest decrease was recorded in the Bratislava region and the only region in the Slovak Republic in which the share of agriculture in the total gross value

added per 1 ha of agricultural land increases after 2007 is the Banská Bystrica region.

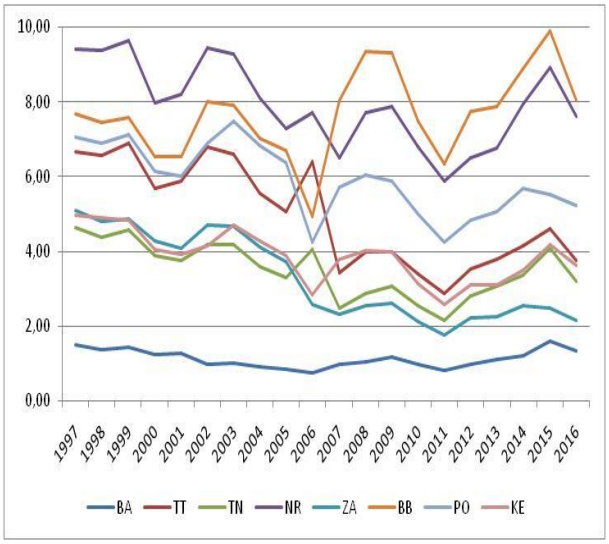

Fig. 5. Share of agriculture on Gross value added per ha of agriculatural land
Source: Own calculations based on Statdat data [28].

The decrease in net value added in Slovak agriculture was significantly due to a change in the structure of production, mainly due to a dramatic decrease in the share of animal production in total agricultural production (from 45% to 38% in 2011), which was the steepest decline among all neighboring countries [29].

Following on from the previous indicators, it is also appropriate to examine changes in agricultural sales, as a larger volume of production creates preconditions for a larger volume of sales. However, the development of this indicator is also influenced by the quality of finished production reflected in the different level of realization prices, which also depends on the regional possibilities of the region. We examined agricultural sales specifically for crop and livestock production in the observed period of sixteen consecutive calendar years 2001 to 2016. Fig. 6 also shows the impact of the economic crisis on agricultural sales, which was reflected in a decline in sales in 2008-2010. Analogous to gross agricultural output, we monitor separately sales from livestock and crop production.

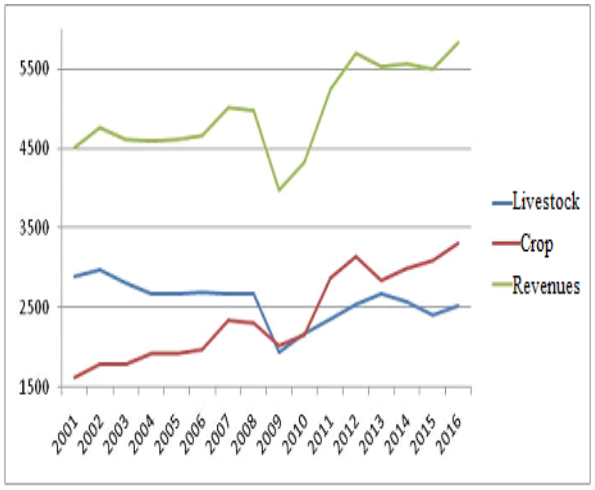

Fig. 6. Revenues from agricultural production in EUR per 1 ha of agricultural land
Source: Own calculations based on Statdat data [28].

Revenues from crop production in EUR per 1 ha of agricultural land (Fig. 7) reflect the development of crop gross agricultural output and show an increase in all regions of the Slovak Republic. Assuming that we examine in more detail the increase in revenues in 2016 due to the period of economic crisis and thus 2009, we can say that the regions with the greatest impact on changes in agricultural sales are Bratislava, Trnava and Nitra region, of which in the Bratislava region 120%, in the Trnava region by almost 60% and in the Nitra region by 47%.

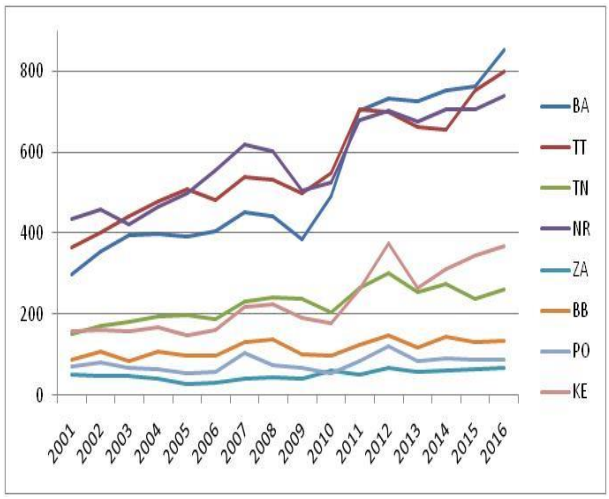

Fig. 7. Revenues from crop agricultural production in EUR per 1 ha of agricultural land
Source: Own calculations based on Statdat data [28].

Although the Košice region has a weaker influence on changes in sales in agriculture and from a visual assessment it can be argued

that the economic crisis did not fully manifest itself here until 2010, when sales from crop production reached their minimum, but in 2016 sales in the Košice region were from crop production. more than doubled compared to 2010. Differences in revenues in crop production between individual regions deepen significantly during the observed period, similarly as in the case of gross crop agricultural output.

All regions of the Slovak Republic, with the exception of the Bratislava region (increase by 40%) and the Košice region (increase by 1.5%), show a declining trend in revenues from livestock production, similarly to the indicator of livestock gross agricultural output in the whole observed period 2001-2016. (Fig. 8). However, from the point of view of the impact of the economic crisis, which did not avoid even revenues from livestock production, we can speak of an increase in revenues in all regions of the Slovak Republic.

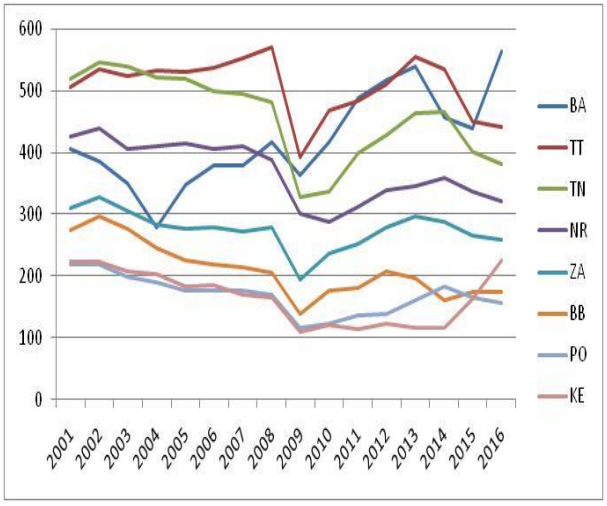

Fig.8. Revenues from livestock agricultural production in EUR per 1 ha of agricultural land
Source: Own calculations based on Statdat data [28].

In the Bratislava region, revenues from livestock production increased by more than 200 euros per 1 ha of agricultural land, in the Trnava region by almost 50 euros per 1 ha of agricultural land and in the Košice region it was by 117 euros per 1 ha of agricultural land but with little impact on changes in revenues of agricultural production. Differences in revenues from livestock production between regions have a growing trend in the observed period, although with more moderate dynamics and in the case of crop production.

In addition to land and capital, the labor factor is an important production factor in agriculture, therefore when analyzing the level of agriculture, it is necessary to examine also the wages factor, which form a crucial component of labor costs, the number of employee in the sector and the number of agricultural subjects.

The number of employees in agriculture in the observed period 2001 - 2016 is decreasing. The most radical year-on-year decrease in employees is in the Nitra Region, where there is a decrease of more than 10,300 employees; resp. a decrease of 60%, in the Banská Bystrica region, where there is a decrease of almost 9,000 employees; resp. a decrease of 64% and in the Trnava region with a decrease of employees working in agriculture by about 8,500 employees; resp. a decrease of 62% compared to 2001.

In the context of the average percentage of employees working in agriculture with the average registered number of employees in individual regions (Fig. 9), it should be mentioned that in 2016 only 4.34% of the total number of employees in the region worked in agriculture in the Nitra region, which is or 7.01 pp. less than in 2001, in the Trnava region even by up to 7.23 pp. (3.75% in 2016) fewer employees and in the Banská Bystrica region by 5.28 pp. (3.42% in 2016) fewer employees working in agriculture.

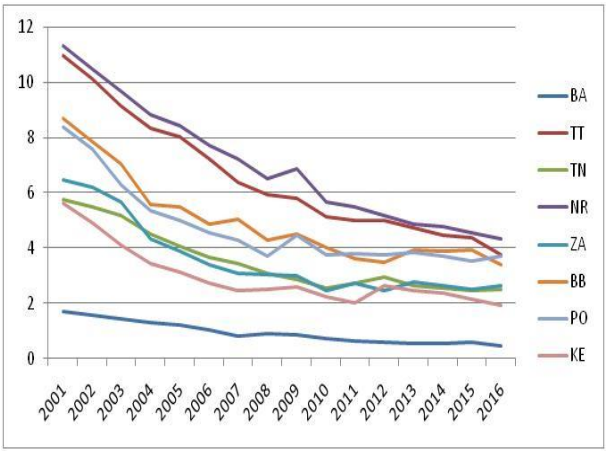

Fig. 9. Average number of employees in agriculture in individual regions of Slovak Republic (in %).
Source: Own calculations based on Statdat data [28].

This is one of the few indicators where regional differences between regions are gradually decreasing (the development of the standard deviation has a declining trend).

From the above, it could be concluded that the attractiveness of employment in agriculture is still declining. However, this is not confirmed by the growing trend in the number of businesses in agriculture. The higest number of natural persons per 1,000 ha of agricultural land during the whole monitored period 2001-2016 were identified in the Prešov region and the least in the Nitra region (Fig. 10). After 2007, only the Žilina region shows a continuing trend of dynamic growth in the number of natural persons, where the number increased by approximately 5 natural persons per 1,000 ha of agricultural land after 2007 and the Bratislava region with a year-on-year increase of 1 person per 1,000 ha of agricultural land after 2007. The Nitra and Trnava regions report year - on - year stability of the number of natural persons per 1,000 ha of agricultural land, and in the remaining regions of Slovakia is this number decreasing year - on - year compared to 2007. In the Prešov region, this decrease represents 3.36 of natural persons per 1,000 ha of agricultural land.

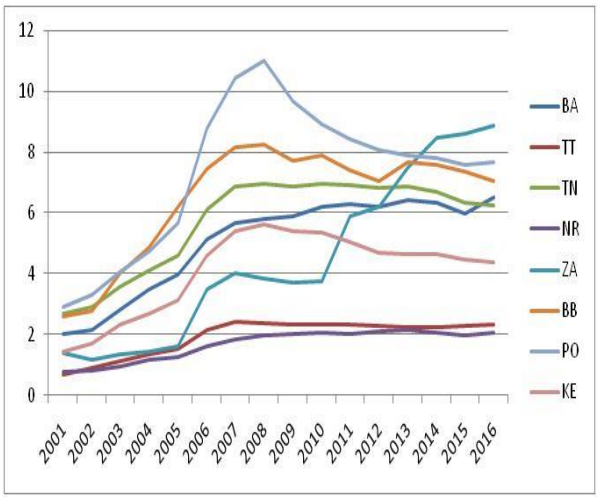

Fig. 10. Number of natural persons per 1,000 ha of agricultural land in individual regions of Slovak Republic.
Source: Own calculations based on Statdat data [28].

In the run-up to the economic crisis, regional disparities increased in the number of natural persons in agriculture. After the crisis, the number of natural persons in agriculture has stabilized, as have the differences between regions (the standard deviation has not changed significantly over the last four years).

The growth in the number of natural persons in all regions of Slovakia before 2005 can be considered stable and comparable in all regions of Slovakia (Fig. 11). After 2005, the number of natural persons in all regions began to rise more radically, but this trend lasted only 2 years. Consequently, it can be said that the growth in the number of natural persons per 1,000 ha of agricultural land has stabilized.

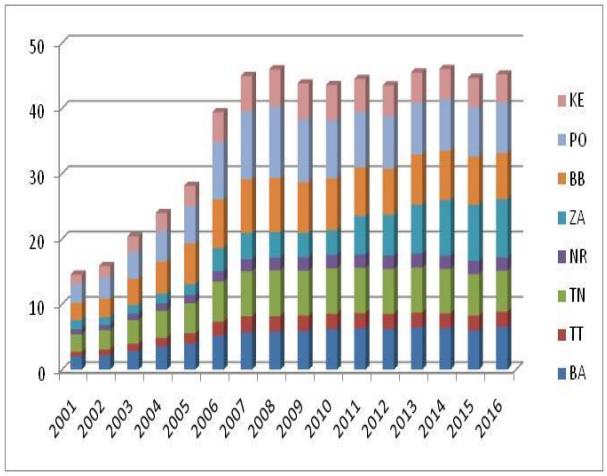

Fig.11. Number of natural persons per 1,000 ha of agricultural land in individual regions of Slovak Republic.
Source: Own calculations based on Statdat data [28].

The increase in the number of natural persons per 1,000 ha of agricultural land since 2001 has been mainly influenced by the Žilina region (7.5 natural persons per 1,000 ha of agricultural land), the Bratislava region (4.5 natural persons per 1,000 ha of agricultural land) and the Nitra region (1.3 natural persons per 1,000 ha of agricultural land).

The number of legal entities per 1,000 ha of agricultural land (Fig. 12) shows a growing trend during the whole monitored period 2001-2016 with the largest growth in Bratislava (4.24 legal entities per 1,000 ha of agricultural land) and the Žilina region (2.32 legal entities per 1,000 ha of agricultural land). It can be said that after 2014, this growth stabilized. The least dynamic increase in the number of legal entities per 1,000 ha of

agricultural land in the entire monitored period 2001 - 2016 was recorded by the Nitra region.

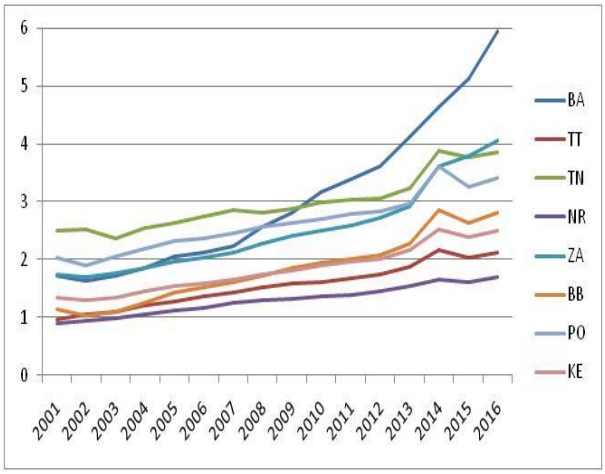

Fig. 12. Number of legal entities per 1,000 ha of agricultural land in individual regions of Slovak Republic.
Source: Own calculations based on Statdat data [28].

Differences in the number of legal entities between regions increase exponentially during the period under review (Fig. 13).

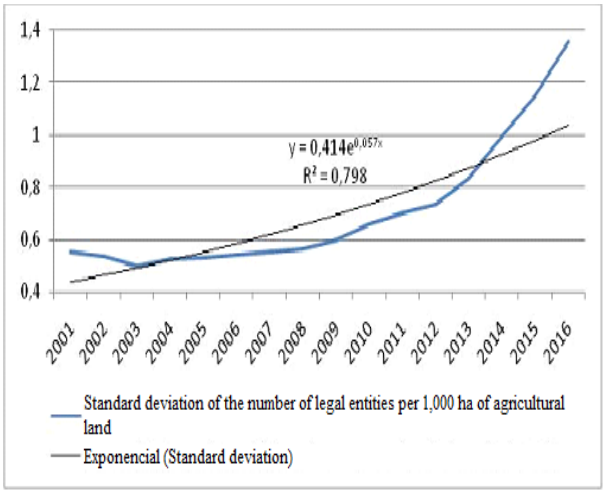

Fig.13. Standard deviation of the number of legal entities per 1,000 ha of agricultural land between individual regions of Slovak Republic.
Source: Own calculations based on Statdat data [28].

The agricultural sector does not attract capable and creative workers if there is no fair social reward on which the social status of qualified agricultural professionals is based [25]. It is needed to support such a programs focusing on the promotion of employment and income for young people, especially in the most vulnerable regions because of low wages in agriculture, quite logically, do not attract the younger generation, qualified and skilled workers who move to other employed attractive sectors and professional activities [7].

Wages in agriculture are constantly increasing with increasing average gross nominal monthly wage of an employee in Slovakia (Fig. 14). In the Banská Bystrica region, a phenomenon can be seen in 2007, which manifested itself in a short-term higher (by 5.20 EUR) average gross nominal monthly wage of an employee in agriculture. The economic crisis has also affected a short-term decline in wages in this area of agriculture in the period 2008-2010. The average gross nominal monthly wage of an employee in agriculture in the observed period increased mainly in the Košice region, where it reaches 84% of the average gross nominal monthly wage of an employee in the region (increase by 8 pp.), the Nitra region to 97.7% in 2016 (increase by 7.13 pp.) and the Banská Bystrica region to 95.2% (an increase of 7.07 pp.). The average gross nominal monthly wage of an employee in agriculture in the observed period decreased (by 2.4 pp.) only in the Žilina region, where it reaches 85.3% of the average gross nominal monthly wage of an employee in this region.

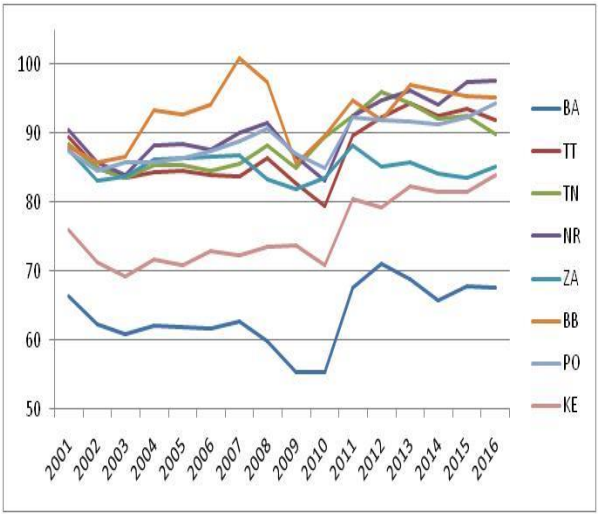

Fig. 14. Percentage expression of the average gross nominal monthly wage of an employee in agriculture with respect to the average gross nominal monthly wage of an employee in individual regions of Slovak Republic.
Source: Own calculations based on Statdat data [28].

The lowest average gross monthly wages compared to the average wage of the region are in agricultural workers in the Bratislava region, only 67.7% of the average gross nominal monthly wage of an employee, despite the fact that these wages are the highest among the evaluated regions [7].

However, the phase of wage modesty in agriculture should be overcome and preferring higher wages is the new strategy. In the past, job retention was preferred to wage increases.

When increasing innovations by introducing new technologies, labor productivity and the substitution of live labor will increase significantly, and this will subsequently enable the diversification of production into other activities and thus the improvement of the overall economic result.

Evaluation of regional disparities in the agricultural sector of Slovakia

Based on a series of production and economic indicators, which we evaluated in the previous chapter, we compiled a model based on sixteen consecutive cluster analyzes monitoring the development of regional disparities in agriculture in individual regions of Slovakia for the period 2001 to 2016.

During sixteen consecutive years, the regions of Slovakia on the basis of a series of production-economic indicators divided into 2 statistically significant clusters (groups). The first group includes the regions of Central and Eastern Slovakia (Banská Bystrica, Žilina, Prešov and Košice region) and the second group includes the regions of western Slovakia (Bratislava, Trnava and Nitra region). The Trenčín region initially belonged to the second group of regions, but over the years it regrouped into the first group of regions. To illustrate the results of the cluster analysis, we use a dendrogram (Fig. 15 and Fig. 16).

The first group of regions does not show significant differences over time, but the second group has undergone minor changes. In 2003, the Trnava region began to be separated from the Bratislava, Nitra and Trenčín regions towards the first group, and in 2005 the Nitra region joined it, but in further development the Trnava region again caught up with the results of the Bratislava region.

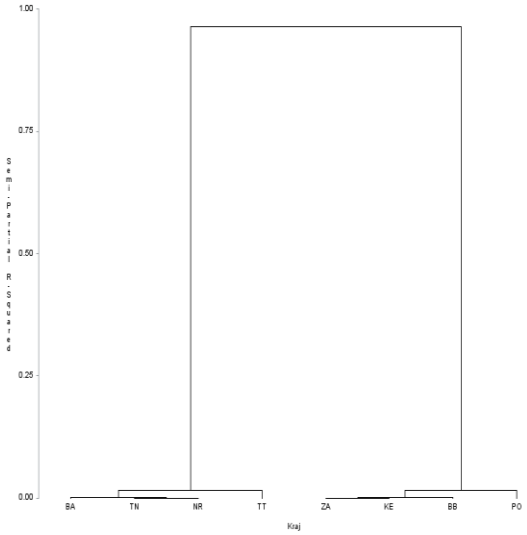

Fig. 15. Dendrogram with the results of the cluster analysis of regions in Slovak Republic for the year 2001

Source: Own calculations with the use of SAS software.

The Trenčín region began to lag behind the Bratislava region together with the Nitra region. This lag was more pronounced in 2011 and 2012, when the Trenčín region was already one of the first group regions. He managed to improve his position vis-à-vis the others from the first group for two years, and again the mentioned production and economic indicators are closer in value to the more developed second group of regions in Slovakia.

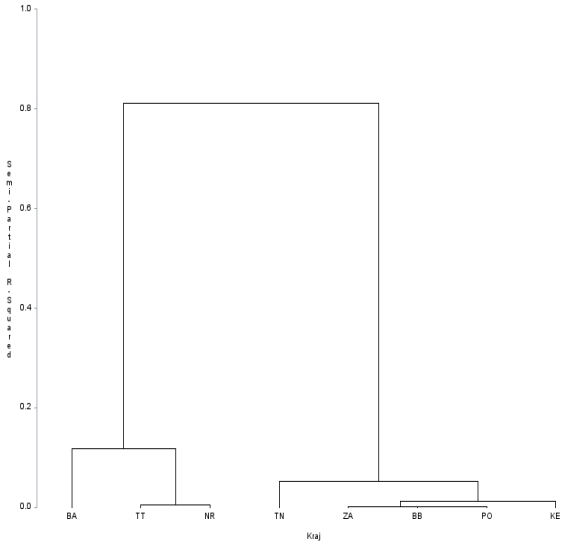

Fig.16. Dendrogram with the results of the cluster analysis of regions in Slovak Republic for the year 2016

Source: Own calculations with the use of SAS software.

In 2015, the results of these indicators in the Trenčín region were again closer to the indicators from the first group of Slovak regions.

The development of regions and the results of the regions of the second group of Slovakia from 2016 even suggest that in the future we can expect a complete separation of the Bratislava region from the Trnava and Nitra regions in terms of production and economic indicators of agricultural development in Slovakia.

Based on the development of the standard deviation of production and economic indicators, it can be stated that in the following indicators: gross agricultural production per 1 ha of agricultural land in euros, share of agriculture in total gross value added per 1 ha of agricultural land, number of natural persons per 1,000 ha of agricultural land and the number of legal entities on the 1,000 ha of agricultural land regions of Western Slovakia (the second group) demontrate a higher degree of regional diversity as the region Central and Eastern Slovakia (the first group). However, the regions of Central and Eastern Slovakia (first group) show greater diversity in the following indicators, the average monthly nominal wage in agriculture and the number of employees in agriculture per 1,000 ha of agricultural land, in comparison to the regions of western Slovakia (second group).

CONCLUSIONS

Based on the evaluation, we can state that there are differences between the regions of western Slovakia and the regions of central and eastern Slovakia, and these differences even deepen in the observed period. In the near future, we can even expect the creation of the third separate cluster, which will include the Bratislava region, if there are no significant positive changes in the monitored indicators in the Nitra and Trnava regions (especially in the indicators of gross agricultural output and wages). Instead of the expected convergence of agricultural development in individual regions of Slovakia, it turned out that the regions diverged from each other. The lowest differences between regions in most of the monitored indicators were in the observed period in 2001 and the highest in 2016. It can therefore be concluded that regional disparities between regions are currently deepening, which is in contrast to the European Union's efforts to ensure the convergence of regions within the framework of regional and cohesion policy for the years 2014-2020. Based on the research results, it could be concluded that the attractiveness of employment in agriculture is still declining. However, this is not confirmed by the growing trend in the number of businesses in agriculture After the crisis in the year 2008, the number of natural persons in agriculture has stabilized. In order to reduce regional disparities in agriculture, more attention should be paid to EU support measures in agriculture targeting more effectively in order to provide more support options for young, small and individual farmers farming in areas with Natural Constraints f.e. with the focus on increasing innovations by introducing new technologies promotion of employment and income for young people.

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ORGANIC FARMING VERSUS CONVENTIONAL FARMING: CASE STUDY, DORNELOR BASIN, SUCEAVA COUNTY, ROMANIA

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Abstract

In the current context of increasing concerns for healthy agri-food systems, the adoption of ecological farming practices has gained ground and visibility both as sustainable approach to the farming activity and as scientific approach. The paper intends to analyse the differences between the organic and conventional systems of livestock raising in Dornelor Basin, Suceava county. The comparison of the two systems was based on several dimensions – labour, agricultural incomes, use of agricultural inputs, adoption of ecological farming practices, etc. The results obtained showed that both farming systems support, in different proportions, the health of ecosystems and inhabitants in the investigated area.

Key words**:** *ecological farming, conventional farming, Dornelor Basin - Suceava*

INTRODUCTION

For several decades, in the European countries, modern agriculture has developed from traditional, natural farming to highly productive, industrial systems. The use of large amounts of external agricultural inputs has caused a series of problems to the environment, such as contamination with pesticides, soil degradation and erosion, etc. However, in some countries, in marginal areas in particular, an orientation to ecological farming systems could be noticed, which use lower amounts of external inputs and focus, with different intensities, on sustainability aspects [16, 9].

Comparing the two systems is important in the approach to identify the best farming system that can sustainably meet the needs of the environment and population (Table 1).

The paper analyses the differences between ecological and conventional farming in Dornelor Basin, where favourable conditions exist for the development of the livestock sector, considered a high favourability area for cattle raising (mainly dairy cows) [14].

Table 1. Main characteristics of the ecological and conventional systems

Ecological farming
The ecological farming systems are more resilient to the changes of environmental conditions, on the short and long term, as they are based on: • homeostasis and self-regulation; • adaptive patterns, complex systems and local particularity; • high agro-biodiversity; • integrating crop and livestock; • multifunctionality
Conventional farming
Conventional farming is vulnerable to environmental changes as it is based on: • artificial natural balance, controlled by the application of large amounts of external inputs; • uniformity and homogenization patterns; • genetic improvement and reductionism; • mono-cropping and intensive livestock raising; • maximization of profits through production intensification;

Source: authors' processing based on [1].

MATERIALS AND METHODS

Study area – Dornelor Basin

Dornelor Basin lies in the south-western part of Suceava county, overlapping the relief unit Dorna Depression, consisting of 12

administrative units: 2 urban centers (Vatra Dornei Municipality and the town Broșteni) and 10 communes (Cârlibaba, Ciocănești, Coșna, Crucea, Dorna Arini, Dorna Candrenilor, Iacobeni, Panaci, Poiana Stampei, Șaru Dornei).

Map 1. Suceava county and Dornelor Basins
Source: [11].

Several protected areas have been established in Dornelor Basin over time, the largest area being included in the European Network "Natura 2000". The most important protected area of national interest is Călimani National Park and the best-known sites of Community importance are the natural reserves: *Pietrele Doamnei – Rarău*, *Codrul secular Giumalău*, *Cheile Zugreni*, *Tinovul Mare Poiana Stampei*, *Tinovul Șaru Dornei* etc.

Dornelor Basin has a total area of 221,517 ha, out of which the agricultural area accounts for only 23%. More than 90% of the region's agricultural area is represented by pastures and natural grasslands. Mountain meadows have a high biodiversity, being classified as meadows of high natural value. Thus, the conditions from Dornelor Basin are favourable to livestock sector development, mainly for cattle raising. However, the number of livestock units per hectare is low: 51 LU/ha [14].

Ecological farming is a constant presence in the region: ecologically certified agricultural areas represent 6.3% of total UAA [8]. In 2019, the total ecologically certified agricultural area in Dornelor Basin was 3,289.6 hectares, and the communes with the largest ecologically certified agricultural areas were: Dorna Candrenilor, Panaci and Saru Dornei (Fig. 1).

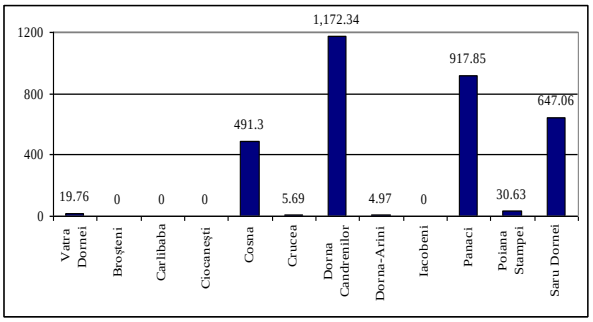

Fig. 1. Distribution of communes in the Dornelor Basin by ecologically certified agricultural area
Source: processing after MARD, 2020 [8].

In 2019, in the Dornelor Basin there were a number of 3,911 ecologically certified cattle, the most numerous being in the communes of Dorna Candrenilor, Panaci and Saru Dornei.

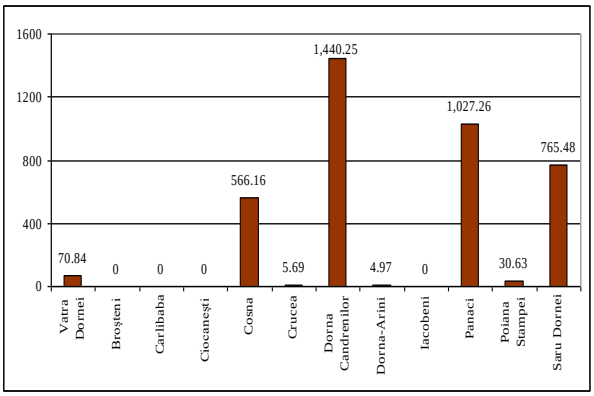

Fig. 2. Distribution of communes in the Dornelor Basin by number of ecologically certified cattle
Source: processing after MARD, 2020 [8].

It should be noted that out of the 12 localities of the Dornelor Basin, four did not have ecologically certified agricultural areas or cattle (Broșteni, Carlibaba, Ciocănești and Iacobeni).

Field survey

To reach the main objective of the paper, i.e. to reveal the differences between raising cattle in ecological system and in conventional system, we used the information collected in a field survey implemented in Dornelor Basin in the year 2019, within LIFT project – Low-Input Farming and Territories – Integrating knowledge for improving ecosystem-based farming, H2020 [7].

A number of 52 questionnaires was applied that contained questions about the general characteristics of farms and farmers, the production practices and the factors that determined the adoption of these practices, alongside with a series of economic information. Thus, data and information were obtained on the practices adopted by farmers in the process of raising dairy cattle.

RESULTS AND DISCUSSIONS

Premises of the analysis

Conventional farming is generally considered a high-input farming type, which includes the use of synthetic chemical fertilizers, fungicides, insecticides and herbicides. However, this term, which is frequently used in the scientific literature, lacks technical content: a general definition shows that conventional farming sums up the prevailing farming practices applied in the region [15].

Conventional farming is often presented in contrast to ecological farming, as the latter prohibits the use of synthetic fertilizers and pesticides. Specialized bodies certify farmers on the basis of a set of production standards. Organic farming is based on sustainable systems, taking advantage of biodiversity and recycling [3].

The comparison between organic farming and conventional farming is present in the literature and covers several areas of interest: population's health [2], environmental impact [13] or biodiversity [6]. Comparing the two systems is necessary in the process of identification of the best farming system that can sustainably meet the needs of the current population.

There are methodological difficulties in comparing the conventional and organic systems that can be also attributed to the lack of knowledge about the diversity of organic farming systems. The main obstacle is represented by the wide range of inputs used in the farming practices all over the world, which do not allow to define a standard management for conventional farms [12].

However, depending on the levels of inputs used, at least two conventional farm management strategies can be distinguished:

(i) high-input or intensive farming systems that are characterized by intensive use of chemical pesticides and fertilizers;

(ii) low-input farming systems or extensive farming systems, terms that can be used interchangeably [10].

Extensive farming is considered here as a very low-input management system that applies very low amounts of fertilizers and pesticides in relation to the low yielding potential of the agricultural area. In addition, the latter type of management can be adopted to respond to specific environmental constraints.

Ecological farming versus conventional farming in Dornelor Basin, Suceava county

In Dornelor Basin, the comparison between the organic and conventional farms targeted several dimensions that are summarized in Table 2.

The organic farm heads are mostly men, the average age of them are 52 years and they have 27 years of farming experience. They need more labour and they hire more permanent and seasonal workers then the conventional farms heads. On average the organic farm head work on week with 11 hours more than the conventional farms one. The share of incomes in total household incomes is 68% in ecological farms, while in conventional farms is 45%. The organic farms have a low density of animals per hectare existing an obvious concern for raising traditional breeds, enhanced by government support.

The share of farms that applied chemical inputs (fertilizers, pesticides and herbicides) was the same in both farms systems, zero. They did no use chemical inputs at all and both types of farms used manure mainly produced on own farms or from neighbouring farms. 42% of organic farms do not used any type of antibiotics.

The farming practices adopted for cattle raising have a strong ecological character in both types of farms. 75% of ecological farms used summer camps for livestock, while only 35% of conventional farms used these types of camps. The organic farms contribute much more to the environmental protection than the conventional farms.

Table 2. Comparison between organic farming and conventional farming – Dornelor Basin

Dimension	Ecological farms	Conventional farms	Remarks/comments
Farm head			
Average age of farm head	52 years	49 years	- organic farm heads, mostly men, are older and have consistent practical experience;
Gender of farm head -male -female	 83% 17%	 68% 32%	
Years of farming experience of farm head	27 years	26 years	
Labour			
Average number of permanent workers	2	1	- organic farms need more labour and consequently hire more permanent and seasonal workers than conventional farms; at the same time, the workload of farm head is higher;
Average number of seasonal workers	3	1	
Average number of hours worked per week by the farm head	53 hours	42 hours	
Agricultural incomes			
Share of agricultural incomes in total household incomes	68%	45%	- the share of income obtained from farming indicates a more pronounced orientation of organic farms towards agricultural activities;
Farm size			
Number of animals per hectare (LU / UAA ha)	0.69 LU/ha	0.42 LU/ha	-organic farms have a low density of animals per hectare; there is also an obvious concern for raising traditional breeds on these farms (enhanced by government support);
Share of farms on which traditional cattle breeds are raised	75%	25%	
Average number of cattle from traditional breeds per farm	5.33	1.18	
Use of production inputs			
Share of farms that applied chemical inputs (fertilizers, pesticides and herbicides)	0%	0%	-there are no significant differences between the two types of farming systems: both farm systems do no use chemical inputs; low exposure to toxic chemicals; - both types of farms use manure mainly produced on own farms or from neighbouring farms; -significant share of organic farms that do not use any type of antibiotic; it is known that excessive use of antibiotics creates resistance and thus makes the treatment of diseases more difficult;
Share of farms that applied manure	100%	100%	
Share of farms that use manure from their own farm or from neighbouring farms (%)	100%	87.5%	
Share of farms that do not use antibiotics to treat animals	42%	25%	
Ecological practices			
Share of farms that use grazing	100%	100%	- the farming practices adopted for cattle raising have a strong ecological character in both types of farms; the grazing systems make it possible to harmonize the lactation period with the vegetation period, to improve feed conversion, to synchronize calving in cows, reduce costs of fodder, reduce costs of fodder preservation; the grazing-based farms are less destructive for soil;
Average number of grazing days	161 days	182 days	
Share of farms that use summer camps for livestock	75%	35%	
Environmental protection and biodiversity			
Share of farms that contribute to environmental protection - shrubs - hedgerows - wetlands	 42% 100% 41%	 20% 3% 15%	-organic farms support eco-system health and biodiversity to a greater extent;

Source: authors' processing, Field Survey conducted under LIFT Project, 2019 [7].

On the basis of data presented, we can draw the conclusion that in Dornelor Basin area, the certified organic farms coexist with conventional farms that use low external inputs. The latter have adopted principles of agro-ecology in one or several stages of the conventional production model, contributing to the diminution of the negative impact on the environment and population. Many of these farms participate in the agro-environmental schemes through which they receive compensations for low production levels and/or higher management costs.

CONCLUSIONS

The analysis of data from the implemented field survey highlights the fact that both farming systems under study support the health of eco-systems and inhabitants in Dornelor Basin area. Both farm types, yet organic farms to a greater extent, are based on ecological practices and processes, on production cycles adapted to local conditions and on the use of local inputs rather than on the use of certain inputs with adverse effects. These combine tradition and innovation to protect the environment, to promote fair relations and a good quality of life for all the involved actors.

The obtained results are in line with previous research that has shown that extensive farming prevails in Dornelor Basin with positive effects on environment and biodiversity [4, 5]. This conclusion is also supported by the interviewed farmers: 83% of the farmers considered conventional in this study declared that they see themselves as ecological farmers and think that most farmers they know have adopted at least one ecological practice (68%). For 78% of these farmers, understanding farm ecology is the basis of agriculture and environmental protection represents a significant part of their activity.

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STUDY ON THE ESTABLISHMENT OF AGROTOURISM PENSIONS IN THE APUSENI MOUNTAINS AREA

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Abstract

The current study highlights the main forms of ownership of agrotourism pensions, a classification of agrotourism pensions in the Apuseni Mountains area, a presentation of agrotourism pensions according to the period of business development in this field of activity, as well as a grouping of agrotourism pensions by funding sources. The Apuseni Mountains areahas been and is a special attraction for both Romanian and foreign tourists, due to the traditional tourist attractions in this region. Following the increase in the flow of tourists, we are witnessing a diversification of the forms of accommodation and catering. Currently, tourism entrepreneurs orient themselves towards the establishment of agrotourism pensions because they have found that tourists are increasingly attracted to the practice of tourism as close to nature as possible. In order to achieve the objectives proposed from the beginning, it was necessary to carry out a quantitative study based on questioning. It was applied to a number of 110 managers from agrotourism pensions in the Apuseni Mountains area. On the one hand, statistical data taken from the Ministry of Tourism were used in the paper, and on the other hand, the information obtained from the application of the questionnaire was used.

Key words**:** *agrotourism, questionnaire, Apuseni Mountains, agrotourism pension, Romania*

INTRODUCTION

Currently, in Romania there are a variety of opportunities to spend free time by escaping in the middle of nature, by exploiting places full of history, a culture that shows us the origins we are proud of. Tourism in our country has developed gradually, starting at the beginning with "the concept of recreation, until the increase of the level of cultural training, by returning to traditions, customs" [5].

In this sense, the agrotourism pension represents "a form of knowledge and reliving the customs that are kept in our villages and communes, in independent buildings or in the citizens' houses that provide accommodation and food for tourists from their own farm" [8]. It is important to note that any household that is for tourists, as a tourist pension, must meet the requirements of agrotourism, which represent the "internal resources that consist of material resources, intangible resources and tourist resources" [7] and which are the key elements in the classification of the accommodation unit.

In the specialized literature, the undertaken studies highlight the similarities and differences between the rural tourist pension and the agrotourism pension and they refer to "living space, knowledge and participation in the life traditionsof the region, traditional household activitiesand services that are provided by the farmer's family" [2].

Currently, the normative acts in the tourism field of the relevant ministry and the books published under the guidance of the ANTREC team of professionals are a real help for entrepreneurs who focus on starting a business in agrotourism, eager to "authorize their accommodation and dining to enter the tourist circuit" [9]. In the present paper, the data obtained after completing a questionnaire by the managers of agrotourism pensions in the Apuseni Mountains area were processed. The questionnaire is the most used research tool in conducting an opinion poll, used for the purpose of "obtaining primary data"[3] regardless of the applicabilityfield. "The

questionnaire involves a series of questions that must be answered in writing" [10], "designed to collect the data necessary to achieve the objectives of a marketing survey" [4].
The purpose of this study was to identify the main legal forms of agrotourism pensions in the Apuseni Mountains area, a classification of agrotourism pensions by types of daisies, a presentation of agrotourism pensions according to the period of economic activities in tourism, and a classification of agrotourism pensions according to funding sources.

MATERIALS AND METHODS

In order to carry out this paper, the applied questionnaire was chosen as the main tool for collecting information in order to achieve the proposed objectives. The questionnaire "on the management of agrotourism pensions in the Apuseni Mountains area", 2020, was applied to a number of 110 managers of agrotourism pension in the Apuseni Mountains area, respectively in the counties of Alba, Arad, Bihor, Cluj, Hunedoara and Sălaj.
Starting from specialized bibliographic sources and the legislation in force regarding the establishment and the classification of accommodation units, the paper highlighted the possibility of establishing or developing a business in tourism by opening an agrotourism pension in Romania and especially in the counties of Apuseni Mountains.
Part of the statistical data that formed the basis of this research were taken from the Ministry of Tourism, and another part were correlated following the application of the questionnaire.

RESULTS AND DISCUSSIONS

The agrotourism activity can be carried out within an agrotourism pension that can take the form of a legal person according to Law no. 31/1990 regarding the commercial companies, namely as LLC, General Partnership, Joint Company or as entities without legal personality regulated by GEO no. 44/2008, namely Self-employed person, Individual enterprise, Family association, Family enterprise.
When choosing the form of ownership, it must be taken into account how many people need to be hired and what services are to be offered to tourists.
At national level, there were 945 agrotourism pensions out of a total of 14,922 tourist reception structures with classified accommodation functions existing on 13.03.2020, according to the Ministry of Tourism. The most common form of ownership as a type of economic operator was the Individual enterprise (491 units), followed by Self-employed person (260 units), LLC (150 units), Family enterprise (32 units), Family association (3 units) and General Partnership (1 unit).

Table 1. Legal form of agrotourism pensions in Alba, Arad, Bihor, Cluj, Hunedoara, Sălaj counties at the beginning of 2020

County	Individual enterprise (no)	Self-employed person (no)	Limited liability company (no)	Family enterprise (no)	Total agrotourist pensions	
					No.	%
CLUJ	18	50	16	1	**85**	37.61
ALBA	19	12	7	3	**41**	18.14
HUNEDOARA	16	11	7	1	**35**	15.49
BIHOR	16	9	3	-	**28**	12.39
SĂLAJ	11	10	6	-	**27**	11.95
ARAD	9	1	-	-	**10**	4.42
TOTAL No.	**89**	**93**	**39**	**5**	**226**	100.00
%	39.38	41.15	17.26	2.21	100.00	x

Source: Ministry of Tourism [6] accessed on 13.03.2020.

Following the research carried out on the main types of property forms related to agrotourism pensions established in the 6 counties studied (Alba, Cluj, Bihor, Sălaj, Hunedoara, Arad) and existing in the Ministry of Tourism database of classified structures, it has been found that the most common are: Self-employed person (93 units), Individual enterprise (89 units), LLC (39 units) and Family enterprise (5 units), with a total of 226 units (Table 1).

Following the analysis of centralized data at the level of the relevant ministry, it was found that out of a total of 945 agrotourism pensions classified at country level, most of them have 3 daisies (533 units), representing a percentage of over 56%, followed by the structures classified with 2 daisies (328 units), representing over 34% (Table 2).

Table 2. Classification by daisies of agrotourism pensions in Romania

1 daisy	2 daisies	3 daisies	4 daisies	5 daisies	Total
27	328	533	51	6	945
2.85%	34.70%	56.40%	5.40 %	0.65 %	100%

Source: Ministry of Tourism, [5] accessed on 13.03. 2020 and own processing.

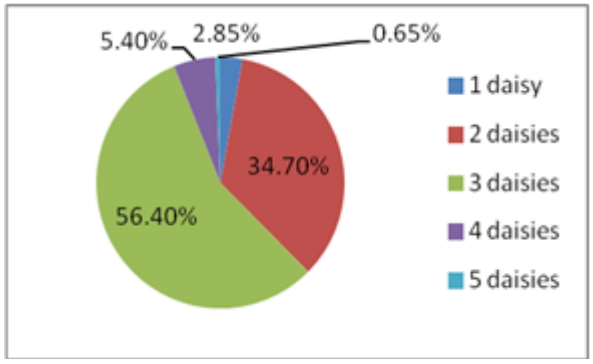

Fig.1 Classification of agrotourism pensions in Romania (%)
Source: own processing.

Currently, at the level of the 6 counties in the Apuseni Mountains area, the agrotourism pensions classified with 3 daisies also predominate, being followed by those classified with 2 daisies (Table 3). Following the research, it was highlighted that in Romania only 6 agrotourism pensions are classified with 5 daisies and one of them is located in Sălaj county, namely Orgona agrotourism pension in Almaşu commune, Stana village. Following the centralization of the data obtained on the basis of the questionnaire completed by 110 managers of agrotourism pensions in the Apuseni Mountainsarea, it was found that in this area the agrotourism pensions of 3 daisies predominate (61 units),followed by pensions of 2 daisies (43 units).

Table 3. Classification of agrotourism pensions in Alba, Arad, Bihor, Cluj, Hunedoara, Sălaj counties, at the beginning of 2020

County	1 daisy (no)	2 daisies (no)	3 daisies (no)	4 daisies (no)	5 daisies (no)	Total agro-turist pensions	
						no.	%
CLUJ	1	54	28	2	-	**85**	37.61
ALBA	2	13	23	3	-	**41**	18.14
HUNEDOARA	-	10	24	1	-	**35**	15.49
BIHOR	1	11	15	1	-	**28**	12.39
SĂLAJ	1	10	15	-	1	**27**	11.95
ARAD	-	2	8	-	-	**10**	4.42
TOTAL No.	**5**	**100**	**113**	**7**	**1**	**226**	100.00
%	2.21	44.24	50.00	3.09	0.46	100.00	x

Source: Ministry of Tourism [6] accessed on 13.03.2020 and own processing.

The following aspects were also highlighted from the analysis of the questionnaire: the existence of an unclassified pension, a pension classified with 1 daisy and 4 agrotourism pensions classified with 4 daisies (Table 4). From the analyzed data it was found that in the Apuseni Mountains area

there is no classified agrotourism pension of 5 daisies.

Table 4. Classification of agrotourism pensions in the Apuseni Mountains area, until the beginning of 2020

County	**unclassified**	**1 daisy**	**2 daisies**	**3 daisies**	**4 daisies**	**5 daisies**	**Total agro-tourist pensions**	
	no	no	no	no	no	no	**no**	%
CLUJ	-	-	25	19	1	-	**45**	40.90
ALBA	1	-	16	21	2	-	**40**	36.36
HUNEDOARA	-	-	1	5	1	-	**7**	6.37
BIHOR	-	1	1	8	-	-	**10**	9.09
SĂLAJ	-	-	-	5	-	-	**5**	4.55
ARAD	-	-	-	3	-	-	**3**	2.73
TOTAL No.	**1**	**1**	**43**	**61**	**4**	**-**	**110**	100.00
%	0.90	0.90	39.09	55.48	3.63	0	100.0	x

Source: own processing according to the data collected on the field between 2018 and 2020.

Considering the period of activities carried out in the agrotourism pensions in the Apuseni Mountains area, following the application of the questionnaire, the answers given by the pension managers can be grouped as follows: 5 of the managers answered that the activity is more recent, less than 1 year, 50 managers responded that the activity dates between 1-5 years, 13 managers responded that the pensions have a length of service between 6-10 years since their opening, 42 managers said that the agrotourism pensions are over 10 years old, having a rich experience in the agrotourism activity (Table 5).

The most numerous agrotourism pensions with a long history are found in Sâncraiu commune, Cluj county, that is 22 units.

Table 5. Presentation of agrotourism pensions in the Apuseni Mountains area taking into account the period from establishment to the beginning of 2020

County	**MU**	**Period**				**Total agro-tourist pensions**	
		< 1 year	1-5 years	6 -10 years	>10 years		
		no	no	no	no	**no**	%
CLUJ	no	3	14	3	25	**45**	40.90
ALBA	no	1	20	7	12	**40**	36.36
HUNEDOARA	no	1	4	1	1	**7**	6.37
BIHOR	no	-	5	2	3	**10**	9.09
SĂLAJ	no	-	4	-	1	**5**	4.55
ARAD	no	-	3	-	-	**3**	2.73
TOTAL	**no**	**5**	**50**	**13**	**42**	**110**	100.00
	%	5.00	45.00	12.00	38.00	100.00	x

Source: own processing according to the data collected on the field between 2018 and 2020.

Considering the period since the opening of the agrotourism pensions in the Apuseni Mountains area, from the analysis of the data obtained on the field, it was highlighted that most agrotourism pensions are young (open between 1-5 years), holding 45% of the total, and others even very young, less than 1 year since their opening, in a proportion of 5%. There are 12% ofthe agrotourism pensions with 6 to 10 years since their establishment and 38% ofthe agrotourism pensions with over 10 years of experience.

Some of the pensions analyzed on the basis of the questionnaire were set up with the help of the Agency for Financing Rural Investments (AFRI) within the Ministry of Agriculture and Rural Development (MARD) which supported rural entrepreneurs to access European funds from the European Agricultural Fund for Rural Development (EAFRD) through the National Rural Development Program (NRDP) 2014-2020 submeasure 6.2. "Support for the establishment of non-agricultural activities in rural areas" of 70,000 euros and through submeasure 6.4 "Support for investments in

the creation and development of non-agricultural activities" of up to 200,000 euros.

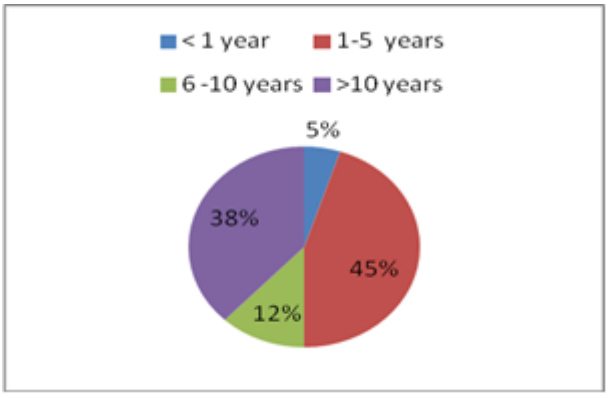

Fig. 2. Agrotourism pensions in the Apuseni Mountains area taking into account the period of establishment (%)

Source: own processing according to the data collected on the field between 2018 and 2020.

On both lines of financing, non-reimbursable financial sources were granted even for the construction of agrotourism pensions, having the CAEN code 5520 - "Accommodation facilities for holidays and short periods," which was a real support for people in rural areas who had the desire to get involved in the hospitality industry.

The development of a business in the field of agrotourism attracted people from the village world who met a series of eligible conditions for accessing non-reimbursable funds.

In order to accept the financing project, "tourist reception structures with accommodation functions such as agrotourism pensions must be included in the tourist circuit and must meet the minimum mandatory criteria provided in the Order of the President of the National Authority for Tourism (NAT) no. 65/2013, with subsequent amendments and completions. The level of comfort and the quality of the services proposed by the project must meet the minimum mandatory criteria for agrotourism pensions classified at least with one daisy"[1].

Analyzing the 110 questionnaires completed by the managers of agrotourism pensions, it was found that 4 respondents used the SAPARD development program (2000-2005), while the non-reimbursed development funds through the National Rural Development Program (NRDP) managed through AFRI were accessed by 55 respondents.

An example in this sense is the manager of the Agape pension from Aghireş, Meseşenii de Jos commune from Sălaj county, who accessed European funds both through SAPARD with 50% financing and through AFRI, the financial aid being 85%.

Table 6. Sources of financing of agrotourism pensions in the Apuseni Mountains area

County	Funds through prin AFRI	Funds through SAPARD	Own funds
	no	no	no
CLUJ	19	2	24
ALBA	17	1	22
HUNEDOARA	5	-	2
BIHOR	6	-	4
SĂLAJ	5	1	-
ARAD	3	-	-
Total No.	**55**	**4**	**52**

Source: own processing according to the data collected on the field between 2018 and 2020.

The questionnaire also showed that 52 agrotourism pensions were opened with their own funds by those wishing to get involved in tourism.

We can add an observation to the ones mentioned above, namely that the pensions opened by their own efforts are more than 10 years old, which shows us that the rural entrepreneurs were not so familiar in terms of attracting European funds.

Currently, due to the competitive pressure, it is necessary for tourism and agrotourism entrepreneurs to constantly make investments in order to: improve services, offer complementary spa services, swimming pools, increase the accommodation capacity by increasing the number of rooms, build houses, etc.

The field questionnaire also considered this issue, and at the end of it a question was asked about the desire to access European funds.The analysis of the respondents' answers revealed that 36 of them want to access more European funds in the future.

CONCLUSIONS

The agrotourism pension is one of the options for tourists who want to relax in a clean and

traditional environment. Some of the villagers who on the one hand sought to carry out profitable activities and on the other hand had as objective the promotion of rural areas started actions for the establishment of agrotourism pensions. Some of these pensions were built on the basis of European projects accessed through SAPARD and AFRI which represented a main financial pillar. Following the analysis of the answers given by the 110 managers of agrotourism pensions opened in the Apuseni Mountains area, it was found that: 4 of them accessed financing projects through SAPARD; 55 respondents received non-reimbursable funds through AFRI and 52 managers had their own financial sources.

According to the statistical data provided by the Ministry of Tourism, at the beginning of 2020, it was found that most open agrotourism pensions are located in the 6 counties in the Apuseni Mountains: Self-employed person (93 units), Individual enterprise (89 units), LLC (39 units), Family business (5 units), with a total of 226 units.

Regarding the comfort provided by the receiving agrotourism pensions, at the national level, at the beginning of 2020 the situation was the following: 533 units of 3 daisies; 328 units of 2 daisies, 51 units of 4 daisies; 27 units of 1 daisy and 6 units of 5 daisies.

At the level of the Apuseni Mountains area, following the result of the questionnaire, the agrotourism pensions were grouped as follows: 3 daisies (61 pensions), 2 daisies (43 pensions), 4 daisies (4 pensions),1 daisy (1 pension) and an unclassified pension.

Also based on the questionnaire, out of the 110 agrotourism pensions studied, in the Apuseni Mountains area, it was found that according to the year of establishment 5 agrotourism pensions are less than one year old, 50 agrotourism pensions are 1-5 years old, 13 agrotourism pensions have been open for 6-10 years, 42 agrotourism pensions have been open for over 10 years.

The managers of the studied pensions are convinced that the establishment of an agrotourism pension represents an opportunity for the entrepreneurs from the Apuseni Mountains area and that it will know a development in the future, both for the Romanian and for the foreign tourists.

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STUDY REGARDING THE PRODUCTION AND MARKETING OF STRAWBERRIES IN ROMANIA

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Abstract

The present study highlights aspects related to the production and marketing of strawberries in Romania, in the period 2014-2019. Specific indicators were presented and analyzed in the paper, such as: areas cultivated with strawberries; strawberry production; the price for strawberries; quantitative imports and exports; value imports and exports, for the category "Strawberries". Romania imports annually the equivalent of 40% of the strawberry production made domestically, which highlights the fact that there are a number of opportunities for local farmers who want to start businesses in this sector of activity. The strawberry crop is suitable in most regions of Romania and can have a yield of over 20 tons of fruit per hectare. The aspects regarding the production and commercialization of strawberries in Romania were captured especially, from a quantitative point of view. The statistical data underlying this study were taken from the FAOSTAT website.

***Key words*:** *strawberries, production, imports and exports, Romania*

INTRODUCTION

Today, strawberry culture is found in many regions of the globe, because it has been found that fruits are on the one hand, an important source of minerals and vitamins for the human body, and on the other hand, they are used in various industries [1]. The strawberry is part of the Rosaceae family, which includes over 20 species and a series of hybrids [2].

In Romania, most soils are friendly for strawberry cultivation, and due to this fact, strawberry can be grown in most regions, and the yield per hectare can be 20-25 tons of fruits [2, 4].

Specialists in the field have highlighted the fact that the adaptability, productivity and quality of the strawberry crop are determined in a significant proportion by the following factors: temperature; disease resistance; tolerance to different types of soil etc. [1].

In Romania, there are many varieties of strawberries that directly influence the level of productivity, such as: Premial variety; Dana variety; Elsanta variety; Magic variety; Florance variety; Talisman variety; Elvira variety etc. [2].

Photo 1. Elsanta variety
Source: [7].

It is necessary to specify some varieties of remontant strawberries that can bear fruit up to 10 months a year with a very short break between production cycles. These remontant varieties present on the one hand, a series of advantages, and on the other hand, a series of disadvantages. The main advantages specific to remontant varieties are: sports yield; special disease resistance; larger fruits; can be kept in good condition; rapid ripening of fruits; self-pollination [5].

Currently, in Romania, the cost related to the establishment and maintenance of one hectare is approximately 9,000 euros. According to specialists, around 5,300 euros is the investment for quality stolons [4].
In order to obtain an appropriate profit, it is necessary to irrigate the strawberry crop immediately after planting it. In terms of irrigation, it is recommended to be done by drip [8, 9].
Internally, strawberry culture can be an alternative for farmers in certain regions who own smaller areas of land and have a starting capital of less than 10,000 euros.

MATERIALS AND METHODS

The present research captures a series of aspects regarding the production and sale of strawberries in Romania, in the period 2014-2019. In this sense, a series of specific indicators were analyzed, such as: the total areas cultivated with strawberries; strawberry production achieved; the price for strawberries; imports and exports both quantitative and value for the category "Strawberries". In order to carry out this study, on the one hand, various specialized materials were consulted, and on the other hand, statistical data provided by the FAOSTAT website were analyzed.

RESULTS AND DISCUSSIONS

In Romania, the strawberry culture, respectively the culture of different berries represents an opportunity for the local farmers because:
-it can be cultivated on small areas, up to 5 ha [10];
-initial investments are lower compared to other crops;
-berries are demanded by consumers, on the one hand, due to the pleasant taste, and on the other hand, because they have a number of nutritional characteristics beneficial to human health;
-the demand for berries increased significantly, both on the domestic market, but especially on the foreign market;
-it contributes to job creation in certain regions, where there are no other types of activities;
-it can bring significant long-term profits to farmers, with the condition that they have patience for 2-3 years to recover their investment [10].

Photo 2. Strawberry plantation
Source: [9].

Specialists in the field have identified those categories of berries that are profitable on small areas of land: strawberries; blueberries; blackberries; sea buckthorn and raspberries [10].
According to the official data published by Faostat, the area cultivated with strawberries in Romania changed, from year to year during the analyzed period (Fig.1.).
This area cultivated with strawberries was on a positive trend, starting from 2014, until 2017. In 2018, there was a slight decrease compared to 2017.

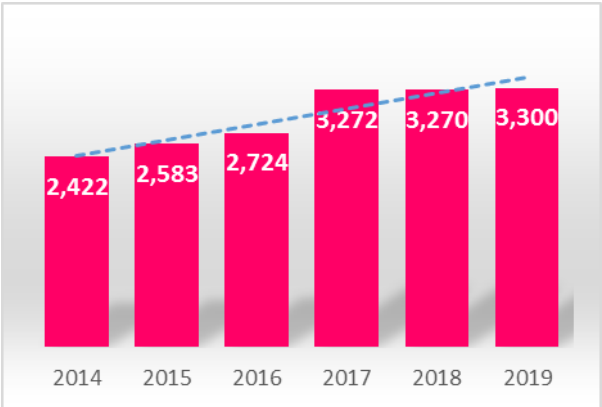

Fig. 1. Area cultivated with strawberries in Romania, for the period 2014-2019 (hectares)
Source: Own design based on FAOSTAT database 2021 [3].

The smallest cultivated area with strawberries in Romania was registered in 2014 (2,422 ha), and the largest cultivated area was of 3,300 ha (2019).

From the presented data it is observed that, in 2019, the area cultivated with strawberries, in Romania, increased by 36.2% compared to 2014.

In 2019, according to official data worldwide, the area cultivated with strawberries was 396,401 ha, and Romania cultivated 0.83% of the area attributed for this crop. In the European Union, also in 2019, 105,784 ha were cultivated with strawberries, and Romania owned 3.11% of the cultivated area. In the medium and long term, an increase in strawberry cultivated areas is expected in Romania, especially due to the growing interest of young farmers.

From the data presented regarding the production of strawberries obtained in Romania, it was found that it varied from one year to another, during the period under analysis (Fig. 2.). The highest strawberry production achieved in Romania was 27,050 tons (2017), and the lowest production was 21,587 tons (2015).

Photo 3. Hanging strawberries
Source: [6].

In 2019, the domestic production of strawberries increased by 3.1%, compared to 2014, but decreased by 16.4% compared to 2017, when the maximum production was reached.

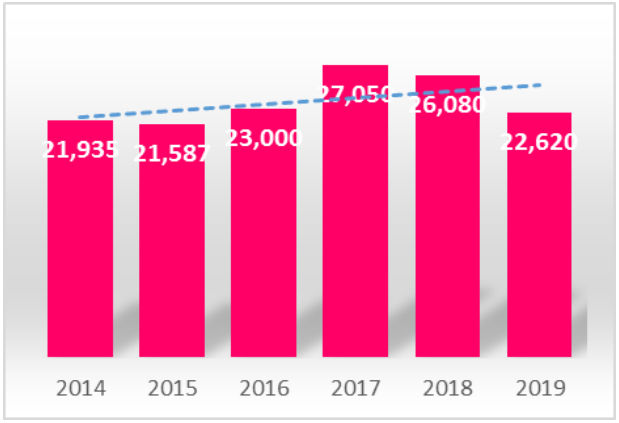

Fig. 2. Strawberry production in Romania, for the period 2014-2019 (tons)
Source: Own design based on FAOSTAT database 2021 [3].

The price for strawberries in Romania registered changes in the period 2014-2019 (Fig. 3.). The lowest price was 1,118.4 USD/ton (2016), and the highest was 1,537.6 USD/ton (2018). In 2019, the price for strawberries decreased by 5.3% compared to 2014.

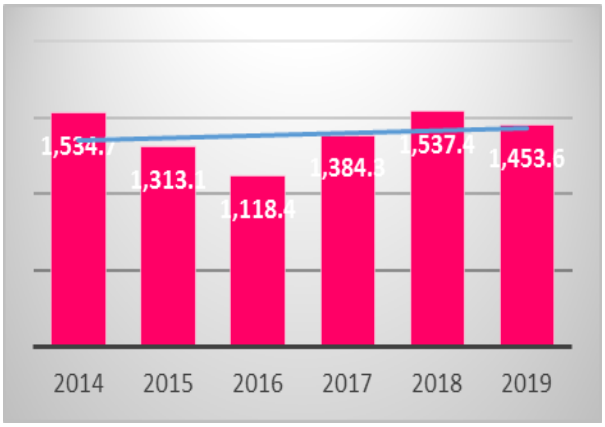

Fig. 3. Price for strawberries in Romania, for the period 2014-2019 (USD / ton)
Source: Own design based on FAOSTAT database 2021 [3].

Quantitative imports of strawberries made by Romania during the analyzed period varied from one year to another, due to domestic demand and also for the charged price (Fig.4.). The most significant quantitative imports of strawberries were 9,124 tons, in 2019. The smallest quantitative imports were 4,454 tons in 2015. From the presented data it can be observed that in 2019, the quantitative imports with strawberries doubled compared to 2014.

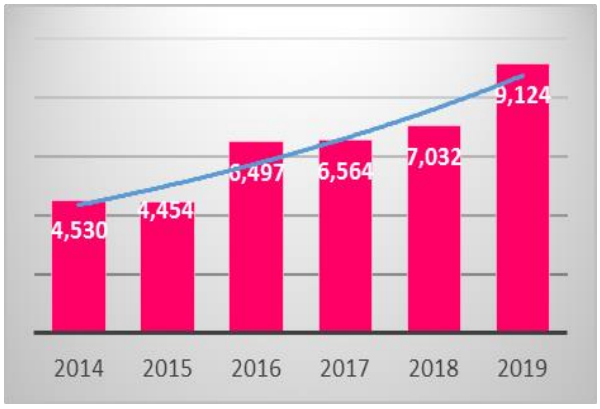

Fig. 4. Quantitative imports of strawberries in Romania, for the period 2014-2019 (tons)
Source: Own design based on FAOSTAT database 2021 [3].

Romania, in 2019 accounted for 1.78% of the quantitative imports made in the European Union for the category "Strawberries".
The most significant importers of strawberries registered worldwide for 2019: United States of America (186,499 tons); Germany (128,105 tons); Canada (96,192 tons); France (64, 357 tons); United Kingdom of Great Britain and Northern Ireland (53,379 tons). In 2019, Romania imported only 14.1% of the quantity of strawberries imported by France, which proves that the consumption of strawberries in Romania is lower, compared to other countries in the European Union. The low level of strawberry consumption is due to several factors, especially of economic nature.
Romania's value imports registered for the "Strawberries" category were substantial in the analyzed period and were on an upward trend (Fig. 5.)

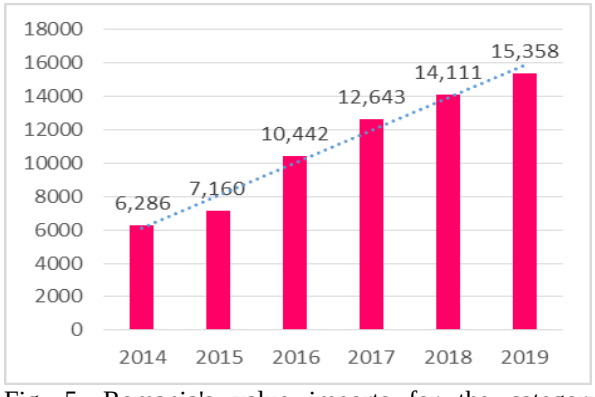

Fig. 5. Romania's value imports for the category "Strawberries", for the period 2014-2019 (thousand dollars)
Source: Own design based on FAOSTAT database 2021 [3].

The lowest value imports were recorded in 2014 ($ 6,286 thousand), and the highest value imports were $ 15,358 thousand (2019). From the presented data it can be observed that in 2019, the value imports increased by 144.3%, compared to 2014. In 2019, Romania, accounted for 0.11% of the value imports made in the European Union for the category "Strawberries".
Romania's quantitative exports of strawberries in the period 2014-2019 were significantly lower than the quantitative imports, which shows us that our country cannot ensure the necessary consumption from domestic production. The most significant quantity of strawberries exported was registered in 2015 (255 tons) (Fig. 6). The smallest quantitative exports of strawberries were 7 tons (2016 and 2019). From the presented data it can be observed that in 2019, the quantitative exports of strawberries have diminished with 53.4% compared to 2014.

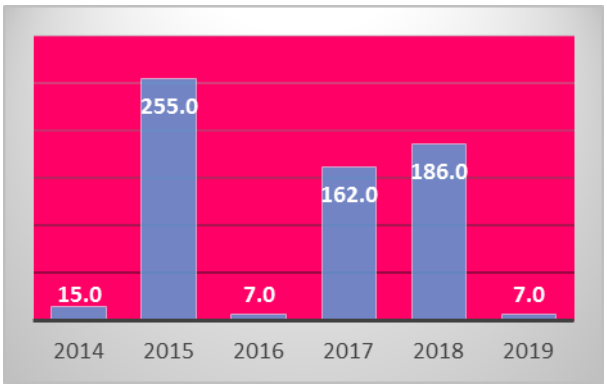

Fig. 6. Quantitative exports of strawberries in Romania, for the period 2014-2019 (tons)
Source: Own design based on FAOSTAT database 2021 [3].

In 2019, Romania registered 0.001% of the quantitative exports made in the European Union for the category "Strawberries".
It should be noted that in 2019, the top 5 exporters of strawberries registered worldwide consisted of: Spain (300,036 tons); Mexico (137,393 tons); United States of America (130,784 tons); Netherlands (57,071 tons) and Greece (45,175 tons). In 2019, Romania exported a quantity of only 7.0 tons of strawberries, which is an insignificant quantity. This demonstrates on the one hand, the fact that the production of strawberries in

Romania is low compared to the domestic need and the demand manifested on the international markets, and on the other hand, it draws a directive for the entrepreneurs interested in this sector of activity.

Regarding the value exports related to Romania for the "Strawberries" category, significant oscillations were registered from one year to another (Fig. 7.). The most substantial value exports were $ 141 thousand (2015). It is necessary to specify the fact that the value exports in 2016 were of 11 thousand dollars, being the smallest, and in 2019, they were of 55 thousand dollars, for the same exported quantity. This significant difference was due to the fact that, in 2019, the price for strawberries was higher compared to the price for 2016.

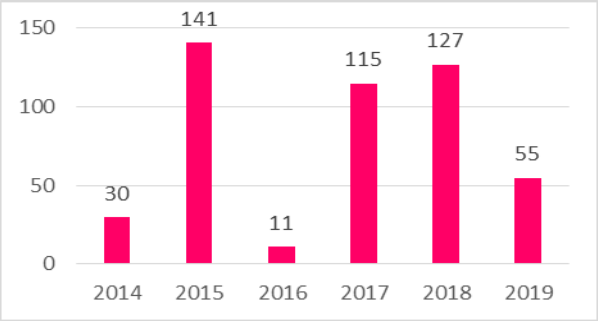

Fig. 7. Value exports of Romania for the category "Strawberries", in the period 2014-2019 (thousand dollars)

Source: Own design based on FAOSTAT database 2021 [3].

In the medium and long term, an increase in investments in the sector of production, processing and marketing of strawberries, as well as in the products obtained based on them, is foreseen.

CONCLUSIONS

Following the analysis of the main indicators specific to the strawberry production and marketing sector in Romania, for the period 2014-2019 the following emerged:

-in 2019, the most significant area cultivated with strawberries was registered, of 3,300 ha;

-the highest strawberry production was recorded in 2017 (27,050 tons);

-domestic strawberry production, in 2019, increased by 3.1%, compared to 2014;

-the most significant price for strawberries was registered in 2018 (1,537.6 USD / ton), and the lowest price in 2016 (1,118.4 USD / ton);

-in 2019, the most significant quantitative imports of strawberries were made, of 9,124 tons, worth $ 15,358 thousand;

-in 2015, there was the largest quantitative export of strawberries, of 255 tons, worth $ 141 thousand.

Currently, in Romania there are both soils and varieties suitable for strawberry cultivation that can provide a large part of the population's consumption needs, but also significant quantities for export, if farmers' interest in this sector of activity increases.

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STUDIES CONCERNING THE EFFECT OF THE ONGOING EVALUATION OF THE IMPLEMENTATION OF THE LOCAL ACTION GROUPS STRATEGIES FINANCED BY LEADER, IN RURAL DEVELOPMENT IN ROMANIA

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Abstract

This article aims to draw attention to the way in which the main instrument of the innovative LEADER approach in the territory, the Local Action Group, is set up, functions and is evaluated. Also, an analysis of their evolution is presented, as from the beginning, the analysis wishing to highlight, with predilection, information on the situation of local action groups in Romania, in the two programming periods, focusing on the South West Oltenia region. The data presented reveal the degree of absorption of the funds allocated to the local action groups, at national and regional level, taking into account a certain reference period. It will highlight the way in which local action groups are penalized or rewarded and the connection between developed or less developed areas and the absorption of funds, by correlating certain relevant factors: rewarded and penalized local action groups and the relative poverty rate. At national level, there are 18 rewarded local action groups, respectively 18 penalized local action groups, the value of the penalties being equal to the value of the bonuses, 2,522,162.40 euros. In the South West Oltenia region, 1 local action group was penalized, 4 local action groups were rewarded, the surplus attracted in the region being of 481,786.05 euros.

Key words: LAG, LEADER, development, rural, strategy, evaluation

INTRODUCTION

The rural population in Romania is an important human resource in the economy, but the standard of living is very low. This situation will be improved by implementing the National Rural Development Program 2014-2020, whose measures aim to increase the level of education and modernize technologies and farm efficiency, resource use, infrastructure in rural areas and social inclusion and living standards. of the rural population [10]. The biggest problem in the "Romanian village" is the migration of the rural population to large urban centers or to other more developed countries, due to unsatisfactory living conditions [2]. The main tool through which the principles of the Leader approach can be implemented is the LAG (local action group). This is the main engine of the activities that will take place in the territory [13]. The local action group, one of the main features of the LEADER approach, is a public-private partnership, which has the role of identifying and implementing a local development strategy as well as managing financial resources. It is set up in accordance with Government Ordinance 26/2000 on the basis of an agreement, in which the private partners must represent the majority (at least 51% of the partnership structure) [6]. In Europe, the emergence of local action groups began with the implementation of the LEADER approach, the number of LAGs increasing with each new stage LEADER, which demonstrates the interest in this concept and its implementation, the number of local action groups has an upward trend since their establishment until now, a number of 2,783

local action groups operating throughout Europe, at the end of 2019 [14]. In Romania, the local action groups had a timid start, as shown in 2009, with 81 LAGs selected, and in 2012 another 82 local action groups will be selected. The 2014-2020 programming period led to the selection of another 76 LAGs, so that at the end of 2019, 239 local action groups were authorized in Romania. The local action groups are authorized based on a Local Development Strategy (SDL) approved and selected, in advance, by the Ministry of Agriculture and Rural Development. Like any partnership, its activity can be and is evaluated based on a procedure established by the Managing Authority [14]. The launch of the Leader program in Romania has provided, since 2012, a number of funding opportunities for local initiatives that have not found their place in other rural programs [4]. The Romanian rural area faces many difficulties, which are the causes of the disparities between different regions of Romania [9].

Local Action Groups (LAGs) are a strong driver of rural progress, and the involvement of all stakeholders in the LAG is essential for good development [8]. The research also confirmed the adequacy of four main pillars of indication (economic, infrastructure, social and environmental), while their indicators should be adapted to the character of the tested territory [7]. A more targeted regional policy is needed, including through the impact of European Union funds to address regional disparities in rural areas [3]. For Romanian public policy, sustainable local development has become a strategic tool for supporting the heritage sector (public and private) and is the objectives of national strategies for social and economic development [1].

MATERIALS AND METHODS

This paper presents the situation regarding the number of existing LAGs and the financial situation of these local action groups, which are financed on the basis of a Local Development Strategy, both at national level and at the level of Oltenia region, having as period reference the interval between the date of their authorization (2016) and 30.09.2019.

The main criterion for evaluating performance is the achievement of a level of at least 60% contracted value relative to the total value of the SDL (including operating expenses). If this level is reached, no penalty is applied [11].

In case of not reaching this level, the penalty percentages are the following:

- 60%, for not achieving the level of at least 60% contracted value in relation to the total value of SDL (including operating costs);
- 25%, for not achieving a level of at least 20% value paid in relation to the total value of SDL (including operating costs);
- 5%, for not meeting the maximum threshold of 30% regarding the evaluation rate of the projects;
- 10%, for the low efficiency of the animation in the territory (in no session of all the launched ones no measure was overbought, so as to demonstrate that through the animation in the territory the beneficiaries were informed and there is interest in the territory, as also demonstrates the SWOT analysis and animation activities performed at the time of SDL).

Proportional penalty applies cumulatively (if there are several criteria not met) to the difference between 60% of the total value of SDL and the value of contracted projects.

On the other hand, the amounts recovered from the LAGs that did not reach the mandatory performance level are redistributed to the high-performance LAGs, with their consent, the number of public-private partnerships being rewarded is equal to the number of penalized partnerships.

40 x the share of the contracted value + 60 x the share of the paid value

The bonus algorithm is as follows:

The amounts are granted progressively, increasing progressively at a rate of 10%, based on the formula:

$S = n * a + [1 + 2 + 3 + ... + (n + 1)] * 0.1a$

$S = n * a + n (n-1) / 2 * 0.1a$, where,

S = amount made available;

a = lowest value awarded (received by the least performing LAG);

n = number of performing LAGs (equal to the number of penalized LAGs) [11].

It highlights the number of local action groups that received additional amounts, as bonuses and the number of local action groups to which amounts were withdrawn, at national and regional level, making a comparison with the relative poverty rate in each region.

In order to highlight the correlations between (1) the number of rewarded LAGs and the relative poverty rate and (2) the number of penalized LAGs and the relative poverty rate, the following are used:

- ***correlation coefficient equation***:

$$r = \frac{\sum(x_i-\overline{X})(y_i-\overline{Y})}{\sqrt{\left(\sum(x_i-\overline{X})^2\right)\left(\sum(y_i-\overline{Y})^2\right)}};$$

where:

$\overline{X}$ and $\overline{Y}$- are the averages for the samples, the mean (matrix1) and the mean (matrix2).

- ***linear function and polynomial function***:

$y = a + bx;$

$y = a_0 + a_1x^1 + a_2x^2 + \ldots + a_nx^n.$

In the analysis, the values of the correlation coefficient (r) and the determination coefficient will be presented (R^2).

RESULTS AND DISCUSSIONS

At national level, the 239 local action groups had allocated a funding amounting to 563,516,550.93 euros in the 2014-2020 programming period, 12.02% of this value being directed to the LAGs in the South-West Oltenia region, respectively 67,785,700.92 euros .

Most local action groups are located in the North-East region and the fewest in the Bucharest-Ilfov region, as well as the amount of funding. The existing local action groups in the South-West Oltenia region represent 11.71% of the total of 239 , the public average value/LAG -2,420,917.89 euro being above the public average value / LAG at national level and on the second place after the West region (Table 1).

This may derive from the fact that, according to the West region, the South-West Oltenia region has the most favorable conditions for establishing such a public-private partnership, given that the value of the financing results depending on the number of inhabitants and the LEADER eligible area.

In the South-West Oltenia region, most of the local action groups are in Dolj county, 8, the county that has the highest financial allocation in the region 19,429,382.90 euros.

The average allocation per LAG in the region is 2,420,917.89 euros, Olt County being on the first place from this point of view with an average allocation / LAG of 2,736,658.47 euros (Table 2).

Table 1. Numerical and financial situation of LAGs at national level, in the period 2014-2020

Region	Number of LAGs	Public value (euro)	Average public value / LAG (euro)
North – East	45	106,413,047.39	2,364,734.38
South East	36	79,130,345.45	2,198,065.15
South Muntenia	42	99,604,958.51	2,371,546.63
South-West Oltenia	28	67,785,700.92	2,420,917.89
West	19	58,842,019.44	3,096,948.39
North – West	31	72,119,672.89	2,326,441.06
Center	34	75,000,407.87	2,205,894.34
Bucharest-Ilfov	4	4,620,398.46	1,155,099.61
Total	**239**	**563,516,550.93**	**2,357,809.83**

Source: Own data processing www.madr.ro [5].

Across the country, as a result of the ongoing evaluation process of the implementation of local development strategies, 18 local action groups were penalized for not meeting the minimum performance criteria and 18 local action groups were rewarded for their successful implementation. The value collected from the penalized LAGs was distributed to the LAGs qualified for bonus, according to the established criteria, this amounting to the amount of 2,522,162.40 euros.

Table 2. Numerical and financial situation of the LAGs at the level of the South - West Oltenia Region

County	Number of LAGs	Public value (euro)	Average public value / LAG (euro)
Dolj	8	19,429,382.90	2,428,672.86
Gorj	5	12,090,657.51	2,418,131.50
Mehedinți	5	10,389,456.75	2,077,891.35
Olt	6	16,419,950.86	2,736,658.47
Vâlcea	4	9,456,252.90	2,364,063.23
Total	**28**	**67,785,700.92**	**2,420,917.89**

Source: Own data processing www.madr.ro [5].

The highest penalty was applied to the local action groups in the Bucharest-Ilfov region, Ilfov county, 663,962.99 euros, where, out of a number of 4 authorized public-private partnerships, 4 were penalized. From the Oltenia region, 1 local action group - Amaradia Jiu LAG - from Dolj County was penalized, the amount of the penalty amounting to 101,416.61 euros (Figure 1).

On the other hand, the largest amount of additional amounts, in the form of bonuses, was distributed to the North-East region, in Vaslui County, where the 3 rewarded local action groups attracted additional funding amounting to 386,277.09 euros, and the lower in Satu-Mare county, 30,455.75 euros (Figure 2). In the South West Oltenia region, 4 local action groups were rewarded (Vedea-Găvanu-Burdea LAG - Olt County, Lunca Jiului LAG-Câmpia Desnățuiului- Dolj County, Cerna-Olteț LAG - Vâlcea County, Ținutul Vinului LAG - Vâlcea County), the value of the bonuses being 583,202.66 euros (Figure 3).

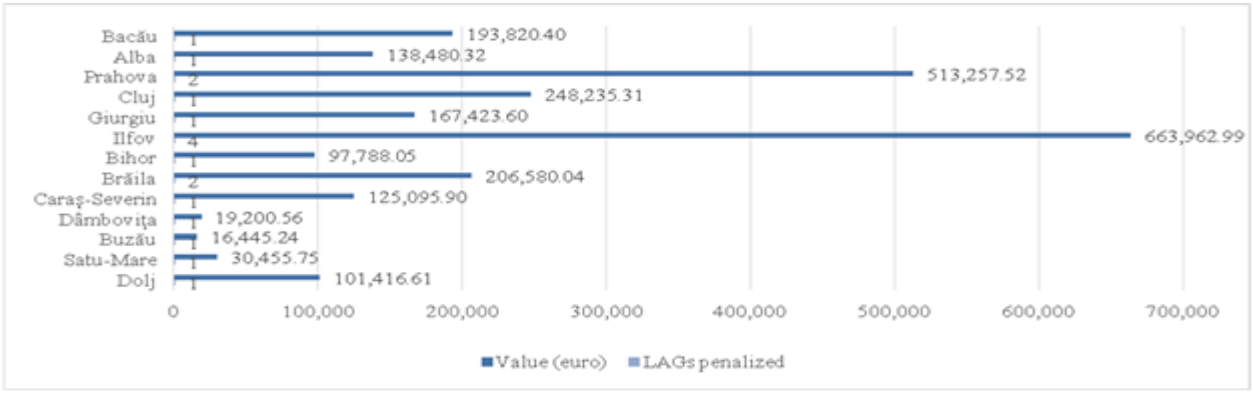

Fig. 1. Number of LAGs and value of penalties at national level, 30.09.2019
Source: Own design.

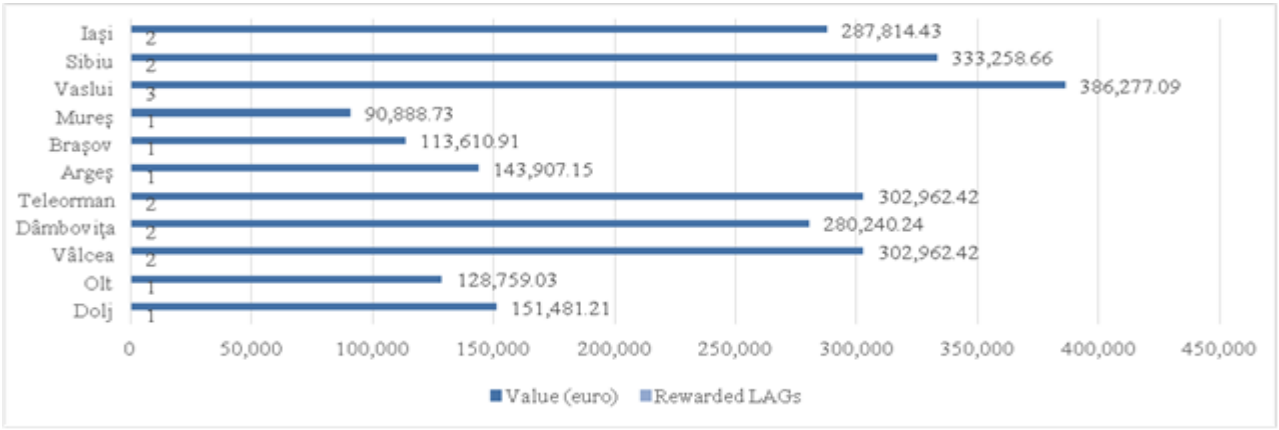

Fig. 2. Number of LAGs and the value of bonuses at national level, 30.09.2019
Source: Own design.

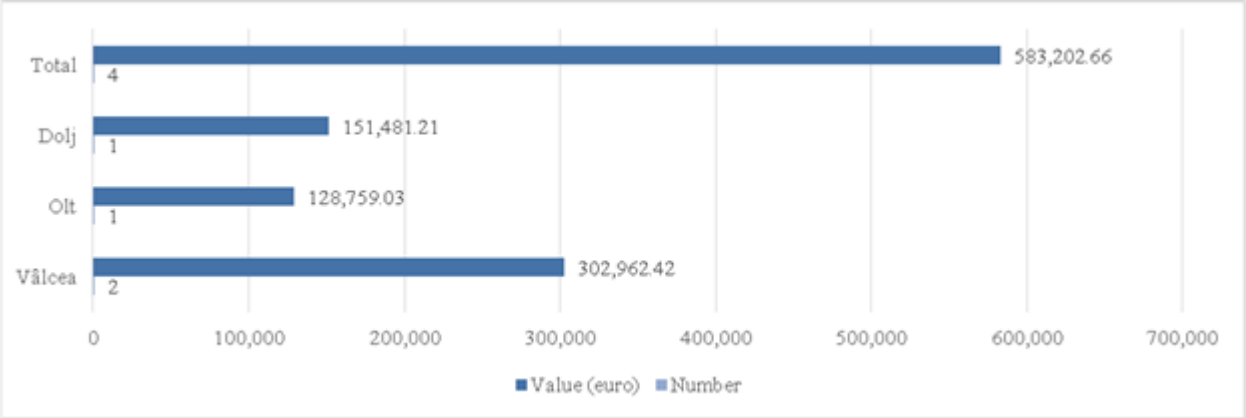

Fig. 3. Number of LAGs and the value of bonuses at regional level, 30.09.2019
Source: Own design.

The relative poverty rate is an indicator that measures the share of poor people in the total population. Among the main causes of poverty are the level of education, lack of interregional mobility, etc. At the level of our country, the highest poverty rate is found in the North-East region, 35.60% and the lowest, 4.1% in the Bucharest-Ilfov region. By region, most penalized local action groups are in the South-Muntenia region, the fewest in the North-East region, none. In terms of bonuses, the most advantaged regions were North-East and South-Muntenia, with 5 local action groups each, while three of them had no award-winning partnership. The South-West Oltenia region is on the second place in terms of the relative poverty rate, with a percentage of 34.3% after the North East region, these areas being included in the category of disadvantaged areas in Romania. We will try to see to what extent this indicator had any influence on the higher or lower absorption of the financing obtained by the local action groups from the respective areas (Table 3).

Table 3. Number of LAGs, rewarded LAGs, penalized LAGs and relative poverty rate, in Romania

Region	Total LAGs	Rewarded LAGs	LAGs penalized	Relative poverty rate (%) *
North - East	45	5	0	35.60%
South East	36	0	3	31.20%
South Muntenia	42	5	5	25.70%
South-West Oltenia	28	4	1	34.30%
West	19	0	1	14.90%
North - West	31	0	3	17.50%
Center	34	4	1	19.40%
Bucharest-Ilfov	4	0	4	4.10%
Total	**239**	**18**	**18**	**-**

Source: Own data processing www.madr.ro [5], *[12].

Figure 4 is the graphical representation of the local action groups that received bonuses following the evaluation of the implementation of local development strategies. We notice that in the North-East region, where the relative poverty rate is the highest, there is the highest number of rewarded local action groups, the same number being found in the South region, where the relative poverty rate is 25.70%. In the South West Oltenia region, in second place in terms of relative poverty rate, the number of LAGs that excelled in their work was 4.

Analyzing the graphical representation in Figure 4, we find that the relative poverty rate is a factor that influences to a certain extent the degree of attracting funding, but we can still highlight the extremes of this situation: North-East region with the highest relative poverty rate has the highest higher number of rewarded LAGs, at the opposite pole being the Bucharest-Ilfov region with the lowest

relative poverty rate but without any rewarded local action group.

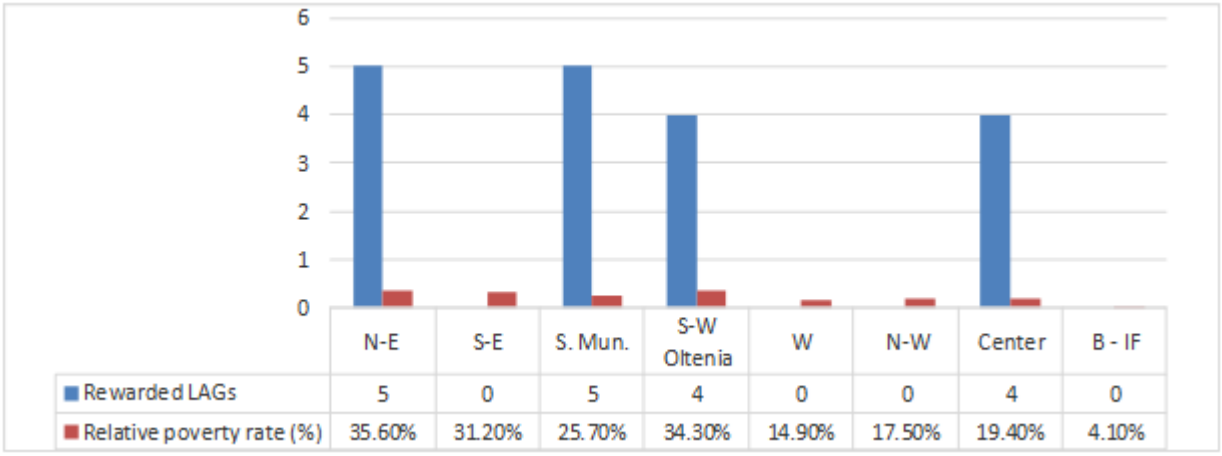

Fig. 4. Number of rewarded LAGs and relative poverty rate in Romania
Source: Own design.

Regarding the relative poverty rate and the number of local action groups that have been penalized as a result of evaluating the implementation of local development strategies, their graphical situation can be found in Figure 5. Most local action groups that have received penalties are in South region, 5, where the relative poverty rate is 25.70%, in the South-West Oltenia region being a single local action group that received penalties. The extremes are the North-East region, the poorest, without any penalized local action group and the Bucharest Ilfov region, the richest, with 4 penalized local action groups. It should be noted that in the Bucharest Ilfov region there are only 4 local action groups set up, the centralized data being easy to follow in Figure 6.

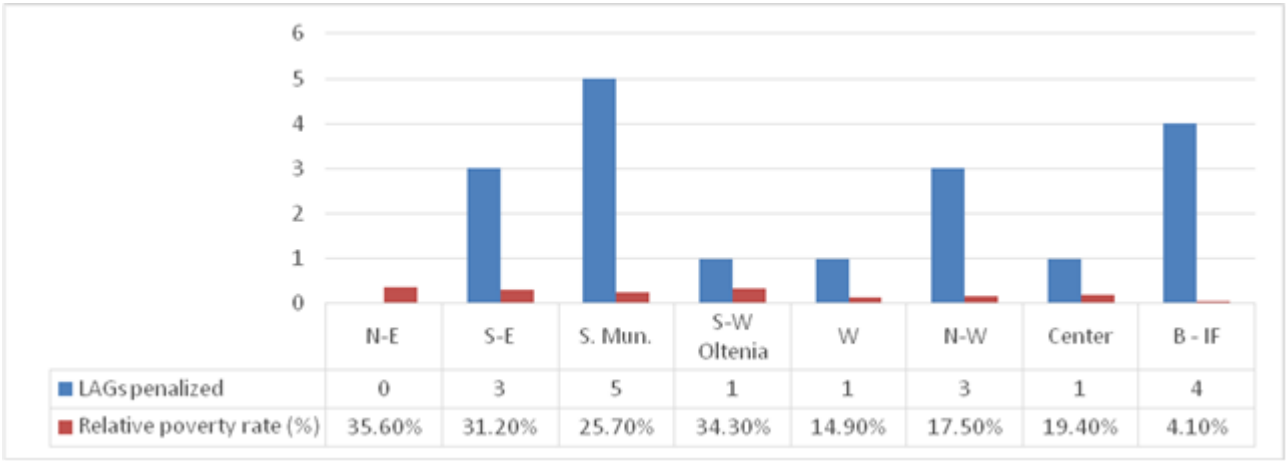

Fig. 5. Number of penalized LAGs and relative poverty rate in Romania
Source: Own design.

Between the number of rewarded LAGs at national level and the relative poverty rate at national level there was a correlation coefficient of 0.5951, respectively a direct dependence between the two variables, so it can be said that the distribution of rewarded LAGs followed the regions Romania's poorest.

The coefficient of determination R^2 has the value 0.3541 for the linear function and for the polynomial function of degree 2 has the value of 0.3557, and shows the connection between the rewarded LAGs and the relative poverty rate (Figure 7 and Table 4)

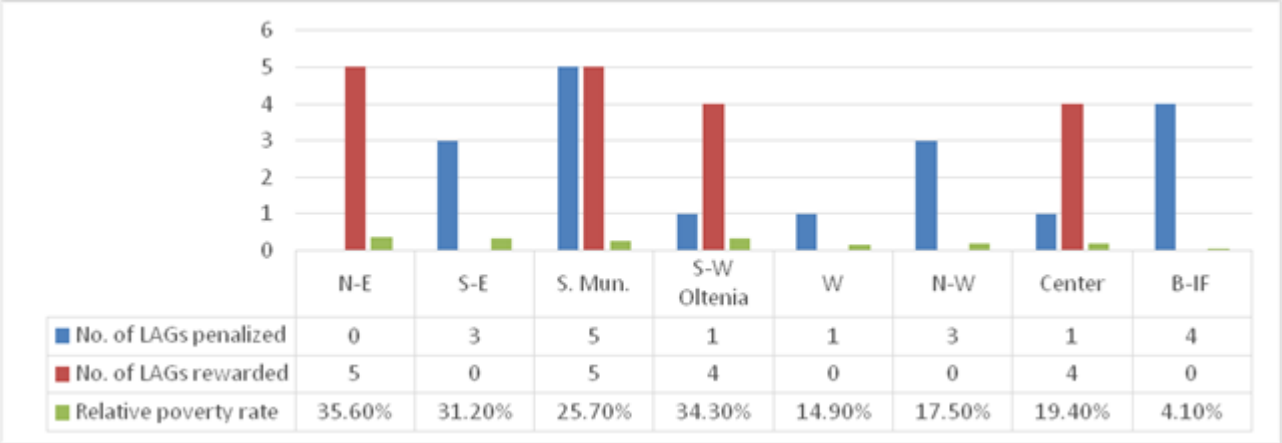

Fig. 6. Number of penalized and rewarded LAGs and relative poverty rate in Romania
Source: Own design

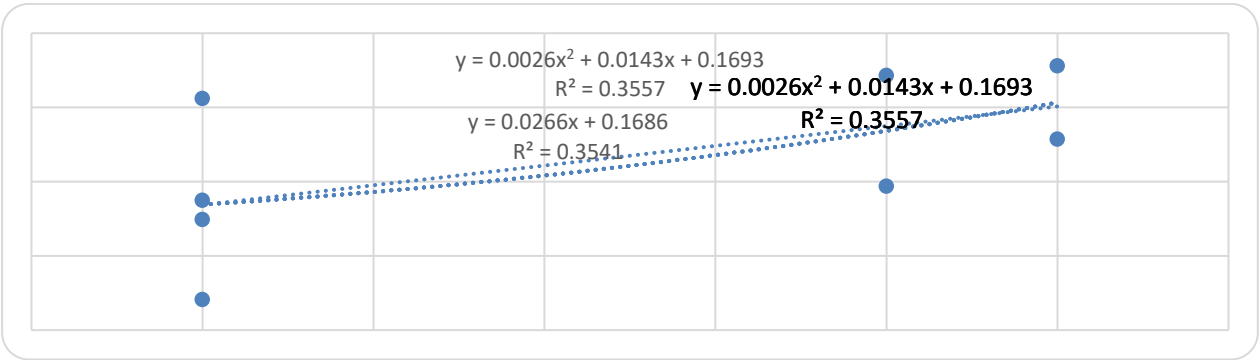

Fig. 7. Correlation between the number of rewarded LAGs and the relative poverty rate
Source: Own design.

Table 4. Correlation values

Correlation	r	R² Linear function	R² Polynomial function Grade 2	R² Polynomial function Grade 3	R² Polynomial function Grade 4	R² Polynomial function Grade 5
Number of rewarded LAGs / Relative poverty rate (%)	0.5951	0.3541	0.3557	-	-	-
Number of LAGs penalized / Relative poverty rate (%)	-0.3861	0.1491	0.2422	0.2424	0.6371	-

Source: Own calculation.

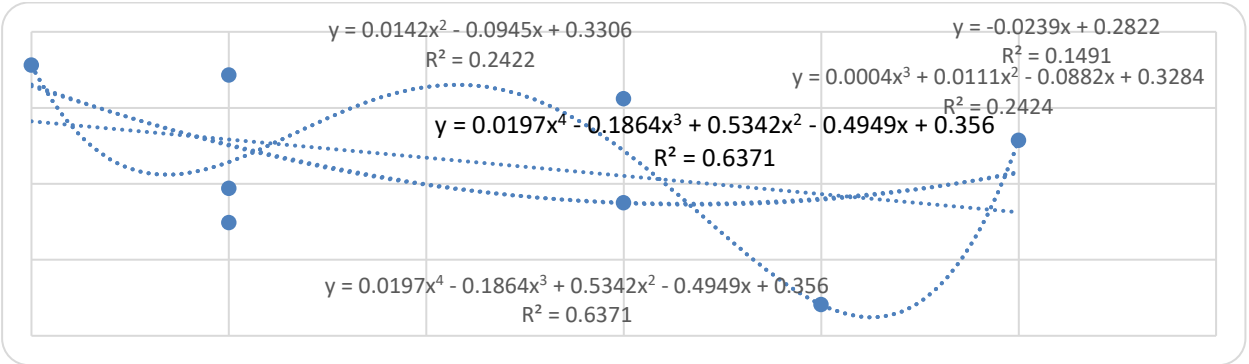

Fig. 8. Correlation between the number of penalized LAGs and the relative poverty rate
Source: Own design

Between the number of LAGs penalized at national level and the relative poverty rate at national level there is a correlation coefficient of -0.3861, so a reduced indirect dependence

between the variable. The determination coefficient R^2 has values of 0.1491 for the linear function and 0.2422, 0.2424 and 0.6371 respectively for the polynomial functions of degree 2,3 and 4 respectively. Starting with the polynomial function of degree 4 we can consider an increasingly strong connection between the two aspects (Figure 8 and Table 4).

CONCLUSIONS

The analyzed data highlight the fact that the LEADER approach, through its innovative principles, is a success. The proof is the number of local action groups set up, both at European and national level, increasing during the 2014-2020 programming period. Their existence is meant to contribute to rural development by attracting funding, so that rural areas are attractive, benefit from a high standard of living and contribute to maintaining biodiversity.

Out of a number of 239 local action groups existing and evaluated in the interval between the date of their authorization and 30.09.2019, 18 were penalized and 18 rewarded, the value of the penalties being equal to the value of the bonuses, respectively 2,522,162.40 euros.

In Romania, the strongly disadvantaged areas were motivated, to a certain extent, to attract financing that would contribute to the improvement of the quality of life of the inhabitants. The South-West Oltenia region, on the second place in the top of the disadvantaged regions, is competitive, in terms of the activity of the local action groups in the territory and motivated to develop, taking advantage of the financing sources offered. From the activity of the existing local action groups in the region, following the evaluation of the implementation of local development strategies, at regional level a surplus of 481,786.05 euros was attracted (the difference between the amount attracted by the rewarded local action groups and the penalty penalized local action).

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MODEL FOR EFFICIENCY EVALUATION OF FINANCIAL SECURITY MANAGEMENT OF JOINT STOCK COMPANIES OPERATING IN THE AGRICULTURAL SECTOR: A CASE STUDY OF UKRAINE

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Abstract

The study identifies a set of approaches to the formation of a financial security management system of joint-stock companies of the agricultural sector of Ukraine based on providing opportunities to increase their capitalization. To do this, it is necessary to determine an effective method of assessing the effectiveness of financial security management based on the application of a system of financial indicators and criteria that have an impact on the financial security of the enterprises of the agricultural sector as the financial results of their activities. The peculiarities of taking into account the indicator of financial leverage as the most effective criterion for assessing financial security of enterprises of the agricultural sector of Ukraine are considered. Emphasis is placed on the need to take into account industry risk when assessing the effectiveness of financial security management of joint-stock companies, which operating in the agricultural sector of Ukraine. It is proved that the use of the proposed approaches to assess the effectiveness of financial security of enterprises of the agricultural sector of Ukraine management makes it possible to predict the specific impact of each individual factor and indicator of the state of the company's financial security. The practical importance of the proposed method for its use in the process of assessing the investment attractiveness of joint-stock companies operating in the agricultural sector of Ukraine is determined.

***Key words*:** *agricultural sector, model, investment attractiveness, financial resources, joint-stock companies, financial leverage*

INTRODUCTION

The issue of determining the effectiveness of the formation and use of financial resources is fundamental in all economic research, which are the results of scientific research on its increase and improvement of the financial mechanism in a particular area in general. The main purpose of financial security management of joint-stock companies operating in the agricultural sector of Ukraine is to develop an effective model for assessing its effectiveness for timely detection of threats and/or dominants and the formation of the financial security strategy to increase the market value of the firm and create a positive investment image. It is investment resources that are decisive in terms of forming the financial potential of the economic growth of a joint-stock company operating in the agricultural sector.

Many scientists and practitioners have been involved in solving the problem of assessing the state of financial security of joint-stock companies, as well as the effectiveness of its management. In particular, researchers such as made a significant contribution to the formation of financial security assessment methods O. Agres [1], O. Apostolyuk [2] O. I. Baranovsky [3], I. O. Blank [4], A. Boiar [5], N. M. Davydenko [6-7], M. Dziamulych [8-10], V. M. Heyets [11], N. I. Kostina [12], A. Popescu [13-22], T. Shmatkovska [23-25], O. M. Shubalyi [26], I. O. Tsymbaliuk [27], V. Yakubiv [28], Ya. Yanyshyn [29], E. R. Zharova [30], I. V. Zhurakovska [31] and others. However, the results of scientific research of these authors are aimed at

determining the essence of financial security management of enterprises or its management mechanism and do not adequately cover the methodological aspects of assessing the effectiveness of financial security management of enterprises operating in the agricultural sector taking into account their organizational and legal form of management.

In general, the specialized scientific economic literature uses a large arsenal of methods for assessing both the financial security of economic entities and the effectiveness of their management. The most common of them are rapid analysis of the financial condition, financial and production leverage, integrated analysis. However, there is no clear sequence for conducting a certain type of analysis in terms of specific components of the system of financial security of domestic corporate structures. Instead, the same techniques are used to analyse the various components of this system, using variations of economic-mathematical and statistical analysis tools.

Thus, there is an objective need to generalize the existing methods of analysis of the effectiveness of financial security management of joint-stock companies operating in the agricultural sector, as well as to develop a model for assessing the effectiveness of financial security of joint-stock companies under the influence of relevant financial security factors.

MATERIALS AND METHODS

In the process of analyzing financial security, scientists in one way or another address the issue of its effectiveness, although they do not emphasize this. For example, rapid diagnostics often lead to conclusions about the deterioration or improvement of the financial condition of the entity, which is the result of effective management. And not for nothing, this technique can be considered a classic in the context of assessing the effectiveness of the formation and use of financial resources of economic entities, the effectiveness of which is confirmed by many years of use in financial analysis.

In addition to this, there are a number of other techniques that are very routine or created with the help of special software, and therefore - difficult to use. Thus, based on the selected factors, we can predict their impact on indicators of financial security in order to form an appropriate model using the regression equation. Regression-correlation analysis is an effective, and therefore a widely used tool for forecasting economic phenomena and processes. However, its effectiveness depends on the adequacy of the data for analysis. The reliability of the forecast by regression will be greater than the range of data underlying its construction. Preferably the following models have the form:

$$\overline{Y_x} = a_1 X_1 + a_2 X_2 + ... + a_n X_n ,$$

where:

$\overline{Y_x}$ – the resulting regression index;

X_{1-n} – causal variables;

a_{0-n} – parameters of the linear equation.

The resulting indicators are considered to be indicators of financial condition: the ratio of own working capital per unit of output, return on assets, liquidity ratios, etc., depending on the objectives of the research. The sample size is not defined and depends on the purpose underlying the construction of regression and subjective judgments of the researcher, however, the inclusion in it of a factor is preceded by checking it for collinearity with the resulting indicator, which provides a deviation from the analysis of those factors which with the analyzed indicator indicates a significant (≥0.9) or insignificant density (<0.75). There is no clear requirement for ranking the bond density, so different scientists set their limits at their own discretion.

Despite the fact that this method of modeling the assessment of financial security of joint-stock companies allows you to accurately predict it, we still believe that it is not without its drawbacks. The model does not take into account the factors that have the greatest impact on the state of financial and economic activities, which calls into question the reliability of the forecast, as it means incomplete analysis.

Ensuring maximum profitability is possible by full-scale use of all financial opportunities to increase the market value of the firm, and

minimization of financial risk - by constant monitoring of the effect of financial leverage. In view of this, we consider it appropriate to determine the effectiveness of financial security management of JSC of the agricultural sector engineering based on a cost-oriented approach to the capital structure by modifying existing approaches [6] to assess the investment image of the entity, which involves determining the weighted average cost of capital; the value of the firm or its rating through capitalized income and leverage; industry risk assessment.

Such an algorithm for assessing the effectiveness of financial security management of JSC (which essentially allows analyzing the financial potential of economic growth) was proposed due to the lack of necessary data for factor analysis of financial leverage, and which is based on the method of N. I. Kostina [12]. Despite the fact that financial leverage occurs only when the structure of financial resources available borrowed funds, we consider it appropriate to determine it even in the absence of borrowing, considering the amount of borrowed resources, which we have allocated in a separate block to emphasize ownership - the company uses them, but they do not belong to it.

According to research, a number of joint-stock companies of the agricultural sector in the field of mechanical engineering are permanently unprofitable in terms of net financial result, but the profitability of their operating activities is positive, indicating their business activity and, in general, reflects the feasibility of their operation. market. Therefore, they are all exposed to systematic risk, the assessment of which indicates the dependence or, conversely, independence from the industry, and thus - the level of security for investors. Based on such considerations, we consider it necessary to determine such a risk for each joint-stock company in the industry.

This risk is a synthesis of the likely negative impact of a number of endogenous and exogenous financial factors, including investment activity, turnover of total and equity, changes in the legal framework, etc., and its value is calculated as follows:

$$\beta = \frac{K_{PPm}}{S_p^2} = R_{PPm} \times \frac{S_{Pm}}{S_P},$$

where:

β – the magnitude of industry risk;

P – a random variable that characterizes the agricultural sector;

P_m– a random variable that characterizes a particular JSC within the industry;

K_{PPm} – covariance coefficient between P i P_m;

S_p – RMS deviation P;

S_{Pm} – RMS deviation P_m;

R – correlation coefficient between P i P_m.

By assessing this risk, it is customary to compare the return on equity of a particular entity and the market average, and its value indicates how many percent the approximate return on equity will increase if market returns increase (decrease) by 1%. Extrapolating the origins of this concept to the subject of the study, we consider the systematic risk to be greater, the greater the indicator of its elasticity. More detailed characteristics of the β-coefficient are shown in the Table 1.

Table 1. Economic content and level of branch risk of joint-stock companies of the agricultural sector by β-coefficient

The value of the β-coefficient	Economic content	Risk level
β < 0	A unique case when the return on total capital of a certain JSC of the agricultural sector and the compared branch are not related	-
β = 0	The profitability of JSC does not depend on the changes taking place in the industry. That is, the level of financial security is moderate	There is almost no risk
0 < β	The total profitability of a certain JSC of the agricultural sector responds quite moderately to changes in the compared branch. Financial security tactics and strategies are protective.	The risk is low (depends on the industry, but not significantly)
β = 1	The profitability of JSC changes in proportion to changes in industry profitability	Risk at the level of the average industry
β > 1	The profitability of a particular JSC largely depends on the changes taking place in the industry	High risk (shows industry dependence)

Source: compiled by the authors.

In this case, if:

β=1, this means that fluctuations in the financial results of an individual JSC of the agricultural sector coincide with the industry;

β<1 – variation in financial results is less than the industry;

β>1 – fluctuations in the results of financial

and economic activities are greater than the industry.

As for the amount of financial leverage, which is the financial lever of profitability, its skillful use can lead to a situation in which a firm with less equity can achieve good profitability. Thus, the size of the lever arm is determined as follows:

$$F = \frac{FL}{FR + D},$$

where:

FL – shoulder of financial leverage;

D – total debt of the joint-stock company;

FR – own financial resources of joint-stock companies.

The value of the joint-stock company (V_{js}) calculated as:

$$V_{js} = FR + LC,$$

where:

LC – the level of capitalization of the joint-stock company.

In turn, the level of capitalization at a discount rate will be determined taking into account the level of return on total capital by the formula:

$$LC = \frac{NP}{RTC \times 0{,}01},$$

where:

NP – net profit;

RTC – return on total capital, %.

RESULTS AND DISCUSSIONS

To summarize the conclusions and assess the effectiveness of financial security management of the JSC, we take into account these factors and form an appropriate formalized model. At the same time, we consider it necessary to compare the weighted average cost of capital, calculated on net income, which characterizes the level of return on shareholders and the value of JSC from the standpoint of financial potential for economic growth, which is useful for investors when making decisions about investing in these JSCs. If the value of a firm exceeds its weighted average price at a positive or increasing level of return on total and equity, as well as the return on its shares, it means that it increases its financial potential by borrowed resources, and thus - investing in its activities is profitable. Adherence to such conditions indicates that the strategy of its financial security is aggressive and aimed at increasing the market value of JSC.

If the weighted average cost of capital is higher than the value of the JSC in terms of positive or growing return on equity, total and share capital with little financial leverage - this means that the JSC is aimed at satisfying the interests of owners, and financial security strategy is protective. The peculiarities of such a strategy are the financing of development only from its own sources of financial resources.

The value of relatively and absolutely unprofitable JSCs should be estimated by the amount of retained earnings, which can be considered as a reserve of additional equity as a potential source of equity, which can be used to cover losses or the depth of the “debt pit” at a net loss. It is possible to allocate such types of strategies of financial safety of joint-stock companies depending on their purposes (Table 2).

Table 2. Types of the financial security strategy of joint-stock companies operating in the agricultural sector depending on their market value

Type of strategy	The level of management efficiency	Content	Features
Aggressive	High (strategy effective)	Aimed at increasing the value of JSC and increasing the financial potential of economic growth in the short and long term. Market activity is high	In the structure of financial resources, in addition to own and involved, there are borrowed funds. The cost of JSC exceeds the weighted average cost of capital, providing a positive value of return on equity and total capital
Protective	Medium (moderately effective strategy)	Aimed at satisfying the interests of shareholders and maintaining a stable financial potential for economic growth. JSCs are passive in the stock and credit markets	There are no borrowed funds in the structure of financial resources. The weighted average cost of capital is higher than the cost of JSC, the return on equity and total capital is positive or growing, and the level of financial leverage is low
Passive	Low (strategy ineffective)	Aimed at maintaining operating activities and covering losses. JSC passive on the stock market and active on credit (periodically or in dynamics)	The structure of financial resources is formed by own, involved, and borrowed funds. The amount of retained earnings decreases in dynamics or the number of uncovered losses exceeds the amount of registered and additional capital (periodically or in dynamics)

Source: Own research.

The financial security strategy of such JSCs should be considered passive, and the financial potential of economic growth is exhausted by the amount of registered capital, increased by the amount of retained earnings, if any. If the amount of uncovered losses exceeds the amount of registered and other additional capital, the internal financial potential of economic growth of such an entity is absent and can be replenished only by the state, as it is extremely difficult to attract private investors to finance the JSC.

Taking into account the above, and in order to simplify the process of assessing the effectiveness of financial security management of JSC, we form an appropriate model, introducing symbols, which distinguish three levels of efficiency of financial security management of JSC of the agricultural sector: effective, moderately effective and inefficient (Fig. 1).

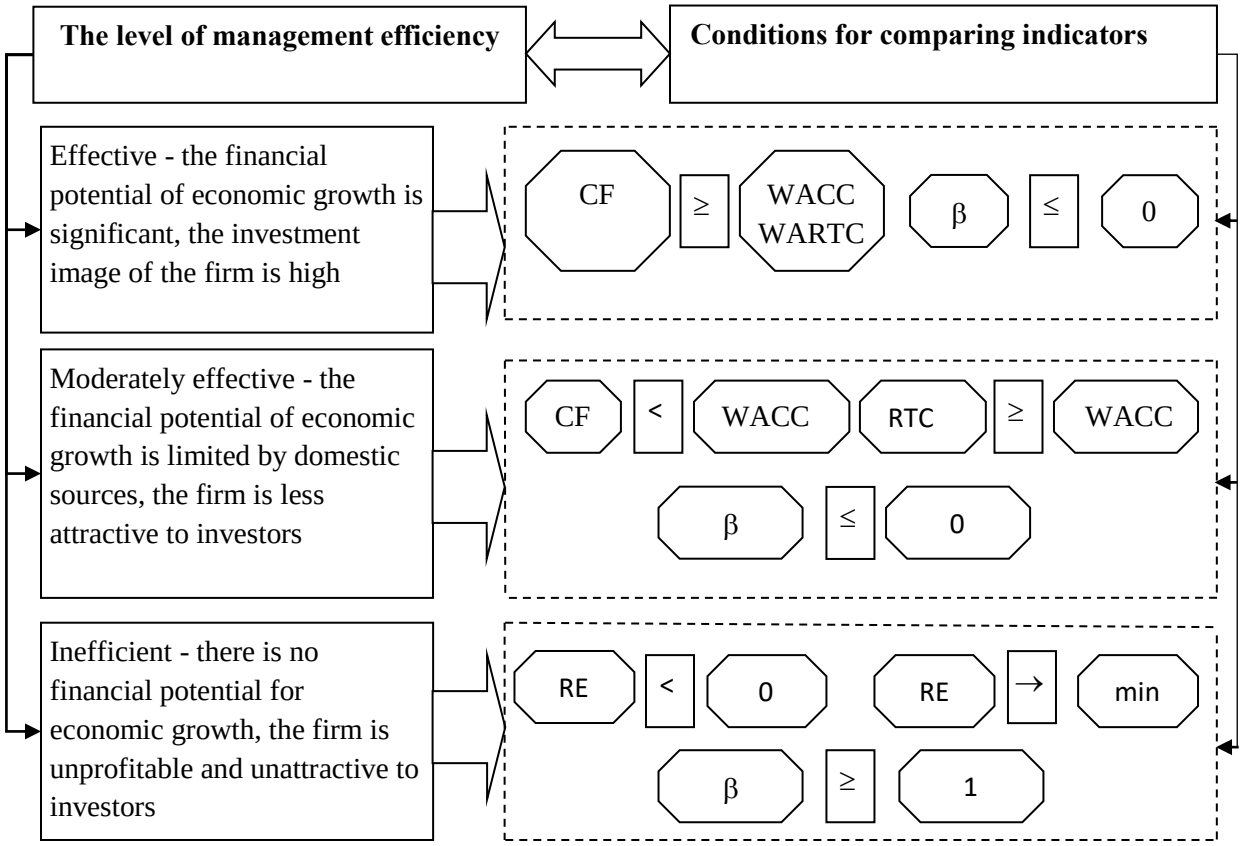

Fig. 1. Model for assessing the effectiveness of financial security management of JSC operating in the agricultural sector

Source: Own research.

Symbols: CF - the cost of the firm; WACC - the weighted average cost of capital; RTC - return on total capital; WARTC - the weighted average return on total capital; RE - retained earnings.

To determine the value of the studied join-stock companies of the agricultural sector of Ukraine according to the above algorithm and try to assess the effectiveness of managing their financial security from the standpoint of the financial potential of economic growth, comparing it with the weighted average cost of total capital and taking into account the amount of financial risk.

It should be noted: all indicators will be calculated in thousands of UAH except for some of them, the units of which are listed directly in the tables.

As can be seen from the Table 3, the value of the leverage of PJSC "Mykolaiv Agricultural Company" was the largest in 2019, which indicates the greatest financial risk this year, which is also confirmed by the largest

percentage of debt in the value of the firm and a simultaneous decrease in return on equity.

Table 3. Indicators for assessing the effectiveness of financial security management of PJSC "Mykolaiv Agricultural Company"

Indexes	2016	2017	2018	2019
Own financial resources	9,242,542	10,762,429	14,234,040	16,252,316
Financial resources involved	3,422,440	5,270,041	5,874,065	5,905,174
Aggregate own resources (group 1 + group 2)	12,664,982	16,032,470	20,108,105	22,157,490
Borrowed funds (debt)	531,128	546,984	648,436	2,968,164
Total capital (gr. 1 + gr. 2 + gr. 3)	13,196,110	16,579,454	20,756,541	25,125,654
Net profit	1,319,191	1,560,367	3,399,842	1,964,443
Operating profit	2,190,854	3,644,326	5,921,863	3,471,445
Return on equity taking into account borrowed funds,%	*10*	*10*	*17*	*9*
Return on total capital,%	*10*	*9*	*16*	*8*
Net profit per 1 share, UAH	634.84	750.90	1636.12	945.36
The weighted return on total capital,%	7	4	10	5
The weighted average cost of capital	**19,916,855**	**36,443,260**	**32,899,239**	**38,571,611**
Capitalized income	19,916,855	36,443,260	32,899,239	38,571,611
Shoulder of financial leverage	0.054	0.048	0.044	0.154
The cost of the firm	**20,447,983**	**36,990,244**	**33,547,675**	**41,539,775**
% of debt in the value of the firm	4.24	3.39	3.32	11.97
Systematic risk	***β-factor = -0.11 risk absent***			

Source: Own research.

This means that the company does not use the opportunities to manoeuvre the effect of financial leverage over its shoulder in order to extensively increase the latter, resulting in avoiding problems of loss of financial independence, increasing the value of "risk premium" in loans. The fact is that with the permanent and excessive growth of borrowed resources there is a risk of losing financial stability due to the need to divert funds to repay the body of the loan and interest on it. In such a situation, the level of financial leverage grows, which automatically increases the "risk fee", which is included in the cost of the loan by lenders. In addition, JSCs must have some untapped borrowing potential in case of unforeseen economic, socio-political, and market circumstances and, in case of urgent need, replenish financial resources with newly borrowed funds, providing a positive differential of financial leverage (i.e. use its stock). These features of the effect of financial leverage should be taken into account when formulating a policy to improve the efficiency of financial security management of JSC of the agricultural sector, which uses credit resources in its activities to increase the return on equity.

At the same time, the excess of the latter over the weighted average price of financial resources indicates that the JSC uses an aggressive strategy of financial security, forming a huge financial potential for economic growth, which indicates an increase in borrowed capital and good return on total capital. However, the reduction of the latter in 2019 to the lowest level for the entire period indicates the need to increase business and market activity in order to achieve the goals of sustainable development and neutralize financial risk. The small and negative value of the b-factor indicates the inverse relationship of the analyzed JSC with the industry and its independence from external factors. Therefore, the rating (and hence the effectiveness of financial security management) of this JSC is the highest in terms of investment among all surveyed entities, given the largest amount of net income per share (Table 3).

As for PJSC Agricultural firm "Verbivske" and PJSC "Bakhmut Agricultural Union", there are no borrowed funds in the structure of their financial resources, however, there are borrowed funds, which we will consider as debts. At the same time, the percentage of debt in the value of the JSC actually reflects the share of funds raised in it, however, affects the value of the JSC (Table 4, Table 5).

Table 4. Indicators for assessing the effectiveness of financial security management of PJSC Agricultural firm "Verbivske"

Indexes	2016	2017	2018	2019
Own financial resources	424,031	589,272	919,024	1,012,019
Raised financial resources (debt)	177,765	252,939	136,794	190,764
Total capital (group 1 + group 2)	601,796	842,211	1,055,818	1,202,783
Net profit	43,580	167,657	324,391	266,157
Operating profit	66,840	265,028	396,828	286,876
Return on equity,%	10	33	43	28
Return on total capital,%	7	20	31	22
Weighted average return on total capital, %	5	15	28	22
Net profit per 1 share, UAH	0.03	0.13	0.26	0.21
The weighted average cost of capital	**954,857**	**1,152,296**	**1,167,141**	**1,195,317**
Capitalized income	622,571	728,943	954,091	1,108,988
Shoulder of financial leverage	0.295	0.300	0.130	0.159
The cost of the firm	**800,336**	**981,882**	**1,090,885**	**1,299,752**
% of debt in the value of the firm	*22.21*	*25.76*	*12.54*	*14.68*
Systematic risk	***β-factor=-0.71 risk absent***			

Source: Own research.

As can be seen from the Table 4, borrowed funds slightly reduce the return on total capital compared to equity. However, during 2016-2018 the price of total financial resources exceeds the value of PJSC Agricultural firm "Verbivske", which indicates the effective management of its financial resources during this period and its slight decrease in 2019 (the value of JSC exceeded the weighted average cost of capital).

The permanent growth of capitalized income, the insignificant amount of financial leverage, and the negative value of the b-ratio of systematic risk testify to the strategy of increasing the dominance of financial security, which is obviously based on the stable development of this JSC.

As for PJSC "Bakhmut Agricultural Union", its value is higher than the weighted average cost of capital, which is due to the use of significant borrowed capital, the share of which in the value of JSC is higher than in the previously analysed JSC. Therefore, the strategy of its financial security is aimed at maintaining a certain financial condition (after all, borrowed capital is not used to finance current activities) and is protective given the value of the elasticity of systematic risk.

Despite the fact that financing activities at the expense of own funds are effective from the standpoint of financial independence, however, the current challenges of European integration and globalization, necessitate an increase in the rating of domestic JSCs of the agricultural sector, and hence their market value. And this cannot be achieved by limiting oneself to one's own funds.

That is why the financial potential of economic growth of PJSC Agricultural firm "Verbivske" and PJSC "Bakhmut Agricultural Union" is insufficient to increase the efficiency of formation and use of their financial resources from the point of view of investment, which indicates a much lower profit per share than PJSC "Mykolaiv Agricultural Company".

Table 5. Indicators for assessing the effectiveness of financial security management of PJSC "Bakhmut Agricultural Union"

Indexes	2016	2017	2018	2019
Own financial resources	2,161,308	2,579,448	3,770,326	3,374,477
Raised financial resources (debt)	1,559,722	1,435,878	1,044,834	1,364,129
Total capital (gr. 1 + gr. 2)	3,721,030	4,015,326	4,815,160	4,738,606
Net profit	582,944	637,397	1,632,751	1,065,328
Operating profit	689,633	628,654	1,867,361	1,178,855
Return on equity,%	31	27	51	30
Return on total capital,%	16	16	34	22
Weighted average return on total capital,%	14	16	32	20
Net profit per 1 share, UAH	1.37	1.50	3.86	2.52
The weighted average cost of capital	**4,056,665**	**3,929,088**	**5,046,922**	**5,358,432**
Capitalized income	3,429,082	3,983,731	4,412,841	4,842,400
Shoulder of financial leverage	0.419	0.358	0.217	0.288
The cost of the firm	**4,988,804**	**5,419,609**	**5,457,675**	**6,206,529**
% of debt in the value of the firm	31.26%	26.49%	19.14%	21.98%
Systematic risk	***β-factor = -0.15 risk absent***			

Source: Own research.

With regard to unprofitable JSCs, the effectiveness of their financial security management should be carried out by the size of the debt hole, which increases in proportion to the growth of losses and is reflected in the structure of their own financial resources. Some of them – PJSC "Vinnytsiaagrotransservis" and Agricultural PJSC "Ukraine" have in reserve retained earnings accumulated in previous periods, and PJSC "Blok Agrosvit" and PJSC "Technological agrarian company united" – accumulate value uncovered losses, further deepening the "debt hole" (Fig. 2).

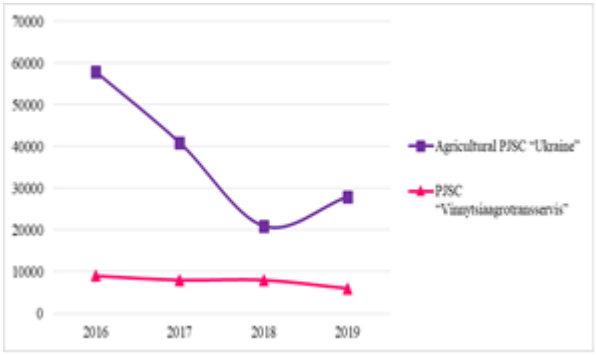

Fig. 2. The level of loss on retained earnings of JSC for the agricultural sector in Ukraine for 2016-2019, thousand UAH
Source: Own research.

In conditions of permanent loss, they all use borrowed resources to finance current activities, so – to determine the amount of financial leverage by the proposed method is impossible and impractical, as it is known that the risk of financial dependence is high and the firm's rating is low. However, we reflect the impact of losses on equity relative to unprofitable enterprises and the size of the "debt pit" of absolutely unprofitable JSCs of the agricultural sector of Ukraine (Fig. 3).

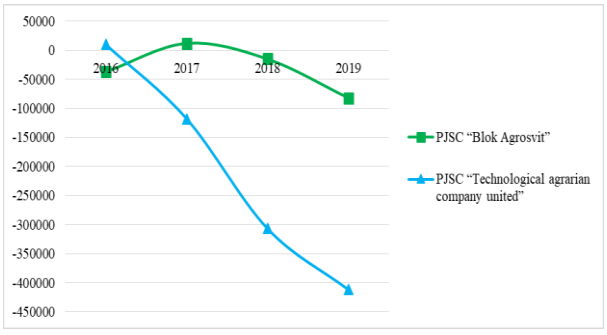

Fig. 3. The level of loss on retained earnings of JSC for the agricultural sector in Ukraine for 2016-2019, thousand UAH
Source: Own research.

As can be seen from Fig. 2 and Fig. 34, retained earnings of PJSC "Vinnytsiaagrotransservis" does not have a clear tendency to increase or decrease,

however, it is positive. The analysed indicator at Agricultural PJSC "Ukraine" was permanently decreasing during 2016-2018, but in 2019 it increased and is also in the safety zone, without falling to the negative axis of ordinates. Instead, its value at PJSC "Blok Agrosvit" is positive only in 2016 and rapidly decreases during 2017-2019, and at PJSC "Technological agrarian company united" - in 2017 and also decreases in 2018-2019

The analysis of systematic risk shows the inverse dependence of the profitability of the agricultural sector of Ukraine and PJSC "Vinnytsiaagrotransservis" and PJSC "Technological agrarian company united", which means the absence of risk associated with changes in the profitability of this industry. Instead, the systematic risk of Agricultural PJSC "Ukraine" indicates a slight dependence on the industry and, accordingly, the changes taking place in it. The highest risk is PJSC "Blok Agrosvit", which indicates a high dependence on the industry (Table 6).

Table 6. Calculation for the β-factor of systematic risk

Profitability of the agricultural sector	**2016**	**2017**	**2018**	**2019**	**K_{ppm}**	**b-factor**
	0.018	-0.133	-0.08	-0.004	**S_p^2=0.0048**	
PJSC "Mykolaiv Agricultural Company"	0.11	0.1	0.18	0.09	-0.0006	-0.1136
PJSC "Blok Agrosvit"	-0.04	-0.3	-0.32	-0.19	0.0058	1.2003
PJSC "Bakhmut Agricultural Union"	0.17	0.16	0.37	0.22	-0.0007	-0.1513
PJSC Agricultural firm "Verbivske"	0.07	0.23	0.34	0.24	-0.0034	-0.7077
Agricultural PJSC "Ukraine"	-0.03	-0.1	-0.19	0.06	0.0037	0.7632
PJSC "Vinnytsiaagrotransservis"	-0.06	-0.1	0.02	-0.11	-0.0003	-0.0711
PJSC "Technological agrarian company united"	-0.17	0.65	-0.25	-0.63	-0.0217	-4.4854

Source: compiled according to the State Statistics Service of Ukraine and the annual financial statements of the JSC of the agricultural sector of Ukraine.

To confirm the above conclusions and compare the investment attractiveness of profitable JSCs, we consider it appropriate to introduce a comprehensive criterion for the effectiveness of financial security management of JSC of the agricultural sector of Ukraine on the basis of individual partial criteria.

For this purpose, we use the analytic hierarchy process (the AHP), which for the past 10 years confirmed its effectiveness at various levels of planning on choosing a compromise solution among the possible alternatives. According to this method, the priority decision (selection of the most attractive JSC for investment) is selected on the basis of pairwise comparisons of scores of certain partial criteria.

The main purpose of our study is the choice of JSC, the overall efficiency of financial security management which is highest among PJSC Agricultural firm "Verbivske" (alternative Nr1), PJSC "Bakhmut Agricultural Union" (alternative Nr2) and PJSC "Mykolaiv Agricultural Company" (alternative Nr3). We believe that the degree of investment attractiveness will indicate the appropriate degree of effectiveness of financial security management for the reason that only a successfully functioning JSC of the agricultural sector that provides a high level of efficiency in the formation and use of financial resources can be attractive to investors. In fact, a high level of financial condition is a measure of the effectiveness of the management of financial security of the JSC of the agricultural sector of Ukraine in a stable development. Despite our understanding of efficiency as obtaining the best (largest) result at the lowest cost, we consider it necessary to move away from the classic practice of performance evaluation, introducing a standard of investment attractiveness or a criterion of the overall efficiency of financial security management.

The basis for such an assessment is the criteria that together form the characteristics of the aggregate effect of financial security

management. These return on equity (K1), business activity (K2), term liquidity (K3), profitability (K4), and solvency (K5). These criteria are based on the results of discussions of the agricultural sector of Ukraine experts (employees, potential investors, government officials, and local governments) to identify the most important indicators for the investor, according to which he decides on the feasibility of investing in JSC. The following indicators include net income per ordinary share and the values of inventory turnover ratios, term liquidity, profitability, solvency. The choice of these indicators of the state of financial security of the JSC of the agricultural sector of Ukraine is due to the sufficiency of information for the investor to draw conclusions about the effectiveness of the formation and use of financial resources of the JSC. Such a sample makes it possible to take into account the specifics of the functioning of the JSC, which is manifested in the difficulty of selling stocks of JSC products of the agricultural sector. In addition, the exclusion of indicators that characterize the same active financial and economic activities greatly simplifies the analysis.

Thus, to assess the solvency of a JSC, the investor needs to analyse the coefficient of financial autonomy, which is the most important in the group of financial stability and characterizes the adequacy of equity to finance operating and investment activities in the short and long term. Despite the fact that the normative value of the ratio is > 0.5, the investor is still interested in it varying between 0.4-0.6 (which will indicate a low level of financial risk and stability of the company in the medium and long term).

The next most important indicator defined by experts are the profitability indicator, which can be used to draw conclusions about the effectiveness of the operating activities of companies. The higher it is, the more profit each unit of the agricultural sector brings, and therefore, it is competitive. Of course, the investor will invest only in an enterprise that has a certain level of profit, so the value of this indicator should be greater than 0.1.

It is important to determine the liquidity of the JSC of the agricultural sector of Ukraine at the time of assessment of investment attractiveness, i.e. to calculate the term liquidity ratio. It is important for the investor that the quick liquidity ratio was in the optimal range – 1-1.5. This means that the company has enough liquid funds to fully repay financial debts and form a minimum reserve of investment resources. Instead, the effectiveness of inventory management should also be assessed by calculating an inventory turnover indicator, the value of which is a priority for the investor if it is more than one. That is, an effective policy of selling stocks requires their turnover once a year.

Another of the most important characteristics of the effectiveness of financial security management of the studied JSCs is the net profit per 1 ordinary share. This indicator characterizes the return on equity by investors and is chosen by experts given the lack of data on the market price of shares of comparable JSCs, which makes it impossible to calculate the return on equity in the classic version. And the value of net income per share is reflected in the financial statements, so there are no problems with the probable distortion of conclusions about the level of profitability of the company. In addition, the use of criteria in different measures is possible when using AHP. The optimal value, which will certify the minimum level of profit by experts, is set at UAH 0.1. Accordingly, exceeding this value will indicate the effectiveness of financial security management of the JSC of the agricultural sector of Ukraine.

Calculate the degree of consistency of the elements of the matrix *D* within the AHP, using the consistency index (consistency index *CI*), which characterizes the deviation of the maximum value of a criterion from what corresponds to the ideal option (which the investor wants to see) and is calculated by the formula:

$$CI = \frac{\lambda_{max} - m}{m - 1},$$

where:

λ_{max} – the maximum value of a certain criterion;

m – the desired (ideal) value of a certain criterion from the position of the investor.

Assessment of the acceptability of the consistency degree of the matrix elements is carried out by calculating the relative consistency (consistency ratio CR) as follows:

$$CR = \frac{CI}{CIS},$$

where:
CIS – the average value of the consistency index (Table 7).

Table 7. The experimental value of the consistency index

m	3	4	5	6	7
CIS	0.58	0.90	1.12	1.24	1.32

Source: Own research.

Therefore, we calculate the priority vectors for each of the alternatives in terms of criteria (Tables 8 - 12).

Table 8. The level of financial security management efficiency of joint-stock companies of the agricultural sector of Ukraine from the position of the investor on the criterion of return on share capital*

	Alternative Nr1	Alternative Nr2	Alternative Nr3	Vector of the priorities
Alternative Nr1	1	2	1/9	0.1140
Alternative Nr2	1/2	1	1/9	0.0718
Alternative Nr3	9	9	1	0.8142

*λ_{max}=3.054; *CI*=0.0268; *CR*=0.0462.
Source: Own research.

Table 9. The level of financial security management efficiency of joint-stock companies of the agricultural sector of Ukraine from the position of the investor on the criterion of business activity*

	Alternative Nr1	Alternative Nr2	Alternative Nr3	Vector of the priorities
Alternative Nr1	1	2	3	0.5499
Alternative Nr2	1/2	1	1	0.2402
Alternative Nr3	1/3	1	1	0.2098

*λ_{max}=3.0183; *CI*=0.0091; *CR*=0.0158.
Source: Own research.

We also define generalized priorities as the sum of the products of the priority vector of a specific criterion by the value of the priority vector by the same criterion for each specific alternative, making sure that the relative consistency does not exceed 10% (Table 13).

Table 10. The level of priority of financial security of joint-stock companies of the agricultural sector of Ukraine for the investor by the criterion of term liquidity*

	Alternative Nr1	Alternative Nr2	Alternative Nr3	Vector of the priorities
Alternative Nr1	1	9	4	0.7009
Alternative Nr2	1/9	1	1/6	0.0562
Alternative Nr3	1/4	6	1	0.2430

*λ_{max}=3.1078; *CI*=0.0539; *CR*=0.0929.
Source: Own research.

Table 11. The level of financial security management efficiency of joint-stock companies of the agricultural sector of Ukraine from the position of the investor on the criterion of profitability*

	Alternative Nr1	Alternative Nr2	Alternative Nr3	Vector of the priorities
Alternative Nr1	1	6	1/2	0.3681
Alternative Nr2	1/6	1	1/5	0.0821
Alternative Nr3	2	5	1	0.5498

*λ_{max}=3.0858; *CI*=0.0429; *CR*=0.074.
Source: Own research.

Table 12. The level of financial security management efficiency of joint-stock companies of the agricultural sector of Ukraine from the position of the investor by the criterion of solvency*

	Alternative Nr1	Alternative Nr2	Alternative Nr3	Vector of the priorities
Alternative Nr1	1	2	1/9	0.1211
Alternative Nr2	1/2	1	1/7	0.0830
Alternative Nr3	9	7	1	0.7959

*λ_{max}=3.0999; *CI*=0.050; *CR*=0.0861.
Source: Own research.

Table 13. Matrix of pairwise comparisons for criteria and its numerical estimates*

CRITERIA	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Vector of the priorities
Criterion 1	1	3	1/5	1/6	1/8	0.0519
Criterion 2	1/3	1	1/6	1/8	1/9	0.0298
Criterion 3	5	6	1	1/3	1/5	0.1433
Criterion 4	6	8	3	1	1/3	0.2706
Criterion 5	8	9	5	3	1	0.5044

*Herewith, λ_{max}=4.0796; *CI*=0.0265; *CR*=0.0772.
Source: Own research.

Summarizing the data on the level of priority for the studied JSC of the agricultural sector of Ukraine (Table 14), we calculate the global priorities for each of the criteria and their amounts (Table 15).

Given the numerical values of the Table 15, the most attractive for investment is PJSC "Mykolaiv Agricultural Company", the assessment of the effectiveness of financial security management, which from the position of the investor is the highest – 0.6335.

For PJSC Agricultural firm "Verbivske" such an assessment gave less value to the global priority – 0.2884, for PJSC "Bakhmut Agricultural Union" – even less (0.2834).

Table 14. Generalized priority assessments when choosing an alternative (summary data)

Alternatives	Numerical value of the priority vector of the priority criterion and evaluation of the priority criteria				
	К 1	К 2	К 3	К 4	К 5
	0.0519	0.0298	0.1433	0.2706	0.5044
PJSC Agricultural firm "Verbivske"	0.1140	0.5499	0.7009	0.3681	0.1211
PJSC "Bakhmut Agricultural Union"	0.0718	0.2402	0.0562	0.0821	0.0830
PJSC "Mykolaiv Agricultural Company"	0.8142	0.2098	0.2430	0.5498	0.7959

Source: Own research.

Table 15. Global priorities

Criteria / Alternatives	Global priorities by criteria					The sum of global priorities
	К 1	К 2	К 3	К 4	К 5	
PJSC Agricultural firm "Verbivske"	0.0059	0.0164	0.1004	0.0996	0.0611	0.2834
PJSC "Bakhmut Agricultural Union"	0.0037	0.0072	0.0080	0.0222	0.0419	0.0830
PJSC "Mykolaiv Agricultural Company"	0.0423	0.0063	0.0348	0.1488	0.4014	0.6335

Source: Own research.

Therefore, in this order, it is necessary to rank the researched joint-stock companies of the agricultural sector of Ukraine on the efficiency of management of financial safety.

CONCLUSIONS

Thus, as a result of the study, the main factors that may be dominant and threats to the financial security of joint-stock companies of the agricultural sector of Ukraine in terms of operating, investment, and financial activities of joint-stock companies have been identified. At the same time, a model for evaluating the effectiveness of financial security management of joint-stock companies of the agricultural sector of Ukraine taking into account relevant factors is proposed. This analysis of financial security covers almost all financial results and the factors that determine them, and therefore is quite thorough and allows you to highlight the various nuances of financial and economic activities that can positively or negatively affect the level of financial security and reflect the effectiveness of both formation and the use of financial resources of joint-stock companies of the agricultural sector of Ukraine.

Thereby, assessing the effectiveness of financial security management of joint-stock companies of the agricultural sector of Ukraine based on determining their value and assessing the amount of retained earnings as a reserve for economic growth or loss level allows distinguishing financial security strategies from the standpoint of investment,

which forms the investment image. And the calculation of a comprehensive criterion of investment attractiveness makes it possible to rank joint-stock companies of the agricultural sector of Ukraine according to the level of efficiency of their financial security management.

It should also be noted that the obtained model for assessing the effectiveness of financial security management of joint-stock companies of the agricultural sector of Ukraine can be used in practice to assess the investment attractiveness of individual companies and in terms of portfolio investment in the price of securities of joint-stock companies. At the same time, the criteria that show the level of financial security of the enterprise are also markers of investment security for investors. In addition, the results of our model can be successfully used to characterize the level of financial stability of joint-stock companies of the agricultural sector of Ukraine in the long run in the formation of their annual audit reports, the materials of which are markers not only for investors but also affect the market value of these companies.

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COMPARATIVE ANALYSIS ON ACCESSING EUROPEAN FUNDS THROUGH THE TWO NATIONAL RURAL DEVELOPMENT PROGRAMS IN THE SOUTH-MUNTENIA REGION, ROMANIA

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Abstract

South Muntenia is an extremely important region from an agricultural point of view, so the European funds granted through the two National Rural Development Programs have contributed to the development of the component counties of the region. The purpose of the paper is to highlight the specificity of the measures accessed from county to county, influenced by certain factors, but also to identify the necessary measures that need to be implemented in the next National Strategic Plan. In the elaboration of the paper were used the qualitative analysis comparing the results of the two National Rural Development Programs, but also the quantitative analysis by processing the obtained data. As a conclusion, there are differences among the counties of the South Muntenia region of Romania regarding the use of the funds allotted within NRDP 2014-2020, but the counties with the most accessed funds are Teleorman, Dambovita and Prahova. Calarasi and Teleorman counties, having a predominant agricultural profile, concentrated investments for purchasing modern machinery and equipment in the agricultural holdings. Also, Calarasi and Ialomita counties have attracted important funds for investing in the development, modernization or adaptation of agricultural and forestry infrastructure, such as investments in irrigation infrastructure.

Key words**:** *development, rural area, European funds*

INTRODUCTION

South region has an area of 34,489 square kilometers, and includes six districts including: Arges, Calarasi, Dambovita, Giurgiu, Ialomita and Prahova, having a total population of 2.965 million inhabitants and a density of 86.1 inhabitants/sq. The largest administrative region is Argeș County, with an area of 6,826 square kilometers and a population of over 585 thousand inhabitants. Also, the unemployment rate has a value of 3.2%, below the average of the South-Muntenia region which is 4% [2, 3, 7, 12].

In this paper we have used data provided on the website of the Ministry of Agriculture and Rural Development of Romania, regarding the situation of authorized storage spaces in the 42 counties of the country, in the period 2015-2018 to identify the evolution trend and what is the impact of the existence of storage spaces in the 42 counties of the country, using the qualitative and quantitative method [5, 13].

Prahova and Arges counties are recognized as administrative regions with developed industries such as the oil processing industry or machine builders, so that in 2019 they hold a share of 32% (40.86 million lei), respectively 23% (29.73 million lei) from the total GDP of the South-Muntenia development region which exceeded the value of 127.4 million lei (Table 1).

Regarding the other counties, at the level of 2019, Dambovita registered a GDP value of 17.5 million lei, having a share of 14% of the total GDP of the region, Teleorman with 10.2 million lei (8%), Calarasi with 9.67 million lei (8%), Giurgiu with 9.85 million lei (8%) and Ialomita with 9.59 million lei (7%) (Fig. 1).

Agriculture is an important branch in the formation of gross domestic product in each county. In this sense, the agricultural sector and the rural area benefited from important funds for development, through NRDP. 2007-2013 and NRDP 2013-2020 [4, 8, 11].

Table 1. Situation of the main indicators at the level of the South-Muntenia macro-region

Specify	Area (sq km)	Population (no. of people)	People/sq	Unemployment rate (%)
Total region	34,453	2,965,205	86.1	4
Arges	6,826	585,730	85.8	3.2
Calarasi	5,088	288,043	56.6	4.2
Dambovita	4,054	496,173	122.4	4.2
Giurgiu	3,526	269,279	76.4	2.3
Ialomita	4,453	258,931	58.1	5.6
Prahova	4,716	725,609	153.9	2.6
Teleorman	5,790	341,440	59.0	7.8

Source: Databases National Institute of Statistics, Accessed on 05.2020 [9].

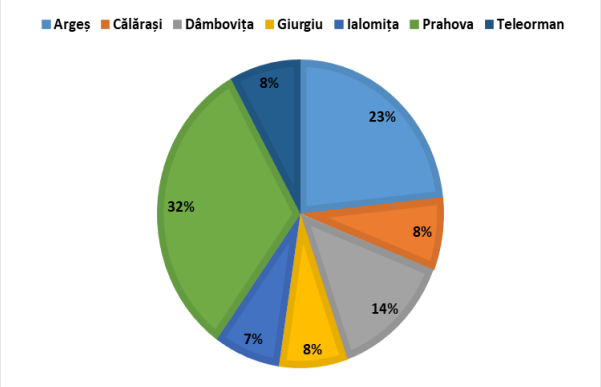

Fig. 1. Percentage distribution of the Gross Domestic Product at the level of the counties from the South-Muntenia region
Source: Processed data, NIS database [9].

The main measures/sub-measures, financed in the South-Muntenia region, in the period 2007-2013, respectively 2014-2020 are monitored by the Agency for Financing Rural Investments (A.F.R.I.) [6, 10, 14].
Within this context, the purpose of the paper was to analyze the situation of the funds provided by the EU in order to identify what measures and sub-measures included in the National Rural Development Program were suitable for South Region, how many projects have been financed, and which the value of the funds used in this region by county.

MATERIALS AND METHODS

For setting up this research work, there were used data obtained from the National Institute of Statistics, as well as the National Forecast Commission. Regarding the data regarding the two National Rural Development Programs were obtained from the Agency for Financing Rural Investments (A.F.R.I.). In the elaboration of the paper were used the qualitative analysis comparing the results of the two National Rural Development Programs, but also the quantitative analysis by processing the obtained data.

RESULTS AND DISCUSSIONS

Through the National Rural Development Program 2007-2013, 86,751 projects were financed, of which 8,853 projects in the South-Muntenia region, having a share of 10.2% of the total projects financed at national level (Figure 2).
Analyzing the number of projects financed by PNDR 2007-2013, the most targeted measure was 141 which supported semi-subsistence farms, namely 4,765 projects were financed out of the total of 55,466 financed nationally, having a share of 8.6% total (Figure 2).
At national level, measure 431 held a 20,4% increase of the total projects funded by the measure, resulting in 58 projects targeting the functioning of the local Action groups (Figure 2).
Another measure with a significant share in the total of projects financed at national level was measure 123, thus financing 204 projects that aimed to increase the added value of agricultural and forestry products (Figure 3).
At county level, Dambovita and Arges were financed the most projects, namely 2549, respectively 2063 projects out of the total of 8853 projects financed at regional level. We can see that in Dambovita County, 1555 projects were financed aiming at measure 141 regarding the support of semi-subsistence farms. Also, 390 projects aimed at installing young farmers were also financed in this county (Table 2).

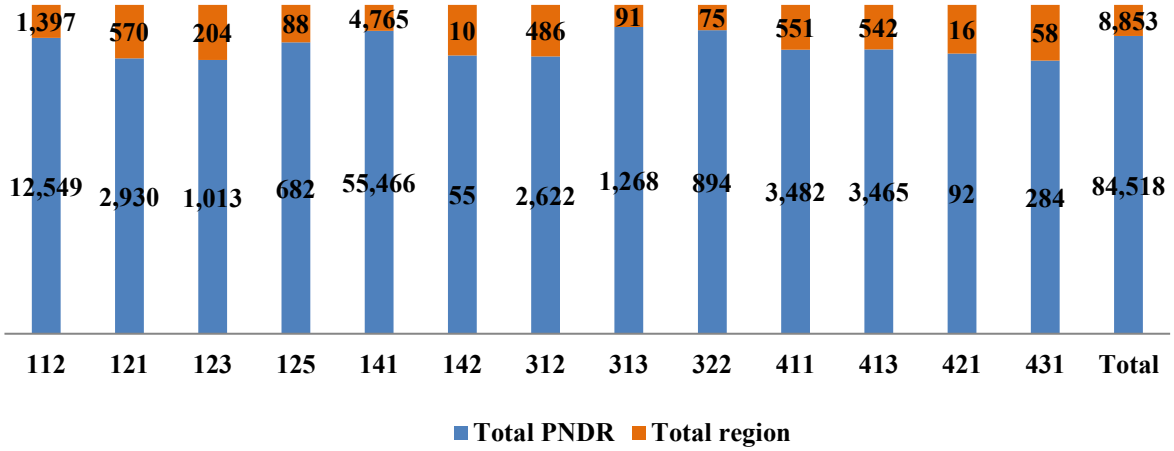

Fig. 2. Situation of the number of projects financed by PNDR 2007-2013 at national level compared to the South-Muntenia region
Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed on 05.2020 [1].

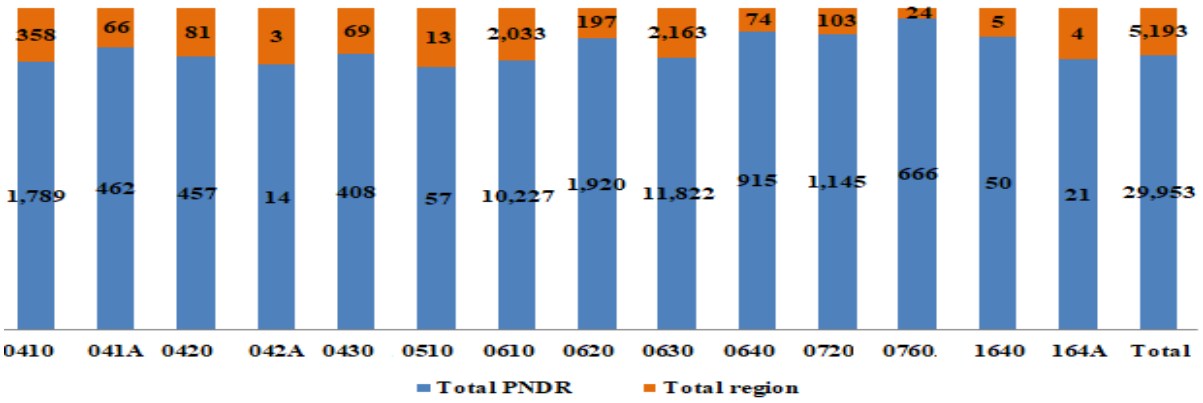

Fig. 3. Situation of the number of projects financed by PNDR 2014-2020 at national level compared to the South-Muntenia region
Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed on 05.2020 [1].

Table 2. Situation of the number of projects financed at the level of the South-Muntenia region through the National Rural Development Program 2007-2013

Specify	Measures													Grand Total	% from total
	112	121	123	125	141	142	312	313	322	411	413	421	431		
Total region	1,397	570	204	88	4,765	10	486	91	75	551	542	16	58	8,853	100
Arges	200	52	32	15	1,372	-	58	47	17	132	124	3	11	2,063	23.3
Calarasi	84	111	29	11	141	7	42	4	3	33	38	-	5	508	5.7
Dambovita	390	53	18	19	1,555		66	25	31	194	168	8	22	2,549	28.8
Giurgiu	48	64	15	11	341	1	96	4	7	31	50	1	5	674	7.6
Ialomita	261	141	33	15	127	1	108		3	63	63	-	6	821	9.3
Prahova	131	36	34	1	219	1	29	10	11	52	46	1	5	576	6.5
Teleorman	283	113	43	16	1,010	-	87	1	3	46	53	3	4	1,662	18.8

Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed 05.2020 [1].

At the level of the South-Muntenia region, the value of the projects totaled over 659 million euros, of which Dambovita County accessed projects worth 144,88 million euros, due to the projects accessed through measure 322 (which aimed at renovation, village development, improvement basic services for the economy and the rural population and the enhancement of the rural heritage) totaling a value of 56.46 million euros and having a

share of 39% of the total projects accessed at county level. Another measure with a significant share of the total number of projects accessed in Dambovita County was measure 413 (which aimed at quality of life and diversification of the rural economy), which totaled approximately 14.7 million euros, with a weight of 10.2 % of the total projects financed at the county level (Table 3).

Also, Arges County accumulated in the period 2007-2013, projects worth 112.9 million euros, representing 17.1% of the total funds accessed in the region, due to the projects accessed through measure 322 (which aimed at renovation, development of villages, improvement of basic services for the economy and rural population and enhancement of rural heritage) totalling a value of 29.9 million euros and having a share of 26.5% of the total value of projects accessed at county level (Table 3).

Table 3. Situation of funds accessed at the level of the South Muntenia region through the National Rural Development Program 2007 - 2013 (million euros)

Specify	Measures													Total	% total
	112	121	123	125	141	142	312	313	322	411	413	421	431		
Total region	31.8	133.7	122.6	68.2	29.7	1.2	55.3	8.8	139.3	20.0	37.1	0.2	11.0	659.0	100
AG	4.1	15.2	16.7	13.1	7.9	0.0	7.7	4.6	29.9	4.1	7.3	0.0	2.1	112.9	17.1
CL	2.1	24.4	17.0	10.2	0.9	1.1	4.4	0.2	5.4	1.9	2.3	0.0	1.2	71.3	10.8
DB	7.1	11.4	9.9	14.7	10.4	0.0	7.9	2.8	56.5	6.0	14.7	0.1	3.5	144.9	22.0
GR	1.2	15.2	10.1	8.3	2.1	0.0	11.6	0.2	15.3	1.3	4.0	0.0	1.0	70.2	10.7
IL	7.1	31.3	17.1	10.1	0.9	0.0	10.0	0.0	7.8	3.0	3.3	0.0	1.5	92.2	14.0
PH	3.1	7.2	24.6	0.7	1.5	0.1	3.7	0.9	20.1	1.5	3.1	0.0	0.8	67.3	10.2
TR	7.2	28.9	27.2	11.1	6.0	0.0	10.1	0.1	4.3	2.2	2.5	0.0	0.9	100.3	15.2

Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed on 05.2020, [1].

Under the national Rural Development Program 2014-2020, 29,963 projects were financed, of which 5,193 were financed in the South Muntenia region and 17.3% of all funded projects at national level (Figure 2).

Most projects financed by PNDR 2014-2020, targeted sub-measure 6.3. through which small farms were supported, namely 2163 out of a total of 11,822 projects financed at national level, the share being 18.3% of the total projects (Figure 3). Sub-measure 5.1 accounted for 22.8% of the total projects financed by this sub-measure at national level, so in the South-Muntenia region 13 projects were financed to support investments in preventive measures to reduce the effects of natural disasters, unfavorable climatic phenomena and probable catastrophic events (Figure 2). Another measure with a significant share in the total projects financed at national level, was sub-measure 4.1, thus financing 358 projects that pursued investments in agricultural holdings (Figure 3).

At county level, in Dambovita and Arges County were financed most projects, namely 2640, respectively 784 projects out of the total of 5193 projects financed at regional level. We can observe that in Dambovita County, 1,342 projects were financed aiming at sub-measure 6.3. on supporting small farms. Also, 1,164 projects aimed at installing young farmers were also financed in this county (Table 4.). The South-Muntenia region totalled a value over 564.4 million euros, of which Dambovita County accessed projects worth 118.2 million euros, due to the projects accessed through sub-measure 6.1 (which aimed at installing young farmers) totalling a value of 47 million euros and having a share of 39.7% of the total projects accessed at county level. Another measure with a significant share of the total number of projects accessed in Dambovita County was sub-measure 7.2 (which aimed at investments in the creation and modernization of small-scale basic infrastructure), which totalled approximately 22.7 million euros, with a share of 19.23% of the total projects financed at the county level (Table 5).

Table 4. Situation of the number of projects financed at the level of the South-Muntenia region through the National Rural Development Program 2014-2020

Specify	Submeasures														Total	% total
	4.1	4.1A	4.2	4.2A	4.3	5.1	6.1	6.2	6.3	6.4	7.2	7.6	16.4	16.4A		
Total region	358	66	81	3	69	13	2,033	197	2,163	74	103	24	5	4	5,193	100
AG	28	14	7	-	1	5	143	94	456	18	13	5	-	-	784	15.1
CL	99	12	15	-	27	-	45	11	31	5	13	5	-	-	263	5.1
DB	12	16	11	2	-	1	1,164	32	1,342	17	29	5	5	4	2,640	50.8
GR	42	12	2	-	5	2	422	9	82	9	11	3	-	-	599	11.5
IL	69	3	11	-	25	2	194	10	62	6	2	-	-	-	384	7.4
PH	13	5	17	1	-	3	14	18	69	8	21	4	-	-	173	3.3
TR	95	4	18	-	11	-	51	23	121	11	14	2	-	-	350	6.7

Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed on 05.2020, [1].

Table 5. Situation of funds accessed in the South Muntenia region through the National Rural Development Program 2014 - 2020 (thousand euros)

Specify	Submeasures											Total	% total
	4.1	4.2	4.3	5.1	6.1	6.2	6.3	6.4	7.2	7.6	16.4		
Total region	151.1	57.8	67.0	1.3	82.6	10.7	32.4	11.7	101.6	9.3	0.5	564.4	100
AG	12.9	4.8	1.5	0.6	5.9	4.9	6.8	3.0	11.4	2.1	0.0	61.9	11.0
CL	48.4	12.0	26.6	0.0	2.0	0.6	0.5	0.9	15.5	2.1	0.0	116.8	20.7
DB	6.2	6.3	0.0	0.1	47.0	1.8	20.1	3.0	22.7	1.5	0.5	118.2	21.0
GR	26.2	1.5	5.4	0.1	17.0	0.5	1.2	1.6	8.9	1.1	0.0	70.6	12.5
IL	20.0	11.8	23.1	0.2	8.0	0.5	0.9	1.0	3.3	0.0	0.0	69.8	12.4
PH	10.5	11.2	0.0	0.3	0.6	1.1	1.0	1.2	16.6	1.6	0.0	46.5	8.2
TR	27.1	10.2	10.5	0.0	2.2	1.3	1.8	1.0	23.1	0.9	0.0	80.5	14.3

Source: processed data, database of the Agency for the Financing of Agricultural Investments, Accessed on 05.2020 [1].

Also, Calarasi County accumulated in the period 2014-2020, projects worth 116.8 million euros, representing 20.7% of the total funds accessed in the region, due to the projects accessed through measure 4.1 (which targeted investments in agricultural holdings) totaling a value of 48.4 million euros and having a share of 41.4% of the total value of projects accessed at county level (Table 5).

CONCLUSIONS

The agricultural sector is of particular importance for the South-Muntenia region, so the National Rural Development programs have had a positive impact on the development of rural and agricultural areas**.** Although projects worth just over € 5 billion were contracted through the first NRDP, approximately € 4.76 billion was actually paid, due to the inability of some farmers to meet their project commitments which they carried out, so that the authority stopped and demanded the return of the sums of money granted.

In the case of the current National Rural Development Program, projects worth 4.08 billion euros were contracted until the beginning of 2020, of which only 2.3 billion euros were actually paid, given that the programming period has not ended.

We can observe that within the NRDP 2007-2013 the largest financial allocations in the South-Muntenia region aimed for renovation, development of villages, improvement of basic services for the economy and rural population and enhancement of rural heritage (measure 322), modernization holdings (measure 121) and increasing the added value of agricultural and forestry products (123). On the other hand, regarding the NRDP 2014-2020, they focused on investments in agricultural holdings (sub-measure 4.1.), Investments in the creation and modernization of small-scale basic infrastructure (sub-measure 7.2.), as well as support for the installation of young farmers (sub-measure 6.1.).

An extremely important source of funding available under the NRDP 2014-2020 is sub-measure 7.2. aiming to investments in the creation and modernization of small-scale basic infrastructure, thus ensuring through this source of financing the minimum living

conditions for the inhabitants of the rural area. In this sense, the counties of Teleorman (23.06 million euros), Dambovita (22.7 million euros), as well as in Prahova county (16.4 million euros) have accessed the most funds of all the counties in the South Muntenia region.

The counties characterized by the predominant agricultural profile, such as Calarasi and Teleorman, concentrated on investments in agricultural holdings, largely purchasing high-performance agricultural machinery and equipment, attracting 48.4 million euros and 27 million euros, respectively. At the same time, through the use of natural resources, Calarasi and Ialomita counties have attracted important funds in terms of investments for the development, modernization or adaptation of agricultural and forestry infrastructure, such as investments in irrigation infrastructure.

Regarding the future National Strategic Program, the financing measures should continue to pursue investments in the creation and modernization of small-scale basic infrastructure. Emphasis should also be placed on the creation and modernization of processing/marketing units, but also on the creation of non-agricultural units.

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APPLICATION OF REMOTE SENSING TECHNOLOGIES TO DETERMINE THE CONTENT OF SOIL FERTILITY MAIN ELEMENTS

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Abstract

One has applied the method of remote sensing of the Earth to calculate the introduction of the optimal rate of basic elements of nitrogen, phosphorus and potassium in assessing the state of crops in the geoinformation platform OneSoil using the selection of productive areas of land use with dense, medium and sparse vegetation based on space image data. Rates of nitrogen, phosphorus and potassium application for land use, with an area of 44.4 ha, located outside the settlement of Tyniv, Drohobych district, Lviv region on sod-gley sandy soils according to the planned yielding capacity and optimal terms of growing crops in crop rotation.

Key words**:** *remote sensing of the Earth, OneSoil geographic information platform, NDVI vegetation index, application rates of nitrogen, phosphorus and potassium*

INTRODUCTION

The improvement of the efficiency of agriculture is possible only due to intensive use of highly fertile soils, restoration of unproductive and degraded lands. In order to assess the quality of agricultural land, it is advisable to apply modern geographic information technologies or remote sensing of the Earth for:
- creation of digital maps of agricultural lands and their classification;
- determination of soil fertility indicators – soil type, humus content and basic elements (N, P, K);
- monitoring the state of development of crops and forecasting their yielding capacity;
- assessment of economic indicators (productivity) and ecological condition (degree of pollution) of agricultural lands.

One applies remote methods for determining the major elements of soil fertility based on reflection in space images of electromagnetic waves of diverse zones of the spectrum by which their fertility can be identified [4]. S. Dovhyi S. [2], S. Kokan [4], V. Lialko [5], M. Popov [9], M. Stupen [11] have carried out the study of spectral reflectivity in the papers, where they investigated dependence of humus content and basic elements, humidity and mechanical composition of soils from the heterogeneity of the image in the space image.

MATERIALS AND METHODS

The fundamentals of scientific and methodological approaches to the research are operational satellite observations of soil condition and crop production in crop rotation on the territory of model land use. The research analyzed the data of space images to identify features of plant reflectivity according to the vegetation index NDVI, their variability and spatial heterogeneity in the geoinformation platform OneSoil [8]. The applied method of remote sensing of the Earth is based on the use of causal relationships between the properties of objects and their images or point data obtained using electromagnetic waves of different lengths [1]. We use the information obtained with the help of space-based remote sensing of the Earth to analyze the potential of agricultural lands, identify types of crops, forecast

yielding capacity, plan the rate of application of mineral fertilizers.

RESULTS AND DISCUSSIONS

We use indirect features – the value of the vegetation index NDVI in accordance with the results of remote sensing technology application in order to study the state of soils for sowing. One fully reflects differentiation of the state of sowing in satellite images during the first stage of crop development. One observes that crops grow earlier and form a more closed vegetation cover on soils with higher humus content and moisture. Due to other physical and geographical conditions and soil fertility, there are areas without vegetation. When crops ripen, the non-uniform tone of the NDVI vegetation index image conveys their sparseness. Taking into account this information, one can make conclusions about the state of soil fertility and increase soil productivity.

The research object of the state of soils for sowing is land use, with an area of 44.4 hectares, located outside the village of Tyniv, Drohobych district, Lviv region on sod-gley sandy soils with a score of soil rating (bonitet) of 20 for arable land with a capital rent income of 15,206.52 UAH for Sambir and Zhydachiv natural-agricultural district [7]. These soils have an unfavorable water-air regime, but concerning nutrient reserves, they are potentially fertile.

Decrypting the state of the soil in the geoinformation environment OneSoil [8] on the example of land use, according to the satellite image data, one has used spectral characteristics of the vegetation index NDVI as of August 29, 2020 in the amount of 0.75, which reflects the highest productivity of crop growing to solve the problems of precision agriculture (Fig. 1).

Fig. 1. Thematic raster image of the highest productivity of the state of sowing according to the data of the vegetation index NDVI on August 29, 2020 in the geoinformation platform OneSoil
Source: on the basis of data [8].

The effectiveness of the application of remote sensing data of the Earth to determine the content of the key elements to improve soil fertility largely depends on compliance with a scientifically sound system of crop rotation and sowing and harvesting. The spring period after the snow cover melting provides the best time to obtain satellite images to decrypt the soil. Autumn plowing of fields is also optimal, as it is characterized by large areas of open ground, providing the ability to perform the function of effective seasonal monitoring of agricultural land, the main tasks of which are

to implement the following tasks for the period [2]:
- October-March
1. the study of the dynamics of the snow cover;
2. the forecast of crop freezing;
3. an assessment of the flood situation.
- April-May:
1. the determination of the area for sowing;
2. the assessment of areas of degraded lands and dead crops;
3. the establishment of areas under monocultures;
4. determination of the spatial distribution of soil moisture;
5. temperature monitoring of certain areas of the underlying surface.
- June-July:
1. the assessment of the state of crops;
2. the determination of the area not for crops;
3. the identification of the area of crop infestation due to unfavorable weather conditions;
4. operational assessment of the state and mass of phytocenoses;
5. the determination of the contours of land plots to optimize fertilizer application;
6. forecasting and preliminary assessment of average yields from individual land areas.
- August-September:
1. monitoring of harvesting works;
2. the assessment of land readiness for the next season.

One has made crop rotation during 2016-2020 with the optimal date of sowing and harvesting for the Forest-Steppe zone [3, 6] based on satellite images in the online information platform OneSoil (Table 1) in order to achieve the planned crop yielding capacity on the example of the research object.

Table 1. Crop rotation system on the territory of land use during 2016-2020 in the geoinformation environment OneSoil.

Year	Crop	Date		Planned yielding capacity, t/ha
		sowing	harvesting	
2016	Winter wheat	September, 15	August, 15	4.3
2017	Sugar beetroots	March, 30	October, 30	51.7
2018	Barley	April, 1	November, 1	5.6
2019	Maize for grains	April, 15	October, 15	9.8
2020	Oats	March, 1	July, 1 л	1.9

Source: on the basis of data [3, 6].

Irrational use of agricultural lands, long-term plowing of lands without soil-preserving crop rotations, lack of optimal application of organic and mineral fertilizers, development of water and wind erosion processes lead to crop failure from growing crops [10]. It is of vital importance to assess the existence of basic elements of sodium, phosphorus and potassium in the soil to increase the productivity of agricultural lands. It is possible in the case of remote sensing methods using space imagery in the OneSoil geoinformation environment [8]. The study of the spectral reflectivity of plants and soil properties according to the vegetation index NDVI allows establishing the necessary standards for the application of mineral fertilizers in a particular area of land use according to the crop rotation system to obtain the planned harvest, which is shown in Figures 2-6.

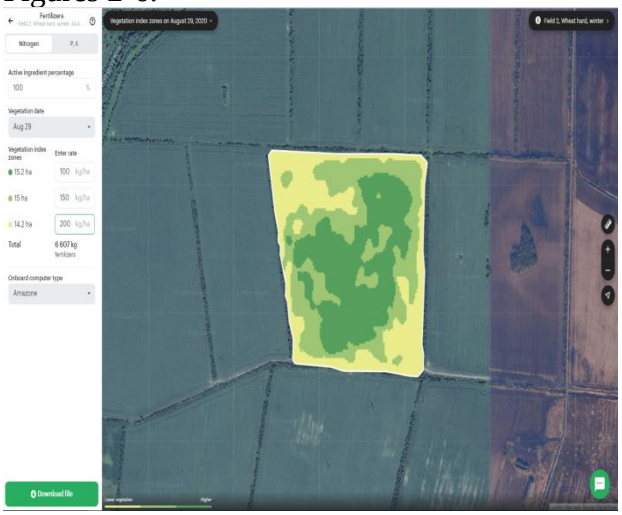

Fig. 2. Thematic raster for calculating nitrogen application during winter wheat cultivation in 2016 on the OneSoil geographic information platform.
Source: on the basis of data [8].

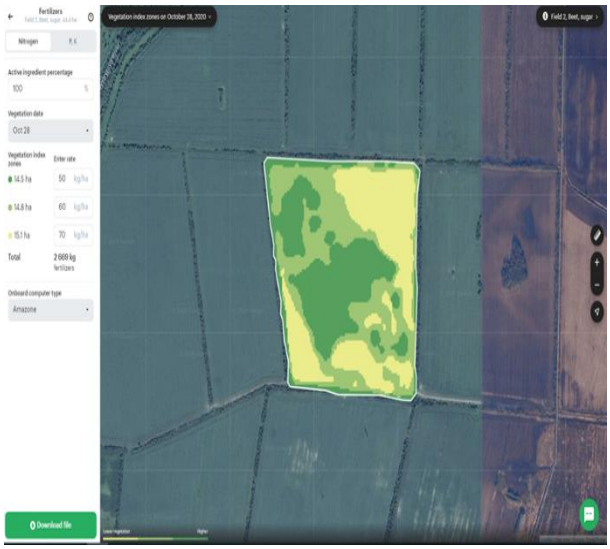

Fig. 3. Thematic raster for calculating nitrogen application in sugar beet cultivation in 2017 on the OneSoil geographic information platform.
Source: on the basis of data [8].

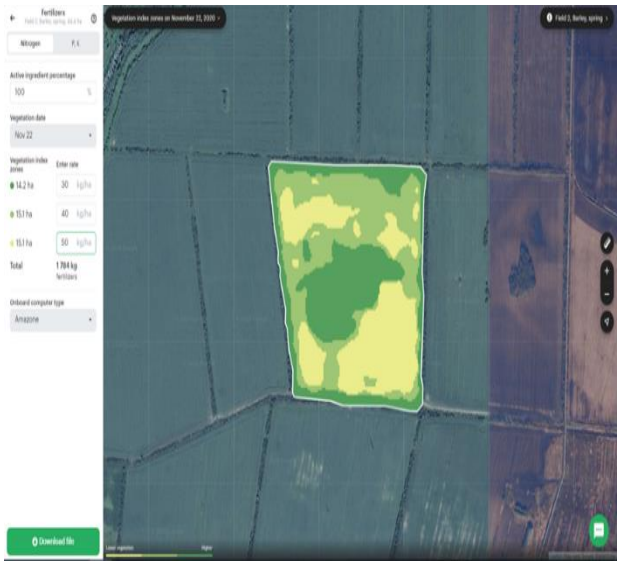

Fig. 4. Thematic raster for calculating nitrogen application in barley cultivation in 2018 on the OneSoil geoinformation platform.
Source: on the basis of data [8].

The amount of humus in the arable layer of sod-gley sandy soils on the territory of the studied land use is 2.5-5.0%. The content of mobile nitrogen is 2.5-11 mg, phosphorus - 0.6-5 mg, potassium - 1.2-6 mg per 100 g of soil [12], which indicates its insufficient supply of phosphorus and nitrogen.
Planning the application of nitrogen in the cultivation of crops in crop rotation during 2016-2020, one has used remote methods in the geoinformation environment OneSoil based on data from space images of the satellite Sentinel [8].

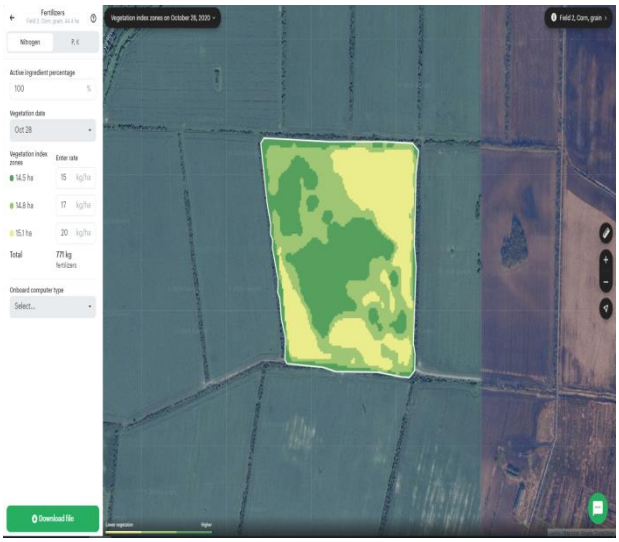

Fig. 5. Thematic raster for calculating the application of nitrogen in the cultivation of maize for grain in 2019 on the geoinformation platform OneSoil.
Source: on the basis of data [8].

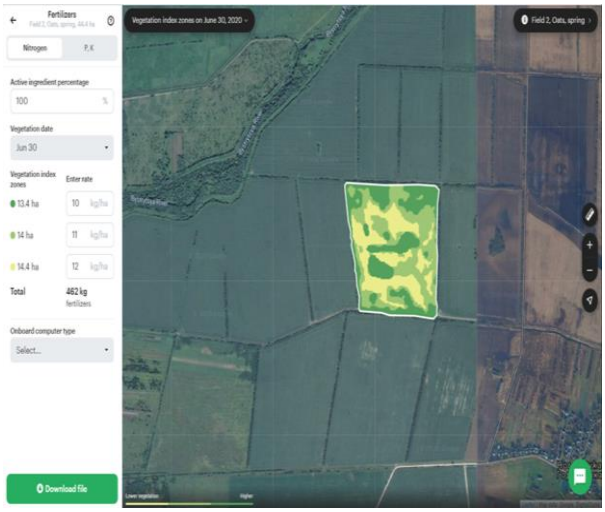

Fig. 6. Thematic raster for calculating nitrogen application in oat cultivation in 2020 on the OneSoil geographic information platform.
Source: on the basis of data [8].

Their application is based on the study of the spectral reflectivity and taking into account the spectral properties of sod-gley sandy soils in the land use, which is shown in Figures 2-6 and are presented in Table 2.
Using remote determination of the content of the main elements of nitrogen, phosphorus and potassium in the soil, information on its spectral properties according to the NDVI vegetation index in certain areas of land use with dense, medium and sparse crop

vegetation in crop rotation, taking into account the planned indicators.

Table 2. Nitrogen application zones on the territory of land use during 2016-2020

Year	Crop	Due to the value of the vegetation index NDVI					
		land use area, ha			nitrogen application rate, kg/ha		
		dense vegetation	medium vegetation	sparse vegetation	dense vegetation	medium vegetation	sparse vegetation
2016	Winter wheat	15.2	15.0	14.2	100	150	200
2017	Sugar beetroots	14.5	14.8	15.1	50	60	70
2018	Barley	14.2	15.1	15.1	30	40	50
2019	Maize for grains	14.5	14.8	15.1	15	17	20
2020	Oats	13.4	14.0	14.4	10	11	12

Source: on the basis of data [8].

The results of the calculation of nitrogen application in the land use area based on the results of the application of the remote sensing method of the Earth are provided in Table 3.

Table 3. Calculation of nitrogen application on the territory of land use during 2016-2020

Year	Crop	Planned yielding capacity, t/ha	nitrogen application rate, kg	
			Calculated	actual (average)
2016	Winter wheat	4.3	6,607	6,680
2017	Sugar beetroots	51.7	2,669	2,664
2018	Barley	5.6	1,784	1,776
2019	Maize for grains	9.8	771	755
2020	Oats	1.9	462	488

Source: on the basis of data [3, 6].

The lack of basic elements of nitrogen, phosphorus and potassium in soils slows down plant growth. Considering the high cost of mineral fertilizers and the possibility of accumulation of their residues, which negatively affect product quality. The use of satellite imagery data allows for differentiated fertilizer application for the research object according to Table 4.

Table 4. Calculation of phosphorus and potassium application in the areas of land use during 2016-2020

Year	Crop	Due to the value of the vegetation index NDVI					
		phosphorus application rate, kg/ha			potassium application rate, kg/ha		
		dense vegetation	medium vegetation	sparse vegetation	dense vegetation	medium vegetation	sparse vegetation
2016	Winter wheat	29	31	32	17	19	19
2017	Sugar beetroots	48	51	53	160	172	178
2018	Barley	39	42	43	31	34	35
2019	Maize for grains	52	55	58	37	40	40
2020	Oats	14	15	16	9	10	10

Source: on the basis of data [8].

The rate of application of the main elements of phosphorus and potassium is the identification of crops in space images of sowing. One has identified and established the area of the zone with dense (14.95 ha), medium (14.75 ha) and sparse vegetation ha) in the geoinformation platform OneSoil in areas of land use during 2016-2020 in the crop rotation system in the space image in order to calculate the rate of accurate application of phosphorus and potassium [8]. Based on the data of application of the vegetation index NDVI, yielding capacity and terms of growing crops in crop rotation, one has established the optimal value of phosphorus and potassium application for the

research object and compared it with its actual (average) values for the Forest-Steppe zone.

Table 5. Calculation of phosphorus and potassium application in areas of land use during 2016-2020

Year	Crop	Planned yielding capacity, t/ha	phosphorus application rate, kg		potassium application rate, kg	
			calculated	actual (average)	calculated	actual (average)
2016	Winter wheat	4.3	1,361	1,376	813	844
2017	Sugar beetroots	51.7	2,248	2,264	7,542	7,637
2018	Barley	5.6	1,834	1,865	1,479	1,510
2019	Maize for grains	9.8	2,440	2,442	1,730	1,776
2020	Oats	1.9	665	666	429	444

Source: on the basis of data [6, 8].

Applying the method of remote sensing of the Earth on the example of the research object, the yielding capacity of crops in crop rotation is increased by 15-20% while reducing the cost of mineral fertilizers by 10-30% in the amount of 150-260 UAH/ha.

CONCLUSIONS

The proposed approach to the method of remote sensing of the Earth involves the use of data from the vegetation index NDVI, the value of which correlates with the degree of development and cultivation of crops in crop rotation and the planned yielding capacity. The vegetation index NDVI allows dividing the land use area into zones with dense, medium and sparse vegetation, which are diverse in their productivity. The established areas should be used when compiling agrochemical cartograms to provide plants with the basic elements of nitrogen, phosphorus and potassium. Differentiated application of mineral fertilizers requires the application of geographic information systems in the practice of precision agriculture.

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SENSITIVITY ANALYSIS FOR MAIZE CULTURE

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Abstract

Maize, one of the most traded agricultural products in the world, was chosen for analysis from several cereals and oilseeds owned by a farm in Ilfov County. Economic analyses were performed on this crop in order to determine: expenses per 1,000 lei income, gross margin and their share in the gross product, rate of net income, rate of operating expenses and rate of depreciation. Following the analysis and evaluation of the mentioned indicators, the sensitivity analysis was applied, this being also the purpose of this paper. Sensitivity analysis highlighted the gross margin in relation to changes in price and average production, based on which the main sources of risk or opportunity in terms of crop profitability can be identified.

Key words**:** *maize, gross margin, sensitivity analysis*

INTRODUCTION

Maize (*Zea mays* ssp), one of the cereals about 10,000 years old [9], has become over time one of the staple foods in many parts of the world with a world production that has far exceeded the production of other cereals. For example, in 2018 the world production of maize exceeded by 47% the production of wheat and by 35% the production of rice [4] and this is due to its uses in other fields, other than direct consumption by humans, such as: feeding in the livestock sector, production of ethanol, starch, syrup and alcohol [6].

Thus, due to its wide uses, corn is traded on international markets, being bought and sold by investors around the world, its price being formed depending on several factors.

According to the objective theory of value, price is the monetary expression of value [3]. This theory argues that the price expresses the value of the goods brought to market. In this sense, the deciding factors in forming the price for corn sold at the farm gate in Romania are related to the mechanism of the product market, dictated by supply and demand and the cost of production with it (inputs, labor, storage, extraordinary costs / unforeseen costs, taxes, etc.) [1], the financial support (subsidy) granted to this crop, the quantity and quality of maize as well as the added value of the producer.

Both, price fluctuations and production fluctuations influence the economic margin of the economic agent. Gross margin is the indicator that shows the trends of the final financial results (profit or loss). In other words, this indicator leads to the identification of information on the viability of products and implicitly of the farm, the planning of future business, as well as the improvement of farm management [7].

Gross margin fluctuations can be predicted depending on the sensitivity analysis, which studies how the variation of a project result (output values) can be attributed to various variations of the input parameters (input values). Sensitivity analysis can also be the starting point of risk analysis [5].

Thus, the maize crop from a small agricultural holding located in Ilfov County was chosen as a case study, in order to perform the sensitivity analysis.

The aim is to identify changes in gross margin and the need to identify key sources of variability and uncertainty for the variation of an expected outcome, so that decisions are better. In this paper, the option is for deterministic sensitivity analysis, which can be numerically implemented based on a step-

by-step formula. A common approach is to change one factor at a time (OAT) to see the effects it has on the outcome. The approach involves moving one factor at a time and returning to the centre/base point after each move. In this case, any observed change with respect to a result will no doubt be due to the change of a single factor, while all other factors remain fixed at the central (baseline) value.

MATERIALS AND METHODS

To apply the sensitivity analysis, the factorial analysis of the operating result will be used initially. This analysis has as main purpose the explanation of the influence of the two factors (operating income and expenses per 1,000 lei income) on the variation of the operating result (profit) compared to a chosen reference period (in this case, compared to a different variant of average production , or compared to other possible scenarios) [2].
The influence of operating income has the following formula:

$$\Delta RE(V)=V1*(1-Ch1/V1)-V0*(1-Ch0/V0),$$

while the influence of operating expenses per 1,000 lei of operating income has the formula:

$$\Delta RE(1-Ch/V)=V1*(1-Ch1/V1)-V1*(1-Ch0/V0).$$

In order to be able to determine the effect of different values of the input parameters (independent variables) on a certain dependent variable, under certain predefined conditions the sensitivity analysis will be used. Such an analysis studies how the variation of the result (associated in this case with the corn crop) called output, can be attributed, quantitatively or qualitatively, to various variations of the input parameters, called input. In this way it can be observed to what extent the dynamics of certain input elements (inputs) can affect the final result of the execution. In general terms, this analysis can answer the question: "What if?" and is used to investigate the feasibility of an investment project. In the present case, the sensitivity analysis can be used as an element to ensure the profitability of the maize crop before making an investment. The choice of variables in the sensitivity analysis allows the determination of the "critical" variables of the model. These are the positive or negative variations and have the greatest impact on the dependent variable (financial result) [8]. For the result variable, the gross margin (dependent variable) will be considered representative, which will be decisively influenced by the delivery price and the average production per hectare (independent variables).
In this paper, the sensitivity analysis will be performed to identify the impact of the assumptions on the evolution of average production per hectare and the delivery price on the results measured by gross margin, applying the "what if" principle. This is intended to evaluate the impact elasticities, which aim at variations of +/- 10% related to independent variables. Following the calculations will result for each analysed variable the change of the gross margin for the maize crop.

RESULTS AND DISCUSSIONS

In order to be able to apply the sensitivity analysis, the maize crop from a farm was selected.
This culture was analysed from an economic point of view for the period 2015-2019. Indicators analysed being: expenses per 1,000 lei income obtained from main production, gross margin and their share in gross product, rate of net income, rate of operating expenses and rate of depreciation expenses.

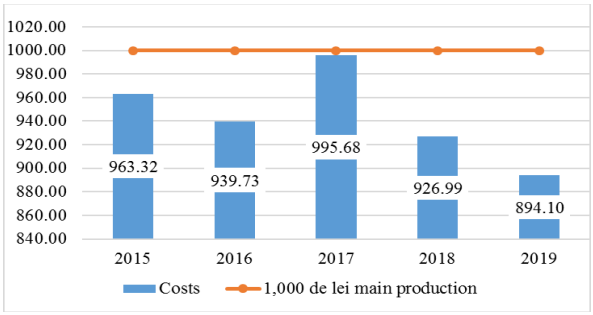
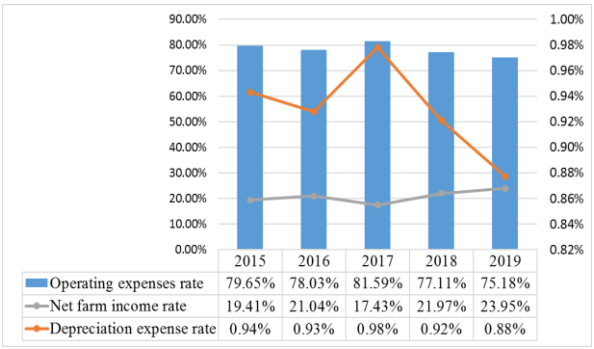


Fig. 1. Expenditures per 1,000 lei main production
Source: Own design based on data provided by the farm from Ilfov County.

From Figure 1 it can be seen that in order to produce corn worth 1,000 lei, an average of 943.96 lei is consumed.

Thus, it can be said that this crop, as shown by the rate of profitability, is economically feasible as it does not exceed the threshold of 1,000 lei spent, so the difference of 56.04 lei/ha represents the farmer's earnings.

Analysing the rates of return on expenditures compared to revenues, calculated as a ratio to intermediate consumption, it can be estimated that, on average, following a leu obtained, an operating expenditure rate of approx. 78.31%. This can be translated as follows: 78.31% of a leu obtained will go to operating costs, representing 0.78 lei (Fig. 2).



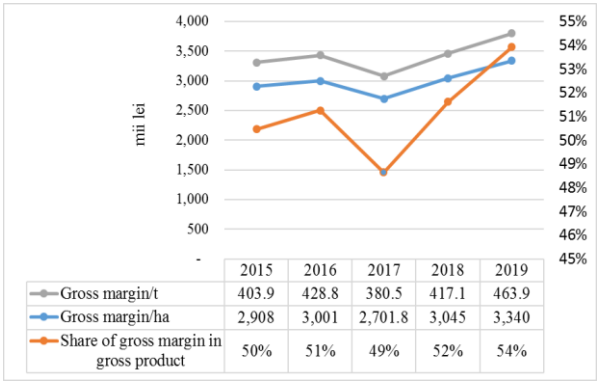
	2015	2016	2017	2018	2019
Operating expenses rate	79.65%	78.03%	81.59%	77.11%	75.18%
Net farm income rate	19.41%	21.04%	17.43%	21.97%	23.95%
Depreciation expense rate	0.94%	0.93%	0.98%	0.92%	0.88%

Fig. 2. Cost of revenue versus revenue for maize
Source: Own design based on data provided by the farm from Ilfov County.

This does not necessarily mean that all costs/expenses have revenue as an opposable effect. Even if this value may seem high, it should be borne in mind that other expenses are also recorded, such as depreciation, which represents, according to Figure 2, approximately 0.93%. Which means that, on average, approximately 0.09 lei out of one lei obtained will go to depreciation costs.

Following the depreciation, the net income from the holding represents approx. 20.76% of the value of one leu obtained. The evolution of this indicator for maize cultivation in the case study recorded the lowest value in 2017, of 17.43%, while in 2019 it has the highest value, of 23.95% (Fig. 3).

The main factor that intervened in this considerable increase in income for the crop in question is related to the granting of subsidies which represent on average 45% of income, but among the causes can be mentioned: the decrease in wages, given the decrease in labour, the reduction of the value of taxes, the previous investments made with the equipment park, the phytosanitary protection and the storage of the corn for a later sale with a higher price in the off-season.



	2015	2016	2017	2018	2019
Gross margin/t	403.9	428.8	380.5	417.1	463.9
Gross margin/ha	2,908	3,001	2,701.8	3,045	3,340
Share of gross margin in gross product	50%	51%	49%	52%	54%

Fig. 3. Calculations of gross margin and its share in the gross product for maize (+ subsidies)
Source: Own design based on data provided by the farm from Ilfov County.

From Figure 3 it can be observed that both the gross margin per tonne and per hectare had ascending evolutions from one year to another, this being attributed to the ascending average products as well as to the prices. Of course, there were also situations when one of the indicators decreased in a certain year compared to the previous period, but the other indicator increased. Thus, it was possible to "equate" and continue the gross margin on an upward trend.

In order to perform the sensitivity analysis, a variation of +/- 10% of the price was taken into account (independent variable), noting that the gross margin (dependent variable) increases by 23%, (from 2,187 lei to 2,691 lei), noting that subsidies were not included (Table 1).

Gross margin can be considered sensitive in relation to the change in the delivery price, in other words the gross margin is sensitive to price increase, but this sensitivity may decrease depending on the level of average production and the capitalization price.

Depending on the size of the gross margin variation, the sensitivity can be considered very high or less high. In the case of maize cultivation, at an average production of 7,200

kg/ha it is observed that the gross margin is sensitive in relation to the change of the delivery price, both to its decrease and to its increase.

Table 1. Effect of average production and capitalization price on gross margin (changes of +/- 10% of independent variables)

Scenario for maize - year 2020-2021	
Average production (t/ha)	7,200
Capitalization price (lei/t)	700
A. Income for main production (lei)	5,040
B. Total variable costs (lei)	2,853
Break even (t)	4.08
Gross margin (A-B)	2,187

Gross

Average production 7.2 t/ha	Farm price lei/ton				
	560	630	700	770	840
5.04	-31	322	675	1,028	1,380
5.76	372	776	1,179	1,582	1,985
6.48	776	1,229	1,683	2,136	2,590
7.20	1,179	1,683	2,187	2,691	3,195
7.92	1,582	2,136	2,691	3,245	3,800
8.64	1,985	2,590	3,195	3,800	4,404
8.64	1,985	2,590	3,195	3,800	4,404

Source: own calculations based on data provided by the agricultural holding under analysis.

CONCLUSIONS

In conclusion, starting from the real situation of the maize crop, we can say that it can be profitable even from the lowest hypothetically established average production, respectively 5.04 tons/ha, provided that the capitalization price is not 0.56 lei/kg. In the unlikely event of an average maize production of this level, the recovery price may be increased only if this cereal is stored and sold in the off-season. Another situation in which the price can increase can be given by the demand and supply on the market of the respective good. Thus, in the situation where at county level, the average maize productions are around 5.04 tons/ha according to economic principles the price will rise. It should be mentioned that this increase does not have to be 10%, as it has variations that are established in the market. Such an analysis can be very useful, giving managers of agricultural holdings and not only, an overview of the profitability of a crop in the event that one of the independent variable's changes.

The independent change of variables can be done at the will of the management team by: reducing variable costs, increasing average yields or subsequent sales at a higher price or, without their will, by: decreasing average yields due to soil conditions and increasing variable costs (irrigation) or the decrease in the market price of the analysed product.

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INCREASING ECONOMIC PERFORMANCES USING OPTIMIZATION

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Abstract

The present paper aimed to evaluate an agricultural holding, based on technical and economic analyzes for the period 2015-2019, whose resources and activities related to the last year were optimized. The optimization led to the improvement of the overall economic performance by the rational allocation of resources and the establishment of the crop structure in order to obtain large yields. The optimization process was accomplished by using a mathematical model of linear programming consisting of variables, constants, constraints and objective function. The modelling and simulation of the real system, by using the simplex algorithm, led to the identification of suitable solutions and implicitly obtaining a maximum effect with a minimum effort (high incomes with minimal expenses).

Key words**:** *agriculture, economic efficiency, optimization, simplex*

INTRODUCTION

The optimization process represents the way in which the sorting or elaboration of possible solutions representative of a system is performed, the final goal being the choice of the optimal solution that meets the system requirement and falls within the limits as well as the conditions imposed by it at the beginning. optimization. Thus, the optimization process will lead to the most favorable use of the resources held by the system to achieve the objective [13].

Optimization can be briefly defined as the activity of selecting a solution from the multitude of solutions offered by the studied problem, a solution that is defined as the best in relation to a predefined criterion. Before performing the optimization, it is necessary to take into account what is subject to optimization, more precisely what is subject to optimization [8], so in any correctly formulated optimization problem a certain criterion will be taken into account that can be expressed. through a quality index; cost function; objective function etc. Thus, following the realization of the best system according to the adopted criterion, the realized system will be optimal only with reference to the chosen criterion.

In order to turn our attention to the approached topic, it is necessary to know what we want to achieve by optimizing, thus, in this case we want to optimize economic performance. However, in order to treat the subject accurately, it is necessary to describe the notion of economic efficiency. According to the American Casson Herbert through his work „Business", the term efficiency is understood in English as "the ability or ability to achieve greater results with a minimum of strength" [1]. Efficiency in general was defined by Novojilov V. as "the ratio between the useful effect (result) and the costs incurred to obtain it" [7]. Românu I. stated that in the most general sense efficiency represents the reverse of an action, of a thing or of a person to create the most favourable effects for the society; the second sense of efficiency compares the results of an action with the resources consumed to carry it out [10]. Encompassing all the definitions given over time to the notion of economic efficiency we conclude that it reflects the quality of actions, activities, economic and sometimes uneconomic processes to produce economic and financial effects with a positive, favourable and minimal effort.

The efficiency of economic activity in agricultural holdings depends largely on three important factors, namely: average yields per hectare, production costs and market prices (factor supply prices and product capitalization prices) [14]. In order to increase the efficiency/economic performance in agricultural holdings, the optimization method described in the "materials and methods" section of the paper can be used, which can be used in agricultural units for the optimal sizing of activities and economic performance. Thus, as the title of this paper suggests, the purpose of this study is to provide a model for optimizing economic performance on a farm, but also to exemplify that the chosen optimization model can provide managers with appropriate solutions and/or improvement of the results obtained in the main activity of the agricultural unit.

MATERIALS AND METHODS

The optimization of production structures in order to increase economic performance was achieved by using linear programming. This method is used in establishing the size and structure of crops in a farm, optimizing / forecasting and replacing the real system with a model of it provides for the researched problem an optimal mathematical and economic form. Briefly defined, the linear programming method tries to determine the optimum of a phenomenon or activity. The economic-mathematical model of linear programming has the role of establishing and ordering the crops in the sense of obtaining the largest productions with a maximum benefit (profit) and minimum effort (expenses) [9]. In this activity, which uses linear programming, three elements will be used: the real system, the model and the two modeling and simulation relations. In other words, the problem of optimizing the structure of crops in order to increase economic performance will lead to the ordering of crops in order to ensure, of course under given conditions, a rational succession of crops, which allows and favors obtaining higher yields in accordance with which disposes of the agricultural holding.

Establishing the areas occupied by each crop is a complex operation because the unknowns of the system will be chosen in the order of their value compared to the optimization criterion and in relation to dependence on other crops [5].

To use linear programming, the following requirements must be met: establishing the list of variables, identifying activities and resources, setting constraints, specifying the objective function (maximum or minimum), knowing the size of inputs and outputs by sensitivity analysis.

The structure of the general linear programming model is constituted first of all by the set of activities denoted thus {A1, A2, ... An} that compose the analyzed economic system but also the set of resources used {R1, R2, ... Rm} as well as through the technical-economic relations between them.

The connection between activities and resources is determined by the manufacturing technology corresponding to each activity Aj (j = 1, ..., n) and can be numerically characterized by the column vector a (j) of components (a1j, a2j, ... amj). The elements {aij, i = 1, ..., m; j = 1, ..., n} are called technical coefficients or specific consumption coefficients and show how much of the resource Ri is consumed to produce a unit of the product (service) Pj (as a result of the activity Aj). All manufacturing "technologies" defined by column vectors a (j) can be organized in an array A with m rows and n columns; each row refers to a resource Ri (i = 1, ..., m) and each column refers to an activity Aj (j = 1, ..., n) [3] [4].

The mathematical model for optimizing the production structure in a farm can be solved through several programs supported by a computer (PC - Excel), but behind the programs for solving linear programming problems will be the calculation algorithm Simplex. This method of solving linear programming problems can be used for three or more variables, essentially being a matrix-type method [12]. The simplex algorithm will search through the set of possible solutions for the optimal solution to achieve the proposed objective, being an iterative procedure for solving the linear programming problems

brought to the tabular form. The simplex method generates new basic feasible solutions that increase the value of the objective function (or leave it unchanged), by generating new tabular forms for the real system of equations [2].
According to specialized studies, the simplex method is the most important method in finding solutions to linear programming problems [11] [6].

RESULTS AND DISCUSSIONS

The agricultural holding taken as a case study, registered for the period 2015-2019 the following variation of the total number of hectares, which are between 847-959 hectares
The total areas were attributed to crops of: wheat, rapeseed, corn, sunflower, peas, barley and it can be seen how in the Table 1.

Table 1. Crop structure for the 5 years under analysis (hectares)

Crop / year	2015	2016	2017	2018	2019	2019/ 2015 %	2019/ 2018 %
Wheat	368.	372	313	375	398	8.15	6,13
Rapeseed	157	169	244	261	188	19.75	(-27.97)
Corn	150	150	179	197	254	69.33	28.93
Sunflower	52	74	52	27	65	25.00	140.74
Peas	64	66	77	79	54	(-15.6)	(-31.65)
Barley	56	58	59	0.0	0.0	-	-
Total area	847	889	924	939	959	13.22	2.13

Source: data provided by the farm under analysis.

Average yields per hectare varied, being influenced by the characteristic of the soil, climatic conditions and investments allocated to those crops. Thus, in the last two columns on the right it can be seen the differences in 2019 compared to the previous year, as well as compared to the base year 2015.

Table 2. Average productions (kg/ha)

Crop / year	2015	2016	2017	2018	2019	2019/ 2015 %	2019/ 2018 %
Wheat	6,500	6,800	6,900	6,700	6,800	4.6	1.5
Rapeseed	3,000	2,900	3,100	3,200	3,150	5.0	(-1.6)
Corn	7,200	7,000	7,100	7,300	7,200	0.0	(-1.4)
Sunflower	2,700	2,900	3,100	3,000	3,050	13.0	(1.7)
Peas	2,800	2,400	2,600	2,500	2,550	(-8.9)	2.0

Source: data provided by the farm under analysis.

The total technological expenses changed in accordance with the crop structure. According to Table 3 the largest increase is recorded in 2017 compared to the previous year, an increase of 7.88% is recorded of which the largest expenditure was made with wheat cultivation. This is due to the fact that 2017 was a dry year, without rain and snow, and the farmer had to allocate investments to irrigate the crop.

Table 3. Technological expenses (lei)

Expenses	2015	2016	2017	2018	2019
Wheat	1,030,400	1,004,400	907,700	1,012,500	1,114,400
Rapeseed	471,000	490,100	756,400	783,000	582,800
Corn	375,000	420,000	465,400	531,900	660,400
Sunflower	150,800	207,200	135,200	72,900	169,000
Peas	108,800	99,000	130,900	118,500	91,800
Total	2,136,000	2,220,700	2,395,600	2,518,800	2,618,400
Evolution with base in a chain %		3.97	7.88	5.14	3.95

Source: data provided by the farm under analysis.

The total expenditure of the holding is formed from the following: technological expenses, salary expenses, rental expenses and headquarters expenses. In the table no.4, it can be seen an upward trend of those, increasing from one year to another by about 5.54 %.

Table 4. Total expenses (lei)

	2015	2016	2017	2018	2019
Technological expenses	2,136,000	2,220,700	2,395,600	2,518,800	2,618,400
Salary expenses	265,680	252,480	288,720	362,400	404,928
Rental expenses	325,000	312,000	299,000	331,500	357,500
Headquarters expenses	3,800	4,100	4,000	4,200	4,000
Total expenses	2,730,480	2,789,280	2,987,320	3,216,900	3,384,828

Source: data provided by the farm under analysis.

According to Table 5, the value of production increases progressively from one year to another with an average of about 7% per year. In the analysis performed, the highest increase is recorded between 2016 and 2017, when the value of production increased by 11.86%, at the opposite pole, the smallest increase was recorded between 2015 and 2016.
The factors that influence this economic growth are the technical factors such as: the surface, which increases from one year to another, the productions that also grow in a

slow but safe rhythm, and economic factors that have in their center the price of capitalization of production. Thus, the value of total production recorded in 2016 was influenced by the low price offered by grain traders.

Table 5. Gross income /production value (lei)

Production value	2015	2016	2017	2018	2019
Wheat	1,650,480	1,897,200	1,662,969	1,809,000	2,029,800
Rapeseed	795,990	710,645	1,270,752	1,302,912	929,754
Corn	658,800	703,500	787,958	934,765	1,280,160
Sunflower	171,288	244,644	228,904	122,688	276,413
Peas	173,,24	145,728	190,190	177,750	137,700
Total	3,450,382	3,701,717	4,140,773	4,347,115	4,653,827
Evolution with base in a chain %		7.28	11.86	4.98	7.06

Source: data provided by the farm under analysis.

Economic efficiency, translated by the result of the year (profit/loss), profit rate, production expenses per 1,000 lei income, material expenses per 1,000 lei income. Thus, the result of the exercise, for the unit under analysis, as well as for the entire analysed period can be seen in Table 6.

Table 6. The economic panel of the farm

Total gross income (without subsidies;) (main production + secondary production)		Total expenditure	Gross profit	Profit rate %
2015	3,450,382	2,730,480	719,902	26.37
2016	3,701,717	2,789,280	912,437	32.71
2017	4,140,773	2,987,520	1,153,253	38.60
2018	4,347,115	3,216,700	1,130,415	35.14
2019	4,653,827	3,385,028	1,268,799	37.48

Source: data provided by the farm under analysis.

The profit results from the difference made between the gross income and the expenses of the farm. In all the years analyzed, the agricultural holding registers profit, and its value increases from one year to another.
The highest value registered is reached when the farm reaches the maximum cultivated area to 595 hectares. The value of the profit being higher by 12.24% in 2019 compared to the previous year. The optimization was performed with Solver from Excel program, by establishing the mathematical model, which includes the objective function, the matrix of technical and economic coefficients, variables, constants, constraints and limits of the linear programming model.

The mathematical model was written in the form of equations with non-negative variables and the optimal objective function according to the requirement (maximum or minimum), later transposed in the form of a table to allow the program to read and provide solutions according to the requirements and restrictions imposed.
The initial problem, the one that starts from solving the linear programming model, is known as the primary problem, from which will later derive another problem known as the dual problem. In addition to the above, the literature recalls that the primary solution is the structure of activities and consumption of each established restriction, while the dual solution will present the resources that are consumed in full.

Table 7. Matrix of coefficients and technical-economic restrictions

Crops	Corn	Sunflower	Peas	Wheat	Rapeseed	Sign	Boundaries/ resources
Restrictions	x1	x2	x2	x4	x5		
Corn Max.	1	0	0	0	0	≤	287
Sunflower Max.	0	1	0	0	0	≤	95
Peas Max,	0	0	1	0	0	≤	172
Wheat Max.	0	0	0	1	0	≤	380
Rapeseed Max.	0	0	0	0	1	≤	90
Diesel (litrs)	100	90	80	100	110	≤	93,000
Weed control	9	117	80	48	244	≤	66,000 (lei)
Pest control	195	61	0	68	388	≤	12,000 (lei)
Fighting disease	113	199	2	228	187	≤	14,600 (lei)
Chemical fertilizers (NPK))	100	180	0	150	200	≤	11,500 (kg)
Total area	1	1	1	1	1	≤	959,00
Corn Min.	1	0	0	0	0	≥	258
Sunflower Min.	0	1	0	0	0	≥	67
Peas Min.	0	0	1	0	0	≥	134
Wheat Min.	0	0	0	1	0	≥	326
Rapeseed Min.	0	0	0	0	1	≥	76
Gross income per hectare	6,349	5,391	3,679	6,349	5,075	MAX	
Total expenses per hectarer	4,506	3,024	2,132	4,391	4,549	MIN	

Source: Own calculations based on data provided by the agricultural holding.

Following the running of the simplex algorithm in order to minimize expenses and maximize income, optimal solutions resulted in the structure of the crops presented in Tables 8 and 9.

Table 8 Solving and interpreting the primary and dual solution in the context of minimizing the expenses

Optimal solution PRIMAL	Optimal solution DUAL
Own primal variable (VPP) ***Cultivated areas*** **X1** = 258 ha of corn; **X2** = 95 ha of sunflower; **X3** = 172 ha of peas; **X4** = 358 ha of wheat; **X5** = 76 ha of rapeseed;	Dual equalization variables (VDE) Deficit of lei/ha culture expenditures **ye1**=0 lei deficit to spend/ha of corn; **ye2**=0 lei deficits to spend / ha sunflower; **ye3**=0 lei deficits to spend / ha peas; **ye4**=0 lei deficit to spend / ha of wheat; **ye5**=0 lei deficit to be spent/ha of rape
Equalization primal variables (VDE) Differences between resources consumed and limits imposed **xe1** = 29 ha corn deficit; **xe2** = 0 ha deficit sunflower; **xe3** = 0 ha deficit peas; **xe4** = 22 ha wheat deficit; **xe5** = 14 ha rape deficit; **xe6** = 730 litters of diesel not consumed; **xe7** = 3154 lei not spent - weed control; **xe8** = 991 unspent lei - pest control; **xe9** = 1901 lei not spent on fighting diseases; **xe10** = 3200 kg NPK not consumed; **xe1**1 = 0 ha of uncultivated land; **xe12** = 0 ha corn surplus; **xe13** = 28 ha surplus sunflower; **xe14** = 38 ha of surplus peas; **xe15** = 32 ha surplus wheat; **xe16** = 0 ha of rapeseed surplus;	Own dual variables (VDP) Marginal expenses **y1** = 0 lei increase of the others / 288th ha of corn; **y2** = (-1367) lei increase cost for the 96 th ha of sunflower; **y3** = (-2259) lei increase in expenditure / 173 ha of peas; **y4** = 0 lei increase in expenditure / 381 th of wheat; **y5** =0 lei increase in expenditure / 91 th ha of rapeseed flower; **y6** = 0 lei increase in expenditure, / + 1 litter of diesel; **y7** = 0 lei increase in expenditure, / +1 lei in expenditure, weeds; **y8** = 0 lei increase in expenditure, / + 1 lei in expenditure, pests; **y9** = 0 lei increase in expenditure, / + 1 lei in expenditure, diseases; **y10** = 0 lei increase in expenditure, / + 1 kg NPK; **y11** = 4391 lei increase in expenditure / + 1 ha of land; **y12** = 114.5 increase in expenditure / 259 ha of maize; **y13** = 0 lei increase celt, / 68 th ha fl, sun; **y14** = 0 lei increase in expenditure, / 135 th ha of peas; **y15** = 0 lei increase in expenditure, / 327 th ha of wheat; **y16** = 154 increase in expenditure, / 77 th ha rapeseed;
F minim 3,734,707 lei (787,049 euro)	

Source: Simplex LP (Solver/Excel) algorithm results.

For the optimal solutions, obtained in Table 8, the following optimal values will be corresponding: average income = 5,441,943 lei (1,145,672 euros); expenditures = 3,734,707 lei (787,049 euros); profit = 1,707,236 lei (359,414 euros); profit rate = 0.46 lei profit per 1 lei spent. Marginal expenses (y1-y16) represent extra expenses if the farmer decides to increase one of the established activities, for example: increasing the area by one hectare will bring an additional cost of 4,391 lei (about 900 euro), while the establishment of another hectare of corn (minimum ha of corn initially established 258 +1), will bring an additional cost of 114.5 lei (23.6 euro). As can be seen in table no.8 surplus resources do not influence expenditure. Using the same calculation formula and the same technical and economic coordinates income was maximized (Table 9).

Table 9. Solving and interpreting the primary and dual solution in the context of maximizing the income

Optimal solution PRIMAL	Optimal solution DUAL
Own primal variable (VPP) ***Cultivated areas*** **X1** = 287 ha of corn **X2** = 67 ha of sunflower **X3** = 152.1 ha of peas **X4** = 374.9 ha of wheat **X5** = 78 ha of rapeseed	Dual equalization variables (VDE Surplus income lei / ha culture **ye1** = 0 lei surplus of income / ha of corn; **ye2** = 0 lei excess income / ha sunflower; **ye3** = 0 lei surplus of income / ha of peas; **ye4** = 0 lei surplus of income / ha of wheat; **ye5** = 0 lei income surplus / ha of rapeseed;
Equalization primal variables (VDE) Differences between resources consumed and limits imposed **xe1** = 0 ha corn deficit; **xe2** = 28 ha deficit sunflower; **xe3** = 19.8 ha deficit peas; **xe4** = 5.11 ha deficit wheat; **xe5** = 12 ha rapeseed deficit; **xe6** = 32.2 liter of unconsumed diesel; **xe7** = 6459 unspent lei – weeds; **xe8** = 4119.93 lei not spent with pests; **xe9** = 0 lei not spent on fighting diseases; **xe10** = 2407 kg NPK not consumed; **xe11** = 0 ha of uncultivated land; **xe12** = 29 ha corn surplus / surplus; **xe13** = 0 ha surplus sunflower; **xe14** = 18 ha of surplus peas; **xe15** = 49 ha surplus wheat; **xe16** = 2 ha of rapeseed surplus;	Own dual variable (VDP) Marginal income **y1** = 1535.4 lei income increase / 288th ha of corn; **y2** = 0 lei income increase / 96th ha sunflower; **y3** = 0 increase in income / 173 ha of peas; **y4** = 0 lei income increase / 381 th ha of wheat; **y5** = 0 lei income increase / 91 th ha rapeseed; **y6** = 0 lei increase in income / + 1 liter of diesel; **y7** = 0 lei income increase / + 1 lei spent, weeds; **y8** = 0 lei increase in income / + 1 lei spent, pests; **y9** = 11.8 lei income increase / +1 lei expenditure, diseases; **y10** = 0 lei income increase / + 1 kg NPK; **y11** = 3661.1 lei income increase / + 1 ha of land; **y12** = 0 lei increase in income / 288th ha of corn; **y13** = (-616.8) lei income increase / 96th ha sunflower; **y14** = 0 lei increase income / 173 th ha of peas; **y15** = 0 lei income increase / 381 ha of wheat; **y16** = 0 lei income increase / 91 ha of rapeseed;
F maxim= 5.519.308 lei (1.697.743 euro)	

Source: Simplex LP (Solver / Excel) algorithm results.

For the optimal solutions, obtained in Table 9, the following optimal values will be corresponding: average income = 5,519,308 lei (1,1697,743 euros); expenditures = 3,821,566 lei (805,353 euros); profit = 1,697,959 lei (357,419 euros); profit rate = 0.44 lei profit per 1 lei spent.

Marginal income (y1-y16) is extra income if the farmer decides to increase one of the established activities, for example: increasing the area of corn by one hectare will bring an additional income of 1,534.4 lei (314 euro), while an expense of + 1 lei for fighting diseases will bring an income of 11.8 lei (2.46 euro). As can be seen, the surplus resources do not influence the incomes.

The modelling and simulation resulted in data close to the real ones (Table 10), the areas used for the cultivation of the five crops did not have major oscillations compared to the real ones. This indicates that the farmer took into account the rotation restrictions of the plants and, also, the economic benefit of each crop.

Table 10. Comparative analysis regarding the real situation of the technical and economic elements vs their modelled situation

TEHNIC	real	modelling and simulation	
		min. costs	max. income
ha			
Corn	254	258	287
Sunflower	65	95	67
Peas	54	172	152
Wheat	398	358	374
Rapeseed	188	76	78
ECONOMIC	real	modelling and simulation	
		min. costs	max. income
euro			
Income	979,753	1,1456,672	1,161,959
Expenditure	712,593	787,049	805,353
Profit	267,158	359,418	357,419

Source: Own calculations.

It can be notes that depending on what option is chosen for optimization (maximum income -minimum expenses) the technical indicator (area) will influence the economic part. From an economic point of view, the real profit obtained by the agricultural holding is approximately 30% below the two profit variants obtained after modelling and simulating the same system and the same thing can be observed in the case of income and expenses. It should be noted that in the modelled and simulated situation no restrictions about unforeseen situations were placed in the mathematical model, which, in most of the case, involve additional costs.

CONCLUSIONS

It is necessary that all the activities carried out within the agricultural holdings to be optimally dimensioned in order to ensure a maximum profit in conditions of increased economic efficiency, which implies a better use of the resources available to the company.

This type of optimization provides to the manager rigorous information of the actions taken by him and the various or multiple ways of correlating them with the resources available, whether if it is material or financial resources. Correlations of the resources with what they want to obtain, is made in a such way as to meet the requirements of the objective set for a period of time, giving them the opportunity to make the best decision without distorting reality in any way.

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CONSUMER PERCEPTION ON FOOD WASTE MANAGEMENT AND INCORPORATION OF GRAPE POMACE POWDER IN COOKIES

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Abstract

The aim of this study was to investigate the consumers' attitude towards the use of food industry waste in newly formulated cookies as well as the consumers' acceptance of these cookies incorporated with grape pomace powder (GPP). Total of 13 varieties of cookies were evaluated by sensory trained panel using hedonistic analysis including an attitude survey. Cookies were prepared with dried grape skin and seeds milled into powder as a replacement for the flour. Four different concentrations (2.5, 5.0, 7.5, and 10.0 %) of GPP with 3 different granulations (0.25, 0.50, 1.00 mm) were prepared and compared to the control sample (without GPP). More than a half of the surveyees are aware of the term functional food and they are eager to try food that contain food waste in it, but unfortunately they are not well informed on how the food waste is disposed and managed. The sensory analysis showed that newly developed cookies are well accepted from the panellists due to their good appearance, likable colour, pleasant aroma and taste with those that contain GPP in granulation 1.00 mm being the best ones.

Key words**:** *grape pomace, granulation, consumers' acceptance, consumers' attitude, cookies*

INTRODUCTION

Food industries create large amount c.a 3 billion tons of waste and by-products each year. Part of this waste is exploited and valorized as animal feed, yet large quantities are disposed on the landfill [11]. If not properly managed its uncontrolled decomposition contributes to a significant contamination of the environment which also creates great economic problems with costs associated to their management reaching tens of millions of euros [13, 39]. Therefore, it is essential to explore other alternative ways for food processing waste application. Food waste coming from agro-industries has an enormous potential to be valorized and recycled in new valuable products if it is supported by extensive information about its functionalities. It is known that this type of waste contains significant amounts of valuable components (proteins, dietary fibers, biologically active compounds, antioxidants, polyphenols, etc.) that remain unused [39]. These compounds can be used as health promoters, texturizers, colorants, natural food additives, antimicrobial components, dietary supplements, nutraceuticals etc. [14].

According to the FAO report, 45% of the total waste is generated during the processing of fruits and vegetables. Grape (*Vitis vinifera* L.), as the largest fruit crop with the worldwide production estimated around 23.5 million metric tons, is used as fresh fruit (table grape) and processed in wine and grape juice [32]. Methods for grape juice and wine production are very different, but in both processes the solid waste is composed from stalks, stems, skins, seeds and liquid waste (wash water, cold water and cleaning chemicals) [38]. The solid by-product called grape pomace or grape mark represents rich source of phenolic compounds that demonstrate antimicrobial and antioxidant properties [4]. Many recent researches were focused on characterization of the chemical

composition of the solid by-product like grape pomace, which has proven as worthy source of different high-value ingredients and their application in food industry and cosmetics, having nutritional, economic and environmental benefits at the same time [33]. The grape pomace is composed of dietary fiber (50-75% of total dry matter), protein (12%), oil (7-12%), and soluble sugars (3-4%), while grape stems contain dietary fiber (77%), protein (7-8%), oil and soluble sugars (1.6 and 1.7%, respectively). In respect of phenolic compounds grape pomace contain 4-5% with main aspect on catechins (proanthocyanidins) and glycosylated flavonols, whereas the stem has twofold higher phenolic content with flavonoids (catechin, epicatechin, epicatechin-3-O-gallate, proanthocyanidins, quercetin, and their glycoside derivates) as main compounds [38]. The anthocyianin and polyphenolic content in the grape pomace depend on the production method and contact time between the juice and the solids and represents crucial information for the market potential application and profitability.

Grape pomace has found its way on the market in different forms. It can be sold as dried organic grape pomace supplement that can be added to smoothies and substitutes for yeast in bread making or as grape seed oil [10]. Large portion of grape pomace is recycled back into the vineyard as compost based on aerobic microbial decomposition [5]. More profitable but still theoretical applications of grape pomace have been proposed in biosurfactant production due to their emulsifying abilities and lower toxicities than the synthetic biosurfactants [28]. Another application of the grape pomace is in the production of pullulan – an exopolysaccharide that can be added to food to increase texture and provide low-calorie bulk [27]. Grape pomace is widely used as antioxidant internally to preserve food especially in meat and meat products [29]. The health benefits coming from the dietary fiber aid the application of the grape pomace in powder-containing products in different concentrations or tea infusions made from grape pomace skins [2, 9].

Cookies and baked goods are affordable, long lasting commonly consumed snacks that vary in taste and texture. In addition to this, they can easily be enriched with grape pomace flour and be transformed in functional products with higher content of dietary fibers and bioactive compounds [16].

The food industry waste incorporation in the existing products may encounter several problems. Initially, there is the need for a new product development, followed by the need of adaptation of the technology and additional processing of the waste to prevent it from rapid deterioration due to autolytic, chemical and microbial spoilage [39]. Finally, the last problem arises from consumer's perception of having food that includes biological waste within. In this regard, product information is important key factor that have an impact on consumers preference of the product cause it can produce certain expectations about the product that might affect its sensory evaluation [9]. If the information of positive health benefits is provided, less desired products are better accepted especially if that information is provided at the stage before consumption of the product [8].

In the literature there are many scientific papers on grape pomace incorporated in baked goods such as cakes [22], muffins [26], bread [20], cookies [2], but there was lack of research on the consumers' opinion about the biological waste that the wine industry creates and its incorporation in food. Other authors have also studied and presented enrichment of food products with grape pomace. San'Atnna et al., 2014 [30] have conducted studies of fettuccini pasta in which they have added 25, 50 and 75 g/kg of grape marc powder. They have concluded that fettuccini pasta with added 25 g/kg of grape marc powder has got the best sensory qualities. Tseng et al., 2013 [37] have studied adding of grape pomace in yoghurt and salad dressings and have found that yoghurt with 1% grape pomace, Italian dressing with 0.5% grape pomace and Thousand Island dressing with 1% grape pomace have the best results for sensory analysis. Sudha et al., 2013 [36] have also done sensory analysis of food products enriched with by-products. They have studied

muffins with 8%, 16% and 24% apple skin powder (ASP) and have come to the conclusion that the muffins containing 24% ASP have got the best sensory characteristics. Sudha et al., 2007 [35] have done a sensory evaluation of a cake in which some apple pomace has been added. According to them the best results are gained when about 20% of the wheat flour is replaced with apple cake.

The aim of this study was to conduct a survey on consumers' attitude towards the use of the food waste in development of a new product and the impact of the granulation of grape pomace powder on the hedonistic acceptance of cookies enriched with this kind of waste.

MATERIALS AND METHODS

Questionnaire and test participants

Questionnaire methodology was used to reach the objectives of this research that was available on the Google platform. The questionnaire was consisted of 10 questions including the socio-demographic ones (gender, age, education). The aim of the survey was to see how well consumers are informed about the food waste management, are they informed about food products containing food waste and whether they would consume such. Separately, the surveyees were given newly developed functional cookies enriched with by-products from wine industry. The survey was conducted with 120 people, form urban city area, elected randomly in Skopje region, R.N. Macedonia.

Sample preparation of GPP

Grape skin, seeds and stems (variety: Vranec) were obtained from the grape juice production industry immediately after pressing the juice. Fresh grape pomace was dried at 50°C for 24 h and milled to obtain powder. The grape pomace powder (GPP) was sieved through 1.00; 0.50 and 0.25 mm pore sized sieves and the three granulations were included in cookie preparation as a partial replacement of the flour.

Cookies preparation

The functional cookies with GPP were prepared at the laboratory for food and biotechnology within Faculty of Technology and Metallurgy in Skopje, N. Macedonia. They were prepared according to the method 10-50D [1]. Total of 13 different recipes were prepared including: control (with 0% GPP) and each granulation (1.00; 0.50 and 0.25 mm) was included in the different concentrations (2.5; 5.0; 7.5 and 10.0%) in the cookie formulation.

Sensory analysis

The sensory analysis method was conducted using the method of Nakov et al., (2016) [25] where each of the attributes: colour, appearance, aroma, taste and texture were evaluated separately. Sensory analysis of new enriched cookies was made according to the guidelines on Ethics and Food-Related research defined by the European [3]. Each consumer panellist was given small pieces of 13 distinct cookies alongside with water to rinse their mouth after consumption. The sensory analysis was conducted during daylight and the cookies were coded for objective evaluation. The information that the cookies contain food waste from the industry was shared with the panellists prior the evaluation. They also had brief training on how to evaluate each attribute.

RESULTS AND DISCUSSIONS

The socio-demographic status of the consumer panel is presented in Table 1. It can be observed that 79.17% were female, while 20.83% were male surveyees. Most of them (45%) were at the age between 18 and 30 years, very similar percentage (44%) were at the age between 31 and 60 years and only small fraction (11%) were over 60 years old.

Table 1. Socio-demographics status of the consumer panel

		Number of surveyees	%
Sex	Male	25	20.83
	Female	95	79.17
Age	under 18	0	0.00
	18-30	54	45.00
	31-60	53	44.00
	over 60	13	11.00
Education	Primary	0	0.00
	Secondary	48	40.00
	Higher	68	56.67
	Ph.D	4	3.33

Source: Own calculation.

The cookies are targeted for any age, but the surveyees younger than 18 weren't included in this study because no volunteers were recruited for the consumer panel.

In terms of education, the majority of correspondents (56.67%) had higher education (university degree), 40% were with high school, while only 3.33% had Ph.D degree.

The biological waste that is created from food industries can be used by the same industry or disposed by a third party. The answers of the surveyees responding to the question "Do you know where the biological waste coming from the food industry ends up?" are presented in Figure 1.

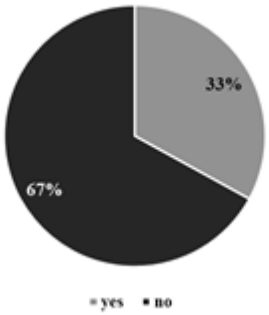

Fig. 1. Answers to the question "Do you know where the biological waste coming from the food industry ends up?"
Source: Own results.

Figure 1 shows that 67% of the respondents are not familiar with where the waste from the food industry ends up, while 33% of them are aware of how the food waste is managed. Due to this high percentage of uneducated consumers, it is necessary to intensify the education of population about this part of the food industry. In Europe, the average level of food waste is 180 kg per person. This high amount of waste coming from the food industry is due to the different cultures and lifestyles of the people inhabiting the continent [6]. Valorisation of by-products of fruit and vegetables would make bioeconomics more circular and would help to reduce high influence on the environment [17]. On the other hand, almost all waste from food industry contains significant nutritional and bioactive substances which can be used for the production of new products in different sectors (food, pharmaceutical and cosmetics). Beside this, waste from food industry very often ends up as a final waste so its further processing is not economically justified. Thus, it is necessary to make a good assessment of economic viability if certain waste is being processed [31].

The answers to the question "Have you ever consumed cookies with added value or functional cookies?" are presented in Figure 2. From the Figure 2 it can be seen that 78% of respondents consumed value-added cookies, and 22% of them haven't consumed any of this kind. Cookies are a widely consumed common food primarily because of their pleasant taste, variety, low cost and long shelf life [18]. Classic types of cookies that are made from white wheat flour contain a large amount of fat, sugar and calories, but little dietary fiber, vitamins, minerals and bioactive substances [15]. However, nowadays demand for nutritionally enhanced and functional products is growing. These products are produced by replacing and/or adding flour to the recipe that has better nutritional properties than white wheat flour. This improves the content of dietary fiber and bioactive substances that have health benefits [34].

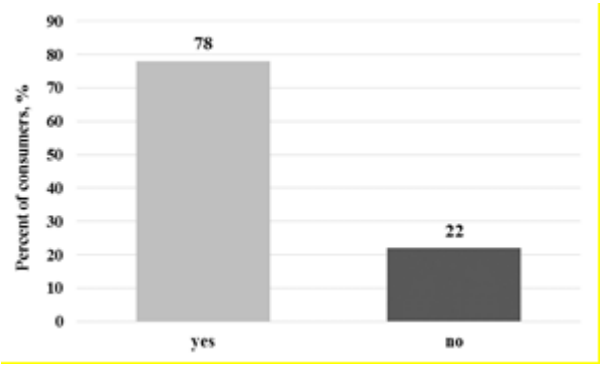

Fig. 2. Answers to the question "Have you ever consumed cookies with added value or functional cookies?"
Source: Own results

The answers to the question "How often do you eat cookies?" are presented in Figure 3. The same percentage of respondents (11%) answered that they do not consume cookies at all or they consume them 2-3 times a week, while none of the respondents (0%) consume cookies every day. In addition to this, the

highest percentage of respondents (78%) answered that they consume cookies 2-3 times a month (Figure 3). In a survey from the previous year conducted in 3 countries (Macedonia, Bulgaria and Croatia) on the question what do you most often consume from grain products, in all three countries the first product is bread, while respondents from the Republic of Macedonia ranked cookies in third place in terms of consumption [21].

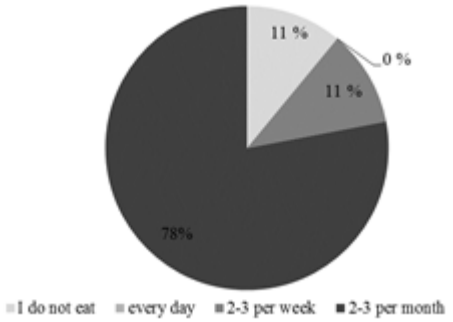

Fig. 3. Answers to the question “How often do you eat cookies?”
Source: Own results

In the questionnaire, the question "What is the most important to you when choosing cookies?" was also asked.

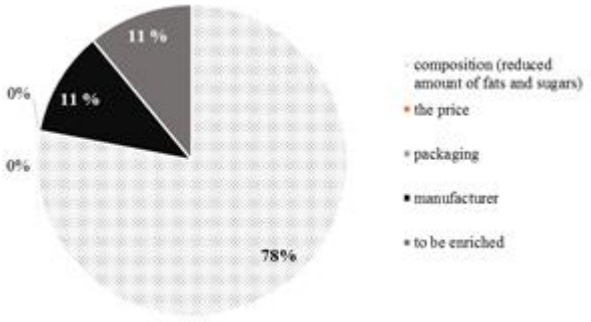

Fig. 4. Answers to the question "What is the most important to you when choosing cookies?"
Source: Own results

For 11% of the surveyees it is important that the cookies are enriched with added-value substances, the same percentage answered that the brand of the product plays an important role, while for 78% of respondents the composition (ingredients) of the cookies is imperative. On the other hand, for the surveyed consumers, the price and packaging (0%) of the product are absolutely irrelevant (Figure 4).

Recently, consumers are progressively paying more attention to the information presented on the packaging of food products. Figure 5. presents the answers to whether the information written on the packaging of food products is important. About two-thirds (67%) of the surveyees believe that it is important to have adequate information about the nutritional composition and energy value of cookies on the packaging. Nakov et al., (2017) [23] conducted a research on the manner of labelling of food products in the Republic of Macedonia and concluded that consumers most often read the information given on the label, when buying a food product. Among the problems consumers face, they give the small font of letters and the use of many signs and numbers (marked as "E"). When choosing the price, the consumers chose the products with longer shelf life.

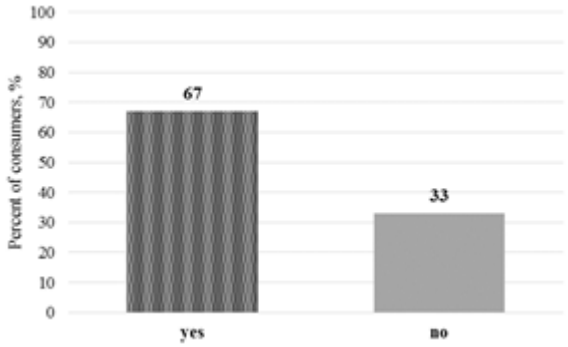

Fig. 5. Answers to the question “Is the information written on the packaging of food products important?”
Source: Own results

Figure 6 represents the answers to the question "Do you know what functional cookies are?"

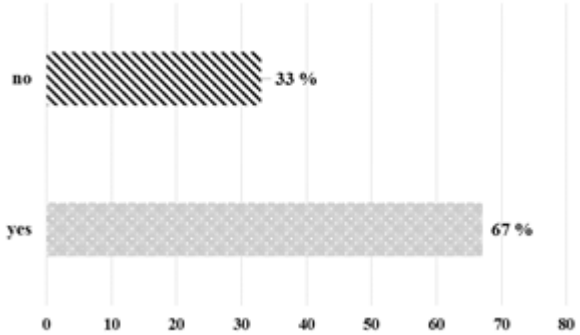

Fig. 6. Answers to the question "Do you know what functional cookies are?"
Source: Own results

33% of the surveyees answered that are not familiar with the definition of functional cookies, while 67% had an opinion about the meaning of functional cookies. In addition, those that responded affirmative to the previous question were kindly asked to give their opinion to what functional cookies are. Some of the given answers are presented in Figure 7.

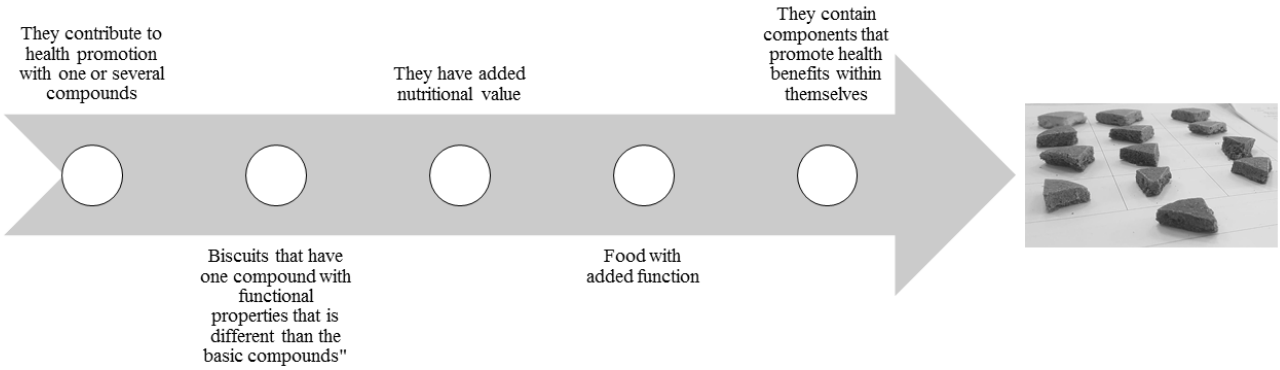

Fig. 7. Answers to the question "What is the definition of functional cookies?"
Source: Own design.

There are different definitions of functional food. The food that has positive influence on one or many functions in the human organism, aids the development of intellectual and physical capabilities, reduces the risk of different diseases and improves the overall health can be called functional food [24, 7].
In Figure 8 the answers of the question "Would you eat cookies that have food waste in their formulation?" are presented.

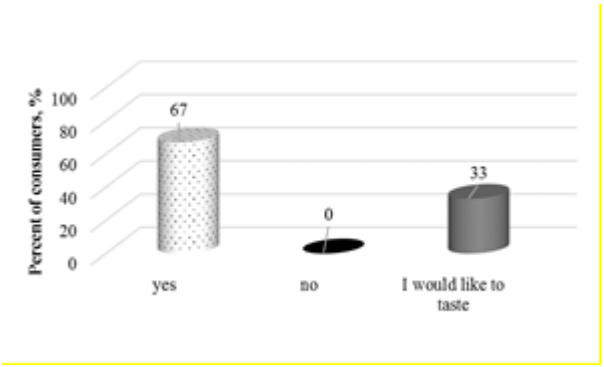

Fig. 8. Answers to the question "Would you eat cookies that have food waste in their formulation?"
Source: Own results

From the results presented on Figure 8 it can be noticed that 67% from the surveyees would consume cookies with grape skin and seed powder, 33% would like to try this kind of a product and none of them wouldn't consume cookies with food waste. Weather one newly developed functional product will find its place on the market depends on numerous factors. These include the price, the acceptability from the consumers, as well as the economic viability throughout its production [12]. In the recent years there is a trend in the research and production of food products incorporated with food by-products, which influence the technological, nutritional, health and sensorial properties [19]. Sensorial properties of food are closely tied with the hedonistic feeling that it provides during the consumption via the attributes that can be determined with the senses of sight, smell, taste and touch. These properties are usually the unique parameters according to which the consumers make a decision whether they shall buy the product or not [25].
In Figure 9 the appearance of the cookies incorporated with GPP in different granulation (1.00; 0.50 and 0.25 mm) and different concentration (2.5; 5.0; 7.5 and 10.0%) are presented. Total of 13 cookies (including the control) were sensory evaluated.
The results from the sensory analysis of the cookies enriched with grape skin and seeds powder added in different concentration and granulation are presented in Table 2.

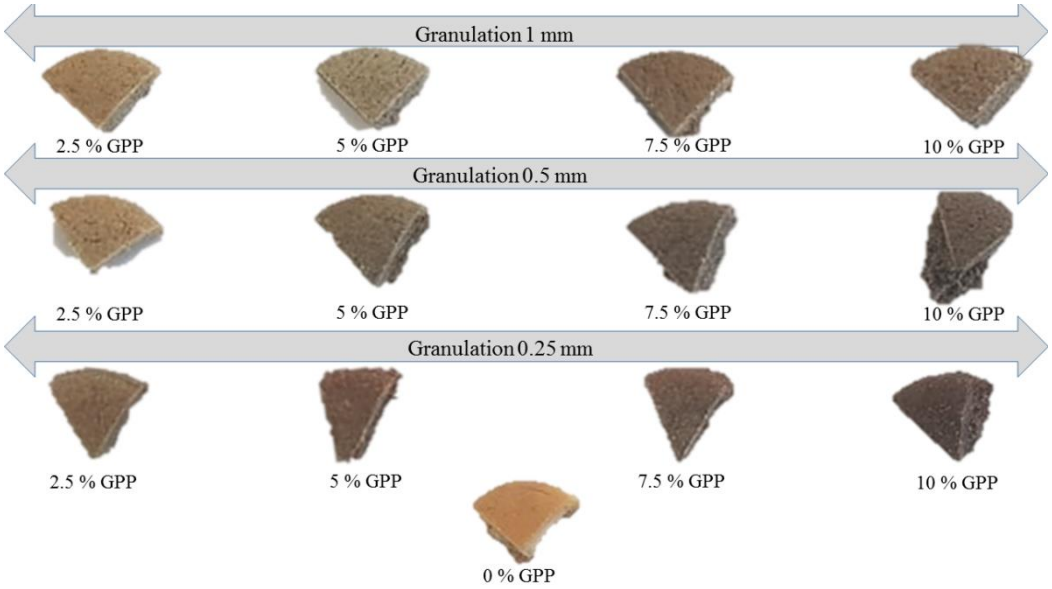

Fig. 9. Cookies with different granulation and different concentration
Source: Own design.

The results from the sensory analysis of the cookies enriched with grape skin and seeds powder added in different concentration and granulation are presented in Table 2.

Table 2. Sensory analysis of enriched cookies with GP

		Colour	Appearance	Aroma	Taste	Texture
Control		8.00 ± 0.12	7.70 ± 0.23	7.22 ± 0.90	6.55 ± 0.39	7.55 ± 0.77
Granulation 1.00 mm	2.5 % GPP	6.00 ± 0.21	7.00 ± 0.36	7.44 ± 0.24	7.66 ± 0.22	8.00 ± 0.45
	5 % GPP	6.00 ± 0.32	6.50 ± 0.54	6.66 ± 0.23	7.66 ± 0.57	8.00 ± 0.21
	7.5 % GPP	5.60 ± 0.17	7.00 ± 0.32	6.88 ± 0.38	6.88 ± 0.66	7.88 ± 0.69
	10 % GPP	5.70 ± 0.54	6.33 ± 0.37	6.55 ± 0.47	7.11 ± 0.75	7.22 ± 0.38
Granulation 0.50 mm	2.5 % GPP	6.50 ± 0.45	6.55 ± 027	7.11 ± 0.65	6.88 ± 0.87	7.44 ± 0.55
	5 % GPP	6.20 ± 0.36	6.66 ± 0.80	7.44 ± 0.35	7.33 ± 0.33	7.55 ± 0.58
	7.5 % GPP	6.00 ± 0.24	6.66 ± 0.58	7.00 ± 0.33	6.88 ± 0.36	7.00 ± 0.32
	10 % GPP	6.70 ± 0.35	6.11 ± 0.96	6.88 ± 0.29	7.00 ± 0.41	6.77 ± 0.41
Granulation 0.25 mm	2.5 % GPP	6.60 ± 0.032	6.77 ± 0.12	7.33 ± 0.56	7.33 ±0.52	6.55 ± 0.44
	5 % GPP	6.80 ± 0.19	6.55 ± 0.39	7.88 ± 0.59	7.66 ± 0.84	6.55 ± 0.63
	7.5 % GPP	7.25 ± 0.47	6.66 ± 0.28	6.25 ± 0.92	6.55 ± 0.11	5.88 ± 0.95
	10 % GPP	7.87 ± 0.63	7.33 ± 0.25	6.55 ± 0.36	6.88 ± 0.85	5.11 ± 0.89

Source: Own results.

From the presented results it can be noticed that the control samples for the attributes colour and appearance were evaluated with the highest scores (8.00 and 7.00, respectively). In the other hand, if the average scores for the same attributes for the cookies with different granulation were to be compared; those that were incorporated with 0.25 mm GPP got the highest average score (7.13 and 6.23, respectively). Cookies that have the best aroma were those incorporated with 5% GPP in 0.25 mm granulation (7.88). When the attribute aroma is compared within the cookies with different granulations, those that were produced with grape pomace powder in granulation 1.00 mm had an average score of 6.88, cookies that had grape pomace flour with granulation of 0.50 mm in their formulation were evaluated with average score of 7.11, while the ones that contained

grape pomace flour in granulation of 0.25 mm scored 7.00 as an average. In terms of taste, the best scores (6.88) were attributed to the cookies that were incorporated with 10% of grape pomace flour with granulation of 0.25 mm. Cookies that contained grape pomace flour in granulation of 1.00 mm in different concentration were evaluated as the tastiest (7.33). The texture was estimated as the best in the cookies that contained 2.5 and 5 % grape pomace flour with granulation of 1.00 mm. Furthermore, cookies in this group (granulation of 1.00 mm of the grape pomace flour) obtained the highest overall score (7.76) for the texture.

The last question in the questionnaire was whether the panelists would buy the cookies that were evaluated in the sensory analysis and why?

From the answers (data not shown) all of the consumers would buy the newly developed cookies enriched with grape pomace powder in different granulation and added in different concentration. Some of the reasons why they would choose to buy the evaluated product were presented in Figure 10. Among other things the panelists stated their satisfactory colour, aroma, flavor, the excellent aftertaste and because they are nutritionally richer than the traditional cookies. On the other hand, part of the panelists will decide to buy this kind of a product because of their higher ecological awareness and the fact that the product includes food waste. They also liked the appearance of the cookies which is certainly one of the most important factors in making decisions.

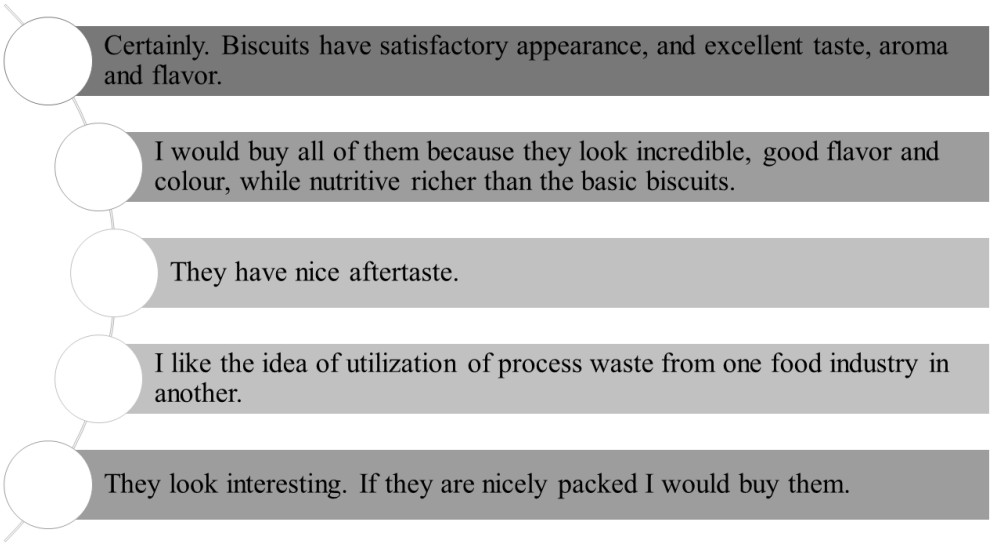

Fig. 10. Some of the reasons why the consumers would buy the enriched cookies with grape pomace.
Source: Own design

CONCLUSIONS

From the conducted survey it is concluded that the surveyees don't have enough information on the topic about food waste, where it is disposed and how it is managed. For that reason additional education on food waste management, its uses and possible applications in the food industry is of a big necessity. More than a half of the surveyees had already consumed functional cookies and the same fraction would also try cookies that contain food waste in their formulation. The results from the sensory analysis demonstrated cookies incorporated with grape pomace powder with granulation 1.00 mm as the best ones.

Newly developed cookies would be bought due to their good appearance, likable colour, pleasant aroma and taste, the fact that they are nutritionally richer than the traditional ones and they contribute to the environmental pollution reduction by containing food waste within.

ACKNOWLEDGEMENTS

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IS THE VAT LEVEL A STIMULATIVE FACTOR FOR AGRITOURISM DEVELOPMENT IN ROMANIA?

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Abstract

Tourism is one of the most important industry of Romania, being considered a major source of income to the state budget, employment and investment. Taxes influence the development of the tourism and the value added tax (VAT) is a main factor of affecting the tourism competitiveness. The present study represents an analysis of VAT and of the impact of VAT rates on the tourism sector, respectively of the Romanian agritourism. Given the fact that VAT can be considered one of the most important types of taxes applied in the tourism sector, the study highlighted the immediate effect of reducing the VAT rate in 2018, compared to 2017 on overnight stays, arrivals and average length of stay, as well as the impact on the economy as a whole. At EU level, in 2017, the average standard VAT rate was 21%, a number of 21 countries having this average rate, including Romania, with 19%. Most Member States also applied reduced VAT rates for accommodation services, Romania being again one of them. Through this analysis it was concluded that in order to obtain the maximum effect of reducing the VAT rate in tourism, respectively agritourism, it takes several years for accommodation.

***Key words*:** *value added tax, reduced rates, agritourism, Romania, effect*

INTRODUCTION

The tourism industry is very vulnerable to tax changes. However, at the same time, tourist taxes do not have the same level of political responsibility as other forms of taxes that generate greater public control [8].

The tourism sector can be taxed either by taxing businesses in the tourism sector or by directly taxing tourists. Both tax systems can be implemented through the general tax system or through tourism specific taxes [7].

Regarding the implications of tourist taxes, value added tax (VAT) can be considered as one of the most important types of taxes borne by tourists [8].

From the perspective of the share of revenues generated from value added tax at the level of the European Union (EU) it is considered that this tax is the most important indirect tax, falling within the general consumption taxes due to the fact that it applies to the total sales volume [2]. VAT revenue is an important source of revenue for Member States' budgets and the EU budget [10].

”The first attempts to harmonize the VAT systems of the Member States took place in the late 1960s, with the adoption of the Sixth VAT Directive only in 1977, when governments agreed on common criteria based on taxation VAT in all Member States” [14].

In 1960, VAT was recognized by more and more countries, which subsequently adopted it, and at present, the number of countries globally that have adopted this indirect tax exceeds 130 [2].

”Member States could apply a reduced rate of VAT for a common list of goods and services, due to the Council wich adopted in 1992, the system of VAT rates. The conventions adopted in 1992 were, in principle, transitional, but still apply” [14]. In 1954, the first country wich implemented value added tax was France [27]. With regard to the European Union, according to the authors Jorge Martinez-Vazquez and Richard M. Bird in the article "Value Added Tax: Onward and

Upward?" (2010), all Member States have adopted value added tax, pursuing two major objectives: eliminating cascading taxation (replacement of the tax on the movement of goods), but also the improvement of the tax system [25].

Member States had to apply a single standard VAT rate, wich it must be greater than 15%, and also, one or two reduced VAT rates, at least 5%, with some exceptions. The reduced rates can only be applied to the delivery of certain goods and services, including accommodation and restaurants.

The value added tax (VAT) was introduced in Romania starting with January 1, 1993, the standard rate having a percentage of 18%. This rate has seen several changes over time, increasing or decreasing, reaching quotas up to 24%.

The changes in the VAT rate are established by the fiscal policy of each country, in accordance with the fiscal policy of the European Union.

Value added tax from tourism activities is often seen as distortive and detrimental to the competitiveness of prices charged in tourist destinations, which is why many EU countries apply reduced rates to tourism services, as allowed by the current EU VAT regime.

MATERIALS AND METHODS

In order to establish the way in which the value added tax (VAT) influences the development of the tourism activity, respectively of the agritourism in Romania, this study has combined the following research techniques:

- analysis of some definitions of VAT;
- the analysis of the main normative acts that establishes the application of this indirect tax both at the level of the European Union and at the level of Romania;
- comparative analysis of VAT rates in EU;
- evolution of VAT rates between 1993-2018;
- the influence of VAT on overnight stays, arrivals and the average length of stay related to the agritourism sector in 2017-2018, using data taken from the website of the National Institute of Statistics.

The average length of stay is calculated as a ratio between the number of overnight stays (SNZT) and the number of tourist arrivals (T):

$$\overline{D}_s = \frac{\sum NZT}{T}$$

This indicator shows the average time (days) of tourists to stay in the accommodation and thus reflects the possibility of the offer to retain the tourist in a certain area, region, etc. [22].

RESULTS AND DISCUSSIONS

"Value added tax is an indirect tax due to the state budget" [4].

"Value added tax (VAT) is also a consumption tax that applies to almost all goods and services bought and sold for use or consumption in the EU" [12].

Another definition given to value added tax shows that it is an indirect tax borne by the final consumer of the respective good / service. VAT is a tax cascaded by each economic agent who participates in the economic cycle of making a product or providing a service that falls within the scope of taxation [27].

Value added tax (VAT) is actually a general consumption tax borne by tourists and residents alike, not necessarily specific to the tourism industry, but affecting businesses operating in the tourism industry, such as accommodation providers, tour operators and travel agencies [8].

Countries from the EU can aplly in a different way the common VAT rules. In generally, for all goods and also for all services, we have to pay VAT [12]. As regards legislation, at the European Union level, Council Directive 67/227 / EEC adopted on 11 April 1967 was the first directive wich regulated the value added tax and also its characteristics like object, place, transactions, persons that have to pay this tax [2]. „Over time, this directive has undergone various changes. The reference document is now Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax, which has consolidated all the texts issued since 1967 on VAT and establishing the specific

scope of taxation, as well as the minimum standard rate to be applied by Member States, which may not be less than 15%" [14].

Also Romania has to align to European practices and for making this possible was adopted Ordinance no. 3/1992 through wich the tax on the movement of goods was replaced by value added tax system starting with January 1, 1993, having a quota of 18% [17]. Government Emergency Ordinance no. 17/2000 and Government Decision no. 401/2000 constitutes the general legal framework regarding VAT.

In 2014, although the standard VAT rate was 24%, according to Law 571/2003 on the updated Tax Code, the reduced rate of 9% was applied to the accommodation, with the following amendments:

- if the accommodation package included one or more meals (in half board or full board), the applicable VAT rate is the reduced one of 9%;
- provided that the tourist has chosen to eat separate accommodation meals then the standard rate of 24% applies [24].

By the Government Decision no. 20/2015 for the modification of par. (6) of point 23 of VI Title "Value Added Tax" from the Methodological Norms for the application of Law no. 571/2003 regarding the Fiscal Code, in 2015 the reduced percentage of VAT of 9% was extended for the accommodation packages that included in the price meal services, restaurant and bar services.

"Given that the bar and restaurant services were provided individually to a client receiving accommodation and were not included in the contracted package, they were billed at 24% VAT" [11].

"Table 1 shows the level of VAT quotas from 2017, applied at the level of each member state of the EU and table 2 shows the evolution of this tax in Romania during the period 1993-2018" [9].

At the level of 2017, the Member States applied a standard VAT rate between 17% (in Luxembourg) and 27% (in Hungary). The average standard VAT quota was 21%, with 21 countries having this average rate, taking into account the plus / minus range of two percent. "Romania is in this range, with a standard rate of 19%. Starting with January 1, 2017, for accommodation services, 25 of the 28 EU Member States have applied a reduced rate of VAT (18 of them applied a rate equal to or less than 10%)" and as regards restaurant services the reduced VAT rate was used only by 17 of 28 Member States having percentage between 3% in Luxembourg and 18% in Hungary [14].

Table 1. VAT rates in EU member countries in 2017

"Member States	Standard rate (%)	Reduced rate (%)	Super-reduced rate (%)
Belgium BE	21	6/12	-
Bulgaria BG	20	9	-
Czech Republic CZ	21	10/15	-
Denmark DK	25	-	-
Germany DE	19	7	-
Estonia EE	20	9	-
Ireland IE	23	9/13,5	4,8
Greece EL	24	6/13	-
Spain ES	21	10	4
France FR	20	5.5/10	2,1
Croatia HR	25	5/13	-
Italy IT	22	5/10	4
Cyprus CY	19	5/9	-
Latvia LV	21	12	-
Lithuania LT	21	5/9	-
Luxembourg LU	17	8	3
Hungary HU	27	5/18	-
Malta MT	18	5/7	-
Netherlands NL	21	6	-
Austria AT	20	10/13	-
Poland PL	23	5/8	-
Portugal PT	23	6/13	-
Romania RO	19	5/9	-
Slovenia SI	22	9,5	-
Slovakia SK	20	10	-
Finland FI	24	10/14	-
Sweden SE	25	6/12	-
United Kingdom UK	20	5	-

Source: table processed after data provided by European Commission (EC), VAT rates applied in the Member States of the European Union, Situation at 1st January 2018" [9].

Table 1 illustrates the standard and reduced VAT rates for 2017 applied in EU Member States.

Since its introduction, the VAT system has been no exception to the modest performance

of general fiscal policy. Between 1993 and 1998, three VAT rates were applied simultaneously - a standard rate (18%), a reduced rate (9%) and a zero rate. Between 1998-2000, the standard rate was increased to 22%, and the reduced rates (11%) and zero were maintained. During this period, several special laws appeared, which changed the number, structure of exemptions and exemptions from VAT payment. As of 1 January 2000, a standard rate of 19% was applied, the reduced rate was abolished and the zero rate was maintained. This change in the VAT system was part of the tax reform initiated in early 2000 [5].

A new growth occurred in 2010, increasing VAT from 19% to 24%, thus delaying the exit from the recession of Romania by approximately nine months and at the same time reducing the demand for food and non-food products, by decreasing the purchasing power of the to consumers, due to rising prices [3].

This increase in the VAT rate has not been fully transferred to consumers, but has been supported by companies, leading to reduced investments, lower employment conditions and possibly, in the worst case, business closure.

In 2014, the standard VAT rate was 24%, and for the accommodation, the reduced VAT rate of 9% was applied, if the accommodation package included one or more meals (in half-board or full-board system).

Regarding the year 2015, the standard VAT rate was 24%, but at the level of the reduced one of 9%, certain changes regarding the accommodation services took place, namely that they benefited from the reduced rate of VAT only the accommodation packages that included in price meal services, restaurant and bar services. At the level of 2017, there was a decrease of the standard VAT rate, from 20% for 2016, to 19%, having a direct impact on consumers and economic agents, by increasing consumption, respectively increasing sales, although the legislation in force at that time it did not oblige companies to reduce prices with the reduction of the VAT rate [20]. "The reduced quotas remained at the same level, respectively 9% and 5%. For accommodation in the hotel sector or in sectors with a similar function, including rental of camping grounds, restaurant and catering services, except alcoholic beverages, other than beer falling within CN code 22 03 00 10 (draft beer) the reduced VAT rate of 9% was applied"[21].

In 2018, the VAT rates remained the same as in 2017, the standard rate being also 19%, and the reduced rates being 9% and 5%, respectively. Since 1.11.2018, VAT for tourist services has decreased from 9% to 5%, including for restaurant and catering services. "This measure aims, on the one hand, to reduce tax evasion, and on the other hand to stimulate tourism and increase domestic consumption"[1].

Romania had one of the highest standard rates of value added tax in the European Union, wich was 24% and was applied between July 1, 2010 and December 31, 2015. Our country was overtaken by Hungary with a VAT rate of 27%, and also by Denmark and Sweden with a 25% quota. The average VAT rates in EU Member States ranges from 18% to 21% [15].

Table 2. Evolution of VAT rates in Romania during 1993-2018

Member state	Date	Low VAT rate	Standard VAT rate
Romania	01.07.1993	-	18%
	01.01.1995	9%	18%
	01.02.1998	11%	22%
	01.01.2000	-	19%
	01.01.2004	9%	19%
	01.12.2008	5%/ 9%	19%
	01.07.2010	5%/ 9%	24%
	01.01.2016	5%/ 9%	20%
	01.01.2017	5%/ 9%	19%
	01.01.2018	5%/ 9%	19%

Source: table processed after data provided by European Commission (EC), VAT rates applied in the member states of the European Union , Situation at 1st January 2018.

The study considers the period 2017-2018, as in 2018 a 4% decrease in VAT on accommodation was established compared to the previous year, from 9% to 5%. We also analyzed the immediate effect of the VAT reduction regarding the accommodation services within the tourism, respectively of the Romanian agritourism.

The total number of overnight stays and arrivals registered in the period 2017-2018 was taken into account, both at the level of the total number of tourist reception structures, with tourist accommodation functions, and at the level of agritourism pensions in Romania.

The overnight stays registered in total tourist reception structures in 2018 were increasing by 6% compared to those of 2017, and at the level of agritourism pensions the increase was 17%. Of the total number of overnight stays in the tourist reception structures in 2018, the overnight stays of Romanian tourists accounted for 81%, while foreign tourists accounted for 19%. In 2017, overnight stays of Romanian tourists were 80%, and the difference of 20% was for foreign tourists. Regarding the agritourism pensions, in 2018 the nights of the Romanian tourists represented 92%, and those of the foreign tourists only 8%. In 2017, the nights of Romanian tourists registered a percentage of 91%, and those related to foreign tourists only 9%.

The arrivals registered in total tourist reception structures in 2018 increased by 6% compared to those of 2017, and at the level of agritourism pensions the increase was also 17%. Of the total number of arrivals from tourist reception structures in 2018, the arrivals of Romanian tourists accounted for 78%, while the arrivals of foreign tourists accounted for 22%. In 2017, the arrivals of Romanian tourists accounted for 77%, and the difference of 23% was allocated to foreign tourists. The arrivals of Romanian tourists related to agritourism pensions, in 2018 were 92%, the remaining 8% coming to foreign tourists. The situation was insignificantly changed, in the sense of decreasing by 1%, respectively 91% Romanian tourists and 9% foreign ones. The increase of the number of Romanian tourists from the level of agritourism pensions both at nights and at arrivals was 18% in 2018 compared to 2017.

The average length of stay was 2.22 days in 2018 compared to 2.23 days in 2017, and at the level of agritourism pensions it was the same in both years, respectively 1.92 days.

As can be seen in table no. 3 presented below, as well as from the ones mentioned above, in Romania there was a slight increase in the number of overnight stays, respectively arrivals of tourists at the level of the total tourist reception structures with accommodation capacity, while the percentage increase of these indicators was was almost triple in terms of agritourism pensions.

As the accommodation expenses of tourists account for most of their total expenses, a low level of VAT rate, coupled with lower accommodation rates, can have a large influence on the number of arrivals and overnight stays, as well as other related expenses

”The relative elasticity of demand and supply can cause tourism units to offer tourists reduced rates, as a result of the reduction of the VAT rate. The application of a low level of VAT rate for tourism and hospitality services not only favors the creation of new jobs but determines economic growth and stimulates investment. Therefore, in order for small businesses and micro-enterprises to continue to invest in tourism, it is very important that Member States continue to apply low VAT rates, as well as mapping all taxes and taxes affecting tourism at national level” [14].

Unlike most export products, accommodation and restaurant services sold to foreign tourists cannot benefit from the VAT exemption. Value Added Tax (VAT) is applied for goods and services sold at home, but not for exports, as specified by World Economic Forum [14].

As can be seen from the above, the immediate effect of reducing the VAT rate was not spectacular. The study by Copenhagen Economics (2007) suggested that it may take up to two years for the effect to be fully realized after a change in the tax rate [23].

Forsyth (2013) conducted a study on assessing the impact of reduced VAT rates on British tourism and the British economy as a whole, with members of the British Hospitality Association as a sample, of whom 95% said that part or all of the quota change VAT is transferred further. Forsyth concluded that around 60% of the VAT reduction would lead to lower prices and that it would also take

four years to achieve the maximum effect [13].

In another survey, conducted by Wason and Nevin (2013) on the reduction of VAT, which had as respondents about 20% of hotels in Germany, it was found that 89% of them started (or planned) new investments, 32 % hired (or planned to hire) more staff and 32% reduced their prices, all occurring in the first year after the VAT rate change [26].

A certain reduction of the VAT rate in the accommodation and restaurant industry it cannot negatively influence the revenues collected by the Government." In the case of Ireland, where VAT on hotels and restaurants was halved in 1986, the tax yield doubled between 1984 and 1993 as a result of the large increase in the number of businesses in this sector and in their volume of business. The government earned more revenue despite lowering the rate. "[6].

The study by Deloitte and Touche (2014) showed that high taxes can reduce tourism revenues, while increasing or decreasing the tax rate significantly influences tourists' decisions about the destination of a trip [18]. In other words, due to mobility, information and price sensitivity, tourists often choose the destination, taking into account the prices charged by travel service providers [16].

Table 3. "Evolution of the number of nights, arrivals and the average length of stay related to agritourism pensions in Romania during 2017-2018"

Types of tourist reception structures	Types of tourists	Overnights		2018/2017 %	Arrivals		2018/2017 %	Average length of stay	
Year		2017	2018		2017	2018		2017	2018
UM		Number of people						Days	
Total tourism	Total	27,092,523	28,644,742	106%	12,143,346	12,905,131	106%	2.23	2.22
-	Romanian	21,801,487	23,315,138	107%	9,383,266	10,108,509	108%	2.32	2.31
-	Foreign	5,291,036	5,329,604	101%	2,760,080	2796622	101%	1.92	1.91
Agritourism pensions	Total	1,928,485	2,255,286	117%	1,004,400	1,173,455	117%	1.92	1.92
-	Romanian	1,750,354	2,068,888	118%	917,213	1,083,662	118%	1.91	1.91
-	Foreign	178,131	186,398	105%	87,187	89,793	103%	2.04	2.08

Source: Table made by the authors based on statistical data extracted from the Romanian National Institute of Statistics (Tempo Online), for the period 2017-2018 [19].

CONCLUSIONS

Value added tax (VAT) can be considered one of the most important types of taxes borne by tourists [8].

Member States had to apply a single standard VAT rate, wich it must be greater than 15%, and also, one or two reduced VAT rates, at least 5%, with some exceptions. As a result, many European Union (EU) countries apply reduced rates to tourism services, as allowed by the current EU VAT regime.

The value added tax has been introduced in Romania since January 1, 1993, the standard rate having a percentage of 18%. This rate has seen several changes over time, increasing or decreasing, reaching quotas up to 24%.

At EU level, the VAT rates in 2017 were between 17% (in Luxembourg) and 27% (in Hungary). The average standard VAT rate was 21%, a number of 21 countries having this average rate, including Romania, with 19%. Most Member States also applied reduced VAT rates for accommodation services, with percentages less than 10, and for restaurants services between 3% and 18%. In 2017, Romania also had two reduced VAT rates, namely 5% and 9%, and in terms of the tourism sector, the rate applied was 9%.

The most important change in terms of the VAT rate in the tourism sector, consisted in its decrease from 9% for the period 2014-2017 to 5% in 2018.

As presented in the study, the reduction of the VAT rate could lead to an increase in the flow

of tourists, respectively the increase in the number of nights, arrivals and the average length of stay both at the level of tourism and at the level of agritourism in Romania. However, the maximum desired effect it can be achieved in a few years from the date of the change, because there may be a gap between the reduction of the VAT rate in tourism industry, the change in the prices of goods and services and also for the tourist demand.

The relative elasticity of demand as well as supply can cause tourist units to offer tourists reduced rates, due to the reduction of the VAT rate.

It should also be noted that even if VAT changes are not fully passed on to consumers, a reduction in VAT may have positive effects on the economy as a whole by increasing state budget revenues, increasing investment in the tourism sector, and increasing strength for work.

In conclusion, in order to improve the competitiveness of the tourism sector, respectively the increase of the number of overnight stays, arrivals and the average length of stay both at the level of tourism and at the level of agritourism in Romania, the reduction of the VAT rate should influenced the decrease of accommodation rates, the prices of the other goods and services offered to tourists and also as well as in the increase of investments in the sector.

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STUDIES ON THE ECONOMIC RESULTS OF SOME MEAT PROCESSORS WHO HAVE ACCESSED NON-REFUNDABLE FUNDS IN THE OLTENIA REGION, ROMANIA

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Abstract

The importance of knowing the financial indicators of companies in the field of meat processing, is to know their evolution and compare them with those of previous financial years, which gives the company management the opportunity to make economic and financial analysis that will have an impact on decision making. The purpose of this paper is to analyze these indicators from the annual financial statements from the period before accessing the non-reimbursable funds, but also from the monitoring period of these companies. At MATRA SRL the net asset had a constant increase in this analysis period, in 2015 it had the value of RON 9,453,864 and in 2019 it reaches the highest value of RON 11,810,270. At TELDOTRANS SRL the net asset had an increase throughout the analysis period, in 2015 it had the lowest value of 709,135 RON and had a constant increase until 2018, where it reached the value of 2,407,842 RON, after this year the value of this index increased considerably, reaching in 2019 the highest value of RON 6,303,358. At AVICARVIL SRL the net asset had a considerable increase in this analysis period, in 2015 it had the value of 58,319,684 RON, in 2016 it had the value of 61,953,476 RON, and in 2019 it reached the highest value of 86,630,011 RON , which highlights that the financial situation at the enterprise level is very good, being the consequence of reinvesting part of the net profit, but also due to accessing non-reimbursable funds in 2016 and 2019.

Key words**:** *processing meat, non-refundable, fixed assets, current assets, net profit, net asset*

INTRODUCTION

Romania accessed European funds for agriculture and rural development in the period 2014-2020, in this financing period, Romania received more than 8.12 billion euros from the European Union budget, more precisely from the Agricultural Fund for Rural Development (EAFDR), through the National Rural Development Program (NRDP) [3]. The central elements of the policy - farms and farmers - will be central elements of the common agricultural policy for the period 2014-2020 [15]. The national rural development program is a program coordinated by the Ministry of Agriculture and Rural Development and is structured in measures aimed at supporting and developing rural areas in Romania [17]. The development of meat processing units through the use of non-reimbursable funds offered by PNDR aims to increase the added value of agricultural products of animal origin by processing them. Sub-measure 4.2 ("Support for investments in the processing/marketing and/or development of agricultural products) refers to the modernization and creation of processing units and the introduction of new technologies in this field [16]. Subsidies for investments in the field of meat processing increase the economic results of the supported companies and their competitiveness [14]. In order to develop a sustainable development strategy in the case of a meat processing enterprise, the following steps are followed: development of a methodology for economic evaluation of the company, data processing and systematization, ensuring the collection, processing and transmission of information [5]. Investments in tangible and intangible

assets made by meat processing companies in Romania are designed for the modernization and modernization of technological and manufacturing lines [2]. In order to improve the internal situation of a meat processing company, it is recommended that each meat processing undertaking have on its staff a review board or a representative (auditor) [4].
Using new technologies to make a real improvement and increase productivity in a business can be effective in the long run only by properly analyzing the current state of the company [7]. In the context in which the pig market in the European Union is declining in terms of pig herds, and exports are growing [10], in order to recover the pig market in Romania, both breeders and processors must comply with the strategy and measures imposed by the authorities regarding pig breeding, transport and slaughter [9].
Further analysis shows that companies in the meat processing industry perform better than animal producers [6]. Romania has an efficient international trade in sheep meat, which turns out to be a net exporting country [8].

MATERIALS AND METHODS

From the annual balance sheet of the companies that have accessed non-reimbursable funds in the field of meat processing from the South - West Oltenia Region, in the analysis period 2015 - 2019, the evolution of the main economic-financial indicators will be presented. The indicators from the annual financial statements from the period before accessing the non-reimbursable funds will be analyzed, but also from the monitoring period of these companies.In addition to balance sheet indicators such as: fixed assets (inventories, receivables, house and accounts), advance expenses, debts, advance income, capital; the indicators from the profit and loss account will be analyzed, such as: net turnover, total income, total expenses, profit or loss.
Based on the indicators presented above, the main economic and financial indicators will be calculated as follows:

Financial balance indicator
Net assets = Total assets - Total Debts;

Liquidity indicators
General liquidity = Current assets/Debts
Payment capacity = Cash and bank accounts/ Debts

Profitability indicators
Net Profit Margin = Net Profit/Turnover *100
Turnover increase = (TI 2019 - TI 2018)/TI 2018 *100
Asset Return = Net Profit/Fixed Assets *100
Capital Return = Net Profit/Equity * 100

Solvency indicator
Total Debt Level = Debts/Total Assets *100
Debt coverage = Net Profit/Debts *100

RESULTS AND DISCUSSIONS

In the South - West Oltenia Region, three commercial companies dealing with meat processing have accessed non-reimbursable funds in order to develop their business. It is about: SC AVICARVIL SRL, Valcea County, which accessed funds in 2016 and 2019, SC MATRA SRL, Olt County, which accessed funds in 2017 and SC TELDOTRANS SRL, Olt County, which accessed funds in 2018.
The total eligible value of the projects implemented by these three companies accounted for 14,071,539 Euro (Table 1).

Table 1. Projects financed from non-reimbursable funds in the South - West Oltenia

Company name	Year of accessing the non-reimbursable funds	The county where the non-reimbursable funds were accessed	Eligible value (euro)	Public value (euro)
SC AVICARVIL SRL	2016	Valcea	5,731,230	2,292,492
SC AVICARVIL SRL	2019	Gorj	5,696,000	2,278,400
SC MATRA SRL	2017	Olt	986,126	493,063
SC TELDOTRANS SRL	2018	Olt	1,658,183	829,091
Total			14,071,539	5,893,046

Source: Own calculation according to data www.afir.info, [1].

SC MATRA SRL financial situation after the implementation of the projects based on non reimbursable funds

The financial data of MATRA SRL as shown by its balance sheet are presented in Table 2.

Table 2. SC MATRA SRL Balance Sheet and Profit and Loss Account (RON)

NAMING OF THE INDICATORS	YEAR				
	2015	2016	2017	2018	2019
BALANCE SHEET Indicators					
FIXED ASSETS - TOTAL	6,428,521	7,477,784	6,661,446	7,429,523	12,885,842
CURRENT ASSETS - TOTAL	8,128,801	8,809,290	10,883,829	17,924,358	14,575,026
Stocks (raw materials, production materials in progress, semi-finished products, finished products, goods, etc.)	2,728,930	3,631,891	5,726,580	8,264,086	7,777,707
Creditors	4,457,274	3,735,695	3,354,445	6,260,187	4,880,968
House and bank accounts	942,597	1,441,704	1,802,804	3,400,085	1,916,351
PREPAYMENTS	-	-	-	-	-
DEBTS	5,103,458	6,693,963	7,564,307	14,507,132	15,650,598
CAPITAL - TOTAL	9,241,421	9,570,344	9,958,201	10,823,982	9,614,173
Capital	1,579,200	1,579,200	1,579,200	1,579,200	1,579,200
Indicators from the PROFIT AND LOSS ACCOUNT					
Net turnover	39,262,265	40,596,804	45,013,392	55,394,340	58,666,155
TOTAL INCOME	41,038,438	42,129,341	46,277,840	58,014,166	61,678,050
TOTAL EXPENSES	38,931,390	38,669,252	45,132,853	55,954,901	61,570,795
Net profit or loss					
Advantage	1,804,088	3,070,738	1,063,014	1,811,044	51,034
Loss	0	0	0	0	0

Source: The balance sheet of MATRA SRL [12].

Figure 1 shows the evolution of fixed assets and current assets reported in 2017 when the company accessed non-reimbursable funds, where it results that the value of fixed assets increased from RON 6,641,446 in 2017 to RON 12,885,842 in 2019, by also, the value of current assets had a downward trend from the value of RON 10,883,829 in 2017 to the value of RON 14,575,026 in 2019.

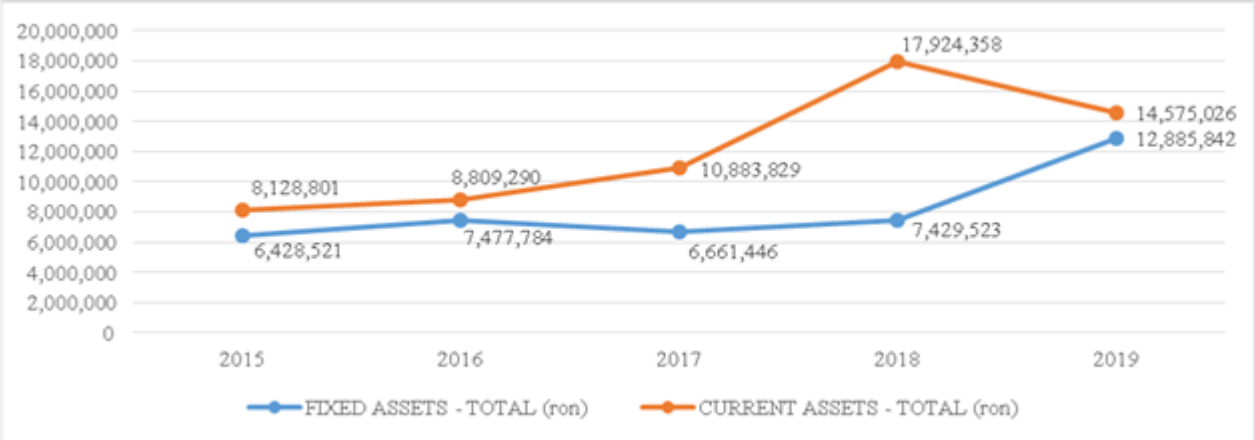

Fig. 1. Fixed assets and current assets of MATRA SRL (RON)
Source: Own construction.

Figure 2 shows the value of turnover which had a constant increase from 39,262,265 RON in 2015 to 45,013,392 in 2017 and reaches a maximum of 58,666,165 RON in 2019, while the net profit had a considerable decrease from the value of RON 1,063,014 in 2017, to the value of RON 51,034 in 2019.

It is observed that the net asset had a constant increase in this analysis period, in 2015 it had the value of RON 9,453,864 and remained approximately constant until 2017, after this year the value of this index increased considerably, in 2018 the value of the asset net was RON 10,846,749, and in 2019 it

reaches the highest value of RON 11,810,270 (Table 3).

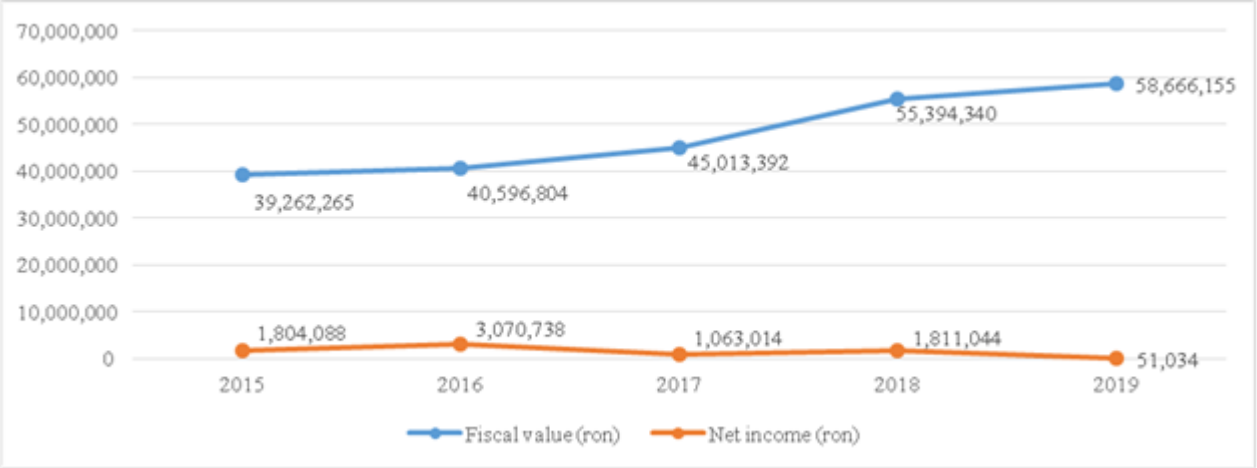

Fig. 2. Turnover and net profit of MATRA SRL (RON)
Source: Own construction.

Regarding the general liquidity indicator, which indicates the extent to which short-term debt can be covered by current assets, it is noted that, although it is not in the range 1 - 2, which is considered optimal, its value is continuous. decrease, from the value of 1.59 in 2015, to the value of 0.93 in 2019. The payment capacity expresses the possibility of the enterprise to meet the due payments to suppliers, employees, banks, and its value increased from 0.18 in 2015 and reaches its maximum in 2017 with a value of 0.24, and in 2019 its value decreases to 0.12 (Table 3).

Table 3. Economic and financial indicators of MATRA SRL

Name	2015	2016	2017	2018	2019
Financial balance indicator [RON]					
Net assets	9,453,864	9,593,111	9,980,968	10,846,749	11,810,270
Liquidity indicators					
General liquidity	1.59	1.32	1.44	1.24	0.93
Ability to pay	0.18	0.22	0.24	0.23	0.12
Profitability indicators [percentages]					
Net profit margin	4.59	7.56	2.36	3.27	0.09
Increase turnover	-	3.40	10.88	23.06	5.91
Asset Return	28.06	41.06	15.96	24.38	0.40
Return on Capital	1,14	1.94	6.73	1.14	0.3
Solvency indicator [percentage]					
Total degree of indebtedness	35.06	41.10	43.11	57.22	56.99
Debt coverage	35.35	45.87	14.05	12.48	0.33

Source: Own calculation.

According to the result of the net profit margin, the situation of MATRA SRL is a stable one, because it falls in the range of 1% - 15%, with values of 4.59% in 2015, increasing in 2016 to a maximum of 7.56%, and due to investments made and of the rather high financial effort in 2017, the value of this indicator decreased in 2017, reaching the value of 2.36%, and in 2019 its value reaches the lowest level of 0.09%. Regarding the growth index It is highlighted that its value was in 2016 at a value of 3.40%, and in 2017 and 2018 its value increases considerably to 10.88% and 23.06% respectively and there is a considerable increase, so it reveals that accessing funds The performance of the asset reflects the efficiency of using the company's assets to generate profit, how much money each RON invested in assets produces, being a relevant indicator of competitiveness and has a value of 28.06% in 2015, in 2016 it reaches the maximum value of 41.06%, in 2019 it decreases to 15.96%, in 2018 it increases to 24.38, and in the last year of the reference decreases a lot to the value of 0.40%. The return on capital in 2015 has the

value of 1.14%, and in 2016 it had a substantial increase, reaching the value of 1.94%. In 2017 the percentage of this index had a considerable increase, reaching the value of 6.73%, but in the next 2 years the value of the yield decreases very much reaching the values of 1.14% in 2018, respectively 0.3% in 2019 (Table 3).

The degree of indebtedness expresses the level of coverage of short, medium and long term obligations of the company from its patrimonial assets, where this index had the value of 35.06% in 2015, in 2016 it registered an increase reaching the value of 41.10%, in 2017 it increased slightly to the value of 43.11%, and in 2018 and 2019 it had a large increase reaching the value of 57.22%, respectively 56.99%. The value of this index is optimal when it is higher than 70%, and in our case the values of this index are below this threshold, so there is a slight risk on debt repayment, but this is normal, due to investments made with non-reimbursable funds. Regarding the degree of debt coverage, in the first reference year it has the value of 35.35%, in 2016 it has the value of 45.87%, in 2017 it decreases to the value of 14.05%, in 2018 it reaches the value of 12.48%, and in the last reference year drops sharply to 0.33% (Table 3).

SC TELDOTRANS SRL financial situation after the implementation of the projects based on non reimbursable funds

The financial data of TELDOTRANS SRL are shown by its balance sheet are presented in Table 4.

Table 4. SC TELDOTRANS SRL Balance Sheet and Profit and Loss Account (RON)

NAMING OF THE INDICATORS	YEAR				
	2015	2016	2017	2018	2019
BALANCE SHEET Indicators					
FIXED ASSETS – TOTAL	873,531	1,574,620	2,322,064	3,672,544	11,743,265
CURRENT ASSETS – TOTAL	1,541,873	1,702,010	1,519,968	2,547,710	5,952,271
Stocks (raw materials, production materials in progress, semi-finished products, finished products, goods, etc.)	16,447	403,985	449,573	944,931	578,191
Creditors	135,388	218,488	166,899	331,509	3,519,389
House and bank accounts	1,390,038	1,079,537	903,496	1,271,270	1,854,691
PREPAYMENTS	-	-	-	-	12,450
DEBTS	1,706,269	1,846,670	2,488,391	3,812,412	11,404,628
CAPITAL – TOTAL	709,135	1,429,960	1,353,641	2,407,842	2,597,797
Capital	533,000	533,000	533,000	533,000	533,000
Indicators from the PROFIT AND LOSS ACCOUNT					
Net turnover	11,729,769	16,641,181	18,229,416	19,583,997	21,560,268
TOTAL INCOME	11,959,473	16,764,387	18,325,731	19,667,451	21,780,313
TOTAL EXPENSES	11,857,127	15,709,025	17,493,828	18,411,070	21,024,605
Net profit or loss					
Advantage	85,874	891,826	709,082	1,054,201	611,008
Loss	0	0	0	0	0

Source: The balance sheet of TELDOTRANS SRL [13].

Figure 3 shows that the fixed assets and current assets of TELDOTRANS SRL had a very high increase after 2018, the year in which they accessed non-reimbursable funds, in 2018 the value of fixed assets was 3,672,544 RON and current assets was of 2,547,710 RON, and in 2019 the value of these indicators increased very much, where the value of fixed assets increased to RON 11,743,265, and the value of current assets increased to RON 5,952,271.

Figure 4 shows that the value of turnover increased from RON 11,729,769 in 2015, to RON 19,583,997 in 2018, and in 2019 it reaches the maximum value of RON 21,560,268. The net profit registered a decrease, due to the investments with non-reimbursable funds, where in 2018 it had the value of 1,256,381 RON, and in 2019 it decreases to the value of RON 755,708 (Figure 4).

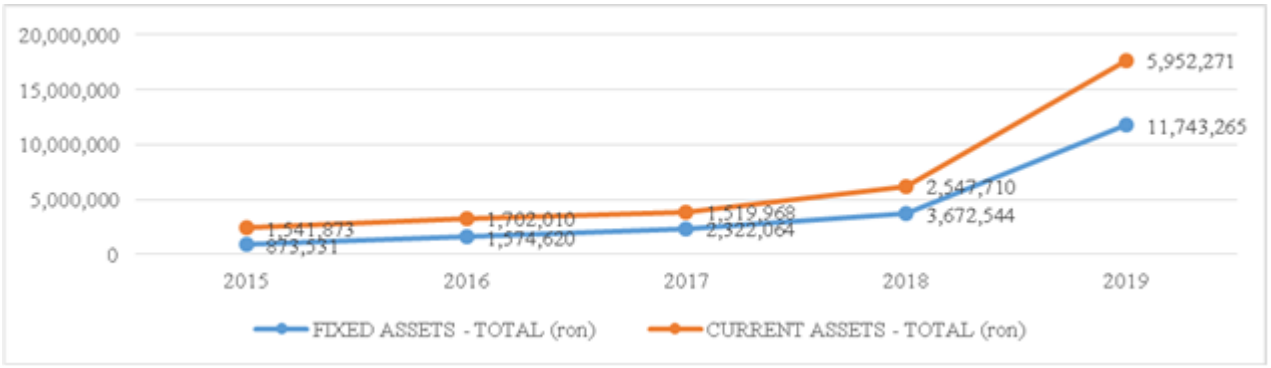

Fig. 3. Fixed assets and current assets of TELDOTRANS SRL
Source: Own construction.

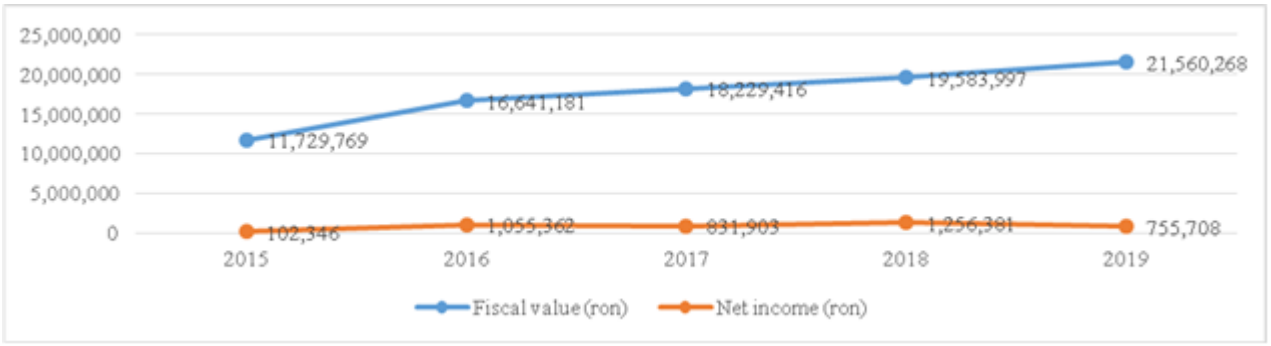

Fig. 4. Turnover and net profit of TELDOTRANS SRL
Source: Own construction.

It is observed that the net asset had a constant increase in this analysis period, in 2015 it had the lowest value of 709,135 RON and had a constant increase until 2018, where it reached the value of 2,407,842 RON, after this year the value of this index increased considerably, reaching in 2019 the highest value of RON 6,303,358 (Table 5).

Table 5. Economic and financial indicators of TELDOTRANS SRL

Name	2015	2016	2017	2018	2019
Financial balance indicator [RON]					
Net assets	709,135	1,429,960	1,353,641	2,407,842	6,303,358
Liquidity indicators					
General liquidity	0.90	0.92	0.61	0.67	0.52
Ability to pay	0.81	0.58	0.36	0.33	0.16
Profitability indicators [percentages]					
Net profit margin	0.73	5.36	3.89	5.38	2.83
Increase turnover	-	41.87	9.54	7.43	10.09
Asset Return	9.83	56.64	30.54	28.70	5.20
Return on Capital	0.16	1.67	1,33	1.97	1,14
Solvency indicator [percentage]					
Total degree of indebtedness	70.64	56.36	64.77	61.29	64.40
Debt coverage	5.03	48.29	28.50	27.65	5.36

Source: Own calculation.

Regarding the general liquidity indicator, which indicates the extent to which short-term debt can be covered by current assets, it is noted that, although it is not in the range 1 - 2, which is considered optimal, its value is continuous. decrease, from the value of 0.90 in 2015, to the value of 0.67 in 2018, and in 2019 it has the lowest value of 0.52. The payment capacity expresses the possibility of the company to meet the due payments to suppliers, employees, banks, and its value has constantly decreased from the maximum value of 0.81 in 2015 and reaches, reaches in 2018 the value of 0.33, and in 2019 has the lowest value of 0.16 (Table 5).

According to the result of the net profit margin, the situation of TELDOTRANS SRL is a stable one, because it falls in the range of

1% - 15%, having the value of 0.73% in 2015, increasing until 2018 to the maximum value of 5.38%, and due to investments performed and of the rather high financial effort this year, the value of this indicator decreased in 2019, reaching the value of 2.83%. Regarding the turnover growth index, it is highlighted that its highest value was in 2016 at a value of 41.87%, and in 2017 and 2018 its value decreases to 9.54% respectively to 7.43% and is highlighted a slight increase in 2019 to the value of 10.09%. The return on assets reflects the efficiency of using the company's assets to generate profit, how much money each RON invests in assets, being a relevant indicator of competitiveness and has a value of 9.83% in 2015, in 2016 reaches a maximum value of 56.64% in 2017 decreases to the value of 30.54%, in 2018 it decreases to the value of 28.70, and in the last reference year it decreases a lot to the value of 5.20%. The return on capital in 2015 has the lowest value of 0.16%, and in 2016 it had a substantial increase, reaching the value of 1.67%. In 2017 the percentage of this index had a slight decrease, reaching the value of 1.33%, in 2018 it has a maximum value of 1.97%, and in 2019 it decreases to the value of 1.14% (Table 5).

The degree of indebtedness expresses the level of coverage of short, medium and long term obligations of the company from its patrimonial assets, where this index had the maximum value of 70.64% in 2015, in 2016 it registered a decrease reaching the value of 56.36% , in 2017 it increased slightly to the value of 64.77%, and in 2018 and 2019 it had a slight decrease reaching the value of 61.29%, respectively 64.40%. The value of this index is optimal when it is higher than 70%, and in our case the values of this index are below this threshold, so there is a slight risk on debt repayment, but this is normal, due to investments made with non-reimbursable funds. Regarding the degree of debt coverage, in the first reference year it has the value of 5.03%, in 2016 it has the value of 48.29%, in 2017 it decreases to the value of 28.50%, in 2018 it reaches the value of 27.68%, and in the last reference year drops sharply to 5.36% (Table 5).

SC AVICARVIL SRL financial situation after the implementation of the projects based on non reimbursable funds

The financial data of AVICARVIL SRL are shown by its balance sheet are presented in Table 6.

Table 6. SC AVICARVIL SRL Balance Sheet and Profit and Loss Account (RON)

NAMING OF THE INDICATORS	YEAR				
	2015	2016	2017	2018	2019
BALANCE SHEET Indicators					
FIXED ASSETS - TOTAL	85,380,373	81,965,700	78,854,721	83,631,025	105,951,572
CURRENT ASSETS - TOTAL	47,030,932	35,746,416	32,624,852	35,275,662	48,092,106
Stocks (raw materials, production materials in progress, semi-finished products, finished products, goods, etc.)	11,944,640	4,750,251	3,263,029	6,296,776	6,868,402
Creditors	34,030,741	30,342,292	27,559,701	27,452,752	39,597,929
House and bank accounts	988,589	584,551	1,743,623	1,464,185	1,567,276
PREPAYMENTS	1,963,155	2,015,411	554,116	158,285	518,310
DEBTS	76,054,776	57,774,054	48,801,351	51,504,542	67,931,977
CAPITAL - TOTAL	54,565,543	58,580,618	60,480,379	64,186,654	83,409,181
Capital	2,000,000	2,000,000	2,000,000	2,000,000	2,500,000
Indicators from the PROFIT AND LOSS ACCOUNT					
Net turnover	178,520,018	171,439,053	159,305,361	201,270,255	281,707,379
TOTAL INCOME	180,015,477	164,826,239	159,381,654	205,874,742	283,112,523
TOTAL EXPENSES	175,823,449	159,688,851	156,877,695	201,594,359	278,934,696
Net profit or loss					
Advantage	3,568,539	4,588,287	1,899,761	3,706,275	3,762,116
Loss	0	0	0	0	0

Source: The balance sheet of AVICARVIL SRL [11].

Figure 5 shows that the fixed assets and current assets of AVICARVIL SRL had quite large fluctuations in this analysis period, 2015-2019, being influenced by accessing non-reimbursable funds from 2016 and 2019. Fixed assets had a value of 81,965,700 RON in 2016, in 2017 they decrease to the value of 78,854,721 RON and in 2019 they increase to the maximum value of 105,951,572 RON. Current assets had a value of RON 35,746,416 in 2016, in 2017 they decreased to RON 32,624,852, and in 2019 they increased to a maximum value of RON 48,092,106.

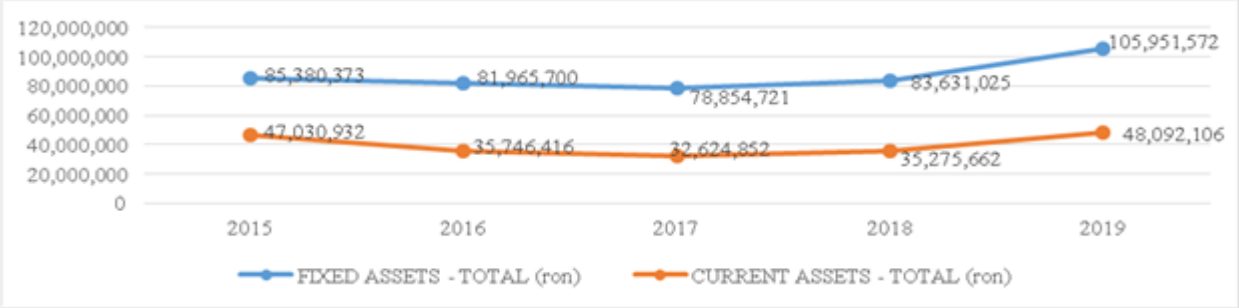

Fig. 5. Fixed assets and current assets of AVICARVIL SRL
Source: Own construction.

Figure 6 shows that the turnover had a very high growth, where in 2016 it had the value of 171,439,053 RON and in 2019 it reaches the maximum value of 281,707,379 RON, while the net profit remained had fluctuations quite large, in 2016 the value of the net profit was RON 4,588,287, in 2017 it decreases to RON 1,899,761, and in 2018 and 2019 it increases to RON 3,706,275, respectively RON 3,762,116.

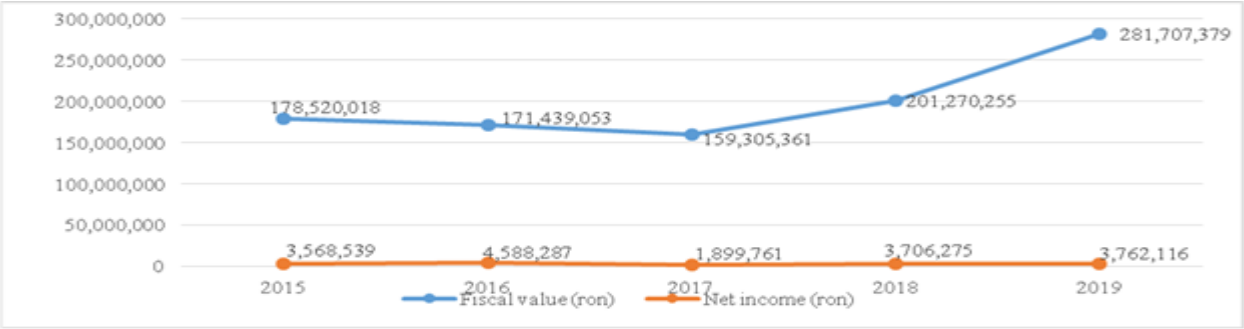

Fig. 6. Turnover and net profit of AVICARVIL SRL
Source: Own construction.

Considering the main indicator of financial balance, it is observed that the net asset had a constant increase in this analysis period, in 2015 it had the value of 58,319,684 RON, in 2016 it had the value of 61,953,476 RON, in 2017 it had the value of RON 63,232,338, in 2018 it had the value of RON 67,560,430, and in 2019 it reached the highest value of RON 86,630,011, which highlights that the financial situation at the enterprise level is very good, being the consequence of reinvesting part of the profit net, but also due to accessing non-reimbursable funds in 2016 and 2019 (Table 7).

Regarding the general liquidity indicator, which indicates the extent to which short-term debt can be covered by current assets, it is noted that, although it is lower than in the range 1-2 - in which it is considered optimal, its value is constantly increasing, from the value of 0.61 in 2015, to the value of 0.70 in 2019. The payment capacity expresses the possibility of the company to meet the due payments to suppliers, employees, banks, and its value increased from 0.01 in 2015, at the value of 0.02 in 2019 (Table 7).

Table 7. Economic and financial indicators AVICARVIL SRL

Name	2015	2016	2017	2018	2019
Financial balance indicator [RON]					
Net assets	58,319,684	61,953,473	63,232,338	67,560,430	86,630,011
Liquidity indicators					
General liquidity	0.61	0.61	0.66	0.68	0.70
Ability to pay	0.01	0.01	0.03	0.02	0.02
Profitability indicators [percentages]					
Net profit margin	1.99	2.67	1.19	1.84	1.33
Increase turnover	-	-3.96	-7.07	26.34	39.96
Asset Return	4.17	5.59	2.40	4.43	3.55
Return on Capital	1.78	2.29	0.94	1.85	1.50
Solvency indicator [percentage]					
Total degree of indebtedness	56.59	48.25	43.55	43.25	43.95
Debt coverage	4.69	7.94	3.89	7.19	5.53

Source: Own calculation.

According to the result of the net profit margin, the situation of AVICARVIL SRL is a stable one, because it falls in the range of 1% - 15%, having values of 1.99% in 2015, increasing in 2016 to the maximum value of 2.67% (the year in which the company access to non-reimbursable funds), and due to the investments made and the rather large financial effort, the value of this indicator had a slight decrease until 2019, reaching the value of 1.33%. Regarding the turnover growth index, it is highlighted that its value was a negative one in 2016 with a value of -3.96%, and in 2017 its value decreased even more, reaching a value of -7.07%. In 2018 there is a considerable increase, where the value of the turnover index is 26.34%, and in 2019 it reaches the value of 39.96%, so it shows that accessing non-reimbursable funds has greatly influenced this index. The return on assets reflects the efficiency of using the company's assets to generate profit, how much money produces each leu invested in assets, being a relevant indicator of competitiveness and has a value of 4.17% in 2015, in 2016 reaches a maximum value of 5.59%, and in the year 2019 decreases slightly to 3.55%. The return on capital shows the net profit brought by each leu invested, a high return on equity means that a small material investment has been transformed into a large profit, this value is greatly influenced by profit, where in 2015 the value of this index was 1.78%, and in 2016 it had a substantial increase, reaching the value of 2.28%.

In 2017 the percentage of this index had a considerable decrease, reaching the value of 0.94%, but in the next 2 years the value of the yield recovers reaching the values of 1.85% in 2018, respectively 1.50 in 2019 (Table 7).

The degree of indebtedness expresses the level of coverage of the company's short, medium and long term obligations from its patrimonial assets, where this index had the value of 56.59% in 2015, in 2016 it registered a slight decrease reaching the value of 48.25% , and in 2017, 2018 and 2019 it had a constant value of approximately 43%.

The value of this index is optimal when it is higher than 70%, and in our case the values of this index are below this threshold, so there is a slight risk on debt repayment, but this is normal, due to investments made with non-reimbursable funds.

Regarding the degree of debt coverage, the value of this index must be higher than 2, and it has a value of 4.69% in the first reference year, in 2016 it has a value of 7.94%, in 2017 it decreases to 3.89% , in 2018 it reaches the value of 7.19%, and in the last reference year it has the value of 5.53% (Table 7).

CONCLUSIONS

At MATRA SRL it results that the value of fixed assets increased from RON 6,641,446 in 2017, to RON 12,885,842 in 2019, also the value of current assets had a downward trend from RON 10,883,829 in 2017 to the value of RON 14,575,026 in 2019. It also results that

the net assets had a constant increase in this analysis period, in 2015 it had the value of RON 9,453,864 and remained approximately constant until 2017, after this year the value of this index increased considerably, in 2018 the value of the net asset was 10,846,749 RON, and in 2019 it reaches the highest value of 11,810,270 RON.

The fixed assets and current assets of TELDOTRANS SRL had a very high increase after 2018, the year in which they accessed non-reimbursable funds, in 2018 the value of fixed assets was 3,672,544 RON and current assets was 2,547,710 RON, and in in 2019 the value of these indicators increased very much, where the value of fixed assets increased to RON 11,743,265, and the value of current assets increased to RON 5,952,271. Also, the net assets had a constant increase in this analysis period, in 2015 it had the lowest value of 709,135 RON and had a constant increase until 2018, where it reached the value of 2,407,842 RON, after this year the value of this index increased considerably, reaching in 2019 the highest value of RON 6,303,358.

The fixed assets and current assets of AVICARVIL SRL were influenced by accessing the non-reimbursable funds from 2016 and 2019. The fixed assets had the value of RON 81,965,700 in 2016, in 2017 they decrease to RON 78,854,721 and in 2019 they increase at the maximum value of RON 105,951,572. Current assets had a value of RON 35,746,416 in 2016, in 2017 they decreased to RON 32,624,852, and in 2019 they increased to a maximum value of RON 48,092,106. The net asset had a constant increase in this analysis period, in 2015 it had the value of 58,319,684 RON, in 2016 it had the value of 61,953,476 RON, in 2017 it had the value of RON 63,232,338, in 2018 it had the value of 67,560,430 RON, and in 2019 it reached the highest value of 86,630,011 RON, which highlights that the financial situation at the enterprise level is very good.

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RURAL–URBAN DIFFERENCES REGARDING THE EFFECTS OF MAIN SOCIO-ECONOMIC FACTORS ON SEVERE MATERIAL DEPRIVATION IN ROMANIA

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Abstract

Although the financial hardship and material deprivation tended to register decreasing levels among Europeans in the last period, there are still some population segments that did not register the same amelioration trend. In this regard, the rural area is still commonly disadvantaged comparatively to the urban one. Particularizing, in Romania, the poverty indicators show a critical situation and also considerable disparity between rural and urban levels of poverty is recorded. Taking into consideration this national context, using data from Eurostat and GCI, registered in the period 2009-2017, path analysis is applied in order to identify the direct and indirect effects of some of the main socio-economic factors on Romanian severe material deprivation. Our empirical findings highlight that the explanatory variables regarding (1) citizens' particularities in terms of education, employment and gender and (2) characteristics of national economic environment such as government efficiency, government expenditure on social protection and economic growth registered significant and different types of effects on rural and urban Romanian poverty. The fact that the direct and indirect causal relationships were different in terms of rural and urban spaces indicates that the poverty policies should concentrate on the distinction between rural and urban specificities and try to particularly answer to each of them. In this way, our study intends to respond to a real need for research in this field, being also possible to represent a support for the policies addressing poverty in the Romanian context.

Key words**:** *path analysis, rural–urban differences, severe material deprivation, socio-economic factors*

INTRODUCTION

Severe material deprivation is a facet of the complex phenomenon of poverty, responding to one of its most popular definition, i.e. the one of Townsend [31] that emphasizes it as the lack of individual capacity to imply in different activities, to benefit by the same life conditions and facilities detained by the most part of the members of a society. In other words, accordingly to Atkinson and Bourguignon [4], poverty supposes the capacity of assuring the basic needs for living and, also, the minimum needs of social inclusion for participating to social and economic activities. Thus, material deprivation represents a perspective of poverty related to basic and consumption deprivation [34], possibly to be perceived as an effect of the lack of income, but also as a function of self-coordinating in a punctual context (in general, at the household level).

The material aspects essentially contribute to the individuals' capacity of being social included, representing a condition for social acceptance among the people from the belonging community. This poverty approach takes more into consideration the concerns people face about relative poverty, shame and social exclusion [25], focusing on daily or frequently preoccupations such as paying rents, bills at utilities or loans, maintaining home hot, making economies and affording some unforeseeable costs, consuming the sufficient quantity of proteins, affording a holiday away from home or detaining some basic goods like a color TV, a washing machine, a car or a mobile [23]. Thus, the rate of severe material deprivation is related to the level of lacking different goods, but also of important activities or amenities, intercepting financial stability and safety, conditions of habitation, food and spare time, that together constitute pillars for the quality of life [34].

Many of the costs of poverty are quite localized at sub-national level. In this way, the local picture can differ substantially from that at the country level [25]. Moreover, Eurofund [10] emphasized that there are still some subgroups in the population that do not have the capacity of benefiting from the general improvement in terms of financial hardship and material deprivation. In this respect, European Commission [11] also mentioned the large disparities between the rural and urban areas, with a lower standard of living in the rural comparatively to the urban [8, 36]. This is consistent to what happens in the Romanian context, where substantive (especially rural) vulnerabilities may be observed, revealing a low national and local capacity of managing and overcoming the problem of poverty [32]. Thus, despite the transformation of the rural, emphasized in the literature (as seen in some studies like [9, 22]), there are still major disparities that contribute to maintaining high levels of inequality on different components (inclusively of income and material possessions). In addition, in the case of Romania, although the problem of rural poverty was not very deeply analyzed, some studies revealed that it is stringent and requires specific solutions adapted to local, regional and national contexts [9, 26, 30, 32-34]. Starting from this general perspective, we observed a lack of attention on the facet of poverty that points out material deprivation. We consider it as an important one, especially in the context of comparatively discussing the urban and rural differences as it is generally known that the rural area is a more vulnerable area, socially more disadvantaged and economically more deprived. In consequence, we focused on the comparison between rural and urban material deprivation and their main determinants, attempting to understand the specificities of each type of area in the Romanian context. The mechanisms of poverty in terms of levels, evolution and causes may prove to be different in function of the type of belonging area of living (i.e. rural or urban).

Thus, for a better understanding of this national context, we put material deprivation in relation to some of the main causes of poverty, found in different studies, as follows: (1) *education* [3, 8, 19, 33], (2) *employment* [8, 15, 18, 24], (3) *gender* [2, 9, 17], (4) *government efficiency* [1, 14, 27], (5) *social protection* [5, 6, 28] and (6) *economic growth* [7, 13, 15]. We expect that these factors to be also significant in relation to severe material deprivation in Romania, both in the rural and urban spaces, but in different ways. Especially these differences are intended to be observed and analyzed for a better understanding and responses adapted to each type of area.

MATERIALS AND METHODS

This paper analyses the severe material deprivation model proposed for Romania and applied separately on its rural and urban areas, along the 2009-2017 period of time, focusing on the poverty's main determinants, selected according to the results found in the academic literature. The data were collected from Eurostat and GCI (Global Competitiveness Index), as shown in Table 1.

Table 1. Definition of factors considered for analysing severe material deprivation

Indicators	Source
Severe material deprivation rate	
*% of total population having **living conditions severely constrained** by a lack of resources - experiencing at least **4 out of 9 following deprivations items**: they cannot afford: i) to pay rent or utility bills, ii) keep home adequately warm, iii) face unexpected expenses, iv) eat meat, fish or a protein equivalent every second day, v) a week holiday away from home, vi) a car, vii) a washing machine, viii) a colour TV, ix) a telephone.*	Eurostat [ilc_mddd21]
Level of education (Tertiary_education)	
Population aged 25-64 by educational attainment level, sex and NUTS 2 regions (%) – tertiary education	Eurostat [edat_lfse_04]
Employment rate (Employment_rate)	
The number of persons aged 20 to 64 in employment by the total population of the same age group (%).	Eurostat [T2020_10]
Gender employment gap (Gender_empl_gap)	
The difference between the employment rates of men and women aged 20 to 64.	Eurostat [sdg_05_30]
Benefits of social protection (Gen_gov_exp_sp)	
The level of total expenditure devoted to social protection	Eurostat [gov_10a_exp]
Government efficiency (Government_efficiency)	
Government efficiency (Wastefulness of government spending; Burden of government regulation; Efficiency of legal framework in settling disputes; Efficiency of legal framework in challenging regulations; Transparency of government policy-making; Provision of government services for improved business performance).	GCI
Economic growth (Ec_growth)	
Real GDP growth rate	Eurostat [tec00115]

Source: Eurostat [12] and GCI [37].

The indicators measuring severe material deprivation have been adopted since 2009 by EU, with the most frequently used threshold [23] of 4+, including in the category of severely deprived the individuals covering at least four from the nine categories of deprivation (Table 1).

After a short descriptive analysis, with the aim of observing the difference between the rural and urban severe material deprivation rates in Romania, in the 2009-2017 period, we opted for applying path analysis, as an extension to multiple regression analysis [20]. Path analysis does not specify the model, but rather estimates the effects of the variables, once the model has been established on the basis of theoretical considerations [21].

Its main general purpose is to determine if a specific set of interpretations (based on previous findings) is consistent throughout [38].

Path coefficients in path models are derived from the values of a Pearson product moment correlation coefficient and/or a standardized partial regression coefficient [35].

In these models, estimation of parameters permits decomposition of the correlation matrix, implying that the original one can be completely reproduced if all parameters in a path model are specified [29].

To test the significance and goodness of fit, the following statistics were used: chi-square statistics; comparative fit index (CFI) and Tucker-Lewis index (TLI), nearby the modification indices (MI) requirement.

In the case of this paper, we focused on Romania between 2009 and 2017, on its rural and urban areas, proposing an analysis that, in the words of Land [16], "involves the construction of an oversimplified model of reality in the sense that the model considers only a limited number of variables and relations out of the universe of social reality".

RESULTS AND DISCUSSIONS

For a better understanding of the state of fact regarding severe material deprivation in Romania, in a comparative perspective between rural and urban areas, the evolution of its rate was analyzed for the period of time between 2009 and 2017. As it can be observed from Fig. 1, although improvements in its rates were registered in the analyzed framework, the high levels of severe material deprivation maintained both in rural (from 36.3 in 2009 to 25.2 in 2017) and in urban area (25.5 in 2009 to 14.3 in 2017 in cities; 24.4 in 2009 to 15.6 in 2017 in towns and suburbs), and, even more, with high difference between their levels even in 2017 (equal to 10.9 in the case of cities; equal to 9.6 in the case of towns and suburbs, to the detriment of rural areas). In this way, the real image of the Romanian village, characterized by different vulnerabilities, social and economic marginalized and, also, politically neglected is (one more time) highlighted. This perspective emphasizes more that analysis of poverty should take into consideration the difference between rural and urban areas, particularizing the discussions in the way of deepening and understanding their peculiarities that may impose specific and distinctive solutions for poverty alleviation. This is why we focused our analysis on observing the main factors of severe material deprivation rate in the rural and, also, urban areas, comparing them, trying to explain the main differences and identifying some drivers for reducing the high levels, but also the gap between rural and urban regarding the severe material deprivation.

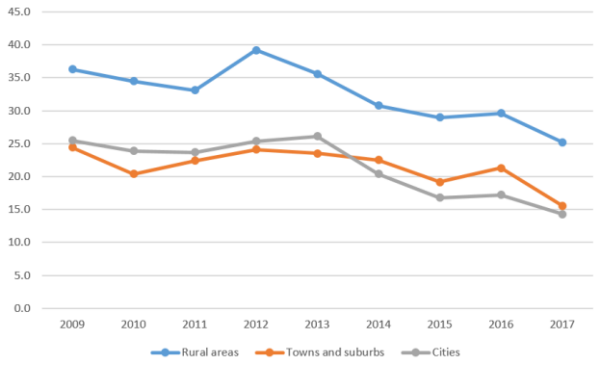

Fig. 1. Evolution of the *Severe material deprivation rate* in the rural vs. urban areas in Romania in the 2009-2017 period

Source: Own determination, based on data from Eurostat, computed in Excel 2013.

As already mentioned in the section dedicated to methodology, path analysis was used to

investigate the relation between *severe material deprivation rate* and the selected socio-economic variables, while also observing, in the case of significant relationships, whether their effects are direct or indirect. In detail, the proposed model hypothesizes that increases in (1) the percentage of people in employment, (2) the percentage of people with tertiary education, (3) the level of expenditures dedicated to social protection, (4) economic growth, (5) government efficiency, along with a decrease of (6) the difference between the employment rates of men and women, are associated with a decrease of the percentage of people living in severely constrained conditions in Romania, both in rural and urban areas.

In order to determine the **total effects** of the selected variables on *Severe material deprivation rate*, but also the direct and indirect ones, we established that:

(1)Sev_mat_depriv_rate is an endogenous variable;

(2)Tertiary_education, Employment_rate, Gender_empl_rate and Gen_gov_exp_sp represent intervening endogenous variables;

(3)Ec_growth and Government_efficiency are exogenous variables.

The estimates for all relationships in the measurement models (the path coefficients using regression analysis) are presented in Tables 2 and 3.

In the first model (Table 2), the one referring to rural areas:

(1)*Sev_mat_depriv_rate* depends on the following variables: Employment_rate, Tertiary_education, Gen_gov_exp_sp and Ec_growth;

(2)*Employment_rate* is affected by Ec_growth and Tertiary_education;

(3)*Gen_gov_exp_sp* depends on Government_efficiency and Ec_growth;

(4)*Gender_empl_gap* is affected by Ec_growth.

Table 2. Standardized path coefficients for the rural area

Predictor	Predictand	Estimate	Sig
Tertiary_education	Employment_rate	-1.017	0.006
Government_efficiency	Employment_rate	-1.067	0.684
Ec_growth	Employment_rate	0.197	0.066
Employment_rate	Sev_mat_depriv_rate	-1.879	0.027
Tertiary_education	Sev_mat_depriv_rate	-3.349	0.037
Gender_empl_gap	Sev_mat_depriv_rate	0.415	0.725
Gen_gov_exp_sp	Sev_mat_depriv_rate	3.469	0.002
Government_efficiency	Sev_mat_depriv_rate	-4.594	0.554
Economic_growth	Sev_mat_depriv_rate	-0.649	0.054
Government_efficiency	Tertiary_education	0.712	0.967
Economic_growth	Tertiary_education	-0.053	0.459
Government_efficiency	Gender_empl_gap	1.683	0.234
Economic_growth	Gender_empl_gap	0.168	0.004
Government_efficiency	Gen_gov_exp_sp	-1.995	0.015
Economic_growth	Gen_gov_exp_sp	-0.181	0.000

Source: Own calculation, based on Eurostat and GCI, computed in StataMP 13.0.

In the second model (Table 3), referring to urban areas of Romania:

(1)*Sev_mat_depriv_rate* depends on the following variables: Employment_rate, Tertiary_education, Gender_empl_gap and Ec_growth;

(2)*Employment_rate* is affected by Government_efficiency and Tertiary_education;

(3)*Gen_gov_exp_sp* depends on Government_efficiency and Ec_growth;

(4)*Tertiary_education* is affected by Ec_growth.

Table 3. Standardized path coefficients for the urban area

Predictor	Predictand	Estimate	Sig
Tertiary_education	Employment_rate	1.688	0.000
Government_efficiency	Employment_rate	0.619	0.000
Ec_growth	Employment_rate	1.744	0.683
Employment_rate	Sev_mat_depriv_rate	-2.602	0.000
Tertiary_education	Sev_mat_depriv_rate	-3.176	0.005
Gender_empl_gap	Sev_mat_depriv_rate	-1.879	0.048
Gen_gov_exp_sp	Sev_mat_depriv_rate	-0.068	0.948
Government_efficiency	Sev_mat_depriv_rate	-3.645	0.705
Ec_growth	Sev_mat_depriv_rate	-0.746	0.062
Government_efficiency	Tertiary_education	3.064	0.164
Ec_growth	Tertiary_education	0.723	0.000
Government_efficiency	Gender_empl_gap	1.581	0.383
Ec_growth	Gender_empl_gap	0.013	0.857
Government_efficiency	Gen_gov_exp_sp	-1.995	0.015
Economic_growth	Gen_gov_exp_sp	-0.181	0.000

Source: Own calculation, based on Eurostat and GCI, computed in StataMP 13.0.

Accordingly, our results showed that, in the rural space, severe material deprivation rate was positively influenced by governmental expenditure on social protection and negatively influenced by the rate of employment, the percentage of people with tertiary education and by economic growth. In other words, the improvements to the levels of expenditure on social protection negatively contributed to reducing poverty rates in terms of material deprivation in Romania along the 2009-2017 period, while the increasing levels of the other three significant variables in relation to poverty proved to have an opposite effect, translated into less people affected by severe material deprivation.

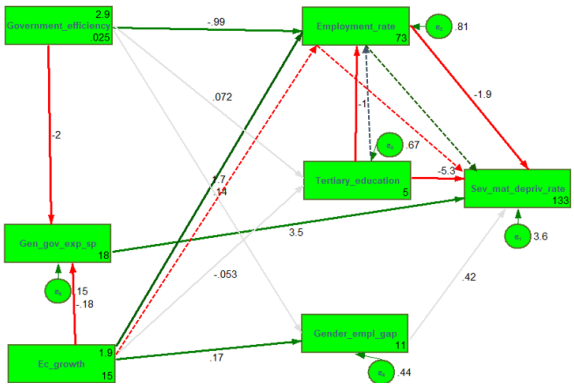

Fig. 2. Path diagram - Direct and indirect effects in the rural area in Romania

Source: Own determination, based on Eurostat and GCI, computed in StataMP 13.0.

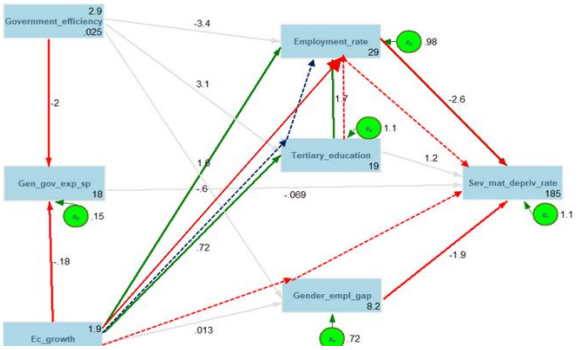

Fig. 3. Path diagram - direct and indirect effects rate in the urban area in Romania

Source: Own determination, based on Eurostat and GCI, computed in StataMP 13.0.

In the case of the urban area, the situation seemed to be different. The governmental expenditure on social protection did not anymore affect the deprivation rate, becoming a non-significant variable in relation to it, while the gender gap in terms of employment was negatively related to the rate of severe material deprivation, nearby the rate of employment, the percentage of people with tertiary education and the economic growth. Thus, in the case of the urban area, all the variables found to be significant in relation to the rate of severe material deprived people positively contributed, when improvements were made, to reducing this facet of poverty.

Comparatively, it seems that the rural severe material deprivation increased when there

were registered higher levels of governmental expenditure on social protection; the urban severe material deprivation seemed to reduce its levels when the gender gap in the case of employment was also reducing; the other significant variables, i.e. the rate of employment, the percentage of people with tertiary education and economic growth, seemed to play a similar role both in the rural and in the urban areas, reducing deprivation when their levels were increasing.

The direct and indirect relationships among the selected variables were also examined, paying attention especially to severe material deprivation rate, as an outcome of the hypothesized model (Fig. 2 and Fig. 3).

Thus, in the case of the rural area in Romania, the most significant paths involved in the outcome of severe material deprivation rate (Fig. 2 and Table 4) were the following:

(P1) Employment_rate → Sev_mat_depriv_rate;
(P2) Tertiary_educ → Sev_mat_depriv_rate;
(P3) Gen_gov_exp_sp → Sev_mat_depriv_rate;
(P4) Tertiary_educ → Employment_rate → Sev_mat_depriv_rate;
(P5) Ec_growth → Employment_rate → Sev_mat_depriv_rate.

Table 4. Direct and indirect effects in the case of rural area

Direct effects				
Predictor	**Mediator**	**Predictand**	**Estimate**	**Sig**
Tertiary_education	-	Employment_rate	-1.017	0.006
Government_efficiency	-	Employment_rate	-0.994	0.606
Ec_growth	-	Employment_rate	0.143	0.078
Employment_rate	-	Sev_mat_depriv_rate	-1.879	0.027
Tertiary_education	-	Sev_mat_depriv_rate	-5.259	0.000
Gender_empl_gap	-	Sev_mat_depriv_rate	0.415	0.725
Gen_gov_exp_sp	-	Sev_mat_depriv_rate	3.469	0.002
Government_efficiency	-	Tertiary_education	0.072	0.967
Ec_growth	-	Tertiary_education	-0.053	0.459
Government_efficiency	-	Gender_empl_gap	1.683	0.234
Ec_growth		Gender_empl_gap	0.168	0.004
Government_efficiency	-	Gen_gov_exp_sp	-1.995	0.015
Ec_growth	-	Gen_gov_exp_sp	-0.181	0.000

Indirect effects				
Predictor	**Mediator**	**Predictand**	**Estimate**	**Sig**
Government_efficiency	Tertiary_education	Employment_rate	-0.073	0.967
Ec_growth	Tertiary_education	Employment_rate	0.054	0.474
Tertiary_education	Employment_rate	Sev_mat_depriv_rate	1.909	0.006
Government_efficiency	Tertiary_education	Sev_mat_depriv_rate	-4.594	0.554
Ec_growth	Employment_rate	Sev_mat_depriv_rate	-0.649	0.054

Source: Own calculation, based on Eurostat and GCI, computed in StataMP 13.0.

In detail, employment rate and the percentage of people with tertiary education registered negative **direct effects** on the rate of severe material deprivation, meaning that their improvements seemed to directly affect this rate, reducing it. Contrary, between the governmental expenditure on social protection and our chosen facet of poverty, a positive effect in the sense that an increase of the first translated into an increase of the rate of deprivation registered.

Moreover, **indirect effects** of (1) the percentage of people with tertiary education and of (2) economic growth on severe

material deprivation rate, with the employment rate in the role of mediator, might be observed. In detail, a higher percentage of people with tertiary education translated into a lower employment rate in the rural area, effect that seemed to contribute to the fact that more people with tertiary education meant a higher severe material deprivation rate. Economic growth seemed to have a beneficial implications on the deprivation rate, based on its direct positive effect on employment rate. In this way, in the Romanian rural area, economic growth seemed to mean more employed people, effect that, in its turn, translated into less people severely deprived from the material point of view.

In the case of the urban area in Romania, the most significant paths involved in the outcome of severe material deprivation rate (Fig. 3 and Table 5) were the following:

(P1) Employment_rate → Sev_mat_depriv_rate;
(P2) Gender_empl_gap → Sev_mat_depriv_rate;
(P3) Tertiary_educ → Employment_rate → Sev_mat_depriv_rate;
(P4) Ec_growth → Gender_empl_gap → Sev_mat_depriv_rate.

Table 5. Direct and indirect effects in the case of urban area

Direct effects				
Predictor	**Mediator**	**Predictand**	**Estimate**	**Sig**
Tertiary_education	-	Employment_rate	1.688	0.000
Government_efficiency	-	Employment_rate	-3.427	0.142
Economic_growth	-	Employment_rate	-0.601	0.015
Employment_rate	-	Sev_mat_depriv_rate	-2.602	0.000
Tertiary_education	-	Sev_mat_depriv_rate	1.216	0.104
Gender_empl_gap	-	Sev_mat_depriv_rate	-1.879	0.048
Gen_gov_exp_sp	-	Sev_mat_depriv_rate	-0.069	0.948
Government_efficiency	-	Tertiary_education	3.064	0.164
Ec_growth	-	Tertiary_education	0.723	0.000
Government_efficiency	-	Gender_empl_gap	1.581	0.183
Ec_growth	-	Gender_empl_gap	0.133	0.857
Government_efficiency	-	Gen_gov_exp_sp	-1.995	0.015
Ec_growth	-	Gen_gov_exp_sp	-0.181	0.000

Indirect effects				
Predictor	**Mediator**	**Predictand**	**Estimate**	**Sig**
Government_efficiency	Tertiary_education	Employment_rate	5.171	0.178
Ec_growth	Tertiary_education	Employment_rate	1.220	0.000
Tertiary_education	Employment_rate	Sev_mat_depriv_rate	-4.492	0.000
Government_efficiency	Gender_empl_gap	Sev_mat_depriv_rate	-3.645	0.705
Ec_growth	Gender_empl_gap	Sev_mat_depriv_rate	-0.746	0.062

Source: Own calculation, based on Eurostat and GCI, computed in StataMP 13.0.

Analyzing **direct effects**, employment appeared to have a significant role, both in terms of the rate of employed people and of gender employment gap. In this way, more employed people meant more people not affected by severe material deprivation. Contrary, as an unexpected result, it seemed that a higher difference between the employment rates of men and women translated into a lower rate of deprivation. This finding might be explained by a potential high gender wage gap and needs future

research for its understanding. Still, its negative role in reducing severe material deprivation seemed to be ammeliorated by the fact that it appeared to play the role of mediator for the economic growth, that indirectly contributed to improve the situation of the people severely material deprived. In addition, a higher percentage of people with tertiary education translated into more people with a job, seeming to concrete, in its turn, into a lower level of severe material deprivation rate in the urban area. It is interesting to observe the opposite role of higher education in the two types of areas regarding employment. While a better education seemed to help people to get employed in the urban areas, in the rural space, probably because of the lack of opportunities, it translated into a lower percentage of people having a job.

Table 6. Comparison of the total effects between rural and urban areas

Variables	Rural	Urban
Employment_rate	(-)	(-)
Tertiary_education	(-)	(-)
Gender_empl_gap	Non-significant	(-)
Gen_gov_exp_sp	(+)	Non-significant
Government_efficiency	Non-significant	Non-significant
Ec_growth	(-)	(-)

Source: Own interpretation.

Table 7. Comparison of the direct and indirect effects between rural and urban areas

Variables	Rural	Urban
Direct effects		
Employment_rate	(-)	(-)
Tertiary_education	(-)	Non-significant
Gender_empl_gap	Non-significant	(-)
Gen_gov_exp_sp	(+)	Non-significant
Indirect effects		
Tertiary_education	(+)	(-)
Government_efficiency	Non-significant	Non-significant
Ec_growth	(-)	(-)

Source: Own interpretation.

Observing Tables 6 and 7, the **main differences between the rural and urban areas** in terms of total, direct and indirect effects of the selected factors of severe material deprivation rate were the following:

(1)Gender employment gap seemed to be significant only in the urban area, but not in the expected manner, its increasing translating into lower levels of deprivation;

(2)Government expenditures on social protection seemed to be significant only in the rural space, but in the way in which their increasing did not imply the decreasing of the severe material deprivation rate;

(3)The percentage of people with tertiary education was significant in both rural and urban areas, but, analyzed in detail, its direct effect seemed to be significant only in the rural space. Moreover, it appeared to have a contrary indirect effect through the mediation of employment rate, affecting, when its levels were improving, the severe material deprivation rate in the way of increasing it. In other words, according to our results, in the rural space, more people with tertiary education meant more unemployed and, in consequence, more severely material deprived individuals. Contrary, in the urban area, more people with tertiary education seemed to translate into a higher employment rate and, in addition, in a lower severe material deprivation rate.

CONCLUSIONS

In this paper, we intended to offer a comparative perspective of the rural and urban material deprivation's mechanism of forming in terms of socio-economic causes (education, employment, gender gap, social protection, economic growth and government efficiency), also pointing out the necessity of finding solutions for poverty alleviation based on them.

Firstly, our paper evidenced the high levels of severe material deprivation in Romania, both in rural and in urban areas, nearby the unreasonable gap between them.

Secondly, according to our results, in the case of Romania, in the period between 2009 and 2017, this poverty indicator was significantly affected by the percentage of people with tertiary education, the employment rate and economic growth, both in rural and in urban

spaces. The difference was identified in the case of government expenditures on social protection that seemed to be linked only to the rural deprivation, while gender employment gap appeared to be significant only in relation to the urban one.

We also observed that, in the Romanian context, regardless of type of area considered, government efficiency, evaluated in terms of wastefulness of government spending, burden of government regulation, efficiency of legal framework in settling disputes, efficiency of legal framework in challenging regulations, transparency of government policy-making and provision of government services for improved business performance, appeared to have any significant effect (direct or indirect) on severe material deprivation rate.

Nearby these general findings, we identified some main differences between the rural and urban areas in terms of effects on severe material deprivation rate. First of all, referring to education, it was shown, as it was above mentioned, that the percentage of people with tertiary education was significant in relation to this indicator of poverty, either rural or urban. But, analysing in detail, its direct effect seemed to be significant only in the rural space. Still, its indirect effect through the employment rate in the role of mediator might be observed both in rural and in urban areas. However, if in the rural space, more people with tertiary education meant less employed and more severely deprived individuals, in the urban area, the effect of attaining higher education by more people was contrary, translating into higher employment and lower severe material deprivation rates. In this way, education is one more time shown to have a significant role in social inclusion, being essential for what people could be and do. The challenges are put in terms of opportunities that seem to be not the same in rural comparatively to urban areas. This might be a plausible explanation for our finding regarding the different indirect effects of the education indicator on deprivation rate in function of the type of analysed area.

In addition, the unexpected effect of governmental expenditures devoted to social protection on the deprivation indicator, attracting attention on their incapacity of improving the state of material deprivation of the rural residents, strengthens once again the idea according to which it is essential to teach the deprived people how to catch fish, not to give them the already cooked one.

This perspective might also be certified by the results regarding employment in terms of (1) the direct link between it and deprivation and of (2) its positive role of mediator in the relation between, on one hand, education and economic growth and, on the other hand, severe material deprivation.

Finally, we consider that these findings indicate that the poverty policies should concentrate on the distinction between rural and urban specificities and try to particularly answer to each of them. Intending to respond to the need for research in this field, our study might represent a support for the policies addressing poverty in the Romanian context. Still, future research needs to concentrate more on rural structural problems in order to identify the main drivers of change, capable of substantially attenuating the level of deprivation in the rural areas.

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SUPPORT OF AGRICULTURAL SECTOR IN THE SLOVAK REPUBLIC

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Abstract

The Common Agricultural Policy belongs to the oldest and most important policies of the European Union. One of its aims is to support economic performance of farms. The objective of the paper was to analyse the support of agricultural sector in the Slovak Republic from 2010 to 2017. The second part of the paper provides an overview of agricultural support in other countries of the world by using the Producer Support Estimate. The results show that support from EU funds as well as from the state budget was very important for maintaining competitiveness of the Slovakia´s agriculture sector. Provided support was classified to five basic groups: market organization in agricultural commodities, direct payments, rural development, state aid with national measures and general services. The most important tool for supporting farmers is direct payments. They aim to stabilize farmers' income, improve the competitive position of farmers, prevent the negative impact of cross-border subsidy competition from neighbouring countries and revitalize livestock production.

Key words**:** *agricultural sector, subsidies, Common Agricultural Policy, economic performance*

INTRODUCTION

The Slovak Republic, as a part of the EU area, follows principles and rules of the Common Agricultural Policy (CAP), which provides income support to farmers in order to provide EU citizens with quality, safe and affordable food products.

According to [12] "the Common Agricultural Policy of the EU is one of the oldest European policies. It is characterized by large and diversified groups of beneficiaries, diversity of objectives, multi-level decision-making and an important budget".

The importance of the CAP has not changed over the years of its existence, despite the ever-changing conditions and situation in the world. The challenges facing not only farmers but also society as a whole are also changing. These include climate change, political and economic instability or the growing importance of the world trade [4].

The Ministry of Agriculture and Rural Development of the Slovak Republic (MARD SR) creates and implements the regulatory and legislative framework in accordance with the EU policies and legislation. Agriculture in the Slovak Republic has joined the new conditions within the globalization of the world economy and thus gained new opportunities arising from the common market within the EU CAP, where all trade barriers for the free movement of goods and services between Member States have disappeared [13].

The concept of agricultural subsidy can generally be understood as any measure of state institutions, which affects the amount of income/profit of the producer [17]. "The impact of such subsidies on farmers' income and farm profitability is obvious and many farms would generate a loss without subsidies" [6]. According to [8] "it is not only this indicator that the subsidy policy has a significant impact on. Subsidies also affect production volume, amount of costs and production efficiency".

[2] states that the influence of subsidies is much wider, because they affect real conditions in specific markets. Part of the economic cost of subsidies has the ability to intervene in market conditions and distort market signals. According to [11] and [5] direct subsidies are often multidirectional and depend on different conditions. The same instrument can positively affect the economy of a farm in one country and harm farms in another. Accurate determination of the effects

of agricultural subsidies requires thorough empirical research and on-going verification of theoretical knowledge.

[10] states that „agricultural subsidies have been criticized for distorting agricultural markets and labour allocation in the economy by constraining or preventing structural change that is essential for economic growth and development. At the same time, proponents of agricultural subsidies have argued that such policies are crucial to support incomes of farmers and to sustain rural communities by creating jobs and preventing out-migration from rural areas".

According to [14] "subsidies are also used to influence production and consumption decisions. The aim of agricultural policy is to ensure that farmers are able to achieve a reasonable profit within average, regional or specific conditions of a given country with the help of targeted support". Subsidies are tools of implementing goals of a particular policy. The choice of these tools and their mutual combination should be based on a clarified strategy, on the knowledge of the environment and on the overall economic situation of the given state [3].

"Agricultural subsidy - support policies influence the optimal decisions of farmers through various mechanisms. Production efficiency and support policies are decisive factors influencing the income situation and the economic stability of agriculture. Other determinants include: optimal structure of production, efficiency of cost factors with an impact on employment, renewal of fixed capital and secured sales of production" [7].

According to [9] within the support policy of Slovak agriculture, subsidies are provided to help to achieve the prosperity of agricultural enterprises, to ensure adequate incomes, assistance to implement strategic objectives of agricultural and nutrition policy of the state in practice and to achieve other goals, such as a wide range of maintaining and developing decent living conditions for the rural population, the rural environment as well as ensuring the consumption of agricultural products.

The aim of the paper is to analyse the support for agricultural sector in the Slovak Republic. In addition to an overview of Slovak support, the paper also provides an overview of agricultural support in other countries of the world, cooperating with the OECD, by using the Producer Support Estimate (PSE).

MATERIALS AND METHODS

The support provided to Slovak agriculture was evaluated for the years 2010 - 2017 and divided into five main groups:

-market-oriented expenditure (MOE),
-direct payments,
-rural development,
-state aid and national measures and
-general services.

Each of the above mentioned groups includes other more specific groups of subsidies. The Agricultural Paying Agency (APA) is responsible for the implementation of all market and trade instruments of the CAP in Slovakia.

Basic mathematical-statistical methods, index method, comparative analysis were used for processing the paper. Information sources of the paper were data from the Ministry of Agriculture and Rural Development of the Slovak Republic, OECD, and materials from the APA as well as other available information from Internet sources.

RESULTS AND DISCUSSIONS

Applicants in the Slovak Republic in the field of agriculture have the opportunity to apply for funding activities from European sources. The 2013 reform was the last stage in the still open process of adapting and shaping the CAP (Regulations (EU) No. 1303 to 1308/2013, of 20 December 2013). The main guidelines of the CAP for the period 2014-2020 relate to the conversion of decoupled aid into a multifunctional support system. Following the CAP reform, the structure of direct payments has changed. The new system of direct payments consists of a multi-component support system and, for the first time, a greening component has been introduced into the first pillar of the CAP.

Measures, which will contribute to the adaptation of crops and livestock to rising air

temperatures and changes in precipitation, are needed to mitigate the impact of climate change on soil and its productive function. The wide range of existing instruments under the second pillar of the CAP has been simplified to focus on promoting competitiveness, innovation, knowledge-based agriculture, young start-ups, sustainable management of natural resources and harmonious territorial development.

The following Table 1 presents the development of total expenditures to agriculture sector of Slovakia in years 2010-2017.

Table 1. Total expenses to Slovakia's agriculture sector in the years 2010-2017 (in million €)

Type of support	2010	2011	2012	2013	2014	2015	2016	2017	Index 2017/ 2010
Market-oriented expenditures	13.6	13.1	9.8	12.0	10.9	13.7	11.5	17.3	1.27
Direct payments	337.6	365.2	370.3	365.2	405.1	385	408	410.5	1.22
Rural development	481.1	408.5	345.8	224.1	189.0	373.8	162.4	233	0.48
Operational Program Fisheries	2.0	1.7	3.2	1.5	2.3	2.6	0.4	-	-
State aid and national measures	18.9	8.1	9.1	16.1	7	6.1	4.6	9.3	0.49
General services from budget chapter	97.6	93.8	99.5	94.3	91	89.4	107.8	105.9	1.09
Total expenditures	**950.8**	**890.4**	**837.7**	**713.2**	**705,3**	**870.6**	**694.7**	**776.1**	**0,82**

Source: Ministry of Agriculture and Rural Development of the Slovak Republic (MARD SR), Agricultural Paying Agency (APA) [15, 1].

In total, 6.44 billion EUR was paid to the agriculture sector in the Slovak Republic for the period 2010 – 2017. Total expenditure on agriculture consisted of following basic groups of expenditures: the organization of the market in agricultural commodities (Market-Oriented Expenditure), direct payments, rural development, state aid and national measures and general services to agriculture. Direct payments (47%) and rural development payments (38%) had the largest share on the total volume of support (Fig. 1).

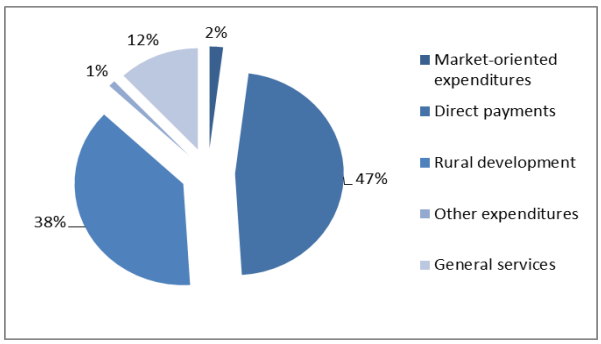

Fig. 1. Structure of support to agriculture in the years 2010-2017
Source: APA, MARD SR. [1, 15].

The structure of support has changed and fluctuated; in 2010 the most significant was the support for rural development. Total expenditure on agriculture in the mentioned period decreased and increased year-on-year differently, the highest volume was in 2010, the lowest in 2014, it was caused by the introduction of the new Rural Development Program 2014-2020.

Market organization - Market Oriented Expenditures (MOE)

Market-oriented expenditures are expenditures on supporting the export of agricultural products outside the EU and on stabilizing the market for agricultural production. They are financed by the European Agricultural Guarantee Fund (EAGF), which is a part of the EU's general budget. Activities related to market organization are provided by the APA - Market Organization Section. Some of the market measures were co-financed from the state budget (e.g. the "School Milk" Program, the "National Program for the Stabilization and Development of Slovak Beekeeping" and

assistance to producer organizations and producer groups under operational programs).
The use of market-oriented expenditures depends on the measures within the market organization in a given year and also on the current situation on the market for the given commodity (Table 2). In the Slovak Republic, it was mainly the drawing of funds under measures in the field of vineyards, fruit and vegetables, milk and dairy products, bees, promotion and export refunds, which was mainly influenced by competitiveness and market opportunities of individual products on markets of third countries.
In the viticulture sector, subsidies were paid, e.g. for the restructuring of vineyards from the National Support Program within the common organization of the market in wine for the years 2014 - 2018.
In the fruit and vegetables sector, funds were disbursed for operational programs of producer organizations. The "School Fruit and Vegetables" Program is a part of the support mechanisms within the EU Common Organization of Agricultural Markets. The "School Milk" Program has been implemented in the Slovak Republic since 2004. Funds for the supply of milk and dairy products to pupils in school facilities are provided by the EU and the state budget of Slovak Republic. The National Program for the Stabilization and Development of Beekeeping was co-financed by the EU in the amount of 50% as well as by the state budget in the amount of 50%.

Table 2. Support for market-oriented expenditures in the years 2010-2017 (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	Index 2017/2010
Market-oriented expenditures in total	13.6	13.1	9.8	12.0	10.9	13.7	11.5	17.3	1.28
thereof: expenditures of the EU	10.9	9.9	7.4	9.7	8.1	11.5	7.9	12.1	1.11
Expenditures from state budget	2.7	3.2	2.4	2.3	2.8	2.2	3.6	5.2	1.93

Source: APA, MARD SR. [1, 15].

Direct payments

Direct payments (Tables 3, 4 and 5) represent direct income support for farmers under pre-established eligibility conditions and form a significant part of EU agricultural expenditure. They are paid in the form of current transfers to non-financial entities directly managing the land, which meet the conditions for their provision. The aim of supporting farmers through direct payments is to: stabilize farmers' income, improve the competitive position of farmers, prevent the negative impact of cross-border subsidy competition from neighbouring countries, develop value-added industries in the Slovak Republic and revitalize livestock production.
Direct payments were paid from the European Agricultural Guarantee Fund (EAGF) based on the fulfilment of conditions set out in Council Regulation (EC) No. 73/2009 establishing common rules for direct support schemes for farmers under the CAP.
The payment deadline is from December the 1st of the current year to June 30th of the following year. The second source of support is the state budget.
Payments requests on individual direct support schemes were administered by the APA in compliance with current legislation. Approximately 90% of direct payments were paid in December of the relevant year. APA notified and paid direct payments to applicants each year in the form of: single area payment (SAPS), dairy cow payment, complementary national direct payments, specific sugar payment, specific fruit and vegetables payment, transitional payment for cultivation of tomatoes, transitional national payments.
The system of direct support, implemented since 2015, aims to achieve a direct positive impact on the actual performance of agricultural holdings, more efficient distribution of support within individual areas, increase of food security, employment and

improve the overall standard of living of the rural population. Separate direct payments since 2015 have been paid in the form of:
-Single area payment - simplified basic payment scheme,
-Payment for agricultural practices beneficial for the climate and the environment,
-Payment for young farmers.

Table 3. Direct payments rates in the years 2010-2014 (in €)

Indicator	Unit	2010	2011	2012	2013	2014	Index 2014/ 2010
SAPS - Single Area Payment Scheme	ha	142.4	155.4	174	188.5	205.57	1.44
Specific sugar payment	ha	273.9	597.5	597.5	594.4	597.96	2.18
Payment for dairy cow	pieces	60.84	79.16	86.15	98.86	209.13	3.44
Specific fruits and vegetable payment	ha	52.71	55.15	55.56	56.63	56.47	1.07
Transitional payment for cultivation of tomatoes	ha	477.9	538.4	-	-	-	-
Payment for cultivation of hops	ha	387.8	300.6	269.8	269	269	0.69
Livestock unit payment	livestock unit (LU)	143	150	135	138	140	0.98

Source: MARD SR. [15].

Table 4. Direct payments rates in the years 2015 - 2017 (in €)

Decoupled direct payments	Unit	2015	2016	2017	Index 2017/ 2015
Transitional simplified basic payment scheme	ha	132.38	134.04	135.45	1.02
Payment for agricultural practices beneficial for the climate and the environment	ha	70.8	71.17	71.7	1.01
Payment for young farmers	ha	60.41	60.41	60.41	1.00
according to § 15 section 2 of the government regulation No. 342/2014, payment coefficient of financial discipline	%	1.280254	1.358046	1.323995	
Coupled direct payments					
Payment for sugar beet cultivation	ha	369.8	374.11	362.36	0.98
Payment for hops cultivation	ha	605.46	406.99	410.13	0.68
Payment for cultivation of selected fruit varieties with high labour intensity	ha	268.48	155.32	134.26	0.50
Payment for cultivation of selected fruit varieties with very high labour intensity	ha	392.48	244.75	255	0.65
Payment for cultivation of selected vegetable varieties with high labour intensity	ha	51.76	45.87	47.87	0.92
Payment for cultivation of selected vegetable varieties with very high labour intensity	ha	101.5	70.48	113.81	1.2
Payment for cultivation of tomatoes	ha	862.69	555.71	508.22	0.59
Payment for ewes, ewe lambs and goats	pieces	19.09	17.01	17.33	0.91
Payment for selected categories of livestock fattening	livestock unit	213.82	223.03	216.08	1.01
Payment for cows reared in a market milk production system	pieces	250.21	274.6	278.59	1.11
according to § 16 of the government regulation No. 36/2015, payment coefficient of financial discipline	%	1.280254	1.358046	1.323995	
Transitional national payments					
Complementary national area payment	ha	0	0	0	-
Complementary national hops payment	ha	0	0	0	-
Complementary national livestock unit payment:					
according to § 4 section 2 letter a), b), c) a f):	livestock unit	0	0	0	-
according to § 4 section 2 letter d):	livestock unit	105	98	91	0.87
according to § 4 section 2 letter e):	livestock unit	68.25	63.7	59.15	0.87

Source: MARD SR. [15].

Since 2015, coupled direct payments have been structured as follows:
-Payment for sugar beet cultivation,
-Payment for hops cultivation,
-Payment for cultivation of selected fruit varieties with high labour intensity,
-Payment for cultivation of selected fruit varieties with very high labour intensity,
-Payment for cultivation of selected vegetable varieties with high labour intensity,
-Payment for cultivation of selected vegetable varieties with very high labour intensity,
-Payment for cultivation of tomatoes,
-Payment for ewes, ewe lambs and goats,
-Payment for selected categories of livestock fattening,
-Payment for cows reared in a market milk production system.

The provision of direct payments was regulated by the Government Regulation no. 342/2014 Coll., which lays down rules for providing support for agriculture sector in connection with schemes of separate direct payments; and by the Government Regulation no. 36/2015 Coll., which lays down rules for providing support for agriculture sector in connection with schemes of coupled direct payments, as amended by the Government Regulation no. 122/2016 Coll.

Table 5. Direct payments in the years 2010-2017 (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	Index 2017/ 2015
Single area payment	259.8	285.9	336.6	332.6	355.4	48.04	0	0	-
Dairy cow	0	10.2	12.2	12.4	24.6	3.56	0	0	-
Separate sugar payment + other direct payments	13.2	20.1	20.1	19	19.2	1.29	0.01	0.01	0.008
Complementary direct payments (transitional national payments), thereof:	64.6	49	1.4	1.1	6	5.96	5.57	5.17	0.87
Complementary area payments	2.9	0.007	0.002	0	0	0	0	0	-
Arable crops	0	0	0	0	0	0.01	0	0	-
Tobacco	0	0	0	0	0	0	0	0	-
Hops	0.1	0.1	0.01	0.01	0.01	0	0	0	-
Livestock unit	61.6	48.9	1.4	1.1	5.9	5.95	5.57	5.17	0.87
Simplified basic payment scheme (new SAPS)						181.7	217.17	222.92	1.23
Payments beneficial for the climate and the environment						97.99	116.73	119.5	1.22
Payment for young farmers						0	0.26	0.45	-
Coupled direct payments, thereof:						41.54	63.24	57.39	1.38
Payment for sugar beet cultivation						6.22	7.83	6.71	1.08
Payment for hops cultivation						0.06	0.04	0.04	0.67
Payment for cultivation of selected fruit varieties with high labour intensity						0.22	0.17	0.17	0.77
Payment for cultivation of selected fruit varieties with very high labour intensity						0.6	0.43	0.4	0.67
Payment for cultivation of selected vegetable varieties with high labour intensity						0.05	0.07	0.08	1.60
Payment for cultivation of selected vegetable varieties with very high labour intensity						0.37	0.37	0.44	1.19
Payment for cultivation of tomatoes						0.27	0.27	0.04	0.15
Payment for ewes, ewe lambs and goats						3.93	6.01	5.30	1.35
Payment for selected categories of livestock fattening						5.63	9.06	8.90	1.58
Payment for cows reared in a market milk production system						24.19	39.01	35.31	1.46
Reimbursement of financial discipline						4.96	4.96	5.05	1.02
Transferred financial resources to Central Control and Testing Institute							0.08	0	-
Direct payments in total	**338.0**	**365.0**	**370.3**	**365.2**	**405.2**	**385.0**	**408.0**	**410.5**	1.07

Source: MARD SR. [15].

Rural development

The Rural Development Program of the Slovak Republic 2007 - 2013 covered Slovakia´s entire territory and it was implemented on the basis of EU legislation. The Rural Development Program of the Slovak Republic 2014 - 2020 (RDP SR 2014 - 2020) is also intended for the entire territory of Slovakia (NUTS I). Based on this document, assistance is provided under 16 measures (including the "Technical Assistance" measure) contributing to the six rural development priorities.

The Commission Implementing Regulation (EU) 2015/831 was changed by the Commission Implementing Regulation (EU) 2016/526. Based on the mentioned change (modification of the RDP SR 2014-2020), public contributions for the implementation of the rural development program were increased from EUR 2,079,595,129 to the level of EUR 2,099,199,696 and the maximum EAFRD contribution from EUR 1,545,272,844 to EUR 1, 559,691,844.

The 2013 reform retains many of the main characteristics of rural development policy from the previous programming period (2007-2013), such as: improving the strategic approach to rural development programming, strengthening the content of rural development measures, simplifying the rules, respectively where possible, reduce the related administrative burden, link rural development policy more closely with other European Structural and Investment Funds. An overview of drawing funds for rural development in the Slovak Republic is given in Table 6 and Figure 2.

The support for rural development reached its highest level in 2010. After this year, we can observe a gradual decline. The only exceptions were the years 2015 and 2017.

Table 6. Rural development support in the years 2010-2017 (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	
Rural Development Program (2007-2013)	481.1	408.5	345.8	224.1	119.3	313.8	0.0	0.0
Rural Development Program (2014-2020)	0.0	0.0	0.0	0.0	69.7	60.0	162.4	233.0
Rural development in total	**481.1**	**408.5**	**345.8**	**224.1**	**189.0**	**373.8**	**162.4**	**233.0**

Source: MARD SR. [15].

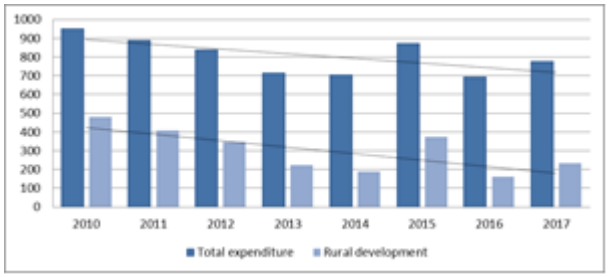

Fig. 2. Total expenditure on agriculture and rural development support (in million €)
Source: MARD SR. [15].

Operational Program Fisheries of the Slovak Republic

The Operational Program Fisheries of the Slovak Republic 2007 - 2013 covered the entire territory of Slovakia and it was implemented on the basis of Council Regulations (EC) and implemented from the European Fisheries Fund in accordance with the Council Regulation (EC) No. 1198/2006 and 1303/2013. The aim was to ensure sustainable development of the fisheries sector, fisheries areas and inland fisheries in accordance with the principles of the Common Fisheries Policy. The total amount of public funds for the given programming period 2007 - 2013 was € 18,922,750, of which € 13,688,528 from EU funds and € 5,234,222 from the state budget of the Slovak Republic for co-financing.

The Fisheries Operational Program 2014 - 2020 was approved by the EC in 2015. The total volume of public expenditure for the seven-year programming period was € 20,832,779 (of which European Maritime and Fisheries Fund: € 15,785,000; state budget: € 5,047,779). It builds on the support implemented in the 2007-2013 programming period, in particular in the field of investment in aquaculture and the processing of fishery and aquaculture products. The support for complementary activities through the diversification of income from aquaculture and measures to comply with rules of the EU Common Fisheries Policy in the field of data collection and control activities, including

enforcement, is a new element in the 2014-2020 programming period. Expenditures for the Operational Program Fisheries in the years 2010-2017 are shown in Table 7. The highest level of support was achieved in 2012.

Table 7. Expenditures on Operational Program Fisheries (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	Index 2017/ 2010
Operational Program Fisheries	2.0	1.7	3.2	1.5	2.3	2.6	0.4	0.9	0.45

Source: MARD SR. [15].

State aid and national measures

State aid and national measures were intended mainly for the development of small and medium-sized enterprises operating in primary agricultural production (Table 8). The basis for the provision of state aid is the legislation of the European Community, implemented into the legal framework of the Slovak Republic, together with the Regulation of the Government of the Slovak Republic no. 369/2007 Coll. on certain support measures for agriculture as amended. State aid may be granted for: activities in primary agricultural production, activities in the processing of agricultural products and the production of food products, activities in the marketing of agricultural and food products, etc. The highest share of state support on total support was in 2013 (2.3 %) and the lowest share in 2015 and 2016 (0.7 %).

Table 8. State aid and national measures in the years 2010-2017 (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	Index 2017/ 2010
Total support	950.8	890.3	837.7	713.2	705.3	870.6	694.7	776.1	0.82
State aid + national measures	18.9	8.1	9.1	16.1	7.0	6.1	4.6	9.3	0.49
Share of state support in % on total support	2.0	1.0	1.0	2.3	1.0	0.7	0.7	1.2	0.60

Source: MARD SR. [15].

General services

General services for farmers (Table 9) are provided mainly by specialized institutions within the agricultural sector. The services of specialized state administration institutions accounted for the largest share of total services. Their activities focused primarily on monitoring compliance with phytosanitary, veterinary and hygienic regulations, in order to maintain the quality and safety of food. Inspection services had the highest share on total general services expenditure every year (55.41 % in average).

Table 9. General services expenditure in the years 2010-2017 (in million €)

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	Index 17/ 10
Research and development	10.4	7.7	7.6	7.1	6.1	6.5	3.6	3.2	0.31
Agricultural education	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.6	1.50
Inspection services	54.7	55.2	61.5	44.5	46.5	53.7	77.8	53.3	0.97
Infrastructure	1.8	1.1	1.4	1.2	1.4	1.0	2.3	1.5	0.83
Marketing and promotion	4.4	0.4	0.4	0.4	0.5	0.6	0.5	0.5	0.11
Other services including support to civil society organisations, non-profit associations and state enterprises	33.3	33.7	34.0	43.6	37.6	28.7	24.8	50.8	1.53
General services in total	105	98.4	105.3	97.3	92.5	90.8	109.3	105.9	1.01

Source: MARD SR. [15].

OECD and Producer Support Estimate (PSE)

Countries around the world have significantly changed their agricultural trade and domestic support policies over the last two decades.

In some countries, support provided to farmers has become more decoupled from production, which means that many farmers no longer receive payments for the production of a particular commodity and have instead started to focus on environmental performance. However, in some developed countries, support remains high and linked to production, while some emerging economies have also been hit hard by policy interventions that undermine production decisions. In both cases, the support could have been better targeted at public services, which benefit producers, consumers and society as a whole. The OECD monitors the extent to which policies adapt to the needs of growth, resilience and sustainability.

Producer Support Estimate is one of the best-known measures developed by the OECD and used worldwide (Table 10). PSE - represents the equivalent of production subsidies respectively estimate of producer support. PSE is the sum of the costs of supporting farmers due to trade barriers that keep domestic prices above world prices (paid by consumers) plus payments from budgetary sources and subsidies to support the purchase of inputs (paid by taxpayers). Through the PSE, it is possible to assess support for agriculture and compare its level with other countries. The highest level of PSE we can observe in case of Norway, Iceland and Switzerland.

Table 10. Overview of PSE development in selected OECD countries in 2000 – 2019

Country	2000	2005	2010	2015	2019	Index 2019/2000
Australia	3.74	3.64	2.95	1.81	1.9	0.51
Brazil	7.11	7.67	6.37	2.56	1.1	0.15
Canada	19.39	21.17	16.61	8.44	8.8	0.45
Colombia	21.97	20.12	20.74	15.58	10.8	0.49
Costa Rica	8.63	6.32	13.96	11.47	7.6	0.88
EÚ-28	33.19	31.23	20.33	19.14	19	0.57
Chile	10.93	4.69	2.62	3.17	2.7	0.25
China	3.67	7.75	12.27	15.67	12.1	3.30
Iceland	70.74	67.13	44.37	57.08	54.6	0.77
Israel	22.2	10.72	13.22	17.78	17.4	0.78
Japan	59.74	53.8	54.11	44.07	41.3	0.69
Kazakhstan	12.79	14.65	9.39	11.37	3.4	0.27
Korea	66.14	59.61	44.64	50.77	46.1	0.70
Mexico	24.2	13.65	12.76	10.96	8.5	0.35
New Zealand	0.32	1.37	0.64	0.64	0.7	2.19
Norway	66.59	65.78	59.67	59.55	57.6	0.86
OECD total	32.92	27.61	19.86	17.89	17.8	0.54
Philippines	21.3	14.18	21.52	25.68	27.1	1.27
Russia	1.53	14.70	22.4	12.21	9.2	6.01
South Africa	5.85	6.26	1.73	4.67	4.6	0.79
Switzerland	67.18	63.81	46.04	59.01	47.4	0.71
Turkey	32.38	28.99	27.48	26.15	13.5	0.42
Ukraine	0.41	10.94	6.43	7.53	1.6	3.90
USA	22.67	15.50	8.58	9.59	12.1	0.53

Source: OECD Agriculture Statistics, Agricultural support estimate (Edition 2019) [16].

On the other hand to the group of countries with lowest PSE belong Ukraine, New Zealand and Chile.

The Slovak Republic also annually provides a report for the "Monitoring and Evaluation of OECD Agricultural Policies", needed for elaboration of the Producer Support Estimate. PSE data for individual states of the European Union are not published, as their publication requires the consent of all EU countries.

The agricultural sector in each country faces many challenges related to meeting future requirements for food, fuel, environmental

services in a more sustainable way in the context of a changing climate.

CONCLUSIONS

Support from EU funds as well as from the state budget in the years 2010-2017 had an irreplaceable importance for the agricultural sector in Slovakia. Overall, 6.44 billion EUR was paid to the agricultural sector of the Slovak republic. These expenditures were classified to following basic groups: market organization in agricultural commodities, direct payments, rural development, state aid with national measures and general services. The largest volume of support was in direct payments (47%) and rural development payments (38%).

Total expenditure on agriculture had a decreasing trend, but varying from year to year. They have been decreasing year-on-year since 2011, increasing in 2015 and 2017. The fluctuations were mainly caused by rural development support and the fact that the highest volume of priority support under the Rural Development Program 2007-2013 was paid in the first years of the programming period.

As a part of rural development in 2016, APA also performed tasks related to the cancellation of liens on projects for which the contract expired, administered responses to control and audit findings of control bodies and related tasks in the preparation of irregularities. The Section of Direct Supports within the RDP SR 2007 - 2013 registered cases of applications in which administrative proceedings were taking place for various reasons (pending appeals of applicants, renewal of proceedings, multi-year court proceedings). The most funds were spent each year to support disadvantaged areas.

Direct payments reached the highest volume in 2016; compared to 2007 they increased from 242.1 million EUR to 408.0 million EUR (by 40.7%); their year-on-year fluctuation was not as significant as in rural development. Single area payments accounted for the largest share of direct payments every year.

Effective agricultural policies are essential to meet the growing demand for safe and nutritious food in a sustainable way. While the growth in demand for food, feed, fuels, etc. presents significant opportunities for agriculture, government policies need to address challenges such as increasing productivity growth, improving environmental behaviour and adapting to climate change, and improving the resilience of farms to market shocks caused by weather and other unforeseen circumstances.

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ASSESSMENT OF THE CONTRIBUTION OF THE INVESTMENT POTENTIAL TO INCREASING THE EFFICIENCY OF AGRICULTURAL PRODUCTION

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Abstract

In the context of the transition to a new technological structure and the formation of an export-oriented economy, the achievement of sustainable agricultural development is inextricably linked with the search for new forms, methods, and mechanisms to stimulate the development of the investment potential of agricultural production. The study aims to assess the contribution of investment potential to improving the efficiency of agricultural production and to develop innovative policy measures to stimulate its development. The theoretical aspects of the development of investment potential have been developed. The role of foreign investment in agriculture in increasing the productivity of the industry and meeting the needs of the industry for various resources has been substantiated. The specificity of the provision of investment resources in agriculture has been studied. An empirical assessment of the multiplier effect of investments was carried out using a pool of indicators. Based on the proposed private indicators, an integral indicator for assessing the effectiveness of the investment potential of agricultural production was calculated. A typology of the constituent entities of the Russian Federation has been carried out on the contribution of investment potential to innovative development and growth of export potential; groups with a low, medium and high level of development are identified. The article proposes measures to stimulate innovative development based on expanding the forms of interaction and methods of investment policy, science, and agribusiness in the context of framework conditions, project, and institutional measures. The practical significance of the results of the study is to improve the methodology for assessing the level of development of investment potential and increase the efficiency of agricultural production based on improving government support measures at all stages of the innovation process.

Key words: *investment potential, agricultural production, assessment methodology, typology of regions, government regulation*

INTRODUCTION

In the context of the transition to a new technological order and the formation of an export-oriented economy, ensuring sustainable agricultural development is inextricably linked with the search for new forms, methods, and mechanisms to stimulate the development of the investment potential of agricultural production [24].

Over the past few years, the growth rate of agricultural production in Russia has significantly outpaced the growth rate for the economy as a whole. From 2014 to the present, there has been an increase in production volumes, the number of unprofitable farms has decreased, import substitution has been ensured in many sub-sectors of agriculture, and a pronounced export orientation has been formed in several sub-sectors. In the context of the sanctions policy, as well as the risks of the COVID-19 pandemic, the threat to the country's food security has increased as a result of changes in the main directions of foreign trade policy [1].

In recent years, to achieve this goal, several legal and regulatory documents have been adopted: the Doctrine of Food Security ", the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025, the State Program of the Russian Federation" Scientific and Technological Development of the Russian Federation ", Passport National project "International cooperation and export" [18]. one of the components of which is the federal project

"Export of agricultural products", according to which it is planned to increase the export of agricultural products by 2024 two times compared to 2018. These documents reflect the priority areas development of the state agrarian policy, according to which targeted financial resources will be allocated to farmers.

Despite the formed favorable conditions for agriculture and other sectors of the agro-industrial complex, in general, the problems of technical support, the financial situation of agricultural producers, the introduction and use of innovations remain [5]. One of the most important constraining factors for the development of agriculture is the low level of investment potential development, including its innovative component [2].

The need to develop and improve the institution of the innovation system in the agro-industrial complex is predetermined by the tasks of creating, introducing, and disseminating scientific and technological achievements in the production process, which will make it possible to form a science-intensive and high-tech export-oriented agricultural sector [31].

The main institutional units of the innovation system of the agro-industrial complex should be innovation and technology centers, business incubators, technoparks, the functioning of which is aimed at the accelerated transfer of developments to production, the development of high-tech products [23].

Theoretical, methodological, and methodological problems of studying the investment process, increasing the efficiency of using investment resources, and assessing their contribution to the development of the economy at the micro, meso, and macro levels have been widely reflected in the works of domestic and foreign scientists. Various theoretical concepts of investment are presented in the works of representatives of Keynesian, neoclassical, and neoliberal directions of economic thought. The greatest contribution to the formation of investment theories was made by such foreign authors as V. Berens, L. J. Gitman, M. D. Jonk, J. M. Keynes, P. Masse, A. Marshall, P. Samuelson, R. Harrod, P. Heine, R. Holt, J. Hicks, M. J. Schumpeter.

Methods for assessing the effectiveness of investments and the problems of increasing investment potential at the federal and regional levels are reflected in the works of such Russian scientists as R.Kh. Adukov, I. Volkov, A.G. Granberg, S. Yu. Glazyev, F. Ilyin, K. Kirov, N. Korda, V. Krutikov, E.V. Kuzmina, V.N. Livshits, I.V. Lipsitz, M.D. Mednikova, V.A. Perfilov, I. Risin, S.A. Smolyak, A.S. Sokolitsyn, G. Urbanskaya, and others.

At the same time, despite numerous publications on this topic, the problems of assessing the contribution of investments to increasing production efficiency have not been sufficiently developed; achieving a match between the level of investment security and the sustainability of economic development [7].

Such positions are shared by such foreign authors as Sarah K. [16].

The authors highlight the key role of investment in agriculture for economic growth, poverty reduction, and food security, highlighting the need to determine the optimal level of investment from various sources to achieve production goals. In furtherance of this provision, the representatives of FAO (United Nations Food and Agriculture Organization) note that investments in public goods (for example, agricultural research) have a higher return than subsidizing certain types of production costs. According to their recommendations, governments should invest in institution building and human development, which will help create an enabling environment for investment in agriculture [28].

The modern concept of science and technology policy, aimed at creating an export-oriented agricultural sector in the transition to the fourth industrial revolution, is based on an integrated approach to the development of the agricultural economy. The need to intensify the integration interaction between the subjects of the innovation process in the agro-industrial complex is sufficiently fully justified and disclosed in the theories of I. Schumpeter and M. Porter. In this regard,

the theory of the investment multiplier by J.M. Keynes, the theory of economic growth by R. Harrod-Domar, and the Solow theory continue to remain quite relevant, on the basis of which it is possible to determine the impact of investments in fixed assets on the development of industries of the agro-industrial complex.

Knowledge, innovation, and investment in human capital as building blocks of Paul Romer's theory of endogenous economic growth have become the most important factors of economic growth in the context of the spread of the digital economy. In these conditions, investments in education, research, and development create incentives for the introduction of innovations, and the development of new technologies largely depends on the conditions of the market. Thus, the priority of knowledge is preserved in both short-term and long-term economic development. This theoretical position of P. Romer has a significant difference from theories highlighting technological innovation as the main source of economic growth [20].

Thus, the level of provision with investment resources is not only the most important condition for economic growth and an increase in the level of competitiveness but also a dominant stimulus for activating the process of innovative structural transformation in the agro-industrial complex [9]. The most widespread theories of structural transformations should be considered the theory of dynamic development of E Domar, J. Schumpeter's theory of structural changes, D. North's institutional theory of structural transformations, as well as the theory of “three-phase development” by H. Chenery, A. Straut. E. Domar's theory of dynamic development substantiates the need to import capital and create favorable conditions for its attraction about economically underdeveloped countries experiencing a shortage of real savings and financial resources. The theory of H. Chenery, A. Straut, called the "theory of three-phase development" of the economy of underdeveloped countries, connects the cause of structural transformation with the influence of numerous factors, and capital accumulation is assessed as the most important factor in structural changes in the economy. "Three-phase development" assumes that the economy goes through the following stages of development: a period of maximum use of investments by the economy to equalize the average propensity to save, as well as the investment rate; a period of lack of investment resources, requiring capital inflows from outside; the period of economic growth due to import substitution and export growth, which directly determines the very process of structural transformation of the economy [3].

Thus, the structural restructuring of the economy is a consequence of the redistribution of investment resources.For the effective development of innovations, it is necessary to establish interconnections at the regional level within the framework of innovation and investment processes; a prerequisite for this is that investments cover the entire innovation chain. The optimal investment and innovation strategy should include measures aimed at increasing the rating of the region; successful implementation of innovation policy; structural shifts due to changes in the distribution of productive forces in the spatial projection [27]. Some Russian scientists substantiate the need to use the latest effective investment and innovation tools, models, and mechanisms aimed at increasing the competitiveness of the agricultural sector, as well as increasing the export potential. To resolve this issue, it is required to develop a targeted agrarian innovation policy, which should contain tasks and mechanisms that take into account previously set priorities, and the harmonization of innovation policy at the federal and regional levels will allow successfully implementing the tasks. An important role is assigned to the development of a mechanism of state support for innovative reproduction, aimed at smoothing technological differentiation as a result of a change in technological structures [19].

The above fully proves the need to improve investment policy, the main directions of which are measures to stimulate investment in priority sub-sectors of agriculture [17].

As a result of the development of the agrarian sector, it is necessary to significantly strengthen the material and technical base of agricultural producers, as well as to complete the technical re-equipment of the processing industry enterprises. The implementation of these tasks will require significant capital investments, which act as the main conditions for the reproduction process [29]. Investment potential is the most important condition for the country's economic development. The economic interests of the state are realized based on the availability of investment potential, an increase in the level of which in the agricultural sector provides a balanced investment activity that determines the dynamics of investment processes in agriculture. In the Russian Federation, the term "investment potential" at the legislative level was first reflected in the regulatory documents in 1999 governing the adoption of the Federal Law "On Investment Activity in the Russian Federation". The current Law contains the following definition: "Investment potential is the availability of opportunities that can be used to achieve specific goals, mainly the capabilities of the invested object, the conditions for long-term investment in a certain asset [10]. When characterizing the investment potential of an enterprise, including an agricultural one, most researchers and economists consider it comprehensively, as a mechanism that includes several potentials that make it possible to evaluate both individual and common elements. The constituent parts of the investment potential, as a rule, include financial, industrial, labor, land, and other potentials [21].

According to Valinurova L.S., Kazakov OV, the investment potential is a set of objective indicators, properties, means and opportunities that determine the potential purchasing power of investments, taking into account the interests of all participants involved in this process " [30].

According to IV Roisman, "The resource potential of agriculture is a set of objective natural and economic conditions that affect the course of the reproduction process in agriculture. It characterizes the possible volume of agricultural production for a given quality of land, provision of production assets, as well as labor [22].

Gorlanov S.A., Shamshinurov M.O. note that "Resource potential is the potential of one resource since an increase in any element of the productive forces will lead to an increase in the value of its individual potential without changing the size of the total production potential with an excess of this element" [11].

According to Shevchenko D.K., Ashitko V.A. the investment potential of the enterprise is "The aggregate of organically balanced resources of the production sector that determine the possibilities of producing a certain volume of products" [26] According to V.G. Gusakov. investment potential is "The combination of resources and economic conditions that provide the formation of clearly defined opportunities for the production of an appropriate quantity and quality of products or services" [13].

MATERIALS AND METHODS

The purpose of this research is to assess the contribution of investment potential to improving the efficiency of agricultural production and to develop innovative policy measures to stimulate the development of investment potential in the agro-industrial complex.

The methodological basis of the study was the state legislative acts, decrees and decisions of the government, scientific works of domestic and foreign scientists - economists and agricultural specialists on the problem under study. In the course of the research, monographic, abstract-logical, analytical, economic-statistical, expert research methods were used. Information from Rosstat, the Higher School of Economics, the Ministry of Agriculture of the Russian Federation, and special reference literature were used as an information base for the study.

There are different approaches and methods for assessing the level of innovative activity that are used abroad. There are several methods among them: European Innovation Scoreboard, Technology Achievement Index, Innovation Capacity Index, World Innovation

Index Boston Consulting Group (GII BCG), World Innovative Index INSEAD (GII INSEAD), Global Innovation Factor Global Innovation Quotient).

A.B. Gusev proposed an approach, on the basis of which a methodology for assessing the level of innovative development of the constituent entities of the Russian Federation was developed [14]. With its help, the procedure for assigning a rating assessment of the competitiveness of Russian regions in the field of innovation is regulated.

The system for calculating the level of investment potential is a complex approach that requires the development of appropriate tools. Currently, there are various methodological approaches to assessing the investment potential of agricultural organizations. However, some scientists identify the most effective methods that allow assessing the investment potential of agriculture in a country or individual regions. In addition, there is a methodology based on mapping sources, which shows all the natural and climatic features of the region.

RESULTS AND DISCUSSIONS

The results of statistical studies and empirical calculations for a more in-depth study of investment activity in agriculture made it possible to assess the contribution of investment potential to increasing the efficiency of agricultural production and substantiate a set of measures to stimulate innovative development based on expanding forms of interaction and methods of investment policy, science, and agribusiness [4].

According to the Institute for Statistical Studies and Economics of Knowledge of the National Research University Higher School of Economics, other studies, and Rosstat data for 2017, in Russia, the share of agricultural organizations that carry out technological innovations in crop and livestock production, in their total number was no more than 3.9% [15].

On the regional level, there is significant differentiation in investment and innovation development. To study the state of investment resources and investment potential, the Volga Federal District was chosen, consisting of 14 regions of the Russian Federation. The choice of this territorial object is explained by the significant contribution of the district to solving the problem of food security. Equally important is the factor of a sufficiently high provision of the district's agriculture with investments in fixed assets, which is most noticeable when comparing the distribution of investments in agriculture in the context of federal districts (Fig. 1).

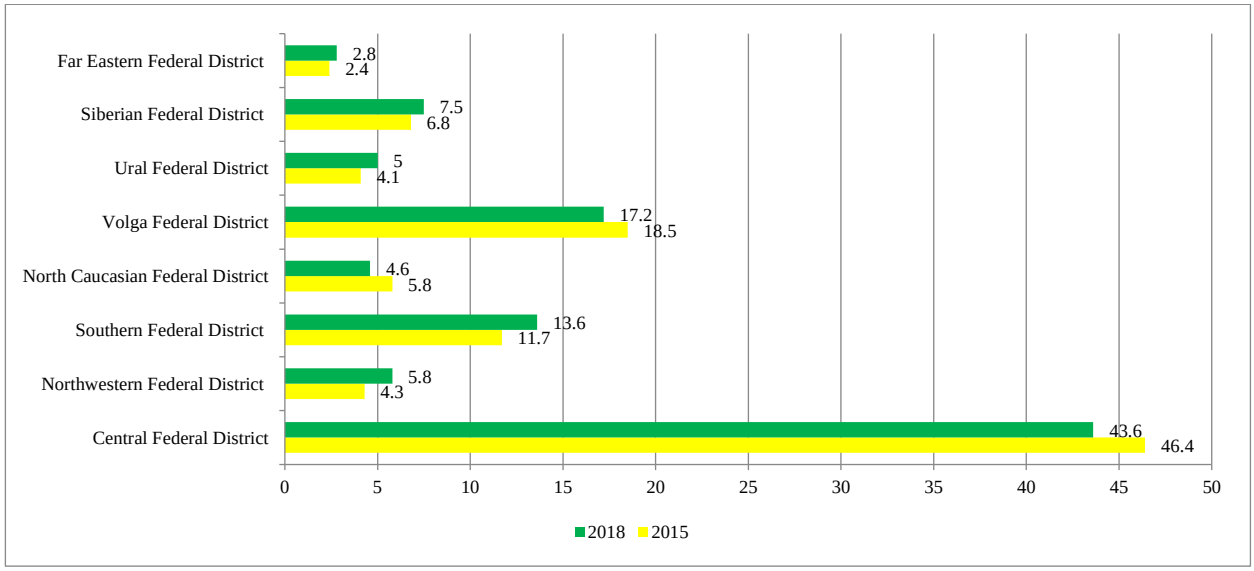

Fig. 1. Distribution of investments in fixed assets of agriculture by federal districts, in% of the all-Russian indicator
Source: Own calculation.

Analysis of statistical data for 2015-2018 showed the presence of significant interregional differentiation in terms of the level of investment provision. Thus, for several years, the highest provision with investments has been observed in the Central Federal District. This district accounted for 43.6% of the total Russian investment in 2018. The Volga Federal District is in second place (17%). For individual Russian regions, the share of investments in fixed assets in agriculture also has significant deviations from the average data for the federal district.

A more detailed analysis of the scale of investment in agriculture is presented by the region of the Volga Federal District in Table 1.

Table 1. Dynamics of investments in fixed assets of agriculture in the regions of the Volga Federal District (2008-2018)

Federal subject of Russian Federation	Investments in fixed assets by type of activity "agriculture, forestry, hunting, fishing and fish farming". mln. Rubles.		The volume of investments in fixed assets by type of activity "agriculture, forestry, hunting, fishing and fish farming" in 2018 relative to 2008. %
	2008	2018	
Bashkortostan republic	7,116	5,691.5	80.0
Mari El republic	1,332	2,328.1	174.8
Mordovia republic	4,972	7,351.0	147.8
Tatarstan republic	11,134	12,050.3	108.2
Udmurt republic	3,050	4,119.2	135.1
Chuvashia republic	1,119	1,265.4	113.1
Perm krai	3,557	2,939.8	82.6
Kirov oblast	3,639	6,594.9	181.2
Nizhegorodskaya oblast	5,458	8,176.9	149.8
Orenburg oblast	4,429	3,035.5	68.5
Penza oblast	4,104	16,351.1	402.8
Samara oblast	1,887	2,787.5	147.7
Saratov oblast	3,338	4,690.7	140.5
Ulyanovsk oblast	1,908	1,119.6	58.7

Source: Own calculation.

It follows from Table 1 that a significant increase in the volume of investments in the period under review occurred in the Republic of Mari-El (174.8%) and the Kirov region (181.2%). However, against the background of these regions, a sharp jump in investment in the analyzed period occurred in the Penza region (398.4%), which ranks first. In 2018 alone, 14 billion rubles were invested in the agro-industrial complex of the Penza region. investment.

In the Republic of Bashkortostan, Perm Territory, Orenburg, and Ulyanovsk Regions in 2008–2018, on the contrary, the volume of investments in agriculture decreased by 20–40%. At the same time, in these regions, the share of agriculture in the total volume of investments has decreased, which has resulted in structural changes in the economy.

To assess the contribution of investment to an increase in gross output, the investment multiplier of Keynes's theory can be used. It is a coefficient reflecting the ratio of the increase in national income (gross output) to the increase in investment, which is a clear characteristic of economic growth.

In our study, to analyze the multiplier effect, we used the indicators of gross output and investment presented in Figure 2.

The ratio of the gross agricultural output and the volume of investments in fixed assets to a certain extent characterizes the multiplier effect. The highest return on investment was obtained in agriculture in the Saratov, Orenburg, and Samara regions (33.8 rubles, 38.1 rubles, and 41.5 rubles, respectively).

According to the rating of investment attractiveness of Russian regions for 2019, the Samara region had a high third level rating, and the Saratov region - an average third level

rating, which characterizes favorable conditions for production and investment.

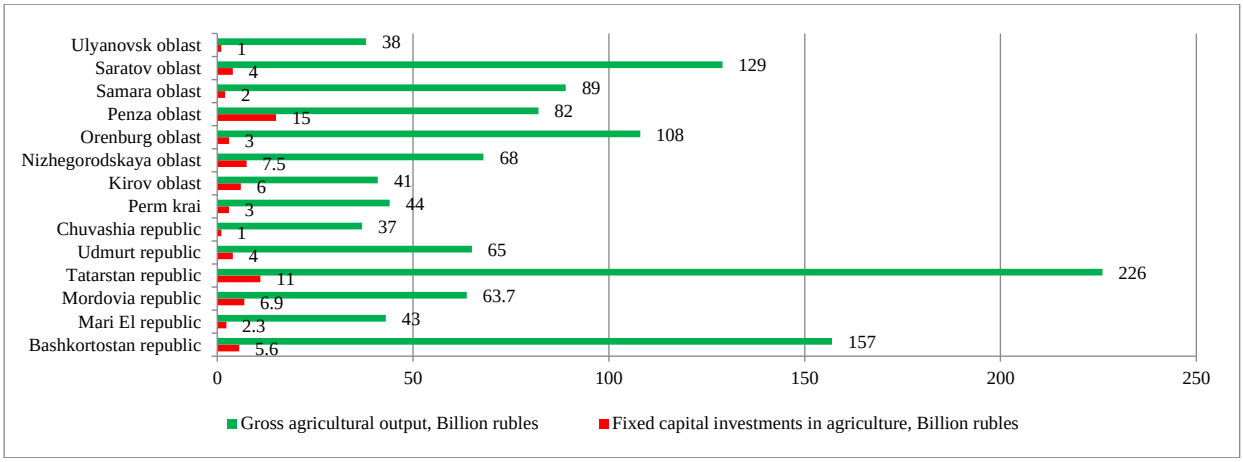

Fig. 2. The ratio between investments in fixed assets of agriculture and gross agricultural production in the regions of the Volga Federal District (2018)
Source: Own calculation.

According to analysts, shortly, the agricultural sector will retain its investment attractiveness, although some decrease in investment activity is allowed, including due to the deterioration of the economic situation in the country and the world due to the coronavirus pandemic.
Based on the particular indicators proposed in this article, it is proposed to construct an integral indicator for assessing the effectiveness of the investment potential of agricultural production. Its construction is proposed to be presented as a set of specific weights of the following indicators: the proportion of budgetary funds in internal research and development; the share of costs for technological innovation in the total volume of shipped goods; internal costs for research and development as a percentage of the gross regional product (GRP); the share of organizations that carried out marketing innovations in the total number of organizations surveyed; the share of organizations that carried out organizational innovations in the total number of organizations surveyed. Table 2 presents indicators for assessing the level of development of the investment potential of agricultural production in 2018.

Table 2. Integral indicator for assessing the level of development of Russia's investment potential and its components in 2019

	Russian Federation
Share of budgetary funds in internal research and development,%	78
Share of costs for technological innovations, in the total volume of goods shipped,%	74
Share of organizations that carried out marketing innovations in the total number of surveyed organizations,%	53
Internal costs for research and development as a percentage of GRP,%	8
Share of organizations implementing organizational innovations in the total number of surveyed organizations,%	94
Investment potential index	61.4

Source: Own calculation.

In the context of the selected private indicators of the development of investment potential, the following conclusions can be drawn. Relatively high values are typical for such indicators as: “Share of costs for technological innovation in the total volume of goods shipped; “The proportion of organizations implementing organizational innovations in the total number of surveyed organizations”; Share of budgetary funds in internal research and development (Fig. 3).

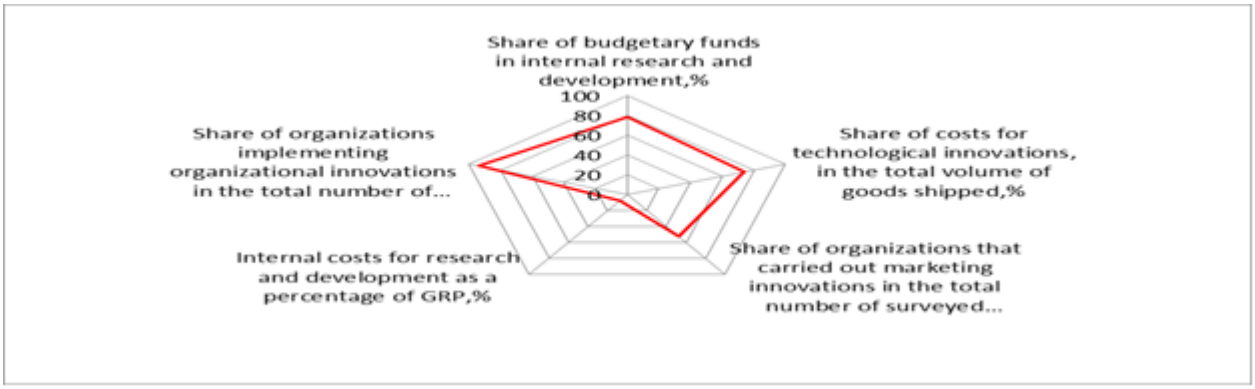

Fig. 3. The ratio of private indicators of the development of the investment potential of Russia's agricultural potential in 2019 (%)
Source: Own calculation.

The following indicators have medium and low values: "The proportion of organizations that carried out marketing innovations in the total number of surveyed organizations"; "Internal costs for research and development as a percentage of GRP." In the context of regions, typology was also carried out [6] by the level of investment potential development as shown in Table 3.

Table 3. Results on the typology of the constituent entities of the Russian Federation according to the level of investment potential development

	Development level		
	High	Middle	Low
Integral indicator of investment potential	Bryansk Region Yaroslavl Region Republic of Karelia Vologda Region Murmansk Region Republic of Kalmykia Republic of Crimea Volgograd Region Republic of Ingushetia Kabardino-Balkarian Republic Karachayevo-Circassian Republic Republic of North Ossetia – Alania Chechen Republic Republic of Mordovia Tyumen Region Altai Territory Republic of Tuva Republic of Khakassia Novosibirsk Region Republic of Buryatia Republic of Sakha (Yakutia) Kamchatka Territory Magadan Region Sakhalin Region Jewish Autonomous Region	Vladimir Region Ivanovo Region Kaluga Region Kostroma Region Lipetsk Region Moscow Region Tambov Region Tula Region Arkhangelsk Region Kaliningrad Region Leningrad Region Novgorod Region Republic of Adygeya Astrakhan Region Republic of Daghestan Stavropol Territory Republic of Mari El Nizhny Novgorod Region Saratov Region Kurgan Region Tomsk Region Trans-Baikal Territory Primorye Territory Khabarovsk Territory	Belgorod Region Voronezh Region Kursk Region Orel Region Ryazan Region Smolensk Region Tver Region Komi Republic Pskov Region Krasnodar Territory Rostov Region Republic of Bashkortostan Republic of Tatarstan Udmurtian Republic Chuvash Republic Perm Territory Kirov Region Orenburg Region Penza Region Samara Region Ulyanovsk Region Sverdlovsk Region Chelyabinsk Region Republic of Altai Krasnoyarsk Territory Irkutsk Region Omsk Region Amur Region

Source: Own calculation.

The weakness of the state investment policy in agriculture is evidenced by the pronounced differentiation of the constituent entities of the Russian Federation by the level of its development. The reasons for such interregional differentiation may be such factors as a low level of resource provision; insufficient funding for research and development; the imperfection of state policy in the distribution of budgetary funds for innovative activities, which does not take into account the level of investment attractiveness of the region.

The article proposes measures to stimulate innovative development based on the expansion of forms of interaction and methods of investment policy, science, and agribusiness. In the direction of "science" support in the form of creating a framework, conditions consist in the allocation of grants for training, the expansion of research grants by the industry specifics. In agribusiness, the forms of support in the form of creating a framework for functioning are patenting, lending, grants, digitalization support, the development of venture investment, tax incentives, and the development of employee competencies. In terms of measures to integrate the interaction of science and industry, it is necessary to support professional communities and clusters, create virtual innovation networks, and develop international cooperation.

In terms of design measures for scientific organizations, it is necessary to intensify contract research and targeted programs. In terms of project measures, agribusiness needs to implement project financing mechanisms and technological programs. The symbiosis of science and agribusiness in the form of project measures is possible in the form of such tools for stimulating innovative development as project financing, the development of cooperation funds, and joint research.

As institutional measures in the direction of "science", it is advisable to provide basic institutional funding for scientific organizations by the needs of the economy and the development of scientific infrastructure. Institutional measures in agribusiness are joint research projects, development of support institutions for technological and innovative start-ups, and stimulation of innovative consulting. As institutional measures of interaction between science and agribusiness, it is necessary to create institutions for the transfer of knowledge and technology, scientific and technological parks, regional centers of competence, and the application of the principles of public-private partnership [12].

It is also advisable to differentiate the presented measures to stimulate innovation policy depending on the stages of the innovation process. At the same time, it is important to choose the optimal form of interaction, taking into account the expansion of the information space, focusing on the benefits of network cooperation, and facilitating the search for partners. After the creation of these structures, the functions of the state are to ensure its openness to new participants based on the concept of open innovation and exclude the interference of market regulation methods [8].

The proposed toolkit will make it possible to create a favorable investment climate in agriculture at the regional level by attracting financial resources to the economy of the territories, to ensure the activation of both investment and innovation activities, including the use of modern digital technologies. The development of the market for advanced scientific and technological achievements will make it possible to identify the actual needs of the agricultural sectors of the Russian regions for specific innovations to achieve indicators of sustainable socio-economic development.

CONCLUSIONS

Investment potential is the most important condition for the country's economic development. The economic interests of the state are realized based on the availability of investment potential, an increase in the level of which in the agricultural sector provides a balanced investment activity that determines the dynamics of investment processes in agriculture. In the context of the transition to a new technological structure and the formation

of an export-oriented economy, the achievement of sustainable agricultural development is inextricably linked with the search for new forms, methods, and mechanisms to stimulate the development of the investment potential of agricultural production [25]. In this work, theoretical aspects of the development of investment potential are developed based on the synthesis of the concepts of innovative development, the knowledge economy, as well as forms, methods, and principles of investment. The analysis of positive foreign experience is carried out and the role of foreign investments in agriculture in increasing the productivity of the industry and meeting the needs of the industry in various resources is substantiated. It has been proved that in the process of deciding on foreign investment in agriculture, especially in developing countries, one should take into account the ratio of positive and negative effects of investment; the state of the investment environment; investment attractiveness of the business. The main determining factor is the presence of positive externalities of investment, therefore, about developing countries, it is recommended to relax international rules and increase foreign investment, even if there is a low investment attractiveness. The specificity of the provision of investment resources in agriculture has been studied using the example of the Volga Federal District. An empirical assessment of the multiplier effect of investments was carried out using a pool of indicators. Based on the proposed private indicators, an integral indicator for assessing the effectiveness of the investment potential of agricultural production was calculated. In the context of the selected private indicators of the development of scientific and intellectual potential, the following conclusions can be drawn. Relatively high values are typical for such indicators as “Share of costs for technological innovation in the total volume of goods shipped; “The proportion of organizations implementing organizational innovations in the total number of surveyed organizations”; "Share of budgetary funds in internal research and development." The following indicators have medium and low values: "The proportion of organizations that carried out marketing innovations in the total number of surveyed organizations"; "Internal costs for research and development as a percentage of GRP." A typology of the constituent entities of the Russian Federation is carried out according to the contribution of investment potential to innovative development and the growth of export potential, based on which it is possible to monitor the process of innovative structural transformation in the agro-industrial complex, groups with a low, medium and high level of development are distinguished. The article proposes measures to stimulate innovative development based on expanding the forms of interaction and methods of investment policy, science, and agribusiness in the context of framework conditions, project, and institutional measures. The implementation of these measures will make it possible to create a favorable investment climate in agriculture at the regional level by attracting financial resources to the economy of the territories, to ensure the activation of both investment and innovation activities, including with the use of modern digital technologies. The practical significance of the results of the study is to improve the methodology for assessing the level of development of investment potential and increase the efficiency of agricultural production based on improving government support measures at all stages of the innovation process.

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SMART GARDEN INTELLIGENT CONTROL SYSTEM IN COMMERCIAL HORTICULTURE AND ITS PRACTICAL IMPLEMENTATION

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Abstract

This article discusses the Smart Garden concept in the frames of development of modern commercial horticulture. Composition and purposes of the automated complex elements are presented, intended for adjustment of soft- and hardware of intelligent control system of commercial garden. The structure of intelligent monitoring and control system for the automated complex is presented. Selection of LoRa wireless standard and network for data acquisition from territorially distributed monitoring and control sensors is substantiated. A variant of development of automated technologist workstation for Smart Garden automated complex is discussed. It has been established that an increase in the yield of fruit and berry plantations by 20% will provide a return on capital investments of about 200 thousand rubles per hectare within one year.

Key words**:** *Smart Garden, automated complex, LoRa, SCADA, automated workstation (AWS)*

INTRODUCTION

Nowadays breakthroughs in the sphere of commercial horticulture are related with competences providing implementation of advanced production technologies and digital transformation, based on PC, smart, high precision and information components integrated with smart control system of production and engineering processes.

This approach creates engineering system combining advantages of serial production and, at the same time, flexibly adjusted for the currently required output, as well as characterized by high customization (personalization) aiming at quick response to market demands.

In the field of engineering support and maintenance of commercial horticulture, the main challenge is development of cardinally new services based on actively developed infrastructure of the Internet of Things, cloud computations, smart technologies, precision agriculture, continuous monitoring and diagnostics of phyto-state of plants, robotized devices.

The Digital agriculture program was developed in the frames of Digital economy program, it is a goal setting tool of social and economic development of the Russian Federation.

The provisions of the Digital agriculture are compared with the initiatives of Industry 4.0 in Germany, Advanced Manufacturing Initiative in the USA, Factories of the Future in the EU, Made in China 2025 in the PRC, and other national programs of digitalization, which are successfully implemented in science intensive and hi-tech spheres of economy.

The terms such as Agriculture 4.0 and even Agriculture 5.0 are widely used in scientific sphere.

The Digital agriculture program highlights some key trends of digital transformation of agriculture, which should be implemented in the form of expanded integrated projects, one

of each is the Smart Garden project [3, 14, 15].

The authors have determined the initial list of provisions and tasks to define, to generate, and to identify the initial concept, principles, attributes, and model architecture of the Smart Garden category, that is:

(1)Creation of unified information space providing inter-operability: capability of two or more systems of various physical essence to exchange information and to apply the information acquired during the exchange.

(2)Development of integrated engineering solutions providing continuous phyto-monitoring and monitoring of ambient environment (sensorics).

(3)Development of integrated engineering solutions providing automated analysis of monitoring data and decision making (smart control).

(4)Development of integrated engineering solutions providing rapid execution of obtained decisions even without human involvement (automation and robotization).

(5)Development of network of test sites for generation of engineering solutions in the format of Smart Garden.

MATERIALS AND METHODS

According to the definition of Digital Agriculture program, the category Smart Garden is an intelligent system of preparation, execution, and control of all procedures of cultivation of horticulture products using robotized unmanned machines and devices.

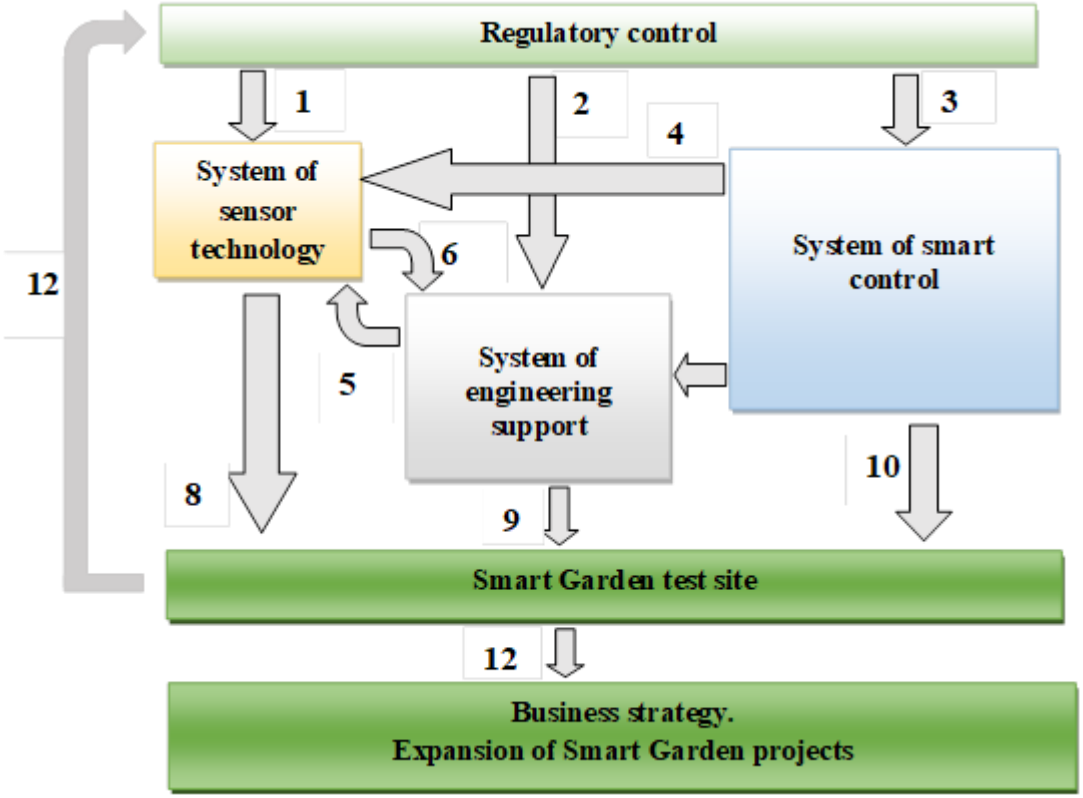


Fig. 1. Provisions and identification tasks of Smart Garden

1 – Development of model structure of sensor technology system; 2 – Development of model architecture of engineering support based on cyber physical systems, mechatronic modules and customized devices; 3 – Development of principles and smart control and decision-making system; 4 – Development of control system of sensor technologies; 5 – Engineering support and maintenance of sensor technologies; 6 – Machine monitoring using elements of precision agriculture; 7 – Development of control system of machine technologies; 8 – Verification and testing of sensor technologies; 9 – Validation and testing of prototypes and simulation samples; 10 – Verification and testing of smart control system for production and engineering processes; 11 – Validation and adjustment; 12 – Development of business strategies and provisions for expansion and commercialization of Smart Garden project

Source: Compiled by authors.

In the frames of solving the formulated problems, the scientists of Michurinsk Agrarian University and Tambov State Technical University arranged Smart Garden test site with elements of smart monitoring and control system for objects of intensive garden.

The main mission and goal setting of the Smart Garden test site are selection, testing, and practical implementation of best global and own engineering solutions with subsequent expansion and implementation in Russian horticulture farms.

This article presents the experimental results and development of automated smart drip irrigation system as exemplified by Smart Garden test site.

Figure 1 illustrates the flowchart of interaction of provisions and tasks identifying the Smart Garden category at current stage of development of commercial horticulture.

RESULTS AND DISCUSSIONS

According to Fig. 1, Smart Garden is comprised of smart monitoring and control systems which are integrated by module principle and include the following components [3, 9, 13]:

(a)Distributed subsystems of data acquisition of soil state (moisture, temperature, water potential of soil and its salinity);

(b)Climatic subsystems (air temperature and moisture, illumination level, wind speed, amount of precipitations);

(c)Stations of phyto-monitoring measuring tree parameters (for instance, tree body thickness, fruit size, and others);

(d)Basic station with backup power source (uninterrupted power source with solar cell);

(e)Actuating subsystem responsible for drip irrigation and fertilizing;

(f)Automated workstation (AWS) of technologist or agronomist with integrated system supporting decision making.

In addition, the smart monitoring and control system is characterized by additional opportunities [1, 3]:

(i)SMS notification: in the case of emergency situations due to technical or engineering reasons, the control system automatically notifies respective persons by SMS. This significantly increases efficiency of response to emergency situations.

(ii)Connection to cloud services via wired or wireless Internet.

Cloud technologies provide remote access to the monitoring and control system from anywhere with the access to Internet. User performs access to cloud service using web interface from any computer or tablet.

Modern commercial horticulture is characterized by gardens positioned in sufficiently large territories. It is reasonable to acquire data from numerous distributed sensors using wireless communication channels. Herewith, it is desirable that the sensors are equipped with independent power supply for operation in several years without replacement [7, 10, 11,12].

In two recent decades, numerous wireless standards and networks have appeared meeting the requirements of constantly increasing data amount: GSM, GPRS, 3G, LTE, Wi-Max, Wi-Fi, ZegBee, LPWAN [8].

One of the most popular LPWAN networks in the world is based on LoRa technology: LoRaWAN [6].

This technology was selected as the main communication technology in pilot project of Smart Garden test site.

LoRa technology was selected for control system due to its unique features:

(1)High signal transmission range in comparison with other wireless technologies.

(2)Very low power consumption.

(3)Good data protection.

Figure 2 illustrates flowchart of automated smart system of drip irrigation comprised of three-level hierarchy. The operator receives information about soil moisture and controls the irrigation system through the irrigation control panel, while receiving data on the amount of water used.

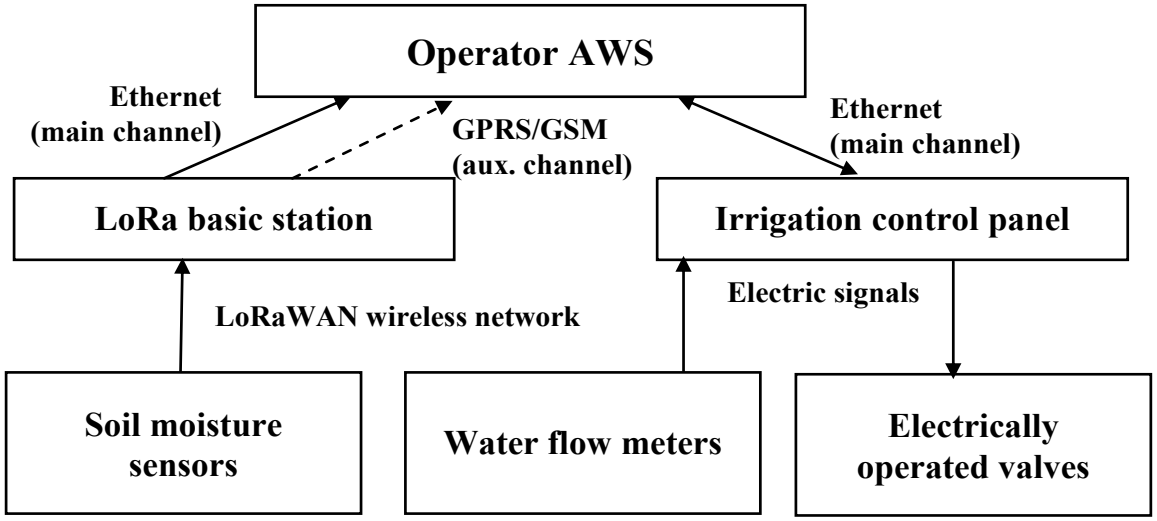


Fig. 2. Flowchart of automated smart system of drip irrigation
Source: Compiled by authors.

Figure 3 illustrates the modules of data acquisition about moisture and temperature of soil, as well as temperature in crown near tree body (3a), and climatic system (3b) measuring temperature and humidity of ambient air.

a) b)

Fig. 3. Data acquisition modules of soil and ambient air state
Source: Compiled by authors.

The equipment of Russian manufacturer, Vega-Absolut company, was selected as preferred variant supporting LoRa technology for development of Smart Garden control system.

Air temperature near soil surface and in tree crown was measured by sensor with LoRaWAN protocol: TD-11; the soil moisture was measured by sensors with 4…20 mA output signal, which were connected to LoRaWAN converter: TP-11.

In addition to transmission of signals of sensors with 4…20 mA interface to LoRaWAN network, TP-11 is also equipped with two discrete open collector outputs and can be used as control device. In addition, the device is equipped with two guard inputs. Ambient air moisture was measured by sensors with 4…20 mA output signal, TP-11 converter.

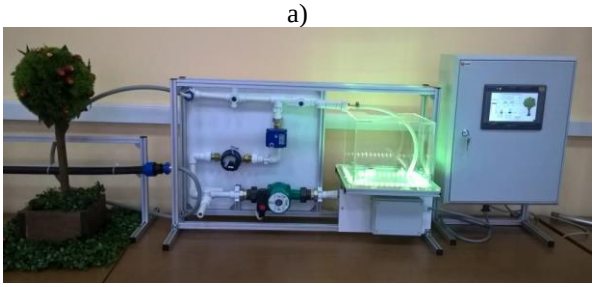
All information from the sensors is transmitted via LoRa radiochannel to the basic station (Fig. 4, a).

The basic station BS-2 is intended for deployment of LoRaWAN network at the frequencies of 863-870 MHz range. The basic station is fed via Ethernet channel; in addition, communication with the server can be executed via 3G channel.

The actuating subsystem of drip irrigation and fertilizing (Fig. 4, b) is based on Russian industrial controller PLK-100 (OVEN company). The actuating subsystem can operate in the mode of either independent or automatic control.

In the mode of independent control, the operator can preset programs of irrigation and fertilizing directly from operator control panel. In automatic mode, the controller executes the control commands generated at upper control level: at AWS of technologist.

a)



b)

Fig. 4. Basic station BS2 and uninterrupted power supply (a), actuating subsystem of drip irrigation (b)
Source: Compiled by authors.

The technologist AWS is based on Russian SCADA system: KRUG-2000, and performs the following functions [2]:
(1)Reception of basic station information from all remote distributed subsystems of data acquisition about soil state, climatic subsystems, phyto-monitoring stations, main controller of actuating system of drip irrigation;
(2)Processing, archiving, visualization of acquired data in form convenient for operator;
(3)Automatic generation of alarm signals in the case of emergency situation with opportunity to send SMS to interested persons;
(4)Logging of all operator actions;
(5)Recommendations to operator on drip irrigation, fertilizing, and other provisions.

Figure 5 exemplifies visualization of monitoring and control of drip irrigation of Smart Garden test site.

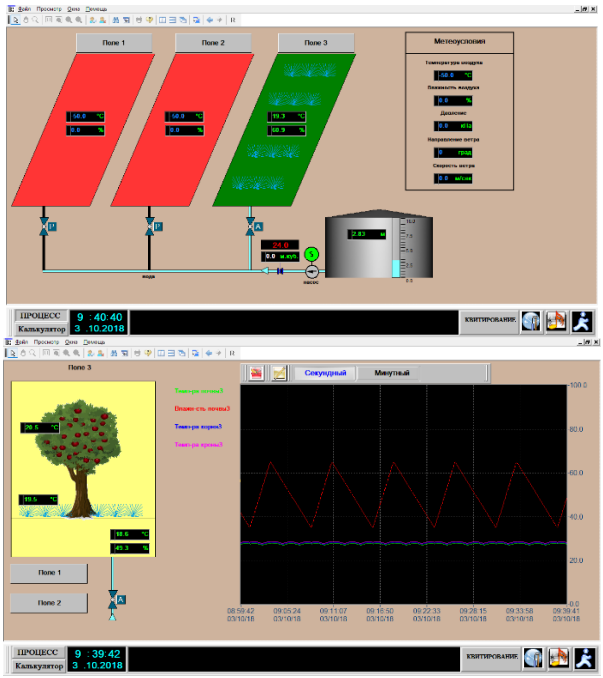


Fig. 5. Operator AWS video frames
Source: Compiled by authors.

A peculiar feature of smart monitoring and control system is the well developed algorithmic support and software. Mathematical provision is based on module principle and includes the modules for processing of measured data from sensors; the module of control commands for pumps and valves; the modules for prediction of irrigation and fertigation variables, and others. The modules of formation of control commands and the modules for prediction of irrigation and fertigation variables interact with database of smart decision-making system where data are accumulated on variables of hydroponics solutions, vegetation species and other parameters of irrigation and fertigation. This allows to develop the most optimum recommendations on drip irrigation and fertilizing.
Fertilizer metering devices are an important element of supply of hydroponics solution (fertigation) [4, 5]. Fertilizers are mixed in mixers. These devices produce hydroponics solution with predefined composition and EC and pH properties. Mixer provides respective ratios of water, concentrated solution of

fertilizers and acid. Mixer is equipped with EC and pH sensors, which allows to control and to monitor these variables in soil solution. Fertigation is carried out automatically depending on soil moisture level, solar activity, seasons, and other variables. The smart control system allows to preset various modes of irrigation frequency, various parameters of hydroponics solution (EC, pH), which can change at different times. The information from sensors is taken into account during planning of irrigation cycles, it is also applied during simultaneous fertigation of various sites.

The use of modern information technologies, software and hardware for automation and control will significantly increase the economic efficiency of industrial gardening, the environmental safety of marketable products, and improve product quality. With the correct implementation of the Smart Garden concept of an intelligent system for managing industrial horticultural objects, the economic efficiency of the site will be several times higher than in the case of using traditional technology.

According to preliminary estimates, an increase in the yield of fruit and berry plantations by 20% will ensure a return on capital investments of about 200 thousand rubles per hectare within one year.

CONCLUSIONS

The proposed application of wireless technologies is sufficiently universal and can be applied nearly for overall range of engineering and production processes in modern commercial horticulture.

A restrictive factor in distribution of such technologies is low awareness of this type of data transfer as well as its low distribution in general and commercial horticulture in particular.

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INVESTMENT MANAGEMENT OF PLANTING CHERRY PLANTATIONS

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Abstract

The branch of cherry production is a sector of perspective for the Republic of Moldova, it is part of the stone fruit sector and a component part of high value agriculture. The article provides a comprehensive analysis of the current state of development of the cherry branch. An important role in the article is assigned to the analysis of investment budgets for the establishment of cherry orchards with the application of different technologies, the analysis of the economic efficiency of cherry cultivation with the application of different cultivation technologies. The authors prepared revenue and expenditure budgets for the fruiting period and compared the economic results and the level of profitability. Based on the research and analyzes carried out, strategic conclusions were formulated for the sustainable development of the cherry branch necessary for the implementation by the actors of the value chains in the sector and especially for the agricultural producers.

Key words**:** *budget profitability, sales income, cost of sales, gross profit*

INTRODUCTION

Modern agriculture must be based on the implementation of scientific innovations in the field and increasing the competitiveness of agri-food products. In the case of horticulture, this is crucial and important for farmers, as it ensures the sustainability of agricultural business and the guaranteed integration of their products into value chains.

The cherry industry is a promising one for the high value sector and in general for agriculture. This conclusion is based on the following considerations: in recent years has seen a constant development and modernization of production technologies; cherries are among the first fruits to enjoy increased demand among end consumers and there is a growing market. In this context, the information presented in this article aims to correctly inform farmers when implementing investments in the cherry production branch, by analyzing the investment needs for planting cherry orchards with the application of different cultivation technologies and arguing economic efficiency in selecting business. Horticulture is the priority directions of agriculture in the Republic of Moldova meant to provide value-added products, with a considerable share in exports and generating job creation for the population of the villages.

MATERIALS AND METHODS

The sources of documentation used in drafting the article were varied and included statistical data collected from the National Bureau of Statistics, Ministry of Agriculture, Regional Development and Environment, sectoral information and studies, and operational information collected from cherry farmers.

The analysis of investment management and economic efficiency in the cherry branch was made possible by drawing up budgets based on two distinctive periods of cherry cultivation, namely: (1) the investment budget (the period from planting to fruiting) and (2) the budget income and expenses (fruiting period). The method of budgeting cherry cultivation technologies and their comparison allowed the creation of an information support for agricultural entrepreneurs interested in

cherry cultivation and ensuring the adoption of qualitative decisions when implementing investment projects.

RESULTS AND DISCUSSIONS

The strategic direction of horticulture consists in the efficient exploitation of plantations with high productivity potential, the deforestation of those plantations that have been exhausted and their consistent replacement with new ones with modern assortment and advanced technologies, which ensure early fruiting, high, constant and quality productivity with competitive assortment on the internal and external market. The evolution of the areas and the volume of production in the horticultural sector of the country, as well as in the cherry branch is presented in Table 1.

According to the data from Table 1, in 2019 compared to 2010, we can observe an increase in all surface and production indicators, both overall on the horticultural sector and in total on the stone fruit subsector.

Table 1. Area and volume of production in the horticultural sector of the Republic of Moldova, years 2010-2019

Indicators	Unit	Years										2019/2010, %
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Horticultural sector - total												
Surface - total	mii ha	209.29	209.24	203.80	204.80	258.89	278.66	250.10	243.07	225.40	228.20	109.0
Fruit surface	mii ha	183.89	180.84	175.30	169.80	223.59	250.96	223.59	218.50	198.30	200.08	108.8
Production volume	**thousand t**	**1,072**	**1,230**	**1,006**	**842**	**1,059**	**905**	**1,279**	**1,363**	**1,481**	**1,451**	**135.3**
Average harvest	t / ha	5.83	6.80	5.74	4.96	4.74	3.60	5.72	5.72	7.47	7.25	124.4
Stone fruits												
Surface - total	mii ha	39.30	40.00	40.40	41.10	36.20	42.03	42.16	42.52	43.20	42.81	108.9
Fruit surface	mii ha	30.40	31.00	32.00	27.60	26.20	35.30	35.79	36.20	36.20	35.93	118.2
Production volume	**thousand t**	**91.52**	**84.80**	**79.30**	**91.80**	**102.30**	**153.80**	**153.26**	**143.00**	**143.00**	**167.57**	**183.1**
Average harvest	t / ha	2.90	2.63	2.41	3.33	3.54	4.26	4.18	3.77	3.77	4.66	160.8
Cherries												
Surface - total	mii ha	3.20	3.20	3.20	3.40	3.50	4.07	4.17	4.25	4.70	5.10	159.4
Fruit surface	mii ha	2.20	2.40	2.40	2.30	2.50	3.12	3.20	3.50	3.60	3.90	177.3
Production volume	**thousand t**	**7.13**	**8.50**	**8.60**	**6.50**	**7.60**	**12.36**	**7.60**	**10.60**	**11.90**	**12.00**	**168.3**
Average harvest	t / ha	3.15	3.44	3.54	2.77	3.08	3.87	2.32	2.95	3.31	3.08	97.7

Source: National Bureau of Statistics [3, 5].

Analyzing the evolution of the cherry sector development in the Republic of Moldova, we can see that the global volume of cherry production increased by 68.3% in 2019 compared to 2010, due to the modernization of technologies, increased intensity and increase in fruit surface by 77.3%, due to the state subsidy policies as well.

Next we propose for analysis the economic information on the investments made in planting one hectare of cherry orchard with the application of three cultivation technologies: regular (with the use of grafted planting material on the generative rootstock - Wild cherry or Frank cherry), intensive (vegetative rootstock - Maxima 14) and super-intensive (vegetative rootstock - Gisela 6 and 5 with planting material of different ages and biological categories, which ensures an earlier fruit bearing, high productivity and fruit quality). An important condition for creating a cherry orchard is the proper selection of land, and namely: it can be set up where there is a minimum of 1,500 hours of sunshine, 36ºC global temperature, 9-11.5ºC average temperature and over 600 mm of rainfall; the soil is permeable to avoid puddles of water; excluded from planting are excessively wet soils which lack drainage, as well as those with the groundwater level below 1.5 m; soils should have a neutral, slightly acidic or slightly alkaline reaction; the soil should be exposed to the sun with southern exposure S-E or S-W, avoiding northern exposures.

Table 2 presents a comparison of the differences between the cherry cultivation technologies, on which analysis were done and which the entrepreneur must know in order to select the most optimal and efficient option for launching his own business.

Table 2. The level of technical indices in cherry plantations cultivated by different technologies

#	Specification of cherry cultivation technology	Operating period, years			Investment recovery term, years	Harvest per hectare, t / ha	Planting scheme, m	Number of trees per hectare, trees
		Total, years	inclusive					
			Vegetation period	Fruitful period				
1	Wild cherry (frank cherry)	26	6	20	**8.05**	**7.10**	5 X 4	500
2	Cherry Maxima 14	20	5	15	**6.52**	**10.56**	5 X 2.5	800
3	Gisela 6 (4x1.9 "Ordinary" biological category)	17	5	12	**8.98**	**17.37**	4 X 1.9	1,316
4	Gisela 6 (4x1.9 biological category "Certificate")	17	4	13	**7.79**	**18.68**	4 X 1.9	1,316
5	Gisela 5 (4x1.6 "Ordinary" biological category)	17	5	12	**7.86**	**21.88**	4 X 1.6	1,563
6	Gisela 5 (4x1.6 biological category "Certificate")	17	4	13	**6.84**	**23.44**	4 X 1.6	1,563

Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

The investment budget for planting cherry orchards is a financial instrument that forecasts the expenses and the need for financial resources over a certain period of time. The presented calculations can serve as a basis for farmers, for economic argumentation in selecting the optimal option for planting orchards. Table 3 summarizes the information on the investment budgets for the establishment and care of cherry orchards until fruiting, with the application of three variants of fruit production technologies: regular (wild cherry rootstock, frank cherry), intensive (Maxima 14 rootstock) and super-intensive (rootstock Gisela 5 or 6).

Table 3. Total investment in planting and care of cherry plantations until fruiting

#	Specification of cherry cultivation technology	Necessary investment, lei / ha	The cost of investments on items from planting to fruiting, lei / ha											Possible subsidies to be obtained, lei / ha	Return on investment to total subsidy,%
			total	drip irrigation system	Support - trellis + project	combined net	Grassing between rows	Land acquisition	the cost of the investment according to the technology						
									means of production	mechanized services	manual operations	other costs and fees	unexpected expenses		
1	Wild cherry (frank cherry)	**137,324**	137,324		2,500			42,000	44,001	17,850	21,875	660	8,439	**15,000**	**10.9%**
2	Cherry Maxima 14	**232,478**	232,478	55,000	2,500			42,000	74,952	19,654	25,733	550	12,089	**42,500**	**18.3%**
3	Gisela 6 (4x1.9 "Ordinary" biological category)	**1,543,135**	1,543,135	65,000	254,500	840,000	85,000	42,000	172,292	26,108	34,355	550	23,330	**390,000**	**25.3%**
4	Gisela 6 (4x1.9 biological category "Certificate")	**1,647,522**	1,647,522	65,000	254,500	840,000	85,000	42,000	278,304	22,054	27,404	440	32,820	**390,000**	**23.7%**
5	Gisela 5 (4x1.6 "Ordinary" biological category)	**1,587,626**	1,587,626	72,000	254,500	840,000	85,000	42,000	200,398	27,705	38,734	550	26,739	**393,500**	**24.8%**
6	Gisela 5 (4x1.6 biological category "Certificate")	**1,713,618**	1,713,618	72,000	254,500	840,000	85,000	42,000	327,120	23,651	30,714	440	38,193	**393,500**	**23.0%**

Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

Thus, we can mention that when planting a hectare of ordinary orchard, the farmer needs approx. 137.3 thousand lei (MDL). For the establishment of 1 ha of intensive orchard, investments will increase by 69.3% (investments are provided for the drip irrigation system) compared to the ordinary orchard, and for 1 ha of super-intensive orchard – by 12.5 times (investments are taken into account for the cost of planting material, higher tree density, drip irrigation system, rain and hail nets) (Table 3).

The intensive and super-intensive technology is the most expensive for the entrepreneur, it requires the largest investments per hectare (but the natural risks are practically diminished). As a result, it allows to obtain the best economic results, quality fruits (fruits are greater than 28 mm in size – they are in demand on export markets), it is recommended for the entrepreneurs who offer competitive advantages to producers. Table 4 summarizes the information on the revenues and expenditures budgets for the care of

cherry orchards which bear fruits with the application of three variants of cultivation technologies.

Table 4. Revenue and expenditure budgets for the care of fructifying cherry plantations

#	Specification of cherry cultivation technology	Sales income, lei / ha	Cost of sales, lei / ha						Profit, lei/ha	Economic profitability,%
			total	inclusive						
				means of production	mechanized services	manual operations	other costs and taxes (including depreciation)	unexpected expenses		
1	Wild cherry (frank cherry)	**113,600**	54,052	6,161	2,191	36,963	**3,823**	4,914	**59,548**	**110.2%**
2	Cherry Maxima 14	**211,200**	85,931	11,030	3,136	46,195	**17,759**	7,812	**125,269**	**145.8%**
3	Gisela 6 (4x1.9 "Ordinary" biological category)	**521,053**	231,438	20,692	5,037	59,465	**125,205**	21,040	**289,615**	**125.1%**
4	Gisela 6 (4x1.9 biological category "Certificate")	**560,526**	228,846	20,692	5,099	58,640	**123,612**	20,804	**331,680**	**144.9%**
5	Gisela 5 (4x1.6 "Ordinary" biological category)	**656,250**	233,035	21,742	5,774	60,241	**123,612**	21,667	**423,215**	**181.6%**
6	Gisela 5 (4x1.6 biological category "Certificate")	**703,125**	238,115	21,742	5,848	60,183	**128,696**	21,647	**465,010**	**195.3%**

Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

If we compare the data from table 4 we find out:
(i)The regular technology allows to obtain a gross profit of 59,548 lei/ha;
(ii)The intensive technology allows to obtain a gross profit of 125,269 lei/ha;
(iii)The super-intensive technology allows to obtain a gross profit from 289,615 to 465,010 lei/ha, which is the most advantageous for a modern and sustainable agriculture.
Table 5 presents the economic indices for the cultivation of cherry orchards with the application of three variants of fruit production technologies for the three analyzed technologies.

Table 5. Economic indices in cherry plantations cultivated by different technologies

#	Specification of cherry cultivation technology	Economic calculations per 1 kg of production, lei / kg			Cash flow available annually, lei / ha	Basic indices for the fruiting period of orchard, thousands lei			Cumulative gross profit on average at one year of operation, lei
		Average selling price, lei / kg	Unit cost, lei / kg	Gross margin (commercial addition), lei / kg		Cumulative total costs	Cumulative total sales revenue	Cumulative gross profit (gross margin)	
1	Wild cherry (frank cherry)	16.00	7.61	8.39	63,632	1,173.1	2,412.0	1,238.8	**47,647**
2	Cherry Maxima 14	20.00	8.14	11.86	144,682	1,291.3	3,421.7	2,015.3	**100,764**
3	Gisela 6 (4x1.9 "Ordinary" biological category)	30.00	13.33	**16.67**	**427,219**	2,852.6	7,069.1	4,216.4	**248,026**
4	Gisela 6 (4x1.9 biological category "Certificate")	30.00	12.25	**17.75**	**467,532**	3,049.7	8,138.8	5,089.1	**299,360**
5	Gisela 5 (4x1.6 "Ordinary" biological category)	30.00	10.90	**19.10**	**559,597**	2,934.8	8,816.6	5,881.8	**345,991**
6	Gisela 5 (4x1.6 biological category "Certificate")	30.00	10.16	**19.84**	**606,455**	3,170.3	10,124.4	6,954.2	**409,069**

Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

Based on the data from Table 5, we graphically present the size of the main economic indicators for the cultivation of cherry orchards with the application of the three variants of production technologies (Fig.1).
According to the economic calculations presented in Table 5 and Fig. 1, when planting a cherry orchard, specialists recommend entrepreneurs to apply super-intensive cherry cultivation technologies (seedlings grafted on rootstock Gizela 5 or 6), because it allows to obtain the best economic results and guaranteed access to strategic cherry markets. Despite the high profitability of cherry orchards and the high demand for the products obtained from them, the expansion of cherry plantations is conditioned by increased natural risks.

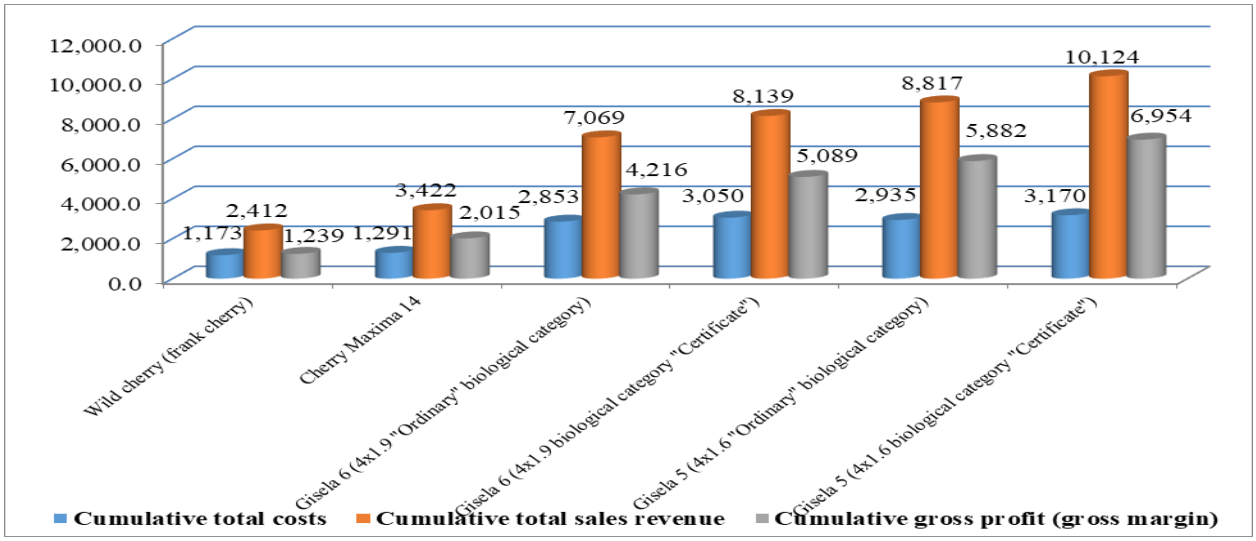

Fig. 1. Economic indicators for cherry cultivation by applying different technologies
Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

Table 6 proposes for analysis the economic efficiency of cherry cultivation with the application of different technologies where the advantages and disadvantages of technologies in economic terms can be easily elucidated.

Table 6. The possible economic efficiency to be obtained in cultivation of cherries with the application of different technologies

The main economic indicators	Unit	Analysis of economic efficiency in cherry cultivation					
		Wild cherry (frank cherry)	Cherry Maxima 14	Cherries Gisela 6 (4x1.9; 1316 trees/ha)		Cherries Gisela 5 (4x1.6; 1563 trees/ha)	
				local planting material	import planting material	local planting material	import planting material
Investment budget for the creation of the cherry plantation	**lei**	**137,324**	**232,478**	**1,543,135**	**1,647,522**	**1,587,626**	**1,713,618**
Possible subsidies to be obtained	lei	15,000	42,500	390,000	390,000	393,500	393,500
Sales revenue (turnover)	lei	113,600	211,200	521,053	560,526	656,250	703,125
Sales costs	lei	54,052	85,931	231,438	228,846	233,035	238,115
Annual gross profit	**lei**	**59,548**	**125,269**	**289,615**	**331,680**	**423,215**	**465,010**
Economic profitability (profits obtained at 1 lei of costs)	**%**	**110.2%**	**145.8%**	**125.1%**	**144.9%**	**181.6%**	**195.3%**
Cash flow at the end of the year - availability of money	**lei**	**63,632**	**144,682**	**427,219**	**467,532**	**559,597**	**606,455**
Unit cost	**lei / kg**	**7.61**	**8.14**	**13.33**	**12.25**	**10.90**	**10.16**
Average marketing price	lei / kg	16.00	20.00	30.00	30.00	30.00	30.00
Gross profit (gross margin) of production	**lei / kg**	**8.39**	**11.86**	**16.67**	**17.75**	**19.10**	**19.84**
Investment return term (fruiting years)	ani	2.05	1.52	3.98	3.79	2.86	2.84
Investment return term (years from planting)	**ani**	**8.05**	**6.52**	**8.98**	**7.79**	**7.86**	**6.84**

Source: Calculations of the group of authors [1, 2, 4, 6, 7, 8, 9, 10].

Analyzing the data from the table, we can conclude that super-intensive technologies are clearly superior and are recommended to be implemented by farmers, because they offer the highest results of economic efficiency and a significantly higher profitability compared to the regular and intensive ones.

CONCLUSIONS

Cherries marketing is advantageous for the entrepreneur, as it allows to obtain income from early sales which is very necessary for cash inflows in the flow of the enterprise and for more efficient management of agricultural holdings. Cherry fruits are in great demand with consumers, being among the first fruits and having an advantageous and stable marketing price for the season (in the case of quality fruits and the required assortment range).

The group of authors recommends to farmers the implementation of super-intensive cherry cultivation technologies, and the following aspects are the arguments:

-The super-intensive orchards allow to obtain qualitative cherries (homogeneous by size and quality with a stable harvest every year);

-The management of super-intensive orchards is more efficient due to the small shape of the tree crown (easier dry cutting, tree spraying, cherry harvesting, short harvest time, etc.);
-The high productivity of cherries in super-intensive orchards allows us to have unit production costs ensuring competitiveness, which is extremely important in the competitive fight on regional markets;
-Production factors in super-intensive orchards are used at a high level and can be more easily controlled by humans;
-Super-intensively planted orchards benefit from substantial subsidies;
-The purchase prices of cherries from the open field will be high, because they are among the first fruits, and the super-intensive orchards allow to have a high level of profitability in these conditions.

Practical recommendations for increasing the economic efficiency of cherries cultivation:
-Integrated cherry business demonstrates that the performance of producers can take place through professional and commercial association/cooperation, where the legal framework should facilitate and develop these initiatives through clear and sustainable mechanisms;
-Professional associations should provide an appropriate information circuit for producers and offer operational information on the real situation in the industry and on regional markets;
-Cherry growers recognize the importance of standards. Quality standards are becoming a critical necessity in the context of general traceability requirements, which relate not only to the exigent EU markets but also to other strategic markets.

The final conclusion is the following: the cherry growing sector has increased profitability, but only if the producer implements a super-intensive fruit production technology, which will allow him to produce competitive cherries that will be easily accessible on strategic markets, by cooperating with producers in the formation of industrial batches for export and ensuring stable deliveries for a longer period.

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EFFECT OF APPLIED FERTILIZERS ON VEGETATIVE GROWTH AND "SOIL RESPIRATION" IN ORGANICALLY GROWN *TR. MONOCOCCUM* L.

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Abstract

Biofertilizers application in agro-ecosystem improves the soil properties, protects the environment and has a positive effect on plants. As a result of the application of the studied biofertilizers, the plants heights in spindle phase are higher in all variants, compared to the control one. This difference is greatest at the treated with Baikal EM - 48.57 cm, which is 14% above control, followed by the one, treated with Amalgerol - 47.85 cm and Tryven - 47.73 cm. The positive effect on the studied biofertilizers on Triticum monococcum L., for good nutrition and intensive plant cultivation, is maintained until full density, where the highest values are reported at the variants treated with Lithovit - 99.6 cm (11% above control), Triven - 97.45 cm (8.8%) and Baikal EM - 97 cm (8.3%). The increase of the microbial activity in the soil at the variant, treated with Baikal EM (heading phase) shows a trend that persists on the 7th, 14th and 21st day and has a positive effect on the plant height.

Key words**:** *biofertilizers, organic agriculture, Tr. monococcum L., soil respiration, vegetative growth*

INTRODUCTION

Chemical fertilizers have been used intensively around the world to increase crop yield. However, they have started depositing their harmful effects to the soil and environment, thus causing reduction in soil quality [31, 4] and disturbing the harmony existing among the soil, plant and microbial population [6]. One of the proposed solutions to environmental and human health protection issues is the implementation of natural technologies of plant cultivation and fertilization through the applications of biofertilizers [1]. A biofertilizer includes mainly nitrogen fixing, phosphate solubilizing and plant growth promoting microorganisms [17, 38, 22, 29], which are the basis of the greatest natural gifts of our agricultural science [24]. Biofertilizers have a very significant role in improving soil fertility by fixing atmospheric N, both in association with plant roots and without it, solubilize insoluble soil phosphates and produce plant growth substances in the soil [22]. Biofertilizers are environment friendly agro-input of organic origin and work on the conversion of unavailable essential elements to available form through their routine metabolic activities [24, 36]. Application of biofertilizers improve physico-chemical properties of soil like soil texture, pH [29], encourage plant growth and productivity [2, 37], enhance soil fertility and health [18], and have important and long-term environmental implications [27]. Precisely because the use of biofertilizers makes the agro-ecosystem healthy [3], they are suitable for practising organic farming [28]. Nutrients are the most important limitation to growth and development of plants [32], but optimal crop productivity and optimal nutrient use efficiency must be in balance [5]. Organic fertilizers contain organic compounds which increase soil fertility either directly or by their decay [27], and also improve soil fertility status by activating the soil microbial biomass [26].

Soil is a dynamic, living natural system that is vital to the function of the agroecosystem [12, 8]. The rhizosphere is an area of soil around the roots that is affected by it [9, 25], as a result of the vital activity of soil

microorganisms (respiration, fermentation and decay of organic residues) emit significant amounts of CO_2, which is immediately used by plants [21]. To determine the soil microbial activity, the most characteristic indicator is soil microbial respiration [35, 33].
The einkorn (*Triticum monococcum* L.) was originally cultivated around Karacadag in Turkey [14] and in the Middle-East, Central Asia, Europe and North-Africa [40]. It is grown mainly in France, Turkey, Morocco [10, 7]. Einkorn belongs to the group of "ancient" wheat (*Tr. monococcum* L., *Tr. dicoccum* Sch. and *Tr. spelta* L.) and in recent years the interest in it is significant because it is an alternative to healthy foods [16, 15, 11, 19] and is suitable for the organic system of agriculture [39, 23]. Its cultivation is encouraged because there is conservation of genetic resources in Turkey [20] and Bulgaria [40], biodiversity of wheat is preserved in organic farming. The aim of the study is to trace whether the types of biofertilizers used affect the vegetative growth and soil respiration of einkorn *Tr. monococcum* grown according to the principles of organic crop production.

MATERIALS AND METHODS

The study was conducted in 2014 - 2017 at the Agroecological Center at the Agricultural University on the alluvial - meadow soil. A three - factor experiment was performed by the block method, in three repetitions with the size of the reported plot 10.5 m^2. The factors are- vegetation year (2014/2015; 2015/2016; 2016/2017); type of wheat - einkorn (*Tr. monococcum* L.*)*; Vegetation fertilization - basic fertilization with Agriorgan pallet and foliar fertilization with Amalgerol, Lithovit, Baikal EM and Tryven. Biofertilizer Agiorgan pellets was applied in a dose of 100 kg/da. All foliar fertilizers were applied twice in the tillering and the stem elongation phases in the following concentrations, respectively: Amalgerol - 200 ml/da in tillering phase and 500 ml/da in the stem elongation phase; Lithovit- in a dose of 150 g/da; Baikal EM - with 0.1% solution; Tryven - 400 ml/da. The selected biofertilizers, belong to the list of permitted biofertilizers in the European Union 'Organic' Regulation No. 889 [30].
Characteristics of used biofertilizers:
Amalgerol - is a liquid emulsion concentrate rich in hydrocarbons and natural plant growth hormones. Contains seaweed extracts, distilled paraffin oil, vegetable oils, distilled herbal extracts.
Lithovit - is a high quality nanotechnology product created by tribodynamic activation and micronization. Contains ($CaCO_3$) - 79.19%; ($MgCO_3$) - 4.62%; (Fe) - 1.31% and others.
Baikal EM - 1Y - is a probiotic product containing beneficial microorganisms (lactic acid bacteria, yeast, bifidobacteria, enzymes and spore bacteria) which are antagonists of pathogenic and opportunistic microflora.
Tryven - is a complex mixture of NPK, contains (N) - 24.4%; Organic nitrogen - 17.3%; (P_2O_5) - 17.2%; (K_2O) - 7.42%. It has a good systemic effect, especially nitrogen.
Agriorgan pellet- is an organic fertilizer from sheep manure, enriched with microorganisms and a supplement of trace elements. Contains: Organic nitrogen (N) - 2.5%; (P_2O_5) - 3.0%; (K_2O) - 1.0%; Organic carbon (C) - 28.5%; Humic acids - 6.0%; pH - 6, fulvic acids.
Einkorn (*Triticum monococcum* L.) is the oldest species in the group of covered or non-essential wheat. When threshing, the class spindle breaks and the grain remains tightly wrapped in chaff. In order to be used for food, additional peeling is required. Pepper was used as a precursor for the experiment. For successful control of early spring weeds in the crop is used harrow in March when the crop is in the phenophase twinning, and weeds are in the early stages of development and this method is extremely effective for weed control in crops with a fused surface in the system of organic production. Due to the pronounced resistance to diseases and pests, plant protection was carried out only in the first experimental year (2014 - 2015), against an attack by the common wheat leech (*Lema melanopus*) with Nimazal - a dose of 300 ml/da. Occurrence of a partial attack of rust (*Puccinia graminis f. sp. tritici*) in the same year at the end of the growing season (in the phase of full ripeness) did not require a fight.

Study Parameters: Plant height - measure the height of 10 plants of each variant and each repetition in the phases of twinning, spindling and full maturity; *'Soil respiration'*- total microbiological activity is determined by the amount of CO_2 released (determination of the intensity of CO_2 release). The method used is a modification of the method of Stotzky [34, 33]. The statistical processing of the experimental data was performed using SPSS V. 9.4 for Microsoft Windows by the method of Duncan [13].

RESULTS AND DISCUSSIONS

Plant height- *Tr. monococcum* L. by phenophases

The results for the plants height influenced by the applied biofertilizers show that in 2015 by *Triticum monococcum* L. in tillering phase highest height was reported in the combined application of Baikal EM biofertilizers - 10.30 cm and Lithovit - 10.03 cm on basic fertilization with Agriorgan pallet (Table 1).

At tillering phase highest value of the indicator is at treatment with Amalgerol - 55.40 cm, followed by the this with Tryven - 54.43 cm and Baikal - 53.33 cm, and in full ripeness phase the highest values are at Lithovit treated variants - 95.77 cm, followed by Tryven - 95.20 cm. Higher values are reported in all fertilized variants, but with no trend.

In 2016 highest plant in tillering phase are reported at the variants treated with Lithovit - 22.50 and Amalgerol - 21.17 cm, wher the increase is respectively 7.6% and 1.3%, compared to the control. In stem elongation phase, the plants are reported at Lithovit - 51.20 and Amalgerol - 47.63 cm, from 5.1% and 7.1% above the control.

Table 1. *Tr. monococcum* L plants height, by phenological phases and fertilization variants (2015 - 2017), cm

Phenological phases	**Tillering**					**Stem elongation**					**Full ripeness**				
Year Variants	2015	2016	2017	Ave rage	%	2015	2016	2017	Ave rage	%	2015	2016	2017	Ave rage	%
Control	-	20.90	11.55	16.22	100	-	44.47	40.90	42.68	100	-	93.72	85.4	89.56	100
Agriorgan pellets	8.63	19.57	12.30	13.50	83.2	49.90	47.37	44.03	47.10	110.3	90.73	97.38	90.7	92.94	103.8
Amalgerol	8.67	21.17	11.13	13.66	101.2	55.40	47.63	40.53	47.85	112.1	92.47	104.77	89.7	95.65	107.9
Lithovit	10.03	22.50	10.90	14.48	89.3	52.27	51.20	39.00	47.49	111.3	95.77	106.60	94.8	99.06	110.6
Baikal EM	10.30	20.22	11.30	13.94	85.9	53.33	47.20	45.17	48.57	113.8	92.43	102.97	95.6	97.00	108.3
Tryven	8.17	20.97	12.23	13.79	85.0	54.43	47.50	41.27	47.73	111.8	95.20	101.65	95.5	97.45	108.8

Source: Own survey.

All tested fertilizers have a positive effect on plant growth and their height values exceed control onse. As a result of the treatment with Lithovit, in full ripeness phase the plants reach height of 106.60 cm, followed by these with Amalgerol - 104.77 cm, which is by 14% and 12%. Feeding with the microbial biofertilizer Baikal EM also has a positive effect on plants growth and reaches an average value of 102.97 cm, which is 9.8% above the control. This percentage difference in the agro-ecosystem is essential to take into account the role of the applied vegetative feeding with biofertilizers.

In 2017 in tillering phase, the highest plants are reported at fertilization with Agriorgan pellet only - 12.30 cm, followed by the variant treated with Triven - 12.23 cm. For all other variants of fertilization, the data are inconsistent. During the stem elongation phase, highest plants are reported when treated with Baikal EM - 45.17 cm, which is 10.4% above the control, followed by the Agriorgan pellets, which is 7.6% above the control, but in full ripeness phase, higher values are reported when Baikal EM is applied (95.6 cm) and Tryven (95.5 cm) - 11.9% and 11.8% more than control variant. Average for the period of study in stem elongation phase, all variants of fertilization increase the values of this indicator, as the highest plant height is reported when treated with Baikal EM - 48.57 cm - 14% above the control, , followed by the variants treated with Amalgerol - 47.85 cm and Tryven - 47.73 cm. In full ripeness the data show that all studied

biofertilizers lead to better nutrition and intensive growth of plants in height at *Tr. monococcum* L., most pronounced in the variant treated with Lithovit - 99.6 cm (11% above control), Tryven - 97.45 cm (8.8%) and full ripeness phases at the average values is a tendency for higher plants in the variants treated with foliar fertilizers, on basic fertilization with Agriorgan pellet, compared to the unfertilized control. This shows the complementary effect of foliar fertilizers on plant nutrition.

Baikal EM - 97 cm (8.3%). *Tr. monococcum* L., reacts clearly to the applied biological fertilizers, expressed in an increase in the values of plant height indicator. This finding is confirmed by the synergistic effect of the applied fertilizer combinations with clear efficiency of foliar vegetation nutrition. It can be pointed out that in the stem elongation and distribution, despite the temperature values above the norm, shows a strong influence on the absorption of nutrients by plants in the different phases of their development (Tables 2 and 3).

Lack of moisture in the soil hinders microbiological processes, the absorption of nutrients by plants and vice versa.

Table 2. Air temperature by months, average for the study period (2014-2017)

Months	IX	X	XI	XII	I	II	III	IV	V	VI
2014 – 2015										
Average Monthly t ° C	18.1	12.8	7.9	5.1	3.1	3.7	6.7	12.4	19.3	21.1
On average for the period 1965 - 1995	18.3	12.6	7.4	2.2	-0.4	2.2	6	12.2	17.2	20.9
2015 – 2016										
Average Monthly t ° C	21	12.8	11.3	5.1	-0.1	8.0	9.3	15.5	17.0	23.3
On average for the period 1965 - 1995	18.3	12.6	7.4	2.2	-0.4	2.2	6	12.2	17.2	20.9
2016 – 2017										
Average Monthly t ° C	19.6	12.7	6.6	2.2	-3.9	3.2	9.7	12.7	17.6	22.8
On average for the period 1965 - 1995	18.3	12.6	7.4	2.2	-0.4	2.2	6	12.2	17.2	20.9

Source: Own Survey.

Table 3. Sum of rainfall (mm/m^2) by months for the period of study 2014 – 2017

Months	IX	X	XI	XII	I	II	III	IV	V	VI
2014 – 2015										
Monthly amounts	195.7	121.1	49.5	93.0	17.4	76.6	138.0	14.0	69.5	76.7
On average for the period 1965 - 1995	65	47	35	36	40	48	44	39	32	36
2015-2016										
Monthly amounts	100.6	70.3	39.6	3.6	69.6	24.4	33.9	30.7	64.7	59.7
On average for the period 1965 - 1995	65	47	35	36	40	48	44	39	32	36
2016-2017										
Monthly amounts	2.3	19.7	32.9	2.4	70.1	11.1	47.9	26.1	52.7	15.4
On average for the period 1965 - 1995	65	47	35	36	40	48	44	39	32	36

Source: Own Survey.

Soil respiration' at *Tr.monococcum* L.

The results for 'soil respiration' at *Triticum monococcum* L. after the first biofertilizer feedings during vegetation in 2016 are presented in Table 4 and show that on the 7th day the microbial activity is highest in the control plants and when Tryven is applied, which is due to the rich mineral NPK composition of the fertilizer and the rapid absorption of its organic nitrogen by the rhizosphere microflora together with appropriate temperature of the soil - 18.5 °C and favorable air humidity - 45%. Under the influence of ongoing processes in the soil and the increased microbial activity in the rhizosphere zone of the cereal crop on the 14th day higher values of 'soil respiration' are found in the variants with applied Lithovit and Amalgerol, which has a simulating effect and the crops shows larger values in plant height during tillering phase - 22.50 cm for Lithovit and 21.17 cm for Amalgerol. At plants treated with Tryven, is reported higher soil activity on the 21st day after treatment, which leads to

a higher plants height in the stem elongation phase - 47.50 cm. There was a general decrease in soil activity on the 21st day after treatment in all fertilized variants.

Table 4. 'Soil respiration' (μg CO_2/h/g) data at *Tr.monococcum* L, on the 7th, 14th and 21st day of fertilizer application (2016)

Variants	7th day	14th day	21st day
	Average ± St.dev	Average ± St.dev	Average ± St.dev
First reporting - (phase stem elongation)			
Control	12.50 ± 0.361 [a]	9.33 ± 0.578 [c]	9.53 ± 0.115 [a]
Agriorgan pellets	11.40 ± 0.693 [b]	11.33 ± 1.155 [ab]	9.50 ± 0.173 [a]
Amalgerol	11.20 ± 0.200 [b]	12.33 ± 0.577 [a]	9.63 ± 0.153 [a]
Lithovit	11.43 ± 0.379 [b]	12.33 ± 0.576 [a]	9.67 ± 0.577 [a]
Baikal EM	12.27 ± 0.252 [a]	10.67 ± 0.576 [b]	7.17 ± 0.723 [b]
Tryven	12.33 ± 0.115 [a]	10.67 ± 0.576 [b]	9.70 ± 0.263 [a]
Second reporting - (phase heading)			
Control	6.8 ± 0.153 [b]	7.1 ± 1.044 [c]	6.9 ± 0.115 [c]
Agriorgan pellets	9.2 ± 0.058 [a]	8.63 ± 0.551 [ab]	7.9 ± 0.231 [bc]
Amalgerol	9.2 ± 0.301 [a]	8.20 ± 0.700 [bc]	9.0 ± 0.702 [a]
Lithovit	7.4 ± 1.300 [b]	9.30 ± 0.608 [ab]	10.4 ± 1.039 [a]
Baikal EM	7.2 ± 1.358 [b]	9.57 ± 0.404 [a]	8.6 ± 0.404 [ab]
Tryven	9.2 ± 0.529 [a]	9.20 ± 0.173 [ab]	9.0 ± 0.551 [ab]

Source: Own Survey; Duncan's multiple range test (P<0.05)

The results for the second reporting (heading phase) show that the 'soil respiration'on the 7th day is proven to be more intensive in the variants with biofertilizer Amalgerol, Tryven and with Agriorgan pallet only. There is a definitely proven increase in soil activity on the 14th day in the variant treated with biofertilizer Baikal EM, which is due to the increased microbial activity of the species that find more favorable conditions for development in this environment. The strongest activity of the indicator on the 21st day was found in the variant treated with Lithovit, followed by Amalgerol, which has a positive effect on vegetative growth in the phase of full ripeness where the einkorn height is 95.77. The results of 'soil respiration' at *Triticum monococcum* L. in 2017 (Table 5) after the first feeding with biofertilizers (tillering phase) show that proven microbial soil activity is enhanced at the variant, treated with biofertilizer Baikal EM on the 7th day - 11.85 μg CO_2/h/g to 10.42 μg CO_2/h/g for the control variant, and this trend is maintained on the 14th day (12.91 μg CO_2/h/g, 10.31 μg CO_2/h/g for the control variant) and on 21st day also (12.06 μg CO_2/h/g at 9.32 μg CO_2/h/g for the control variant).

The long-term action of the organic product and the rapid crop assimilation affect the vegetative growth and the plants reach a greater height in the phase of full ripeness - 95.6 cm, compared to the control variant (85.4 cm) (Table 1).

Table 5. 'Soil respiration' (μg CO_2/h/g) data at *Tr.monococcum* L, on the 7th, 14th and 21st day of fertilizer application (2017)

Variants	7th day	14th day	21st day
	Average ± St.dev	Average ± St.dev	Average ± St.dev
First reporting - (phase stem elongation)			
Control	10.42 ± 0.104 [e]	10.31 ± 0.092 [e]	9.32 ± 0.121 [e]
Agriorgan pellets	11.13 ± 0.026 [c]	11.83 ± 0.066 [d]	9.64 ± 0.074 [d]
Amalgerol	11.84 ± 0.050 [a]	12.42 ± 0.171 [b]	11.82 ± 0.132 [b]
Lithovit	10.93 ± 0.078 [d]	12.03 ± 0.062 [c]	11.43 ± 0.162 [c]
Baikal EM	11.85 ± 0.049 [a]	12.91 ± 0.081 [a]	12.06 ± 0.059 [a]
Tryven	11.27 ± 0.015 [b]	11.83 ± 0.047 [cd]	11.82 ± 0.100 [b]
Second reporting - (phase heading)			
Control	9.35 ± 0.050 [d]	8.14 ± 0.026 [f]	7.91 ± 0.032 [f]
Agriorgan pellets	11.32 ± 0.188 [b]	10.28 ± 0.031 [e]	8.14 ± 0.012 [e]
Amalgerol	10.47 ± 0.095 [c]	10.83 ± 0.084 [c]	10.63 ± 0.055 [b]
Lithovit	10.61 ± 0.151 [c]	11.24 ± 0.052 [b]	9.72 ± 0.114 [d]
Baikal EM	11.82 ± 0.038 [a]	12.47 ± 0.090 [a]	12.33 ± 0.020 [a]
Tryven	10.63 ± 0.046 [c]	10.65 ± 0.032 [d]	10.42 ± 0.031 [c]

Source: Own Survey; Duncan's multiple range test (P<0.05).

Higher values of the indicator 'soil respiration' are proven reported seven days after treatment at the Amalgerol-applied variant - 11.84 μg CO_2/h/g at 10.42 for the control. The proven positive effect of fertilization is maintained on the 14th (12.42 at 10.31 μg CO_2/h/g for the control) and 21st days (11.82 at 9.32 μg CO_2/h/g for the control) after the Amalgerol application.

The increased soil microbial activity at the variants, treated with Amalgerol and Baikal EM is also contributed by the favorable environmental factors during the reporting period, the higher soil moisture (19.6 mm/m^2 precipitation) in the previous 7 days before reporting, as well as the average soil temperature - 16.5˚C in the layer of 0 - 10 cm (Table 2).

The agrometeorological conditions of the environment, preceding the second reporting have a strong influence on the soil respiration and vegetative growth of plants. The increase of the microbial activity in the soil at the variant, treated with Baikal EM (heading phase) shows a trend that persists on the 7th, 14th and 21st day and has a positive effect on the plant height. There is an increase in soil microbial activity on the 7th day, in the variant with Agriorgan pellets only, which can be explained by the rich organic composition of the fertilizer.

CONCLUSIONS

Einkorn reacts positively to the applied biofertilizers. All studied biofertilizers increase the height of the plants compared to the control. In the spindle phase, the highest height was reported after treatment with Baikal EM - 48.57cm (14% above control), Amalgerol - 47.85cm and Tryven - 47.73cm, and in full ripeness after treatment with Lithovit - 99.6 cm (11% above control), Tryven - 97.45 cm (8.8%) and Baikal EM - 97 cm (8.3%). 7 days after treatment, the soil microbial activity is highest at the variants, treated with Amalgerol and Baikal EM, on the 14th day at the variants with Baikal EM, Lithovit and Amalgerol applied, and this trend is maintained on the 21st day. At the Tryven-treated variant, is reported higher soil microbial activity on the 21st day after treatment. There is a tendency to increase the values of soil respiration from the 7th to the 14th day and a general decrease to the 21st day.

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