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INFORMATION AND TRAINING NEEDS OF COTTON FARMERS ON THEIR FARMING ACTIVITIES IN ZAMBIA

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Abstract

A major reason for farmers' poor yield of farm products and low returns may be adduced to dearth of statistics and teaching about their farming activities. This study, thus, focused on the cotton farmers' information and training needs required their farming activities in Zambia. A simple random sampling technique was used to select 86 cotton farmers for the study. Descriptive statistics were used to examine the data collected while the Kruskal-Wallis H test was used to test the hypothesis. The results revealed that the mean age of the cotton farmers was 45 years while their average yearly income was ZMW 2061.62. The cotton farmers' attendance of business skill development training ($\chi 2$ = 14.9), steady farm budget operations ($\chi 2$ = 5.16), consistent farm financial analysis execution ($\chi 2$ = 4.96) and information and training needs on fertilizer ($\chi 2$ = 12.56), pesticides ($\chi 2$ = 4.69), labour ($\chi 2$ = 17.7), sources of inputs ($\chi 2$ = 19.78), cost on household expenses ($\chi 2$ = 8.68), methods of calculating profit from farming activities ($\chi 2$ = 5.18), income generation from farming activities ($\chi 2$ = 5.97) and non-farming activities ($\chi 2$ = 6.02) were significantly different in the agro-ecological regions of Zambia. The study concluded that cotton farmers' training needs are location-specific. Meaningful and effective training, therefore, require that training institutions need to identify the training needs of farmers in the different agro-ecological regions and develop appropriate training modules for these different regions. This has the potential of higher returns of farm-based productivity and profitability of cotton farmers in Zambia.

Key words: *Zambia, information, training, needs, cotton, farmers*

INTRODUCTION

Cotton remains amongst Zambia`s foremost crops positioning next to the basic food products such as maize with respect to its importance and the number of agrarians who cultivate it. Nearly three hundred thousand agrarians produce cotton by the year and making total joint returns of almost US40 Million to the country [12].

Training is the deed of aggregating the understanding and abilities of an individual(s) in undertaking a specific job [20]. This typically focused on enhancing the skill of an individual to do his/her job well. It is the need as the gap between what is going on at present and what ought to go on [22]. It is the gap between the present and the standard level of work output. The training needs of farmers are dissimilar and differ from one crop to another crop [9]. It is important because it induces enthusiasm, builds self-confidence and indoctrinates competence in an individual [1]. It is inevitable for conveying new understanding and bring up-to-date the abilities of the farmers. However, the training of farmers had anticipated added significance and resolution as inputs are being used arbitrarily, not properly sourced for, unsteady farm budget operations and inconsistent farm financial analysis execution by farmers in cotton crop production [20]. Pest prevalence is the main problem of cotton farmers owing to use of indigenous varieties [3; 14; 15; 21; 23].

In order to achieve the goal of reducing the loss of farm output and to be environmentally friendly, farmers have to be prudent in the use of farm inputs with respect to cost, dosage, time, source and method of application with the objectives of maximizing cost-benefit

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ratio and output at minimum cost to maximise profit and satisfaction [16].

In regard to the aforementioned issues, this study examined the following objectives: To

(i) profile the personal characteristics of the Zambian cotton farmers;

(ii) assess the production characteristics of the Zambian cotton farmers;

(iii) estimate the training and record-keeping experience of the Zambian cotton farmers;

(iv) evaluate the information and training needs of the Zambian cotton farmers;

(v) determine the factors responsible for Zambian cotton farmers not keeping records.

Based on the objectives of the study, the following hypotheses were tested.

H_{01}: There are significant differences in cotton farmers' training and record-keeping experience in the Agro-ecological regions of Zambia.

H_{02}: There are significant differences in cotton farmers' information and training needs on the farm activities in the Agro-ecological regions of Zambia.

MATERIALS AND METHODS

Study area

The study area is the agro-ecological regions of Zambia. Cotton is a semi-arid crop. It is grown in fringe, little or modest precipitation regions [11; 18]. The foremost cotton-producing provinces in Zambia are Eastern, Southern and Central provinces [17]. Based on agro-ecological characteristics, Zones 1 (AEZ 1) and 2a (AEZ IIa) [10] are the major cotton-producing areas in Zambia. The agro-ecological zones are defined on the base of precipitation array and soil features. Region I obtains less than 800 millimetres of rainfall annually and set up 12 percent of Zambia's aggregate terrestrial space. It entails of loamy clayey soils on the gorge ground and rough to fine loamy trivial soils on the cliff. It is also regarded by small rainwater, dumpy emergent periods, great warmth during the growing seasons, and high threat of dearth. Region II takes rainfall between 800 to 1,000 millimetres on a yearly base and the region institutes 42 percent of the country. It is sub-divided into two, namely, Region IIa (Central, Lusaka, Southern and Eastern fertile plateau of the country and largely comprises intrinsic rich soils) and Region IIb (Western Province and contains sandy soils). Region III is considered by high rainfall between 1,000 up to 1,500 millimetres each year, extended emergent times, low likelihood of famine, and serener heats during the growing term. This region creates 46 percent of the country's total land area. It covers the Copperbelt, Luapula, Northern and North-Western Provinces. Cotton is a drought-tolerant crop and obtains the right amount of rainfall when planted in AEZ Region 1. Cotton production is severely intense in Eastern, Central and Southern provinces respectively [24]. On the other hand, the attentiveness intensities are not as high as likened to food crop production [26].

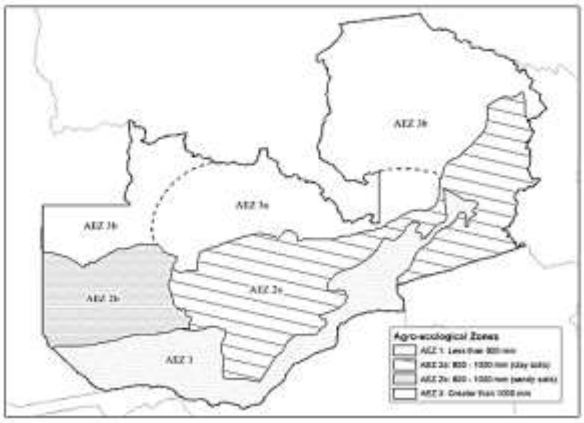

Fig. 1. Agro-ecological zones of Zambia
Source: [10].

Sampling procedure and sample size

Cross-sectional primary data were collected using the survey method. Interviews were conducted using the questionnaire. Simple random sampling technique was used in picking 105 cotton farmers (35 cotton farmers from each region) from the list of 150 cotton farmers (50 cotton farmers from each region serving as the sample frame) who attended the Farmers Business School training session. Only 86 cotton farmers responded to the questionnaire administered constituting about 71% of the sample frame. The data collected were analysed and used for this study.

Data Analysis

Descriptive statistics: These include the use of means, percentages and frequencies. These were used to present the personal characteristics of respondents and other analysis of subsequent objectives.

Kruskal-Wallis test: This is a one-way analysis of variance by ranks. It tests the insignificant guess that multiple self-determining samples come from the same population. Not like standard analysis of variance, it does not shoulder normality, and it can be used to test ordinal variables. The nonparametric tests for various autonomous samples are useful for determining whether or not the values of a particular variable differ between two or more groups. This is exclusively true when the expectations of analysis of variance are not met.

RESULTS AND DISCUSSIONS

Personal Characteristics of respondents

Table 1 presented the distribution of personal characteristics of the respondents. The result showed that the mean age of the farmers was nearly 45 years while majority of the respondents (60.5%) were above the age of 40 years. This indicated that the cotton farmers were relatively middle-aged. Although it is speculated that the older age group of farmers may affect cotton production in the study area. This finding is supported by [25] who disclosed that cotton farmers in Zambia, had an average age of 47 years while [17] disclosed an average age of 48 years. Besides, the majority (81.5%) of the respondents were male. This is an indication that male farmers dominated cotton production in the study area. This is consistent with other studies which showed that there are fewer female farmers than male farmers participating in the agricultural related activities [5; 6; 7]. Moreover, 94.6% of the respondents were married. Farmers' marital status was an important factor in affecting the production participation decision. It is a proxy for other factors such as household size in explaining the production participation decision [17]. The marital status of the farmers may be adduced to the fact that the societies and culture expect matured individuals particularly farmers to get married. Often times the wives and children see to assist the farmers on their farms. This is an indication that more members of the farm family are likely going to be available for cotton production thus increasing cotton production. This is an advantage because the availability of the farm family members on the farm may reduce the labour cost on the farms. Family labour is an important component of labour for small farmers, because the pressure by the large family size, could lead to land fragmentation, therefore, small farm holdings tend to abound [4]. The effect is that such farmers who are challenged by insufficient land area may not readily adopt an extension package that requires large scale farming. This finding corroborates [17] who reported a high percentage of cotton farmers to be married.

More than half of the respondents (53.1%) had primary school education. The level of education is an important attribute of farmers in decision making. This finding implied that the majority of respondents spent relatively few years in school [25]. They had the basic educational ability to read and write. This might have been helping them to read instructions during seminars and training. It is an important factor in the success of seminars, workshops and training presented. [17] noted that the educational level of the farmers was significant in influencing their production participation decision. This seems to reflect the level of decision making that takes place in crops production. It reflects positively on the level of their decision making on the varieties of crops produced.

Table 1. Personal characteristics of respondents

Personal Characteristics		Region			Total (N=86)
		1 (n=30)	2 (n=32)	3 (n=24)	
Age (Years) $\bar{x} = 44.58$ $\sigma = 12.83$	≤ 30	13.3	21.9	12.5	16.3
	31 - 40	23.3	34.4	8.3	23.3
	41 - 50	26.7	21.9	50.0	31.4
	≥ 51	36.7	21.9	29.2	29.1
Education Level	Vocational	3.4	6.7	13.6	7.4
	Primary	65.5	60.0	27.3	53.1
	Secondary	31.0	30.0	59.1	38.3
	Diploma	0.0	3.3	0.0	1.2
Marital Status	Married	90.0	87.1	100.0	91.6
	Not Married	10.0	12.9	0.0	8.4
Sex	Male	86.2	82.8	73.9	81.5
	Female	13.8	17.2	26.1	18.5

Source: Own Calculation.
Note: Values are in Percentages.

The results further revealed that majority of the respondents (67.5%) had more than 4 children. The average number of children of the respondents was approximately 6 children. Majority of the respondents (84.6%) made sure that their children assisted them on the farm. This is an indication that the large household size of the farmers is as a result of the need for assistance by the household members. Household size is an important variable especially in crops which are labour intensive such as cotton. However, other studies such as [2; 8] found a positive relationship between large family size and efficiency. Their argument was that large household size enhances the availability of labour which may guarantee increased efficiency. Furthermore, 94.6% of the respondents reported that they planted other crops apart from cotton, although, 74.1% considered cotton production as a productive, profitable and worthwhile business. The average yearly income of the respondents was ZMW 2,061.62, and 84.6 % of these cotton farmers indicated that they made about ZMW 2,000 as their yearly income.

Table 2. Production characteristics of respondents

Production Characteristics		Region 1 (n=30)	Region 2 (n=32)	Region 3 (n=24)	Total (N=86)
Children $\bar{x} = 6$ $\sigma = 3$	≤4	36.7	37.5	20.8	32.6
	4-7	36.7	34.4	33.3	34.9
	≥8	26.7	28.1	45.8	32.6
Child labour	Yes	84.2	83.3	85.7	84.6
	No	15.8	16.7	14.3	15.4
Other crop(s) production	Yes	88.9	93.3	100.0	93.6
	No	11.1	6.7	0.0	6.4
Cotton production is profitable	Yes	82.8	51.6	95.2	74.1
	No	17.2	48.4	4.8	25.9
Av. Yearly Income (ZMW) $\bar{x} = 2061.62$ $\sigma = 1512.19$	≤2,000	82.4	91.7	80.0	84.6
	≥2,001	17.6	8.3	20.0	15.4

Source: Own Calculation.
Note: Values are in Percentages.

Training and record keeping experience of respondents

Table 3 showed the respondents' training and record-keeping experience. Results revealed that most of the respondents (51.2%) had not attended any pieces of training on business skills development in the past. This implied that the majority of the farmers had not gotten the experiences of farm business management training, workshops and seminars on business development and these experiences are been found useful to them. [19; 26] stated that the inexperience of farmers on training and record-keeping warrants the need for organising training sessions for farmers and serve as the platform for organising training classes. Many (60.8%) of these cotton farmers indicated that they have not been keeping records of activities on their farms. Majority of the farmers (62.7%) further indicated that they do not know how much they spent and realized from their previous cotton production cycle. They have never calculated their profit to know whether they are doing well in the business or not. This is line with [27] who stated that issues related to farmers' business skills development, record-keeping activities, farm budgeting and financial analysis are important synopsis in organising training for farmers.

Table 3. Training and record keeping experience of respondents

Training and Record-Keeping Experience		Region 1 (n=30)	Region 2 (n=32)	Region 3 (n=24)	Total (N=86)
Have you attended any training in business skill development before?	Yes	20.7	70.0	56.5	48.8
	No	79.3	30.0	43.5	51.2
Before now, have you been keeping records of your activities on farming?	Yes	25.0	41.4	54.5	39.2
	No	75.0	58.6	45.5	60.8
Do you know how much you spent and how much you realized from your farm last year?	Yes	30.4	26.1	57.1	37.3
	No	69.6	73.9	42.9	62.7
Have you ever calculated your profit to know whether you are doing good business?	Yes	31.0	29.0	56.5	37.3
	No	69.0	71.0	43.5	62.7

Source: Own Calculation.
Note: Values are in Percentages.

Information and training needs of farming activities of respondents

Information and training needs of farming activities of respondents are presented in Table 4.

The areas of farming activities identified were the cost of inputs (fertilizer, herbicides, pesticides, household expenses and farm labour). Others included sources of input, income generation and methods of calculating profit from farming and non-farming activities.

The results showed that sources of inputs ($\bar{x}$ = 2.66), cost of pesticides ($\bar{x}$ = 2.65), cost of fertilizer ($\bar{x}$ = 2.49) and methods of calculating profit from farming activities ($\bar{x}$ = 2.39) were the major identified aspects where training and relevant information were needed the most. This is line with [13] who indicated that the farmers' training should be on their identified training needs as indicated by them.

Table 4. Information and training needs of respondents' farming activities

Cotton farmers' information and training needs of farming activities	$\bar{x}$	σ
Sources of inputs	2.66	1.26
Cost of pesticides	2.65	1.25
Cost of fertilizer	2.49	1.25
Methods of calculating profit from farming activities	2.39	1.27
Cost of herbicides	2.37	1.23
Income generation from farming activities	2.35	1.22
Income generation from non-farming activities	2.14	1.21
Cost on farm labour	2.07	1.15
Cost on household expenses	1.96	1.09

Source: Own Calculation.

Factors responsible for respondents not keeping records

Table 5 revealed the respondents' distribution according to the factors responsible for their reasons for not keeping farm records. The results indicated that most of the respondents (41.9%) never thought that record-keeping was necessary while 26.7% responded that they loved keeping records of their activities but they do not know how to go about it. From this finding, it is obvious that the cotton farmers did not know the importance of keeping records.

Table 5. Factors responsible for cotton farmers not keeping records

Factors responsible for cotton farmers not keeping records	%
I cannot read and write	5.8
Record keeping is tiring and difficult	7.0
I never thought record keeping is necessary	41.9
It is not necessary for keeping records	4.7
Love to keep a record but do not know how to do it	26.7

Source: Own Calculation
Note: Values are in Percentages.

This is line with [27] who specified that farmers had wanted to keep records of their farm activities but are incompetent and inexperienced in the technical know-how on how to go by it.

Test of hypotheses

Hypothesis One

Table 6 showed the differences in training and record-keeping experience among cotton farmers in the agro-ecological regions of Zambia. The cotton farmers' training and record-keeping experience on the attendance of business skill development training (χ^2= 14.9), steady farm budget operations (χ^2 = 5.16) and consistent farm financial analysis execution (χ^2 = 4.96) are significantly different in the agro-ecological regions of Zambia. The table indicated the levels of training and record-keeping experience among cotton farmers differed by location of cotton production activities of the farmers.

Table 6. Kruskal-Wallis Test of training and record-keeping experience

Training and Record-Keeping Experience	χ^2	Asymp. Sig.	Decision
Attended business skill development training	14.9 3	0.001	S
Regular record keeping activities implementation	4.54	0.103	NS
Steady farm budget operations	5.16	0.076	S
Consistent farm financial analysis execution	4.96	0.084	S

a. Kruskal Wallis Test
b. Grouping Variable: Region
Source: Own Calculation.

Hypothesis Two

Table 7 showed the differences in information and training needs of activities among cotton farmers in the agro-ecological regions of Zambia. The cotton farmers' information and training needs on cost of fertilizer (χ^2 = 12.56), cost of pesticides (χ^2 = 4.69), sources of inputs (χ^2 = 19.78), cost on household expenses (χ^2 = 8.68), cost on labour (χ^2 = 17.7), income generation from farming activities (χ^2 = 5.97), income generation from non-farming activities (χ^2 = 6.02) and methods of calculating profit from farming activities (χ^2 = 5.18) are significantly different in the agro-ecological regions of Zambia. The levels of information and training needs of activities among cotton farmers differed by location of cotton production activities of the farmers.

Table 7. Kruskal-Wallis Test of information and training needs of activities

Information and training needs of activities	χ^2	Asymp. Sig.	Decision
Cost of fertilizer	12.56	0.002	S
Cost of herbicides	1.15	0.562	NS
Cost of pesticides	4.69	0.096	S
Sources of inputs	19.78	0.000	S
Cost on household expenses	8.68	0.013	S
Cost on labour	17.70	0.000	S
Income generation from farming activities	5.97	0.051	S
Income generation from non-farming activities	6.02	0.049	S
Methods of calculating profit from farming activities	5.18	0.075	S

a. Kruskal Wallis Test
b. Grouping Variable: Region
Source: Own Calculation.

CONCLUSIONS

The study showed that the major identified areas where training and relevant information were needed the most were methods of calculating profit from farming activities, sources and cost of inputs (fertilizer, pesticides, and labour). The farmers never thought that record-keeping was necessary although they loved keeping records of their activities but they do not know how to go about it. However, the cotton farmers' training and record-keeping experience on attendance of business skill development training, steady farm budget operations, consistent farm financial analysis execution and information and training needs on cost of inputs (fertilizer, pesticides, and labour), household expenses, sources of inputs, methods of calculating profit from farming activities, income generation from farming activities and non-farming activities are significantly different across the agro-ecological regions of Zambia.

Based on the results of this study and with respect to effective and meaningful training, it is vital to have business schools for the cotton farmers. Such training institutions need to identify the training needs of cotton farmers in each of the agro-ecological zones and develop appropriate training modules on farm budget operations and financial analysis vis-à-vis the information on the sources and cost of inputs in the different agro-ecological regions of Zambia. This would guide the cotton farmers to have a higher degree of farm-based productivity and profitability achievement in the country.

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THE DEMAND FOR RICE BY HOUSEHOLDS IN NIGERIA: A QUADRATIC ALMOST IDEAL DEMAND SYSTEM APPROACH

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Abstract

In Nigeria, households' per capita calorie consumption is below the required level and this in turn has reduced food security and productivity among households. Rice is a high calorie given food item that has contributed to the improved nutrional status and welfare of Nigerians. Therefore, the study determined the demand for rice in Nigeria as a means of enhancing calorie intake and food security status among households. The study used Harmonised National Living standard survey (HNLSS) data obtained from National Bureau of Statistics. 32,012 households comprising rural (24,941) and urban (8,071) sectors were used. The methods of data analysis include descriptive statistics, probit regression analysis and Quadratic Almost Ideal Demand System (QUAIDS.) The study revealed that Per-capita expenditure on rice is lowest among rural (₦2, 275.48) and North-west (₦2, 019.17) residents. It is also lower among male headed households. Rice is a necessity (0.801) and could serve as substitute for luxury food items such as beans (0.919) and other cereals (0.199). Gender, sectoral and regional food policy measures should be options in increasing rice demand among households in Nigeria in order to ensure increase per calorie intake.

Key words: *rice demand, budget share, QUAIDS, elasticity, luxury goods*

INTRODUCTION

According to [23], rice is recognised as a major food item for five out of every ten households globally serving about 80% of their calorie requirements. Rice is of a distinct significance in economic transformation as its grains are used extensively as food; constituting the principal food of half of the human race [18]. From African perspective, Nigeria is the largest consumer of rice in the West African region and its demand for rice has been soaring at a very fast rate over the years [13], with a widened demand-supply gap [6]. In the country, rice is the most important staple food crop, both for food security and cash income. It also constitutes 21% to 24% of total food expenditure among city and community dwellers [19].

Rice, as an essential food item plays a vital role in economic advancement. The physical availability and price has direct effect on the food security status and well-being of families. [7], particularly amongst the poorer segments of population, both in the rural and urban sub-sectors. Of all the basic food commodities in Nigeria, rice is of particular importance having contributed to the socioeconomic well-being of Nigeria both as a major element in the nation's food security calculations and as a commodity for internal commercial transactions [14]. For a healthy balance diet, a man needs 2,500Kcal a day to maintain body weight, while a woman needs 2,000Kcal a day. This is not being achieved in \most developing countries like Nigeria where the per capita calorie consumption is below the required threshold level. The effect of which is reduced productivity in the country; thus, the need for this study.

Moreover, there exists a dearth of studies on rice demand by households at the country level in relation to variations in rice intake, income level, food prices (own price and price of substitutes) and other factors influencing households' demand for rice. This is the recognised vaccum this research intends to fill. In averting price and income shocks, ammending houeholds' consumption in response to changes in price of rice and income of households is of great importance.

In developing countries, known for allocation of higher budget share on food [8], consumer expenditure surveys are particularly useful because they can provide information on specific sub-population of households that are more likely to be affected by changes in commodity prices or income of the households.

The aims of the research are: to estimate the budget share of households on rice in Nigeria, establish the compensated and uncompensated elasticity of households' demand for rice and determine the factors influencing the demand for rice by households in Nigeria.

Food demand studies have become an area of focus globally, most especially in the third world where budget share on food take a significant portion of the household income. Thus, the studies unravel how variations in price, income and taxation policies influence food demand.[12]. Analysis of Food demand is germane due to its high correlation with standard of living resource base of households in Nigeria. Another pertinent reason for carrying out this research is due to the large disparity in rice demand between city and rural dwellers.

It is discovered that there is more demand for this produce in urban area than in rural area. This gap is due to the different income levels of the populace in these different areas

From empirical perspective, [1], and [4] adopted Almost Ideal Demand System (AIDS) model in analysing the demand for food. Also, [21], examined "Households' Demand Structure for Rice Consumption in Kaduna State" using primary data. LA-AIDS model, Logit model and Z- statistics were also adopted for the analysis. [15] estimated the demand for rice in Nigeria using Ordinary Least Square (OLS) model.

The focal point of this research is on the demand for rice in Nigeria revealing urban and rural gap. Also, this study varies from the aforementioned in the use of secondary data obtained from Harmonized National Living Standard Survey (HNLSS) adopting Quadratic Almost Ideal System (QUAIDS) model as the emperical tool.

MATERIALS AND METHODS

Harmonized Nigeria Living Standard Survey, (HNLSS), 2010 collected by the National Bureau of Statistics [16] was used for the study. Data used comprised a total of 32,012 households across the rural (24,941) and urban (8,071) sectors. Descriptive statistics, budget share index, probit regression analysis and Quadratic Almost Ideal Demand System (QUAIDS) were the analytical techniques adopted.

Model Specification

Budget share index

Budget share index is expressed as:

$$W_r = \sum_{i=1}^{n} \frac{\mathbf{X}_{\mathbf{r}i}}{\mathbf{X}_i}$$

where:

w_r = Budget share on rice by i[th] household

$\boldsymbol{X_{ri}}$= Expenditure on rice by i[th] household (~~N~~).

X_i = Total expenditure on grains considered by ith households (~~N~~)

n= total number of respondents.

Probit Model

It is expressed as

$$Z_i = b_0 + \sum_{j=1}^{n} b_j X_j + u$$

where:

Z_i is the unobservable level of stimulus for the ith household, [24].

This is represented as (1, for rice purchaser, 0 for non- rice purchaser)

b_j=parameters to be estimated

X_j = identified explanatory variables as highlighted under the **Quadratic Almost Ideal Demand System (QUAIDS) Model**

Quadratic Almost Ideal Demand System (QUAIDS) was adopted to establish the determinants of households' demand for different food groups in Nigeria and across sectors, as stated in the equation below:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2$$

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In line with [10]; [11], socioeconomic characteristics of the households were also incorporated to influence preferences through the intercept in equation as:

$$\alpha_i = \rho_{io} + \sum_{j=1}^{s} \rho_{ij} d_j$$

where: *dj* is the jth socioeconomic variable of which there are S. This approach is adopted to incorporate the demographic variables because of its easiness [22].

Ij = food groups;

αi, λ β γ= are parameters to be estimated

Wi = Average expenditure share of households on food item i

αi = Average value of budget share in the absence of price and income effects.

β_i = parameters that determine whether goods are luxuries or necessities

γ_{ij} = Effects on the budget of item i of 1% change in the prices of items in group j

Pj = price of item j (₦)

d_j = Vectors of socioeconomic and demographic variables.

Ui = error term.

The uncompensated or Marshallian price elasticities are stated as $e_{ij}^u = \mu / w_i - \delta_{ij}$ where δ_{ij} is the krnonecker delta which is equal to one when *i* = *j*, otherwise δ_{ij} = 0. Using the Slutsky equation, $e_{ij}^c = e_{ij}^u + w_j e_i$, the compensated (Hicksian) price elasticities can be estimated and used to measure the symmetry and negativity conditions by examining the matrix with elements $w_i \left[e_{ij}^c \right]$, which should be symmetric and negative simi-definite.

Dependent variable:

W_i = budget share on rice and other grains

Independent variables:

P_1= Price of rice (₦)

P_2= Price of Beans (₦).

P_3= Price of Maize (₦)

P_4 =Price of other cereal (₦). (Guinea corn, millet, wheat)

Socio-economic variables:

X_1= Sector (rural = 1, 0 = urban)

X_2 = Household size

X_3 = Sex (1 male, 0 female)

X_4 = Age (Years)

X_5 = Households' income (₦).

RESULTS AND DISCUSSIONS

Table 1 highlights the socio-economic characteristics of the households in Nigeria. Across urban and rural sectors and the pooled data, about 8 out of 10 respondents, in the country, were within the working age range of 18 to 60 years. Also, the mean age of almost 48 years indicates that majority belonged to the active and productive age.

Table 1. Demographic Characteristics of Households in Nigeria

	Pooled		**Rural**		**Urban**	
Variables	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Age						
<18	40.00	0.12	33.00	0.13	7.00	0.087
18-60	26,340.00	79.79	19,986.00	80.13	6,354.00	78.726
>60	6,632.00	20.09	4,922.00	19.74	1,710.00	21.187
Mean	47.67		47.62		47.83	
Gender						
Male	28,033	84.918	21,624	86.701	6,409	79.408
Female	4,979	15.082	3,317	13.299	1,662	20.592
Household Size						
1-3	13,092	39.658	9,321	37.372	3,771	46.723
4-6	13,078	39.616	10,076	40.399	3,002	37.195
>6	6,842	20.726	5,544	22.228	1,298	16.082
Mean	4.442		4.582		4.012	

Source: Results from Harmonised National Living Standard Survey Data.

Male headed households constituted over 80% of the total respondents in the pooled data and rural sector, while they were 79% in the urban sector. This implies that households in Nigeria are mostly headed by male. Majority of households in villages and cities and Nigeria, as a whole, had a moderate household size of less than six, with the means being 4 for both the urban and the pooled data, while rural respondents had mean household size of five.

As illustrated in Table 2, expenditure on rice and beans was higher in urban sector (₦3, 540.99 and ₦2, 773.64) than in rural sector (₦2, 275.48 and ₦ 2,415.03) respectively. However, rural respondents spent higher on maize and other cereals than their urban counterpart.

The implication of this is that households residing in urban areas have preference for rice and beans, compared to the rural dwellers that tend to prefer maize and other cereals such as guinea corn and millet.

Table 2. Per Capita Expenditure on Selected Grain across Sector in Nigeria

	Pooled (₦)	Rural (₦)	Urban (₦)
Rice	2,584.88	2,275.48	3,540.99
Maize	1,162.23	1,298.71	740.49
Beans	2,502.71	2,415.03	2,773.64
Other cereals	2,651.26	3,150.43	987.25

Source: Source: Results from Harmonised National Living Standard Survey Data.

Table 3 reveals the demand for rice and other cereals across the six zones in Nigeria.

Residents in the South-South, Southwest and North- Central zones spent the most on rice (₦2, 699.91 ₦3,002.98 and ₦3,296.30 respectively), while those residing in Southeast spent the most on beans (₦2,759.14). However, residents in the Northern divide of the country expended the most on other cereals (guinea corn, millet, wheat). It is clear from these results that the demand for rice is higher in the South than in the North.

Table 3. Zonal Analysis of Households' Expenditure on Selected Grains in Nigeria

	South-South	South East	South West	North Central	North East	North West
Food Items	Per capita expenditure (₦)					
Rice	**2699.91**	2514.14	**3002.98**	3296.30	2177.19	2019.17
Maize	262.58	669.93	459.86	2337.58	2024.77	1198.44
Beans	1972.15	**2759.14**	2789.25	2406.38	3255.56	2077.32
Others	60.68	107.36	397.28	**3649.68**	**4222.01**	**5564.94**

Source: Results from Harmonised National Living Standard Survey Data.

The analysis of households' decision to consume rice was estimated using probit regression as shown in Table 4.

Sex, prices of rice and maize and household income were significant at $p<0.01$. Household size was significant at $p<0.05$. Unit increase in the prices of rice and maize would increase the probability of households to consume rice by 62.61% and 87.61% respectively, indicating that households would be willing to demand for rice if the price of rice and maize is increased. The decision to consume rice by male headed households increases by 0.1103, relative to the female respondents, an indication that male headed households have higher probability of consuming rice than their female counterpart.

A unit increase in household size would reduce the likelihood of rice demand by 0.8%, indicating that respondents with larger household size have lower probability of consuming rice, relative to those with smaller household size. Increases in households' income would increase the decision of households to demand for rice. In other words, higher income earning households have the tendency to demand more for rice than those with lower income.

The factors influencing households' demand for rice and other cereals were highlighted in Table 5. The Inverse Mills Ratio (IMR)

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ensures that the sample is devoid of the problem of selectivity bias.

Table 4. Factors Determining the Decision of Households to Demand for Rice

Budget Share on Rice	Coefficient	Standard error	Z	Significance
Sector	-0.0003	0.0186	-0.02	0.987
Household size	-0.0084	0.0033	-2.58	0.010**
Household sex	0.1104	0.0228	4.84	0.000***
Household age	-0.0004	0.0005	-0.81	0.417
Price of rice	0.6262	0.0987	6.34	0.000***
Price of maize	0.8761	0.1111	7.89	0.000***
Price of beans	0.0542	0.0805	0.67	0.501
Price of other cereals	-0.0271	0.0670	-0.39	0.699
Total income	0.4707	0.0123	38.43	0.000***
Constant	-11.1449	0.8086	-13.78	0.000***

Source: Results from Harmonised National Living Standard Survey Data.

That is, the selected sample is a true representation of the entire population. Sector and sex of household heads were the factors affecting households' demand for rice in Nigeria. The expenditure share for rice among rural households increases by 0.71%; compared to urban sector. This is expected as rural households spend larger share of their earnings on food. This is corroborated by the by the findings of [9], where demand for staple is higher in rural sector (though not significant) than the urban. Also, male respondents' demand for rice is reduced by 0.26%, in comparison to female.

Sector prices of maize and beans were the factors influencing households' demand for maize in Nigeria. The demand for maize will increase by 0.5757 and reduce by 0.496, for every unit increase in prices of maize and beans respectively, implying that the demand for maize tends to reduce with increase in price for beans.

Rural residents' demand for maize reduces by 0.0033, relative to those that dwell in the cities. Thus, city dwellers demand more of maize than those residing in rural areas in Nigeria.

Table 5. Determinants of Households' Demand for Rice in Nigeria

Variables	Rice	Maize	Beans	Other cereals
Price Coefficients				
Price	0.0033 (0.10)			
Pmaize	-0.0112 (-0.15)	0.5757 (2.92)***		
Pbeans	0.03446 (0.45)	-0.4962 (-2.81)***	0.3668 (1.88)*	
Pothers	-0.0265 (-1.14)	-0.0684 (-0.86)	0.0949 (1.31)	-0.0002 (-0.00)
Households' Characteristics				
Sector	0.0071 (6.90)***	-0.0033 (-3.84)***	0.0014 (0.91)	-0.0058 (-2.81)***
Hhsize	-0.0002 (-1.14)	0.0002 (1.61)	-0.0001 (-0.37)	0.0000 (0.01)
Hhsex	-0.0026 (-1.80)*	0.0000 (0.00)	-0.0037 (-1.67)*	0.0063 (2.56)***
Hhage	0.0000 (1.32)	0.00003 (1.42)	-0.0000 (-0.96)	-0.0000 (-0.42)
Lny	-0.0042 (-1.63)	-0.0036 (-1.58)	-0.0115 (-4.46)***	0.0194 (5.65)***
IMR	-0.0010 (-0.65)	0.0386 (2.78)***	0.0356 (2.58)***	-0.0643 (-3.69)***

*** Significant at 1 per cent ** Significant at 5 per cent *Significant at 10 per cent
Source: Results from Harmonised National Living Standard Survey Data.

Household income, price of beans and sex are the significant determinants of households' demand for beans at 1, 10 and 10 per cents levels respectively. As price of beans increases by a unit, the demand for beans increases by 0.3668, indicating households' high preference for beans despite increase in its price. However, as income of households increases by a naira, the demand for beans is reduced by 1.15%. This implies that the consumption of beans tends to reduce as income of households increases in Nigeria. The implication is that as income of households rises, they tend to buy more expensive substitutes of beans such as meat, fish and chicken. The demand for beans is reduced by 0.0037 for male headed households, compared to those headed by female. This is an indication that households headed by female consume more of beans than those headed by male.

Lastly, the factors affecting the demand for other cereals by households in Nigeria are sector, income and sex at one percent level of probability. Rural households' demand for other cereals is reduced by 0.0058, relative to those in urban sector, implying higher consumption of other cereals by the urban households, relative to those in the communities. The demand for other cereals by male respondents increases by 0.67%, in comparison to females. A unit increase in the income of the households tends to increase their demand for other cereals by 0.0194. This is in line with the findings of [5]; [9] that revealed higher demand for staples among high income earning households. This reveals that high income earners consume more of other cereals (millet, guinea corn, wheat) than those earning low income.

The uncompensated own price elasticity estimates of the identified food items show that rice and maize are price inelastic having values less than unity, while beans and other cereals are price elastic, with values greater than unity. These are shown in Table 6**.**

The cross price elasticity estimates revealed that negative value indicates complementarity between two food items, while positive value implies the goods are substitutes. In view of this, maize could serve as complement for rice, while rice can act as substitutes for beans and other cereals.

Also, maize could substitute beans, while beans could replace rice, maize and other cereals. Lastly, other cereals could also replace maize and rice.

Table 6. (Marshalian /Uncompensated) Price and Income Elasticity of Demand

Commodity	**Rice**	**Maize**	**Bean**	**Others**
		Price coefficient		
Price of rice	**-0.982**	-0.300	0.404	0.078
Price of maize	-0. 005	**-0.698**	0.196	1.344
Price of beans	0.121	0.233	**-2.022**	-1.403
Price of other cereals	0.086	-0.101	0.177	**-1.083**

Source: Harmonised National Living Standard Survey, 2010.

As revealed in Table 7, own price (compensated) elasticity of demand revealed that rice, maize and other cereals are price inelastic; signifying that proportionate increase in prices of these grains would lead to less than proportionate decrease in their demand [2]; [17].

Table 7. (Hicksian/Compensated) Price and Income Elasticity of Demand

Commodity	**Rice**	**Maize**	**Bean**	**Others**
		Price coefficient		
Price of rice	-0.774	-0.129	0.564	0.339
Price of maize	-0.222	-0.877	0.029	1.071
Price of beans	0.919	0.890	-1.409	-0.401
Price of other cereals	0.199	0.132	0.395	-0.726
Income	0.801	0.837	3.069	1.094

Source: Results from Harmonised National Living Standard Survey Data.

However, the demand for beans is price elastic, as it reveals more than proportionate decrease in its demand due to a proportionate increase in its price. Cross price elasticity estimates show that rice can serve as substitute for beans and other cereals, while maize can complement rice. Furthermore, maize can substitute beans and other cereals, with rice serving as complement. On the other hand, beans can serve as substitute for all the identified grains/cereals. Lastly, other cereals (guinea corn, millet and wheat) could complement beans. Rice and maize are observed to be income inelastic (necessity food items) corroborating the findings of (Abdulai, 2002; [3]; [20]; [17]; [9] and [15] that major staple foods are necessities. However, beans and other cereals are income elastic (luxury food items).

CONCLUSIONS

Rice is a major staple in Nigeria with high calorie content which could improve the food security situation of the population. It is made clear in the study that expenditure on rice is higher in the metropolis than in villages.

Also, the northern divide of the country spends less on rice relative to their southern counterpart. Sector and sex are the factors influencing rice demand in Nigeria. Elasticity estimates revealed that rice is price and income inelastic and could substitute for beans and other cereals.

From the foregoing, gender and regional specific food policy options that would increase the consumption of rice among male headed households and residents in the northern region of the country is of importance in order to increase their calorie intake to ensure food security status among the particular groups.

Also, since beans and other cereals are regarded as luxury food items, rice, as a necessity food item, could serve as a perfect substitute for both, thereby eliminating the price stress of consuming these luxury food items from low income earners in Nigeria.

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TYPES OF INSECTS ASSOCIATED WITH POTATO PLANTS (*SOLANUM TUBEROSUM* L.) AND THE INCIDENCE OF THE DISEASE IN MODOINDING, NORTH SULAWESI, INDONESIA

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Abstract

The study was conducted in Modoinding District in the villages of Palelon, Makaaroyen and Linelean. The purpose of this study was to determine the types of pests and diseases and their populations. Insect sampling using the diagonal slice method where in each plot there are 5 subplots, 4 at the end and 1 in the middle, each subplot is 4m x 2m wide. Samples were collected by sweeping using 10 nets of insect swings. Insect samples were anesthetized with ethyl acetate and put in bottles containing alcohol and labeled. Samples are taken to the laboratory to identify and calculate the population. Insect sampling was carried out at the age of the plant 14, 28, 42, 56, 70, 84 days after planting. Plant disease sampling also used diagonal slice method, each subplot was 2m x 2m with 22 plants per subplot. Sampling of plants affected by disease is carried out on plants aged 35, 42, 49 days after. Found as many as 27 types of identified insects known as pests, predators and parasitoids. The dominant insects found and the population average is Empoasca sp. 49 individual, Lygus sp. 16.44 individual, Leptorna sp. 15.89 individual, Acrididae 11.44 individual, Nezara sp. 11.22 individual, Epilachna sp. 10.89 individual, Bactrocera sp. 10.78 individual, Phthorimaea sp 10.17 individual. Identified plant diseases are dry spots Alternaria solani, fusarium wilt Fusarium oxysporum and Ralstonia solanacearu. The incidence of the disease found is not too significant where the numbers are relatively small. Bacterial wilt disease was found as much as 7.5%, fusarium wilt 4.54% and dry spots 3.61%.

Key words: *insects, identification, pests, diseases, predators, parasitoids*

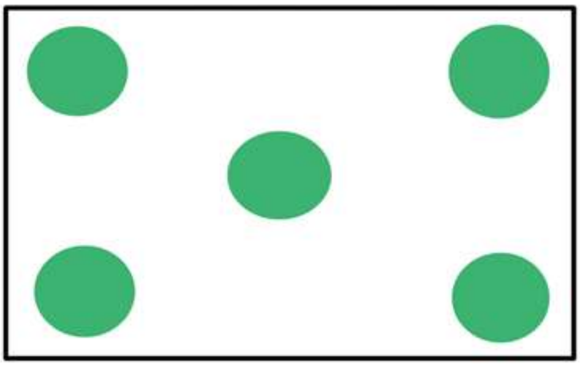
INTRODUCTION

Modoinding District is located in the highlands of North Sulawesi about 1600m above sea level. This region is well-known as a center for food crops in North Sulawesi. One of its superior products is potatoes. Potatoes, *Solanum tuberosum L.*, is one of the important food plants as a source of vegetable carbohydrates, proteins, minerals and vitamins (Sembel, 2014) [12]. Potatoes are also an important source of carbohydrates for animals including various types of fitopagous insects. Therefore many types of pest insects are known to attack potato plants (Kalshoven, 1981; Lumowa, 2010; Kandowangko and Ratulangi, 2012) [1, 3, 4, 5]. Potato plants have 266 pests and diseases derived from 23 viruses, 38 fungi, 6 bacteria, 2 mycoplasmas, 1 viroid, 68 nematodes and 128 insects (Sastrahidayat, 2011) [10]. Potatoes are often susceptible to pathogen infections. Lateblight caused by *Phytophthor infestans* is reported as the main disease affecting potato plants in Indonesia. This pathogen causes blotches and rot on plant tissue that is infected and results in yield losses of between 10-100% depending on the level of infestation, season, height, and potato varieties (Nathasia et al., 2014) [6].

MATERIALS AND METHODS

Insect sampling

Sampling as shown in Figure 1. Each sub plot is 4x2 meters in size. Insect sweeping is done 10 times a double swing each subplot. Sampling is done every 2 weeks on the day 14, 28, 42, 56, 70, 84 days after the planting or 6 times for each plot. Insects captured were identified using the Kalshoven (1981), Johnson *et al.* (2005) [3, 2] and the amount is calculated.



Remark: → Sample Location
→ Sample Sub – Location

Fig. 1. Layout of sampling diagonally
Source: Own results in the laboratory.

Sampling of plants affected by disease

Sampling of plants affected by disease using the diagonal slice method. In each subplot, a distance of 2m x 2m containing 22 plants or 110 plots per plant. Sampling was carried out on days 35, 42, 49 days. Plants that experience symptoms of illness are collected and taken for identification. Then the sample is isolated where each Petri dish is given 0.5 mm / 0.5 cc specimen from a 10-4 test tube, then labelled and placed on a culture rack. Observations were made on each petri dish by looking at the morphology in accordance with the characteristics of the disease, then a subculture process was carried out to obtain pure culture.

Pathogens that grow on the second day after isolation in subcultures to obtain pure culture. The method used is the diagonal (*zigzag*) slice method on other NA media. Media that have been overgrown by bacteria are taken using a sterilized needle, then a diagonal line (*zigzag*) is made on the NA media and placed on a culture rack.

RESULTS AND DISCUSSIONS

Associated Insects

27 species of insects was found (Table 1). Many species are known to be the main pests of potato plants, but some of them are known as predators and parasitoids.

Table 1. Insect types and insect population averages in every village

No.	Insect types			Insect population average per villages			Averages
	Order	Family	Genus	Makaaroyen	Palelon	Linelean	
1	Hemiptera	Cicadellidae	Empoasca sp.	57.67	46.33	43.00	49.00
2	Orthoptera	Acrididae		16.50	11.17	6.67	11.44
3	Coleoptera	Tenebrionidae	Alphitobius sp.	7.50	5.67	7.00	6.72
4	Coleoptera	Coccinellidae	Epilachna sp.	12.67	9.83	10.17	10.89
5	Hemiptera	Miridae	Lygus sp.	15.50	19.33	14.50	16.44
6	Coleoptera	Carabidae		0.83	1.50	0.50	0.94
7	Coleoptera	Cerambycidae		0.83	0.50	0.00	0.44
8	Coleoptera	Chrysomelidae	Chaetocnema sp	1.00	3.67	4.50	3.06
9	Hemiptera	Miridae	Leptopterna sp.	16.00	15.17	16.50	15.89
10	Dermaptera	Forficulidae	Forficula sp.	0.33	0.83	0.50	0.56
11	Coleoptera	Curfculinonidae	Graphognatus sp.	0.50	0.00	0.67	0.39
12	Diptera	Tephritidae	Bactrocera sp.	13.00	10.00	9.33	10.78
13	Hemiptera	Pentatomidae	Nezara sp.	12.83	9.67	11.17	11.22
14	Diptera	Tephritidae	Peronyma sp.	7.17	10.00	9.50	8.89
15	Hemiptera	Pentatomidae	Scotinophora sp.	5.33	6.67	6.67	6.22
16	Diptera	Chloropidae		12.50	10.50	7.00	10.00
17	Coleoptera	Scarabaeidae		2.83	1.17	0.50	1.50
18	Lepidoptera	Gelechiidae	Phthorimaea operculella	11.67	9.67	9.17	10.17
19	Coleoptera	Coccinellidae	Stethorus sp.	3.67	3.50	4.00	3.72
20	Diptera	Agromizydae	Liriomyza sp.	8.67	6.17	5.83	6.89
21	Diptera	Dolichoppodidae	Dolichopus sp.	5.17	5.67	4.00	4.95
22	Hymenoptera	Formicidae	Dolichoderus sp	7.00	4.67	6.17	5.94
23	Hymenoptera	Ichneumonidae	Eriborus sp.	2.00	1.00	1.83	1.61
24	Coleoptera	Coccinellidae	Hyperaspis sp.	1.33	3.00	4.50	2.94
25	Hymenoptera	Sphecidae	Pemphredon sp.	0.83	0.67	0.83	0.78
26	Diptera	Syrpidae		1.50	0.00	0.33	0.61
27	Araneae			3.83	0.83	2.50	2.39
Sum				224.83	196.33	184.83	202.00

Source: Own results in the laboratory.

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The largest insect population is in the village of Makaaroyen 224.83 individuals, Palelon villages 196.33 individuals, and Lineleyan villages 184.83 individuals.

In this study, many secondary pests are found, which are not the main pests, because their population are small. These pests are from other plants. But, the main pest population found in this study decreased, for example *Empoasca sp*. According to Bororing (2015) [1], *Empoasca sp*. was found an average of 109.03 individuals, but now *Empoasca sp*. found, only 49 individuals.

Insect population known as predators and parasitoids are small in number, compared to pest insect population. The emergence of secondary pests, the small number of natural enemies, and the decline in the number of primary pest populations may be due to the intensive administration of pesticides.

In controlling pest populations, farmers overcome it by administering chemical insecticides intensively.

However, excessive use of insecticides can cause environmental pollution, the occurrence of pest resistance, the emergence of secondary pests, pest resurgence and killing of natural enemies (Redcliffe et al, 2009; Sosromarsono, 1989; Parella, 1987; Settle, *et al*., 1986) [9,14, 8, 13]. In this study, five dominant insects were found namely *Empoasca sp., Lygus sp., Leptopterna sp., Acrididae sp., and Nezara sp*.; but *Empoasca sp*. is the most population. *Empoasca sp.* which is a type of planthopper pest is the main pest reported in Modoinding (Tomayahu, 2007; Bororing, 2015) [15, 1].

Table 2. Incidence of Potato Disease

Species	INCIDENCE of DISEASE (%)												AVG
	LINELEYAN				MAKAAROYEN				PALELON				
	I	II	III	AVG	I	II	III	AVG	I	II	III	AVG	
Alternaria solani	1.82%	2.73%	6.36%	3.33%	2.73%	4.55%	5.45%	3.89%	0.91%	2.73%	8.18%	3.61%	3.61%
Fusarium oxysporum	0.91%	2.73%	5.45%	2.78%	2.73%	5.45%	9.09%	5.28%	1.82%	4.55%	8.18%	5.56%	4.54%
Ralstonia solanacearum	4.55%	7.27%	16.36%	8.61%	1.82%	8.18%	13.64%	7.22%	2.73%	3.64%	15.45%	6.67%	7.50%

Source: Own results in the laboratory.

Disease

Observation results obtained 3 types of diseases identified are diseases originating from fungi namely *Alternaria solani* dry spots and fusarium wilt *Fusarium oxysporum* and derived from bacteria namely *Ralstonia solanacearum wilt*. The incidence of plant disease was found to be relatively small in number (Table 2).

The incidence of bacterial *Ralstonia solanacearum wilt*, 7.5%; *Fusarium oxysporum wilt* 4.54%; and *Alternaria solani* dry spot, 3.61%. In plants that have symptoms of dar4k patches on the potato leaves, indicates the plant has a disease of *Alternaria solani* dry spots (Semangun, 1989). While the plant were found to have symptoms of wilting, from the observation, showed that the plants were attacked by *Fusarium oxysporum wilt* and wilted bacteria *Ralstonia solanacearum.*

Symptoms caused by fusarium wilt disease, will clearing the leaves bones and leaf stalks. Furthermore, the leaves on the lower site, will turn yellow and then die (Miller, et al., 2006) [7]. While in p0lants that are attacked by bacterial wilt disease has symptoms of wilting leaves and yellowing quickly and then the stems will collapse (Semangun, 1989) [11].

CONCLUSIONS

Found as many as 27 types of insects in potato cultivation in Modoinding, both as pests and natural enemies (predators and parasitoids). There are 5 main pests namely *Empoasca sp., Lygus sp., Leptopterna sp., Acrididae, Nezara sp.* There were also 3 types of diseases, but the number was not significant, namely diseases originating from fungi namely *Alternaria solani* dry spots and fusarium wilt *Fusarium oxysporum* and from bacteria, namely wilted bacteria *Ralstonia solanacearum*. The incidence of bacterial wilt *Ralstonia solanacearum* 7.5%, *Fusarium wilt*

Fusarium oxysporum 4.54% and *Alternaria solani* dry spots 3.61%.

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HOW CAN SMART ALDER FORESTS *(ALNUS GLUTINOSA (L.) GAERTN.)* FROM THE SOUTHERN CARPATHIANS BE IDENTIFIED AND MANAGED

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Abstract

The concept of smart forest is rather recent, being adapted from the climate smart agriculture concept, which has appeared in 2010. The forest situated in this category should fulfill the following criteria: increased income and productivity, improved resilience and reduces greenhouse gases. In addition, climate-smart forestry in mountain regions tries to situate forests from the mountain area based on their adaptation towards climatic changes, carbon stocks, biodiversity or other synthetic indices. The present article tries for the first time the framing of alder forests from the Southern Carpathian Mountains based on 16 indices regarding their site and stand characteristics. Alder stands from this area are generally located on plain fields, at low altitudes and on average or superior bonity stations. However, only 3.6% of them can be situated in the smart forest category. These stands are indicated on humid and rich soils, while their exploitation should be realized when they reach an age of 60-70 years.

Key words**:** *smart forest, alder stands, station type, altitude, exposition*

INTRODUCTION

In the last decades, an increasing concern was shown worldwide on improving forest management under rapid environmental changes [3, 16, 19, 27, 29]. In this context, an urgent need for new and efficient planning tools that can help cope with these challenges was emphasized [14, 24]. In this regard, the concept of Climate-Smart Forestry (CSF) was suggested as a comprehensive solution for increasing the forest ecosystem's capacity for adapting to climatic changes. The CSF notion represents a complementary option of the Climate-Smart Agriculture (CSA) concept, created and widespread by FAO (2010). Furthermore, it is considered one of the most adequate and rapid method through which the forest sector can contribute to climate change adaptation and mitigation, being sustained by numerous specialists [15, 21, 22, 30].

Compared to conventional approaches, a forest-smart approach to climate generates threefold benefits (triple-win): increased income and productivity, improved resilience and reduced greenhouse gases [17].

Recently, the *Climate-smart forestry in mountain regions* initiative was launched at a European. Its main purpose is to identify, define and develop "smartness" criteria for ensuring a sustainable long-term forest management in regard with global environment changes [6]. Mountain forest ecosystems generally present a high stability, especially due to their high structural diversity [23]. Some of the most important Romanian forest ecosystems can be found in the Southern Carpathian Mountains, this being known as the mountain chain with the largest surface of unfragmented forest [13]. The health state of these forests is good [2], as well as the soils [8, 20, 28]; in addition, the last period of time has recorded a forest altitudinal advancement [9].

Due to its eco-protective and structural importance, alder is one of the species that ensures a higher stand stability. All three indigenous species (*Alnus glutinosa*, *A. incana* and *A. viridis*) display a great climate adaptability and fulfill important soil protection functions.

More importantly, the resources of *Alnus* sp. can provide many opportunities for socio-economic development, especially in the surrounding rural areas. For example, black alder is a fast-growing species, being appreciated as a source of raw materials, mainly timber and bioenergy [5], but also tannins and natural pigments [25].

Moreover, grey alder proved to have real productive wood biomass potential in short-rotation tree plantation on agricultural lands [7].

Also, the village communities can obtain financial benefits from practicing ecotourism, as the region is renowned for outstanding landscapes with an evident cultural heritage.

MATERIALS AND METHODS

The database present at INCDS Brasov was used as it contains information regarding forest management plans realized between 1992-2018 for the 45 forest districts from the area [1]. From here were extracted data regarding site and stand characteristics for all stands that contain alder (between 10% and 100%), namely 2998 stands. Each parameter has obtained a grade from 1 to 5, where: 1 = very low; 2 = low; 3 = average; 4 = high; 5 = very high (Table 1).

Table 1. Grades obtained based on stand and station characteristics.

Crt. No.	Characteristic	Grade				
		1	2	3	4	5
1	Average diameter (cm)	0-10	12-16	18-20	22-26	28-52
2	Average H (m)	0-9	10-12	13-15	16-17	18-27
3	Production class	5	4	3	2	1
4	Volume (m^3)	0-16	17-30	31-65	66-129	130-313
5	Current growth (m^3/an/ha)	0.1-0.3	0.4-0.6	0.7-1.2	1.3-2,2	2.3-12.2
6	Liter	1	2	3	4	5
7	Flora	35; 45; 53; 68; 74; 75	14; 15; 16; 17; 36; 42; 46; 52; 67	12; 22; 23; 32; 34; 44; 63; 65; 71	13; 33; 43; 51; 61	11; 21; 31; 41
8	Soil type	1703, 2207, 3305, 4102, 9101	1701, 1704, 2205, 2402, 2408, 3107, 3304, 4205, 9601, 9901	201, 401, 2101, 2212, 2214, 2501, 3104, 3105, 3206, 3302, 4101	2407, 3101, 3301, 9505	3102, 3108, 3115, 3306, 6101, 6205, 9501, 9502, 9506, 9511
9	Forest type	1162, 1342, 1521, 2116, 2213, 2214, 5172	1113, 1114, 1141, 1152, 1153, 1241, 1341, 1361, 1362, 4112, 4114, 4173, 7181, 4182, 4191, 4212, 4221, 4261, 4282, 4313, 5121, 5323, 5513, 6132	1121, 1151, 1321, 1331, 1422, 2212, 2221, 2231, 2241, 2251, 2261, 2321, 4131, 4141, 4142, 4151, 4161, 4211, 4231, 4241, 4311, 4322, 4331, 5314	1111, 1112, 1181, 1211, 1311, 1313, 1411, 2111, 2112, 2211, 4111, 5151, 5153, 5211	1171, 9112, 9211, 9712, 9721, 9722, 9811, 9812, 9820, 9821, 9822, 9831, 9912
10	Site type	2120 3120 4120 4210 5112	1510 2311 2321 3210 3311 3331 4311 4321 5131 5231 5241 7520	2322 2331 2510 3312 4220 4322 4324 4420 5132 5141 5152 5212 5221 5253 6142 6252 6263 7530	2333 2540 3333 3640 3720 4430 4720 5142 5153 5232 5243	2630 3730 3740 4520 4530 4540 5233 5254
11	Lopping	0.1; 0.2	0.3; 0.4	0.5	0.6	0.7
12	Vitality	5	4	3	2	1
13	Structure		1	2	3	4
14	Consistency	0.2-0.4	0.5-0.6	0.9	0.7	0.8
15	SUP	O; Q; C	A	J, V	B; G,K	E, M
16	Functional group + functional category	1,3C; 2,1A; 2,1C	1,4B;1,4C; 1,4D; 1,4E; 1,4F;1,4I; 1,4J;1,4K; 1,5L; 2,1B	1,2B; 1,5H; 1,5I	1,2A; 1,2C; 1,2E; 1,2F; 1,2H; 1,2L; 1,5C	1,1A; 1,1B; 1,1C; 1,1D; 1,1E; 1,1G; 1,2D; 1,2I; 1,5A; 1,5B

Source: original.

The meaning of terms present in Table 1 is rendered below:

Vitality: 1= very vigorous; 2= vigorous; 3= normal; 4= weak; 5= very weak

Structure: 1= even-aged stand; 2= relatively even-aged stand; 3= relatively uneven-aged stand; 4= uneven-aged stand

Production/protection subunits (SUP): A= regular forest, common assortments: wood for timber, constructions, cellulose; E= Reservations for integrally protecting nature; J= quasi-selection system forest; M= Forests submitted to exceptional conservation regimes; V= Forests with recreation functions through hunting.

Functional group (GF) and functional category (FCT) (excerpt): 1,1B= Forests on direct accumulation or natural lake slopes, present or approved; 1,1E= Forests situated in the river's superior bed (in the measure in which they don't reduce water leaking sections) or under its necessary limit and forests for protecting river shores, including the ones from the mountain region;

1,2I= Forests situated on fields with permanent swamps from terraces and interior meadows; 1,2L= Forests situated on fields with very vulnerable lithological substratum towards erosion and landslides; 1,4I= Forest strips situated along very important touristic roads;1,5A= National parks; 1,5L= Forests located in reservation protection areas (buffer areas); 2,1B= Forests destined to produce thick trees with superior timber quality.

Litter: 1= missing litter; 2= thin interrupted litter; 3= thin continuous litter; 4= normal continuous litter; 5= thick continuous litter.

Flora (excerpt): 11= Oxalis-Dentaria; 15= Hylocomium; 16= Vaccinium; 21= Asperula-Oxalis; 22= Luzula albida-Hieracium transilvanicum; 31= Asperula-Dentaria; 33= Symphytum cordatum-Ranunculus carpaticus; 35= Luzula-Calamagrostis; 41= Asperula-Asarum; 42= Carex pilosa; 44= Festuca altissima; 46= Vaccinium-Luzula; 51= Asarum-Brachypodium; 53= Luzula albida-Carex montana; 61= Asarum-Stellaria; 67= Poa pratensis-Carex caryophyllae; 71= Erachypodium-Geum-Pulmonaria; 74= Carex brizoides-Agrostis alba; 75= Carex riparia-Iris pseudacorus.

Soil type (excerpt): 201 = histosol; 2201= typical preluvisol; 2209 = stagnic preluvisol; 2401= typical luvisol; 3101= typical eutric cambisol; 3301= typical dystric cambisol; 4101= typical entic podzol; 4102= lytic entic podzol; 4201= typical podzol; 6205= gleysol; 9501= typical fluvisol, 9506= gleic fluvisol.

Forest type (TP), (excerpt): 1171= Norway spruce and white alder stand; 1311= Normal resinous and common beech mixture with mull flora; 1321= Resinous and common beech mixture with Rubus hirtus; 2212= Fir-common beech stand with mull flora of average productivity; 4111= Normal common beech stand with mull flora; 4131= Mountain common beech stand with Rubus hirtus; 4151= Mountain common beech stand with Luzula luzuloides; 4211= Hill common beech stand with mull flora; 4221= Common beech stand with carex pilosa; 4241= Hill common beech stand with acidophil flora; 9712= Alder stand on gleysols of average productivity; 9721= Black alder park; 9722= Pure black alder of superior productivity from the hill area; 9811= Alder stand with Oxalis acetosella; 9821= White alder on sandy and gravel soils; 9831= White alder stand on muddy soil.

Type of station (TS), (excerpt): 2311= Mountain Bi podzolic Norway spruce stands with Vaccinium of raw average and low humus; 3331= Mountain mixtures, Bi low edaphic eutric cambisol with Asperula-Dentaria +- acidophilus; 3332= Mountain mixtures, Bm average edaphic eutric cambisol with Asperula-Dentaria; 3333= Mountain mixtures, Bs high edaphic eutric cambisol with Asperula-Dentaria; 3720= Mountain mixtures, Bi alluvial, weakly humiferous; 3730= Mountain mixtures, Bm moderately alluvial, humiferous; 4321= Mountain-pre-mountain, Bi low edaphic dystric cambisol common beech stands; 4410= Mountain-pre-mountain, Bi low edaphic eutric cambisol common beech stands with Asperula-Dentaria; 4420= Mountain-pre-mountain, Bm average edaphic eutric cambisol common beech stands with Asperula-Dentaria; 4520= Mountain-pre-mountain common beech stands, Bm alluvial, weakly humiferous; 4530= Mountain-pre-mountain common beech stands, Bm alluvial, moderately humiferous; 5253= Hill holm stands, Bm-s alluvial, moderately humiferous in the low meadow; 5254= Hill holm and common beech stands, Bs-m, gleysol in the high meadow.

RESULTS AND DISCUSSIONS

We can consider that the smart forest alder category includes stands that have a grade higher than 59, namely 3.6 % of the total number of alder stands present in this area (Fig. 1).
From a geographic repartition point of view, the majority of smart alder forests are located in the Retezat, Făgăraș, Parâng and Bucegi Mountains (Fig. 2).
As it was expected, the majority of alder stands are located on plain fields without slopes as well as on expositions (especially shadowed) with small inclinations (Table 2).

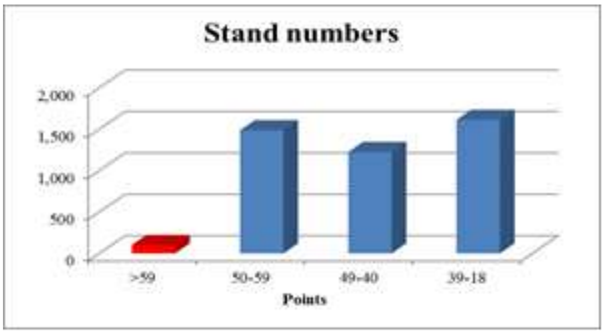

Fig. 1. Framing of alder stands from the Southern Carpathians in the smart forests category
Source: original.

Fig. 2. Distribution of the first 10 smart alder forests from the Southern Carpathians
Source: original.

Table 2. The characteristics of the first 20 smart alder stands from the Southern Carpathians

Crt. No.	Location	Alder percentage (%)	Age (years)	Exposition	Field slope (%)	Altitude (m)	Site type
1	RETEZAT	6	40	0	0	1,250	9506
2	RETEZAT	7	30	0	0	1,250	9506
3	NEHOIASU	10	45	NV	15	590	9501
4	ARPAS	8	50	N	12	445	9501
5	BUMBESTI	10	35	SE	6	730	9501
6	NOVACI	7	40	0	0	570	9501
7	NOVACI	10	40	0	0	560	9501
8	PIETROSITA	7	35	NE	15	800	3108
9	BUMBESTI	10	30	0	0	605	9501
10	ARPAS	4	40	N	10	585	3101
11	ANINOASA	8	70	NE	15	440	9502
12	BUMBESTI	10	35	0	0	380	9501
13	POLOVRAGI	10	60	E	6	520	9501
14	NOVACI	3	60	0	0	570	9501
15	ARPAS	5	70	N	20	595	3101
16	ARPAS	8	80	N	10	575	3101
17	ARPAS	8	70	SE	25	475	9501
18	ARPAS	8	60	SE	15	490	9501
19	TALMACIU	8	55	0	5	570	9505
20	TALMACIU	9	35	0	3	560	9505

Source: original.

Most of the alder stands are located in the following categories: 5253 (Hill holm stands, Bm-s alluvial, moderately humiferous in the low meadow), 5254 (Hill holm and common beech stands, Bs-m gleysol in the high meadow) and 3730 (Mountain mixtures, Bm alluvial, moderately humiferous) (Fig.3).
The stations have a superior bonity in this area due to the increased quantity of humus present in forest soils [10, 12] as well as due to their good water supply [11].

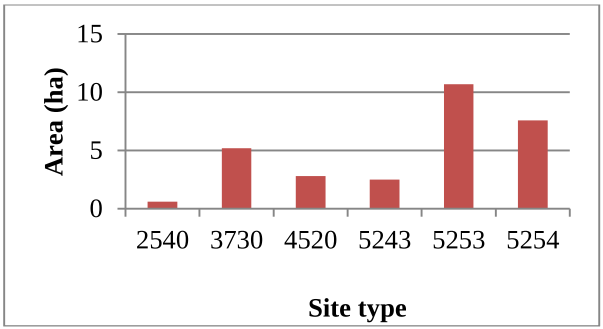

Fig. 3. Distribution of the first 20 smart alder forests from the Southern Carpathians on station types
Source: original.

It can also be observed that alder stands are located in the Southern Carpathians both at reduced altitudes (400-700 m), as well as at average ones (800-1,000 m) (Fig. 4). This fact is caused by the alder's ecologic specific as the species spreads near riverbeds (mountain ones in this case) but does not adapt well at very high altitudes (where it is replaced by Norway spruce, mountain pine or arolla pine).

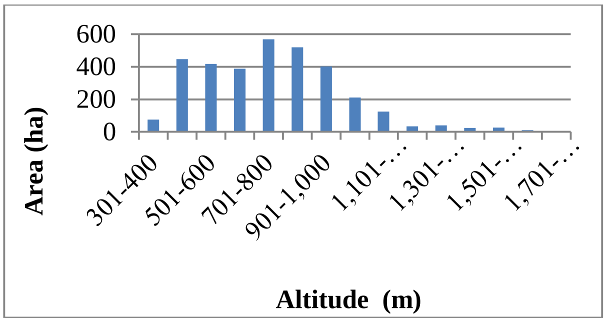

Fig. 4. Distribution of the first 20 smart alder forest from the Southern Carpathians by altitudes.
Source: original.

Management measures concerning alder stands from the Southern Carpathians.

Green alder (*Alnus viridis* (Chaix) D.C.) is scarcely spread in comparison with the black one, being adapted to harsher climates of high altitudes. Present in areas with short periods of vegetation, the species has an extremely important role in consolidating debris and landslide aisle. However, its reduced presence (it does not even form pure stands) does not lead to the establishment and adaptation of specific silvicultural measures.

Black alder (*Alnus glutinosa*, named alder from now on) is the most widespread alder species in our country. The following management measures concern this species.

As alder is a frost-resistant species, its spreading area also covers mountains and does not require special protection measures against this harmful climatic factor.

Alder prefers fertile soils, rich in humus, well drained and profound but it can also adapt on muddy soils, weakly aired. For this reason, fluvisols, gleysols and stagnosols are the soil types indicated for it.

Alder is a species with a light temperament, preferring sunny places. As such, the species will not be introduced in the composition of stands with growths faster than his as it can be eliminated by them.

Alder stands play an extremely important ecologic role, being a food and shelter source for many animal species such as birds, deer, rabbits, or butterflies [4]. The species is associated with over 140 plant-insect species and with 47 mycorrhiza species [31].

Alder trees must be extracted at the age of 60-70 years [5].

The alder wood has recently many usages, much more important than in the past so that attention offered to this species has increased lately. Until recent times, alder was considered more as a natural species that appears in places where other species cannot survive (mountain meadows), being considered more valuable than the birch but more inferior than Norway spruce, fir or common beech. The alder's wood value for the foundation of buildings located under water was well known from the past (being used in Venice or Ravenna). However, recently, this wood is used for producing veneer, furniture, window frames, toys, pencils, as well as for charcoal production.

Adler bark is used in treating swelling, inflammation and rheumatism, pharyngitis and other disease [26], while the seeds can be used against pathogenic bacteria and as anti-MRSA drugs [18].

CONCLUSIONS

Alder stands can be found in the Southern Carpathians especially on plain fields. The species can also be found on reduced slopes (0-10%), being situated especially on shadowy expositions, at reduced or average altitudes, on mountain or hill stations of average towards superior bonity (this bonity is caused by soil humidity and its supply with high humus quantities).

By taking into consideration 16 site and stand characteristics and by organizing hierarchically the obtained results for all alder stands from this area, we can say that only 3.6% of these stands can be situated in the smart forests category.

The mountain areas from the Southern Carpathians with a consistent presence of smart alder forests are: Retezat, Făgăraș, Parâng and Bucegi.

Alder is a tree species with many usages (wood destined for constructions and other usages, bark and seeds with medicinal properties, etc.), as well as with important ecologic consideration (food and shelter source for numerous animals, association with mycorrhiza that enrich the soil, etc.). Alder stands are recommended for humid and fertile soils, without competing with other species that can grow faster, while their exploitation is indicated at the age of 60-70 years old.

Furthermore, alder forests can contribute significantly to maintaining landscapes with natural, cultural and material heritage values, and also for a durable economic development in rural areas.

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PROSPECTS OF AGRARIAN FORMATIONS DEVELOPMENT AT THE STAGE OF LAND RELATIONS TRANSFORMATIONS IN UKRAINE

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Abstract

The article provides insight into improvement of the methodological approaches and methodic tools concerning solution of polyvariant tasks of land management with application of mathematical programming. Variety of the forms of initial information description forces both choice of the methodology of research concerning land use, and the model form. It is proven that appropriate application of mathematical programming secures the most rational use of land resources, which are one of the most important constituents of the system of land relations regulation. Territory of Ukraine is chosen as an object of the research, because the research studies transformation of land relations in the process of land reform implementation. The article presents results of empiric analysis, which argues the necessity to perform land surveying, which makes a base for an accurate land circulation and develops scientific approaches to formation of the structure of land use and administrative-territorial organization, protection of lands, as well as their ecosystem functions, supply of the branches of land resources economy, etc. The empiric investigation confirms and theoretically grounds that at the final stage of the land reform in Ukraine it is necessary to develop an appropriate scientific-theoretical basis, which would contribute to establishment of the system of modern flexible and efficient agrarian formations, being able to reveal the whole potential of Ukrainian black land soils.

Key words: *agrarian formations, market relations, land reform, mathematic modeling*

INTRODUCTION

Implementation of the land reform in Ukraine demonstrates both positive and negative consequences. In numerous cases, organization of agricultural land use is performed only from the position of maximum profit, without regards to its ecological component and neglecting land organization. According to the Law of Ukraine "About Land Organization", land organization is a complex of social-economic and ecological measures, aimed to regulate land relations and rational organization of the territory of administrative-territorial units and business entities. The measures are performed under the impact of social-productive relations and development of productive forces [10].

MATERIALS AND METHODS

Researches concerning agricultural land use by agrarian formations and agrarian holdings in Ukraine under current conditions are performed by V. Bilyk [1], S. Volkov [19], V. Holian [4], T. Zinchenko [20], V. Kurochkin [5], A. Martyn [6], N. Palianychko [7], S. Pyrozhkov [8], V. Snitynskyi [13], M. Stupen [17], R. Trynko [18], A. Shvorak [11] and others. Works of the scientists have developed a system approach and practical recommendations concerning improvement of the organization of rational land use, particularly agricultural lands.

The article proposes another direction of the mentioned problem solution, i.e. by development of the projects of land organization concerning organization of a scientific approach to land use.

The main task of the article is to ground the necessity to develop the projects of land organization for agrarian formations and agrarian holdings of Ukraine in order to improve the system of land management and ecology of land resources.

Special attention is also paid to improvement of the methodological approaches and methodic tools concerning solution of polyvariant tasks of land management with application of mathematical programming.

RESULTS AND DISCUSSIONS

Nowadays, we reap the benefits of errors in implementation of the land reform in Ukraine. Currently, there is a process of formation of agrarian enterprises, founded on the base of hundreds of land shares. However, practically, the process is not always successful and the formations do not meet the world standards.

As of January 1, 2017, in Ukraine there were 1,1 million hectare of degraded, low-productive and technologically polluted lands, which had to be conserved, 143.4 thousand hectare of deteriorated lands, which required reclamation, and 315.6 thousand hectare of low-productive lands, requiring improvement [6].

Considering the fact that currently the main task of agrarian producers is to get a maximum profit, while neglecting ecological and social indicators, one should note that quality of economic activity is not the indicator of rational use of land resources.

However, the situation with development and introduction of the projects concerning land organization with optimization of the schemes of territory organization has principally changed. Currently, private landowners should choose the most desired projects by themselves, and local communities should agree to the corresponding changes of the schemes of their territory organization. Nowadays, land management service should propose some the most suitable models of land organization to land owners concerning their territories as well as some scenarios of their introduction. Only after agreement of the scenarios with local population, they should move to development of a final project of land organization and business-plans for new farms. It should be agreed with almost every resident of the territory and with each juridical person. Thus, it is really necessary to organize special public land committees in each settlement to visit everyone.

Organizational fundamentals of land fund protection should be crucially transformed. Particularly, protection of the lands, used for growing of agricultural products, should be a compulsory constituent of technological processes of arable farming, and the process should be controlled by the Ministry of Agrarian Policy and Food of Ukraine [4, p.28].

Efficiency of land organization of particularly valuable lands is first represented by the opportunity to define lands of different quality by means of classification and zoning. Thus, low-productive lands can be withdrawn of non-agricultural use, high-productive ones can stay in agricultural circulation. However, withdrawing low-productive lands and substituting the gap with developed lands without their rational use, we get a rise of yield capacity by improvement of soil fertility, increase of income of agricultural enterprises [2, 8, 11, 13, 20].

Formation of the directions of land use processes regulation should be initiated at a local level. However, the basis is made by establishment and development of the institute of land management. The institute of land management is considered as a complex of permanent formal and informal rules, norms, procedures of all participants of land management processes, i.e. local authorities, state administration, juridical and physical persons, etc. [3, 7, 9, 10].

Under conditions of legal uncertainty, investors become actual owners of land. They got money from oil-gas and other kinds of business and are called oligarchs. Consequently, land gradually becomes to be owned by those, who have never treat it and will never do, while a peasant, who has been a farm-hand, will stay in the same position [1, p.10].

It is obvious that Ukrainian farmers are not able to overcome all bureaucratic obstacles by themselves and export their products. It makes them less competitive comparing to the large agrarian formations and agrarian holdings, which apply modern machinery and technology, have access to cheap credits, tax privileges and thus, get profits that are much higher than the average at the market.

It is worth mentioning that excess of the profits of agrarian formations and agrarian holdings over the average level in agrarian sector is connected with the moratorium and relative arrears of the prices for land comparing to their potential. Some scientists argue that appearance and development of agrarian holdings in Ukraine and other former republics of the USSR is an understandable consequence of inefficient implementation of land reform, particularly land one [17, p.92].

If the state does not increase investments into reproduction of natural-resource potential and does not stimulate the business sector to behave in the same way, the resource base of many branches of the national economy will be intensively reduced. Consequently, it will cause a considerable fall of the level of economic self-capability of our country and will bring it into the category of outsider-countries in the global economic environment [5].

The bodies of executive branch do not propose to perform consolidation of lands for improvement of land relations and there is no any law about land consolidation in the country, as well as no projects of land organization concerning land consolidation.

Consolidation of lands was a constituent of land reform in almost all countries of Europe. Owners rejected their land parcels within the territory of the developed project of consolidation and got new land parcels of the corresponding value [18, p.13; 15, p.67].

Consolidation of agricultural lands includes a complex of juridical, social-economic and ecological measures, focused on optimization of sizes and location of land parcels for organization of rational and the most efficient land use in the interests of an owner or a land user, and the society in general.

In the context, one should note that development of land use depends on an appropriate and efficient use of land, as well as on labor forces, fertilizers, agricultural machinery, transportation means and other resources. The experience proves that skillful application of mathematical programming helps the most complete and rational use of the resources [14, 16].

Modern theory of land use management is based on the concept of optimization. Thus, it is necessary to find optimal solutions, i.e. value of variables, which secure a maximum (minimum) for the objective function and satisfy a set of constraints. Speaking about objectives and constraints, it is mostly assumed they are well-known. Recently, it has become a clear idea that the theory of production management has reached the edge when uncertainty is of great importance.

Capability to solve the uncertainty [12] or simply work with it requires careful attitude to the environment. It forces the necessity to consider the made decisions, where objectives and constraints are not clearly defined. It is important to learn how to identify such type of tasks, characterize peculiarities of their solution and develop methods of their solution, as far as it is possible.

Under conditions of uncertainty, making of decisions in the system of land use should be interpreted as a conflict of the subject, who makes the decision, and the “nature”. Thus, it is considered as a game [19].

Tasks of decision making under uncertainty conditions are characterized by the fact that each definite choice gives the only value of the objective function. It means that there are no particular difficulties about advantages description at outcomes. Thus, each person, making decision, works with a number of accurately determined objectives, which make base for determination of the necessary advantages.

Considering definite actual situations of decision-making, one should note that they do not meet requirements of the described scheme.

It is obvious that actually decision-making applies the expression of the type “Z should be in close surrounding of Z*”, which is not a clearly defined objective.

It is known [14; 16; 12] that some fuzzy conditions can be considered as a number of X alternatives along with its fuzzy subsets, which are revealed in unclearly defined criteria (objectives and constraints).

Practically, it often deals with application of an accurate theory of optimization of fuzzy models, where there is no reasons to write accurate figures and there are often difficulties, being hard to overcome.

Science and practice prove that character of the employed information defines application of determined, statistical, inaccurate and calculating methods. Such rubricating helps choosing of a group of methods, as well as methodology of the research at the initial stage of land use optimization (in the process of collecting and estimating of informative base of the research). In case of inaccurate methods, they use different statements: flexible planning, fuzzy mathematical programming with clear objectives, linear programming with fuzzy coefficients, robust programming, tasks of achievement of inaccurately set goals with clear constraints, aggregate task of fuzzy mathematical programming.

Let us consider some aspects of flexible planning, particularly planning of land use. The aspects are expressed in the form of tasks of linear programming. They are characterized with constraints of the following expression:

$$\sum_{j=1}^{n} a_{ij} u_j \le b_i, \quad i = \overline{1,m}, \qquad (1)$$

which determine an admissible domain.

It is clear that in case of incompatible constraints the domain is empty. Thus, it is desired to make modification of the constraints. Subject of planning should get to know how it is possible to change constraints of the task to find available solutions. Actually, the subject wants to know how minimally change the initial variant of the description, in order the task can be solved. It is obvious that is requires changes of bi coefficient. However, how much should it be changed?

The authors of the article consider that planning is made in a flexible way, i.e. the planner operates not with figures, but with intervals. It means that in spite of bi figures, the planner uses the intervals [bi, Bi]. Thus, the previous task can be successfully solved, in case the interval includes such figure γ, that inequality $\sum_{j=1}^{n} a_{ij} u_j \le \gamma$ describes an admissible domain.

Now, let us describe the procedure of detection of the figure γ in the interval [bi, Bi]. The figure is close to bi, or, in other words, the task is to find the vector u=(u1, u2, …, un), which can, first, satisfy the condition

$$\sum_{j=1}^{n} a_{ij} u_j \in [b_i, B_i]$$

and, second, the difference

$$\sum_{j=1}^{n} a_{ij} u_j - b \qquad (2)$$

is $\forall\ i = \overline{1,m}$ the least one.

The difference (2) can be minimized by means of a fuzzy set [5]

$$F_1 = \frac{B_i - \sum_{j=1}^{n} a_{ij} u_j}{B_i - b_i} : R^n \to [0,1]. \qquad (3)$$

Introducing the marks, the authors come to the following task of planning: to find max un+1 (3) under the condition:

$$\sum_{j=1}^{n} a_{ij} u_j + (B_i - b_i) u_{n+1} < Bi. \qquad (4)$$

Advantage of such expression of the tasks is obvious: it enables using of common calculating methods to find optimal solutions. In such situation, uncertainty is not a disagreeable peculiarity of the planning task. Probably, that way to use flexibility of fuzzy constraints corresponds to the character of human thinking. The main idea is that many originally fuzzy models can be described in the determined way, and the drawback of the model accuracy is compensated by its flexibility.

Let us transform the task (1), assuming that bi boundary can be changed up to bi + di, where di ≥ 0, while different deviations from bi value get different limits of admissibility (the larger deviation is, the less value of its admissibility is). Such situation is often seen in practice. For instance, a producer is confident that his/her production requires a purchase of bi raw material at the previously approved price. Besides, he/she considers that it is worth to buy additional amount of the raw material, but it can be without a definite agreement and shipping, and probably, at a higher price.

Such construction can be presented in the following way:

$$a_{i1}u_1 + ... + a_{in}u_n \,\tilde{\leq}\, b_i, b_i + d_i, \qquad (5)$$

where "soft" correlation "$\tilde{\leq}$" should be interpreted as "not deteriorating (exceeding), but staying less or equal to bi + di in any case".

Essentially, modern interpretation of the tasks of linear programming has our habit to consider a decision, made by an individual, although it can be made by a group. It is assumed that some individuals have no difficulties to choose advantages. The main difficulty, we try to avoid, concerns collective decision-making, which has more than one system of advantages. Thus, there is a need to consider the way of consolidation of different ideas into an aggregate expression of the choice of advantages.

A more detailed study of the above-mentioned data needs the following fragment situation. Thus, at the private-leased enterprise "Progress" in Kamianka-Buzka district, it is necessary to transform pastures and swamps into gardens and arable land. To implement the task, the enterprise has got 140,000 UAH and 18,000 man-days.

The input data and searched unknown variable are presented in the Table 1.

Table 1. Transformation of lands

№	Lands, subjected to transfor-mation and their area	Projected lands		Costs of transfor-mation of 1 ha (work payment, UAH/costs man-days)	
		gardens	arable land	gardens	arable land
1	Pastures, 150 ha	$\frac{U_{11}}{1,220}$	$\frac{U_{12}}{36}$	$\frac{800}{140}$	$\frac{30}{2}$
2	Swamps, 200 ha	-	$\frac{U_{22}}{480}$	-	$\frac{360}{40}$
	Income from 1 ha per a year, UAH)	860	260		

Source: calculated by the authors.

Considering the above-presented data, the target function will look like:

$$Z = 860U_{11} + 260(U_{12} + U_{22}) \rightarrow \max \qquad (6)$$

$$U_{11} + U_{12} \leq 150, \quad U_{22} \leq 200. \qquad (7)$$

Human resource and money constraints:

$$860\ U_{11} + 30\ U_{12} + 360\ U_{22} \leq 140{,}000, \qquad (8)$$
$$140\ U_{11} + 2\ U_{12} + 40\ U_{22} \leq 18{,}000$$

While calculating the limits of capital investment efficiency, it is possible to determine the ratios r_{ij}. Thus, the standard ρ_H is equal to 0.2, and twenty hryvnias of income are got from one hectare of pastures, whereas ten hryvnias are gained from one hectare of swamp. Considering the above-mentioned, one can calculate

$$r_{11} = 0.2 \cdot 1{,}220 - (860 - 20) = -596,$$
$$r_{12} = 0.2 \cdot 36 - (260 - 20) = -233,$$
$$r_{22} = 0.2 \cdot 480 - (260 - 10) = -154.$$

The limits of capital investment efficiency are measured as:

$$-596U_{11} - 233U_{12} - 154U_{22} \leq 0 \qquad (9)$$

The model can also include some other additional constraints. For instance, in the present case, above the mentioned five constraints (7-10), there are also imposed ones, which suggest that not less than 180 ha should be transformed into arable land. That constraint is described as

$$U_{12} + U_{22} \geq 180 \qquad (10)$$

Having solved the problem (9) under condition (7–10), the following optimal plan is obtained:

$U^*_{11} = 70.3$ ha; $U^*_{12} = 79.7$ ha;
$U^*_{22} = 200.0$ ha,

and the value of the target function accounts for 133,200 UAH.

The problems of production planning and land transformation optimization are the typical tasks of linear programming. Moreover, fuzziness of the parameter ρ_H causes that the problem of land transformation is considered a fuzzy task of linear programming.

The research argues the well-known and principally new tools, which are based on the modern mathematical instruments (fuzzy sets).

Application of the fuzzy sets secures a more adequate depiction of social-economic conditions of the territory and contributes to effective managerial decisions.

The work presents improved methodic approaches to managerial decision making in the field of land use, basing on fuzzy fundamentals, particularly solution of the tasks of production planning and optimal transformation of lands.

CONCLUSIONS

Thus, land organization is one of the most important components of the system of land relations regulation in Ukraine, because it influences an accurate circulation of lands, formation of the structure of land use and administrative-territorial order, protection of lands, as well as their ecosystem functions, supply of the branches of land resources economy, etc.

However, there should be different approaches to implementation of land organization. Considering the changes, introduced by the land reform into the structure, size and style of agrarian formations' operation, projects of land organization should define the main directions of an enterprise's performance without specification of separate elements and pay maximum attention to ecological constituent of land use.

In Ukraine, implementation of the land reform expects creation of the system of modern flexible and efficient agrarian formations, being capable to employ the whole potential of Ukrainian black land soils.

Under current market conditions, there is an urgent necessity to improve methodological approaches and methodic tools concerning solution of polyvariant tasks of land use with application of mathematical programming.

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DYNAMICS OF VEGETABLE AGRICULTURAL PRODUCTION IN GIURGIU COUNTY, ROMANIA

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Abstract

This paper aims to present the evolution of agriculture in the Giurgiu County, during the period 2014-2018, analyzing in particular one of the two major components, namely the vegetal production. Regarding the active population in Giurgiu County, 41.69% is involved in agriculture. In order to highlight the main tendencies of the vegetal production in the Giurgiu County, the areas cultivated with: main cereals, main oilseeds plants, potatoes, melons, perennial fodder, vegetables, as well as the areas occupied by orchards in bearing, flowers and ornamental plants, vineyards in bearing were studied. Wheat occupies the largest area within this county. In 2018, the largest areas were cultivated with wheat - 85,861 ha, maize - 44,404 ha and sunflower - 27,350 ha. For the analyzed period, there were increases in the surface of oats, rapeseeds, soybeans, perennial fodder, vineyards in bearing, flowers and ornamental plants. Apart from rye, sunflower and potatoes, for the other crops analyzed, production increases are recorded.

Key words**:** *agriculture, agricultural production, cultivated area, Giurgiu County*

INTRODUCTION

Giurgiu County is one of the 7 Counties that make up the South-Muntenia Development Region, NUTS 2, according to the Annex I of the EC Regulation No. 1059/2003 [4].
It is located in the south-eastern part of Romania, in the historical province of Muntenia. It has a surface of 3,526 km^2 and as neighbours the County of Călărași, the County of Teleorman, the County of Ilfov, the County of Dâmbovița, the County of Argeș, and in the South, on a length of 72 km, the Danube [12].
The highlighted relief forms are the Danube Lunca and the Romanian Plain. The surface of the county is made up of forests and arable land. Due to this fact, Giurgiu County is predominantly agricultural, with almost 50% of the population involved in agriculture.
Giurgiu municipality is an important border crossing point and an important port on the Danube [1].
From an economic point of view, the South Muntenia Region is among the least developed regions. The GDP/inhabitant below 75% of the EU average. In 2015, in the South Muntenia Region, the GDP / capita reached Lei 28,436.4 being 21.92% smaller than the average GDP / capita in Romania [11].
Labor employment in agriculture places the South-Muntenia Region on the third place [5].

MATERIALS AND METHODS

Statistical data was taken from the National Institute of Statistics (NIS) website, in order to achieve this study. For capturing the major trends in the evolution of agriculture in the Giurgiu Countya number of indicators were analyzed and a wide range of specialized materials were consulted.
The main indicators analyzed in this study are: the population occupied with activities in agriculture, forestry, fishing, in this County; areas cultivated with wheat, corn, rye, barley and beer barley, oat, sunflower, rapeseed, grain, soybeans, potatoes, vegetables, melons, perennial fodder, orchards, vineyards,flowers and ornamental plantsin Giurgiu County; total production of wheat, corn for grains, rye, barley and beer barley, oat, sunflower, rapeseed, soy beans, potatoes, vegetables, fruits and grapes for the Giurgiu County. The

indicators of this study were analyzed for the period 2014-2018.

RESULTS AND DISCUSSIONS

Located on the left bank of the Danube, Giurgiu county has the plain as the predominant form of relief, which has determined agriculture to have a significant share in the economy of the County.

Fig. 1. Map of Giurgiu County
Source: [12].

From the data collected from NIS, it appears that, in the year 2018, out of the total of 79.4 thousand people engaged in activities for the national economy in the Giurgiu County, 41.69% worked in agriculture, forestry and fishing, more exactly 33.1 thousand people.

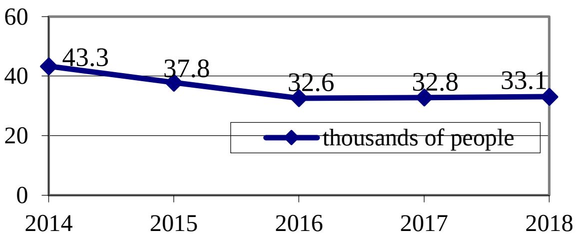

Fig. 2. Dynamics of population by their activity in agriculture, forestry, fishing (thousands of people) in the Giurgiu County, 2014-2018
Source: NIS, 2019, [10].

Figure 2 highlights the dynamics of civilian employment in agriculture, forestry and fishing for the Giurgiu County during 2014-2018. There is a tendency to decrease the number of persons involved in specific activities in these sectors, by 23.56%, in 2018 compared to 2014, when the highest value of this indicator was registered.

As a large number of people perform agricultural activities, measures are needed to develop this sector. With the accession to the European Union agriculture is sustained by the structural funds, alongside the measures to develop the rural space [8].

According to NIS data, in 2014 the arable area of the Giurgiu County was 258,965 ha, the one occupied by orchards and fruit nurseries of 584 ha and vineyards and vine nurseries 3,664 ha. After the arable area, Giurgiu County occupies the 4th place in the South-Muntenia Development Region.

In this context, the paper will present the areas cultivated with the main agricultural and horticultural crops, as well as the production obtained.

Thereby, Table 1 shows the areas cultivated with rye, wheat, grain maize, barley and beer barley and oat in the period 2014-2018.

The wheat is the crop that occupied the largest area in Giurgiu County, 85,861 ha in 2018. If in 1990 maize was the crop with the most cultivated ha (69,720 ha, according to NIS), in 2018 the places were reversed and on the first place was wheat. Other crops that occupied important areas in 2018 are: maize - 44,404 ha; barley and beer barley - 22,598 ha.

The area cultivated with wheat in 2018, in Giurgiu County represents 14.57% of the total area cultivated with wheat in the South-Muntenia Development Region.

Table 1. The area cultivated with the main cereals (ha) in the Giurgiu County, during the period 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Rye	33	21	20	47	25	75.76
2.	Wheat	88,966	92,471	83,583	82,572	85,861	96.51
3.	Maize	49,789	56,105	51,957	44,581	44,404	89.18
4.	Barley and Beer Barley	31,370	23,975	25,187	25,041	22,598	72.04
5.	Oat	720	761	668	801	789	109.58

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

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Analyzing the data presented in the table above, we notice an increase in the surfaces cultivated with oats, of 9.58%, and for the other cultures, a decrease of the surfaces. Barley and beer barley crops recorded the largest decrease, 27.96%. For wheat and maize crops, the largest cultivated areas were registered in 2015 and for rye, barley and beer barley in 2014.

In table 2 we find data on the evolution of the areas cultivated with the main oilseeds plants in the period 2014-2018. The crop that has met the largest surface in 2018 is sunflower - 27,350 ha. Except for the sunflower crop (with a decrease of 26.49% of the surfaces), for the other crops there were increases, the highest being in rapeseed.

Table 2. Area cultivated with the main oilseeds plants (ha) in the Giurgiu County during 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Sunflower	37,207	37,439	32,646	29,819	27,350	73.51
2.	Rapeseed	18,418	13,868	21,490	25,372	27,079	147.03
3.	Soy beans	2,387	5,131	3,610	6,771	5,154	215.92

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

As shown in the previous table, for sunflower, the largest cultivated area was registered in 2015, for rapeseed in 2018, and for soybean in 2017.

Sunflower was the crop which was cultivated most of the oilseeds plants and in 1990 - 14,082 ha, according to NIS. After 28 years, the sunflower remains in the preferences of the cultivators from Giurgiu County, who almost doubled these areas.

The area cultivated with sunflower in 2018, in Giurgiu County represented 12.63% of the total area cultivated with sunflower in the South-Muntenia Development Region.

Table 3. Area cultivated with different crops (ha) in the Giurgiu County, 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Potatoes	667	651	580	577	579	86.81
2.	Vegetables	5,070	5,005	4,377	4,345	4,553	89.80
3.	Watermelons and melons	297	278	313	270	263	88.55
4.	Perennial fodder	9,370	10,590	10,572	11,554	10,653	113.69

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

Table 3 presents the surfaces cultivated with different crops, in Giurgiu County, between 2014 - 2018. Perennial fodder increased by 13.69%, while potatoes, vegetables and melons decreased. The largest decrease was noted in potatoes, 13.19%.

The vegetables from Giurgiu County, which occupies the largest area of the crops presented in tables 3, represented 11.02% of the total vegetable surfaces in the South-Muntenia Development Region.

Figure 3 shows the dynamics of orchard-cultivated areas for Giurgiu County. The highest value was in 2014, of 328 ha and the lowest in 2016, of 293 ha.

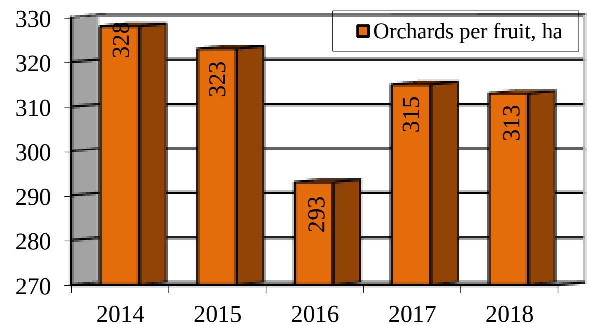

Fig. 3. Dynamics of orchards (ha) per fruit in the Giurgiu County during 2014-2018
Source: own processing based on NIS, Tempo On-line Database, 2019, [10].

Although from 2016, the areas occupied with orchards registered a slight increase in Giurgiu County, in 2018, compared to 2014, a decrease of 4.57% is noted. It should be noted that the orchards are owned by the private sector. Giurgiu County owns only 0.79% of the total area with fruit orchards in the South-Muntenia Development Region.

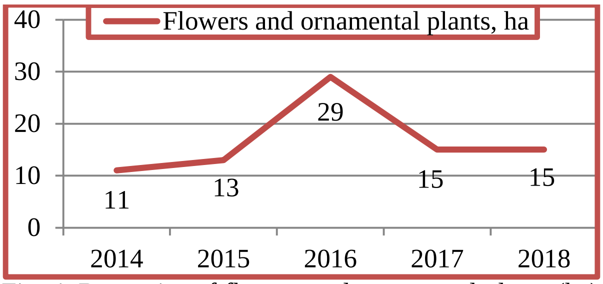

Fig. 4. Dynamics of flowers and ornamental plants (ha) in the Giurgiu County during 2014-2018
Source: own processing based on NIS, Tempo On-line Database, 2019, [10].

Figure 4 shows the surfaces cultivated with flowers and ornamental plants in the period 2014-2018. For this period, the largest area is found in 2016, of 29 ha, and the smallest, of 11 ha, in 2014.
The areas occupied with flowers and ornamental plants registered an increase in 2018, compared to 2014, with 36.36%. These areas are owned by the private sector.
Giurgiu County owns only 26.32% of the total area cultivated with flowers and ornamental plants located in the South-Muntenia Development Region.
Figure 5 shows the dynamics of vineyards-cultivated areas for Giurgiu County. The highest value was in 2018, of 3,727 ha and the lowest in 2017, of 3,432 ha.

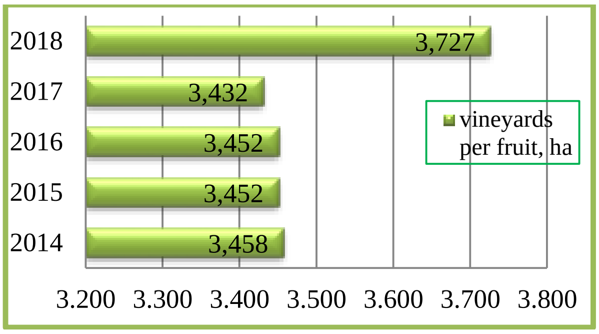

Fig. 5. Dynamics of vineyards (ha) in bearing in the Giurgiu County during 2014-2018
Source: own processing based on NIS, Tempo On-line Database, 2019, [10].

Although the areas occupied with vineyards in bearing registered a slight decrease in 2017, compared to 2014, an increase of 7.78% is observed in 2018. Of the total vineyards registered in 2018 (3,727 ha), 3,446 ha are owned by the private sector. Giurgiu County owns only 13.78% of the total area of vineyards in bearing in the South-Muntenia Development Region.
Table 4 highlights the production in the period 2014-2018 for different cereals. Despite the fact that the cultivated areas have decreased (Table 1), there has been an increase in production for all 5 crops analyzed.
The largest increase was obtained in maize, 33.17%. At the rye, the same quantity was harvested in 2018 as in 2014, 53 tons.
For rye and oat, the year in which the highest production was obtained is 2017, of 135 tons, respectively 1,516 tons.
Analyzing the production obtained from the main oil plants (Table 5), we see a decrease for sunflower, by 5.14% and increases for the other crops analyzed, in accordance with the growth of the cultivated areas (Table 2). It is worth mentioning that the highest increase is registered in soy, of 196.89%.

Table 4. Production obtained on the main cereals (t) in the Giurgiu County during the period 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Rye	53	39	38	135	53	100
2.	Wheat	330,506	344,170	289,733	386,843	410,625	124.24
3.	Maize	281,055	213,223	191,248	297,957	374,286	133.17
4.	Barley and Beer Barley	99,253	87,592	94,086	110,530	114,707	115.57
5.	Oat	1,279	1,341	1,252	1,516	1,358	106.18

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

Table 5. Production obtained on the main oleaginous plants (t) in the Giurgiu County during 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Sunflower	85,749	71,780	55,697	85,801	81,339	94.86
2.	Rapeseed	47,911	39,468	59,534	81,688	84,443	176.30
3.	Soy beans	8,008	14,176	4,597	23,513	23,775	296.89

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

For vegetables, watermelons and melons, perennial fodder the production increased over the period 2014-2018 (Table 6), despite the decrease of the surfaces of vegetables and melons (Table 3). The highest increase is recorded for perennial fodder, 39.74%. As it can be seen, the potato production decreased by 27.25% during the analyzed period, in accordance with the decrease of the surfaces.

Table 6. Production obtained in different crops (t) in the Giurgiu County during 2014-2018

Nr. crt.	Specification	2014	2015	2016	2017	2018	2018/2014 %
1.	Potatoes	7,697	6,992	7,297	6,063	5,592	72.65
2.	Vegetables	77,041	79,610	63,896	73,047	90,120	116.98
3.	Watermelons and melons	4,345	4,284	6,509	4,093	4,889	112.52
4.	Perennial fodder	163,189	173,288	65,312	112,370	228,033	139.74

Source: Own calculation based on NIS, Tempo On-line Database, 2019, [10].

The most cultivated vegetables in Giurgiu County, in 2018, were in order: tomatoes - 30,072 tonnes, white cabbage - 21,598 tonnes, peppers - 7,992 tonnes, eggplants - 7,502 tonnes, dried onions - 4,323 tonnes and dry garlic - 2,021 tonnes.

Tomato production accounted for 33.37% of the total vegetable production obtained in Giurgiu County contributed to the ranking of the Three Macroregion on the 3rd place at the country level for the production of tomatoes. This macroregion, obtained in 2015, 24.52% of the tomato production in Romania [15].

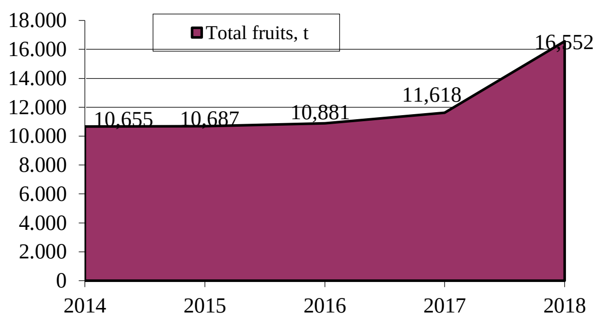

Fig. 6. The dynamics of fruit production (t) in the Giurgiu County during 2014-2018
Source: own processing based on NIS, Tempo On-line Database, 2019, [10].

In terms of fruit production (Figure 6), in 2014-2018, the highest value is recorded in 2018, of 16,552 tons, and the lowest in 2014, of 10,655 tons. Compared to 2014, in 2018 there is a 55.34% increase.

Of the fruits grown, the highest production is recorded in plums - 4,661 tonnes in 2018 (NIS). It is known that the Three Macroregion is in the second place at the country level, in terms of the number of plum trees, which explains the production obtained [7].

In Giurgiu county, apples are ranked 2nd in the production obtained (2,451 tons in 2018 according to NIS), as, at the level of development regions, South-Muntenia obtained in 2016 115,918 tons of apples, being outclassed by the Region of North West Development [13].

Macroregion Three obtained the smallest production of cherries and sour cherries in 2016 [16]. In Giurgiu County, these fruits had a production of 2,420 tons, in 2018.

Other productions obtained in 2018, in Giurgiu County: apricots - 1,619 tons, strawberries - 1,109 tons. With a production of 1,038 tonnes of pears (in 2018) in Giurgiu County, it is confirmed that Romania is not an important player in pears trade [14].

In the figure 7 it is presented the vineyards production. We observe an increase for the analyzed period of 38.52%.

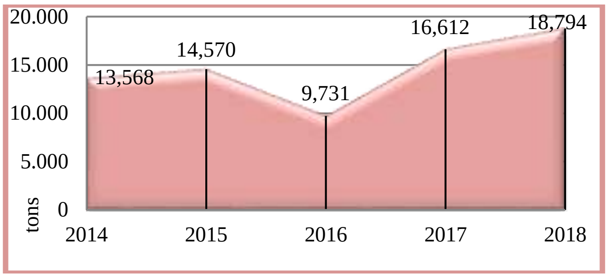

Fig. 7. The dynamics of vineyards production (t) in the Giurgiu County during 2014-2018
Source: own processing based on NIS, Tempo On-line Database, 2019, [10].

Giurgiu County enters into the wine region of the Danube Terraces, located mostly on the Danube terraces in the southeast of the Romanian Plain. This region includes: Greaca vineyard - with the localities: Greaca, Puţu Grecii, Hotarele, Izvoarele, Prundu, Puieni, Băneasa, Pietrele, Giurgiu vineyard- with the localities: Daia, Dăiţa, Plopşoru [17].

Different varieties are cultivated, from those that have early ripening, to the late ones. Grapes are obtained mainly for table consumption. The wine production is varied, being mainly composed of wines of current consumption, especially white wines. Some red wines may have the characteristics required for superior wines [6].

The grape varieties for wine grown in the wine region of the Danube Terraces are: “Crâmpoşie, Fetească Regală, Fetească Albă, Riesling Italian, Riesling de Rhin, Pinot Gris, Pinot Blanc, Sauvignon, Chardonnay, Băbească Gri, Aligoté, Traminer Roz, Tămâioasă Românească, Muscat Ottonel, Cabernet Sauvignon, Cabernet Franc, Merlot, Malbec, Negru de Drăgaşani, Pinot Noir, Fetească Neagră, Băbească Neagră, Sangiovese, Syrah, Dornfelder, Rebo” [2].

In addition to supporting agricultural activities, the financial support provided by the U.E. makes possible the diversification of the activity in the rural area, by developing some non-agricultural activities, which exploit the local natural resources and allow the expression of the entrepreneurial spirit and the preservation of the local traditions [3], [9].

CONCLUSIONS

Giurgiu County occupies the 4th place in the South - Muntenia Development Region, in terms of arable area.

From the studies, it appears that, in the Giurgiu County, in the year 2018, out of the total of 79.4 thousand people engaged in activities for the national economy 41.69% worked in agriculture, forestry and fishing. There is a tendency to decrease the number of people involved in this sector of activity.

The largest areas cultivated in 2018 were occupied by wheat, maize, sunflower, rapeseeds, barley and beer barley.

In the period 2014-2018 there was a decrease of the cultivated areas for rye, wheat, maize, barley and beer barley, sunflower, potatoes, vegetables, melons and watermelons and orchards.

With the exception of three cultures from the ones analyzed - rye, sunflower and potatoes, for the others there are production increases.

Although the areas cultivated with vegetables have decreased, production has increased. In 2018, in Giurgiu County, the most cultivated vegetables were: tomatoes - 30,072 tons, white cabbage - 21,598 tons and peppers - 7,992 tons.

Fruit production has been increasing, although the areas occupied by orchards have decreased. At plum, the most cultivated fruit in the Three Macroregion, 4,661 tons were obtained in 2018.

The wine-growing areas and the production obtained were increasing in the period 2014-2018. Giurgiu County is part of the wine-growing region of the Danube Terraces, where the production is mainly focused on obtaining table grapes and wines of current consumption, especially white wines.

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EFFECTIVENESS OF AGRICULTURAL DEVELOPMENT PROGRAMME COMMUNICATION METHODS ON BROILER PRODUCTION TECHNOLOGY ADOPTION AMONG FARMERS IN ANAMBRA STATE, NIGERIA

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Abstract

Improved agricultural activities ensure food security at all levels and Agricultural Development Programme (ADP) in every state in Nigeria is saddled with the responsibilities of ensuring that up to date technologies are disseminated to farmers with a view to eradicating hunger. Broiler is among the popular livestock raised as means of income generation among farmers in the Southeast. However, little is known about the effectiveness of ADP communication methods on broiler production among farmers in Anambra State, therefore, the need for this study. Simple random sampling was used to select 90 farmers for the study and validated interview schedule was used for data collection. Findings reveal that only 39.3% of broiler farmers in Anambra State had post secondary education and the mean farming experience was 7.34 years. Among the six ADP communication methods identified, only three Results demonstration (3.48±0.90); method demonstration (2.99±0.83) and fellow farmers ($\overline{X}$ 3.57±0.99)) were indicated to be effective for the adoption of broiler production technologies among farmers. Farmers' awareness of broiler technologies (b= 2.59; t = 3.157; p≤0.05) was influenced by the ADP communication methods disseminated to farmers by the extension agents. It was observed that the effective ADP communication methods were inter-personal. It was therefore recommended that extension workers and other stakeholders should intensify efforts in using mass media as communication methods in order to reach out to large number of farmers.

Key words: *effectiveness, adoption, broiler production, technology*

INTRODUCTION

Nigerian agricultural technology transfer policy since political independence had emphasized the dissemination of technical innovations to farmers through various agro-technology systems (Madukwe *et al*, 2002) [9]. Advanced technology can revolutionize global agricultural development. Developments in crop and animal production techniques could facilitate the rate at which products and processes which have been proved successful in developed nations can be adapted and adopted around the world particularly in developing countries such as Nigeria. Advances in technology consist of discovering new methods of production, developing new products and introducing new techniques (Maduekwe, 2010) [10]. These technologies can be transferred to farmers through adequate means of communication. Various technologies are being transferred by the ADP to farmers in the study area. These technologies are in the areas of: housing orientation; bio- security; stocking and brooding; disease control and feeding.

In spite of the abundance of poultry technologies developed by researchers and transferred by ADPs, poultry production in Nigeria is still far from actualizing its maximum potential (Apantaku, 2006) [2]. Sustained agricultural production in general and poultry production in particular cannot be realized in the absence of a solid and functional extension network with an efficient communication system. Effective communication of research results to farmers and feedback on farmer's field problems to research institutions is the primary role of extension service. The use of adequate communication methods by extension agents to reach farmers at their door step and make positive impression that will bring about the desired change in knowledge and practices are still some of the key inputs necessary for improved broiler production among farmers. However, extension efforts to the farmers over several decades with beneficial research based agricultural technologies do not look to have made the expected impact in developing countries (Okunade and Oladosu, 2005) [14].

In Nigeria, the ADP is currently the prominent government funded agro-technology transfer outfit (Madukwe *et al*., 2002) [9]. ADP transfers technologies in both crop and animal sections, the livestock development component is responsible for the development of improved technologies for lower ruminants and poultry production; these are extended to resource-poor farmers. Though ADPs in some states of the federation are experiencing poor funding and other challenges, a study conducted on the ADPs in Nigeria: status and policy implications by Auta, and Dafwang (2010) [3] shows that 63.6% of the ADPs have weak or very weak funding status. Despite the funding problems, 89% of the states paid visits to farmers,68% established SPATs while 54% established OFARs in 2008. Also, MTRMs/QTRM, FNTs/MTs and MTPs were conducted by 86% of the states. Furthermore, Ifenkwe (2010) [8], states that investigation reveal that the ADPs of the nine states in South- East agro-ecological zone, Nigeria transferred extension messages and technologies on major livestock species such as; goat, sheep, poultry, cane rat and rabbits. The key technologies on poultry were based on; housing, feeds and feeding, health management, record keeping and artificial brooding.

Poultry farming also serves as part-time job to supplement the income of small and marginal farm families and that of other categories of workers (Chah et al., 2013) [4]. The development of poultry industry has also been described as the fastest means of bridging the protein deficiency gap prevailing in the diets of Nigerians, however, poultry production in Nigeria is associated with numerous problems ranging from low egg production, disease and pests to low and poor performing breeds, poor weight gain/feed conversion, feeding and management problems and lack of capital (Mungube *et. al.*, 2008) [11]. Many studies conducted on the communication methods of the extension agencies on adoption in the area have focused mainly on crops with less attention given to livestock and poultry (broilers) in particular. Moreover, the extent of adoption of broiler technologies in Anambra State has not yet been fully established, thus the need for the study.

The purpose of the study was to ascertain the effectiveness of ADP communication methods on broiler production technology adoption among farmers in Anambra State with a view to unveiling among the technologies those that are effective. The study hypothesized that there was no significant influence of the ADP technologies on the adoption of broiler technologies.

MATERIALS AND METHODS

The study was conducted in Anambra, State in South East zone of Nigeria. Agricultural production such as crop and livestock production is the major occupation of the people living in the rural communities of the State. Poultry production is almost a household business in the study area as large population of the farmers engaged in livestock production keep poultry at a small to medium scale level. The population of the study includes all the small scale poultry farmers in the state. There are 21 local government areas, and four extension zones in Anambra State. The zones are Awka, Anambra, Onitsha and Aguata extension zones.

Poultry (broiler) farmers were selected through a multi-stage sampling procedures follows:

1st step: Simple random selection of three extension zones from the State.

2nd step: Simple random selection of three extension blocks from each of the 3 extension zones (i.e. 9 extension blocks);

3th step: Purposive selection of one extension circle from each of the 9 extension blocks in the state based on the intensity of poultry production. (i.e. 9 extension circles);

4th step: Ten poultry (broiler) farmers were randomly selected from the 9extension circles from each of the extension blocks in the State, making 90 respondents selected for the study.

However, 89 copies of questionnaire administered were returned.
Structured questionnaire was used to collect primary data from the respondents. Secondary data were obtained from the literature relevant to the study. Data obtained were described with descriptive statistics such as frequency counts and percentages while linear regression analysis was used to determine the influence of awareness on adoption. The model specification is given below:
The relationship explicitly was expressed as:

$Y_i =_f a + bX_1$. . . (1)

where:
Y_i = Adoption score as dependent variabl
X_1= Awareness of technologies.

RESULTS AND DISCUSSIONS

Socio-economic characteristics of the respondents

Results in Table 1 show that about 68.5% of broiler farmers were male, while 31.5% of them were female. This findings show that male constituted the majority of broiler farmers in the study area. This finding conforms with the studies of Ifenkwe (2010) [8] that males dominated animal farm enterprise in Abia State. The male dominance may be due to the numerous responsibilities attached to women (child bearing, mother care and home maker) as identified in the gender analytical framework by Ogunlela et al. (2009) [13] and Abdullahi (2007) [1]. However, the findingsdisagreed with the reports of Chah et al., (2013) [4] that described poultry farmers in Enugu North Local Government Area as female dominated. The results also showthat 9% of the respondents were less than 30 years of age while 47.2% and 29.2% of the respondents were within the age groups of 30-39 years and 40-49 years, respectively while only 11.2% and 3.4% of these farmers were within the age brackets of 50-59 years and 60-69 years ofagerespectively. The mean age was 49.19 years and the standard deviation was 12.10 years.This implies that broiler farmers in the study area were in their active and prime ages. The implication of the findings is that they will be able to use their youthful characteristics such as innovativeness, quick reaction times and faster knowledge acquisition (Torimiro et al., 2003) [16] in the poultry management practices. This means that adoption of broiler technologies is expected to be high among them.

Table 1. Socio-economic characteristics of broiler farmers (N= 89)

Variable	F	%
Sex		
Male	61	68.5
Female	28	31.5
Age (years)		
<30	8	9.0
31-39	42	47.2
40-49	26	29.2
50-59	10	11.2
60- 69 and above	3	3.4
Mean		**49.19**
Std. Dev		**12.10**
Education level		
No formal education	14	15.7
Primary education	16	18
WASC	24	26.9
NCE/OND and above	35	39.3
Experience (years)		
0-5 years	31	34.8
6-10 years	35	39.3
11-15 and above	23	25.8
Mean	**7.34**	
Std. Dev	**2.27**	
Kind of production		
Full time	29	32.6
Part time	60	67.4

Source: Field survey.

Level of adoption of broiler technologies

Result on table two shows that farmers had a high adoption level of broiler production technologies with a grand mean of ($\overline{X}$ =3.10) in 'building orientation of poultry house'. Similarly, in 'sourcing for breeds', analysis shows that the grand mean of ($\overline{X}$ =3.54) was recorded; implying a high adoption level (Table 2).
Furthermore, in 'stocking and brooding', farmers recorded a grand mean of ($\overline{X}$ =3.49), farmers also recorded high level of adoption in 'prevention of diseases (bio-security)' with a mean value of ($\overline{X}$ = 3.64) which is lower than the 2.5 benchmark. Furthermore,

'adequate feeding' also recorded high adoption by the farmers as was shown in the pooled mean of ($\overline{X}$=3.22). The pooled data indicate high level of adoption of broiler production technologies introduced to farmers in the study area. It could be recalled that farmers had high experience in broiler production.

Table 2. Distribution of respondents by their adoption of broiler technologies (N=89)

Variable	Mean	Std. Dev
Adequate siting of poultry house		
Long side backing sun direction	2.61	1.09
Siting house away from residential areas	2.87	1.07
Siteing house in a noiseless area	2.84	0.89
Ensuring adequate ventilation	3.06	1.16
Ensuring safety of surrounding	3.60	0.54
Pooled mean	**3.10**	
Sourceing of feeds		
Getting fast growng breeds	3.64	0.48
Acquiring disease resistant breeds	3.53	0.50
Getting good breeds with high weight gain	3.46	0.57
pooled mean	**3.54**	
Stocking and brooding		
Stocking in batches	3.02	1.13
Maintaining adequate stocking density	3.33	0.82
Ensure adequate climatic environment	3.36	0.74
Effective monitoring	3.63	0.57
Providing the necessary brooding equipment	3.82	0.39
Ensuring adequate handling of chicks	3.77	0.42
Pooled mean	**3.49**	
Prevention of diseases (bio-security)		
Use of good litter material l(wood-shavings)	3.75	0.49
Effective use of disinfectants	3.68	0.47
Careful handling of birds	3.61	0.65
Effective disease control	3.49	0.63
pooled mean	**3.63**	
Adequate Feeding		
Giving the right feed at the right age	3.41	0.86
Giving the right quantity of feed	3.54	0.68
Giving good quality feed	3.45	0.73
Supplementing commercial feeds using local feeds materials recommended by ADP	2.31	1.31
Supplementing commercial feeds recommended by other bodies	3.41	0.86
Pooled mean	**3.22**	

Source: Field survey, 2016.
Mean ≥2.5 = High

This factors could be responsible for the high adoption level established in the findings of this study as Ekong (2010) [7], Deji and Koledoye (2013) [6], Yusuf (2009) [17], among other studies had documented the positive correlation that farming experience and awareness had on adoption of agricultural technologies.

Effectiveness of ADP's communication methods in transferring useful information on broiler technologies to farmers

Data on Table 3 reveal that method demonstration ($\overline{X}$=2.91; SD=1.01); result demonstration (Field day) ($\overline{X}$=3.48; SD=0.78), and fellow farmers ($\overline{X}$=3.57; SD=1.00) were the ADP communication methods rated effective in adoption of broiler production technologies among farmers.

Table 3. Distribution of farmers based on the effectiveness of ADP's communication methods in transferring useful information on broiler technologies to them (N= 89)

Variable	Mean	Std. Dev
News bulletins	2.02	0.75
Village meetings	2.00	0.74
On- farm adaptive research	2.00	0.75
Method demonstration	2.91*	1.02
Result demonstration (Field ay)	3.48*	0.78
Fellow farmers	3.57*	1.00

Source: Field survey, 2016.
*Mean ≥2.5 = Effective

This finding shows that interpersonal methods of communication are the best communication methods that would be effective in raising adoption of broiler production technologies among farmers. In agreement, the finding of Nwabueze, et.*al* (2012) [12] reports that friends (97.0%) and relatives (92.3%) showed relative effectiveness as information sources of fisher folk in Delta State.

Perceived effect of adoption of broiler technologies on farmers

Results in Table 4 show that adoption of broiler production technologies had the following effects on farners: understand better how to manage birds ($\overline{X}$=3.66; SD=0.50), help birds to grow faster ($\overline{X}$=3.51;SD=0.50), increase farmers' supply of chicken(meat)to people ($\overline{X}$=3.51;SD=0.50), help farmers contribute to soil fertility ($\overline{X}$=3.73;SD=0.49), improve farmers' income ($\overline{X}$ =3.69; SD=0.47), improve farmers' wellbeing ($\overline{X}$ =3.60; SD=0.49), help farmers contribute to protein intake of people around them ($\overline{X}$ =3.69; SD=0.47) and help farmers contribute to food security of Nigerians ($\overline{X}$ =3.22; SD=0.91). The grand mean of $\overline{X}$ =3.50 indicates that adoption of broiler production technologies had a high effect on farmers.

Table 4. Distribution of respondents based on their responses on perceived effect of adoption of broiler technologieson them (N=89)

Variable	Mean	Std. Dev
Understand better how to manage the birds	3.66*	0.50
Help birds to grow faster	3.51*	0.50
Increases my supply of chicken (meat) to people	3.51*	0.50
Helps me contribute to soil fertility	3.73*	0.49
Improves my income	3.69*	0.47
Improves my wellbeing	3.66*	0.48
Helps me contribute to protein intake of people around me	3.69*	0.47
Helps me contribute to food security of Nigerians	3.22*	0.91
Grand mean	**3.50**	

Source: Field survey, 2016.
Mean ≥2.50 = High effect

This finding corroborates the study of Oyeyinka *et al.* (2011) [15] and Cheboi *et al.*, (2014) [5] that adoption of agricultural technologies and improved farming practices has signficant impact on the farmers' productivities and livelihood means.

Influence of awareness of ADP communication methods on the adoption of Broilers production technologies

Results in Table 5 show that farmers' awareness of ADP communications (t = 2.59) was significantly related to the adoption of broiler production technologies in the study area at 0.01 level of significant. This shows that farmers that aware of these technologies stand the chance of adopting and this will invariably have positive effect on their production as reported earlier. The finding is in-line with the findings of Maduekwe (2010) [10] that reported that awareness of technology was a determinant of its adoption. The Nagelkerke R Square of 0.149 implies that awareness of technology could explain about 14.9 percent variation in the adoption.

Table 5. Results of Linear regression analysis showing the awareness of ADP communication methods on the adoption of broiler technologies among farmers

Regressor	B	S.E.	t	Sig.
Awareness	2.59	0.820	3.157	0.01
Constant	3.67	0.976	3.760	0.01

Source: Field survey, 2016.
-2 Log likelihood= 345.301, Cox & Snell R Square= 0.370 and Nagelkerke R Square= 0.149
** Significant at 0.01 level of significance

CONCLUSIONS

The study therefore concludes that adoption of broiler technologies in the area studied had high effect on broiler production. Results and method demonstrations with fellow farmers were the ADP communication methods that had significant influence on the adoption of broiler production technology in the study area.

Based on the findings of the study, it was recommended that, since farmers already have positive disposition towards poultry technologies, through their adoption of the technologies, they should be encouraged to expand their production through better funding such as giving of grants and soft loans by government and other stake-holders.ADP should also intensify their effort on the use of those communication methods that influence farmers positively towards adoption of the technologies.

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THE MANAGEMENT OF PINE STANDS SITUATED OUTSIDE THEIR HABITAT

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Abstract

Pines stands from outside their areal were created from 1972 in field and plain areas with the purpose of substituting degraded stands (oaks) or derived ones (linden, hornbeam). These cultures had a good evolution up to the age of 30-35 years, after which they were affected by drought and/or breaks with an effect on their stability, protection, regeneration functions and forest continuity. The degree of damaged caused and the danger that this phenomenon poses in disordering the ecologic equilibrium requires the adoption and appliance of complex silvo-technical measures and works. The present paper shortly presents data regarding the current state of pine stands situated outside their areal as well as their ecological reconstruction solutions. These solutions were scientifically sustained based on the results of investigations realized during 2015-2018. The ecological reconstruction works of pine stands located outside their areal are necessary for improving their current structure, as well as their capacity for ensuring regeneration and their transition towards other forest zonal types. The recommended ecological reconstruction solutions intend to reestablish a natural forest type by substituting pine stands from lands located in "natural" stations or slightly altered towards a natural forest type. This can be achieved by restoring-substituting pine stands situated in moderately degraded lands with improved vegetation conditions.

Key words: *pine stands from outside their areal, damages, drying, ecological reconstruction*

INTRODUCTION

Pine stands from outside their habitat are located in Romania in the silvo-steppe area (especially black pine stands) and in hill ones (black pine and Scots pine), on lands with different site conditions. These stands were introduced from the year 1972 in order to replace some degraded stands (generally oak ones) or derived ones (linden, hornbeam). As such, at the present moment their age varies between 35 and 40.

Pine trees were also frequently used in the afforestation of degraded lands from the silvo-steppe area [7] up to higher areas [8]. They have a good behaviour when mixed with different broad-leaved species [11, 12] and with the white sea buckthorn on very strongly degraded lands [5]. Pine plantations from degraded lands have offered good results only after the implementation of special field management/consolidation works [5, 13].

Pine cultures from outside their habitat had a good evolution up to the age of 30-35 years, after which they were affected by climatic changes (drought, wind, etc.). The damages were moderately up to strongly in the external silvo-steppe with extreme conditions (drought) and moderate up to weak in the hill areas [6]. In this manner, the stand's structure has degraded (the number of trees and their consistency has reduced, sometimes even considerably), affecting their stability, protection functions and landscape [3, 14]. Significant damages (entire drying) were registered for Norway spruce, fir and Douglas fir cultures extended outside the habitat. Their decline will be accentuated in the following decades, especially in the hilly areas [2, 10].

The amplitude caused by damages on resinous stands situated outside the habitat and the danger that this phenomenon poses in disordering the ecological equilibrium requires the adoption and appliance of complex measures. These measures regard the ecological reconstruction of the affected stands and the steady return to the natural forest type. The ecological reconstruction of natural ecosystems has favourable effects in increasing their biodiversity, in diversifying ecosystem services [1], in reshaping the landscape and in forest regeneration and continuity.

Replacing resinous stands located outside their habitat must be substantiated with care in order to avoid new crises [2, 9]. These types of works are recommended as emergency when the stand's health state and vigour significantly decreases, without the possibility of a natural rectification. This situation is caused by a decrease in consistency, soil sodding and compacting or by the regeneration of some species with a reduced ecological value.

The present paper presents the state of pine stands situated outside their habitat and their ecological reconstruction solutions, based on the results of investigations realized during 2015-2018.

MATERIALS AND METHODS

Field investigations were realized in order to achieve the intended objectives, followed by data interpretation. Taking into consideration the diversity of the research's situations (stands, site conditions etc.) and objectives, representative pine stands located on lands with different site conditions from the East part of Romania were analysed.

One of the main objective was to identify the ecological factors that limit ecological reconstruction and the regeneration of pine stands located outside their real. The current state of pine stands in relation with the action of some harmful agents was also taken into study. The structural and qualitative characteristics of stands located outside their habitat has a special importance as it helps in creating an overview of their regeneration state, structure, stability and capacity.

In order to attain the purpose of the investigations, ecological reconstruction experiments were realized in pine stands located outside their habitat from lands with different site conditions (five experimental blocks).

The research surfaces and experimental blocks were situated in the following forest districts: Iasi, Bacău, Vrancea, Buzău, Galaţi, Cluj and INCDS "Marin Drăcea" - BE Vidra.

Observations and measurements (the entire measurement of the base diameter and heights on species, the inventory of the number of trees and shrubs on species) were realized in the research surfaces, followed by an evaluation of their consistency and health state. In addition, other elements were also determined: seedling composition and characteristics, coverage composition and degree, herbaceous vegetation etc.). Representative images were captured in areas with important characteristics for the intended purpose.

Tree heights were measured with the Vertex dendrometer, while the diameter was measured on two directions with a caliper.

The health state was expressed through the defoliation degree. As such, its evaluation was realized based on the forests' state evaluation methodology.

In order to emphasize the stands' structural characteristics, an experimental distribution analysis was realized for the main biometric parameters through the theoretical distribution functions (normal, beta) that correspond to the horizontal structure. Another analysis method for the stands' structure was represented by the analysis of correlations between different qualitative and quantitative characteristics, through general statistical methods.

The stands' quality study and establishing dependency connections between different qualitative and quantitative characteristics has involved the usage of a structure analysis in regard with the site conditions.

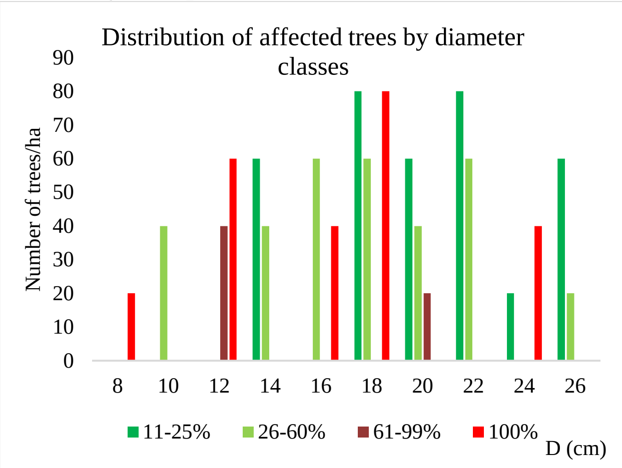
RESULTS AND DISCUSSIONS

During the last period of time, as an effect of climatic changes, pine stands (Scots and black) located outside their habitat have suffered damages caused by drought (drying) and sometimes by windfalls and snow [7]. The lands on which these types of stands were created are diverse from the point of view of geomorphologic and pedosite conditions. Affected pine stands were identified from the external silvo-steppe area (with severe climatic conditions) up to the area with oaks, namely hills with altitudes of up to 400 m (500 m, in Transylvania's plateau). The lands were both normal and degraded. The most frequent damages were drying – especially in silvo-steppe and breaks (stem, crown) caused by wind and snow – in the oak area as well as in the interior silvo-steppe.

Vegetation conditions were analysed in order to emphasize the purpose of factors that cause the evolution and behaviour of pine stands, in correlation with the harmful factors.

The health state of pine stands located outside the habitat

The realized investigations have emphasized the stands composed of a single species as the most vulnerable ones. They are dense (plantation schemes of 1,0x1,0 m or 1,0x1,5 m), without on time management works (cleanings), situated in the steppe/silvo-steppe area and in the oak sub area, with ages between 30-40. At this age, the pine's water necessary is reported as maximum [4].



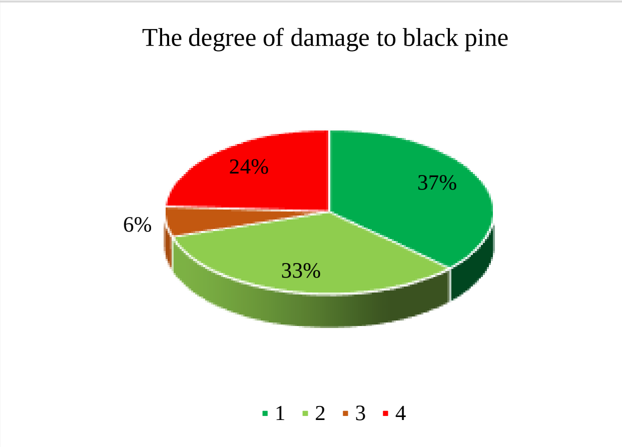


Fig. 1. Damage characteristics for u.a. 40B, UP II Rareş, OS Galaţi.
Source: original.

Scots pine was more strongly affected by the above-mentioned conditions, in comparison with the black pine.

The analysis of the pine damages degree has shown that the percentage of damaged trees (affected by drying in a percentage of over 25%) is of over 50% in most of the analysed situations (Fig.1, 2), and can reach even 75 – 77%. The largest percentage of damaged trees is observed in most stands located in the silvo-steppe area, in places were extraction works were not implemented.

Fig. 2. Black pine stand (40 years old) strongly damaged with cherry and manna regeneration, u.a 40B, U.P. II Rareş, OS Galaţi.
Source: original.

Besides drying, pine stands from outside their habitat have suffered damages caused by wind and snow. As such, in most of the analysed situations, a significant percentage of the number of trees in vegetation (over 70%) presents different defects. Breaks predominate for Scots pine, while the black suffers more from bending/ leaning due to the pressure exercised by adherent snow and winds. The most important damages were recorded in pine stands located in the internal silvo-steppe, up to the superior vegetation levels.

The height distribution and the number of trees per diameter classes (Fig. 3) emphasises the degraded structure of black pine stands affected by drought.

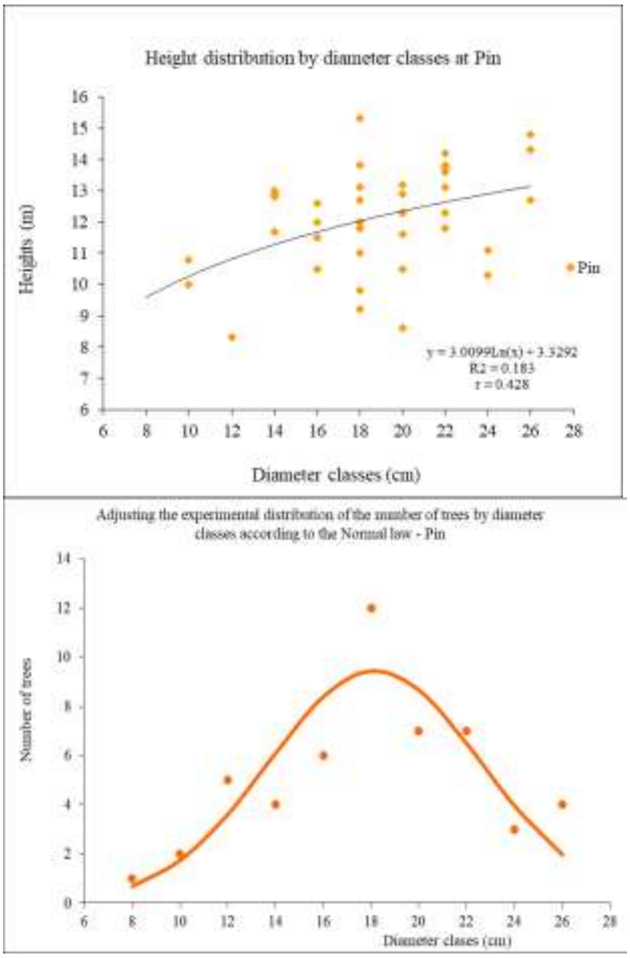


Fig. 3. Height distribution and the number of trees per diameter classes (u.a 40B, U.P. II Rareş, OS Galaţi). Source: original.

Generally speaking, the damages were moderate to strong in the external silvo-steppe and moderately to weak in the superior vegetation levels where strongly damaged species (over 60%) were extracted through silvotechnical works. As such, the number of trees and their consistency was significantly reduced.

In approximately 50% of the analysed situations, the pine stands included broad-leaved species (Fig.2) that have regenerated naturally (originating from the old substituted stands). Their role is essential in ensuring consistency and the stands' structural diversity [15].

The investigations realized in regard with the evolution of pine stands located on lands from different site conditions sustain the fact that nature tries to restructure ecosystems with a too high degree of uniformity. The intervention periods and means are different than the ones used by a forester. The necessary silvicultural management measures must take into account the complexity of site conditions, stand characteristics as well as their evolution directions.

The urgency of interventions with ecological reconstruction works

Intervention urgencies with ecological reconstruction works were established based on the stand structure and degree of damage. However, establishing ecological reconstruction solutions is difficult as it requires different solutions and techniques, based on the site conditions and other characteristics of the affected stands.

The urgency of intervening with ecological reconstruction works in pine stands located outside their habitat is differentiated based on consistency, damage degree and the structural characteristics of the affected stands.

As such, the following intervention urgencies were differentiated based on the obtained researches:

-very strongly affected stands (with over 60% trees affected by drought or breaks, or with the consistency under 0.4), pure, without natural regeneration – Ist degree urgency (reconstruction);

-strongly affected stands (26-60% trees affected or a consistency under 0.6), pure or mixed with broad-leaved species (20-40%), without or with a weak natural regeneration from unwanted species – IInd degree urgency (reconstruction);

-strongly affected stands (26-60%), 0.6 – 0.8 consistencies, mixed with broad-leaved species (at least 30%), with a natural regeneration with valuable local species (on at least 30% of the surface or covering 0.3 of the surface): permanent maintenance works; reconstruction/helping natural regeneration/additions – III^{d} degree urgency;

-weakly-moderately affected stands (11-25%) – maintenance works and additions, IVth degree urgency.

The ecological reconstruction works of pine stands located outside their habitat are necessary both for improving the current situation (consistency, composition, etc.), as well as for restoring their capacity for ensuring regeneration and a transition towards other zonal forest types. The proposed ecological reconstruction works are: substituting, restoring-improving, helping natural regeneration.

Taking into consideration the biological particularities of pine and their predisposition towards damages, the ecological reconstruction works, namely introducing or promoting local species with a high ecological value intend to create stands resistant to the action of damaging factors. At the same time, their hydrological efficiency and anti-erosion are increased, helping them easily regenerate naturally and ensuring the continuity of forests and their protective functions.

The ecological criteria for choosing species for the ecological reconstruction of pine stands located outside their habitat was the basis for technical recommendations. According to this criterion, only healthy and robust forests composed of proper species adapted to site conditions area capable of superior functionalities that can respond to multiple economical, hydrological, anti-erosion, hygienic, sanitary and landscape requirements that can activate in complete stability and a high economic profitability. Compositions with the main species that correspond to site conditions were recommended. Using a large number of species in afforestation compositions can lead to an increased biodiversity, tree resistance towards the impact of harmful biotic and abiotic factors and, implicitly, to improving their stability.

The ecological reconstruction solutions imply a reverse to the natural forest type by substituting pine stands from lands situated in "natural" stations or slightly changed and steadily switching them to a natural forest type. This can be achieved by restoring-substituting pine stands located in degraded field stations with extreme site conditions (with an advanced degradation, superficial, skeletal soils, high slopes, drought etc.). Restoration-improving solutions were proposed (where pines had a percentage of 25-50%) in mixture with broad-leaved species and shrubs, with the switch towards a natural forest in a subsequent stage.

The intervention methods with ecological reconstruction works were differentiated based on the stand's damage degree and site conditions:

For *very strongly and strongly damaged* stands, pure, without a natural regeneration or with a weak regeneration and/or from improper species:

-on plain lands or weakly inclined (slope < 10 degree) – substituting through erased cuttings (floorings smaller than 3 ha);

-on inclined lands (10-25 degrees) – substituting through erased cuttings (in strips with a length of approximately 3 x the average stand's heights on 1/3 of the stand's surface);

-degraded lands, moderately up to strongly eroded - tree restoration on strips with a 1 - 3 length, average stand heights, for 1/3 of the stand;

-on degraded lands with large slopes and high erosion risk – ecological reconstruction through improving the stand's composition in holes with 1-3 diameter, average stand heights, located in the points with the highest damage intensity, with consistencies under 0.6.

For *strongly damaged* stands, composed of pines and broad-leaved species and with a natural regeneration of valuable local species, the silvicultural intervention direction is to manage the stands through silvotehcnical works, extracting pine species affected by drought, selecting/promoting local broad-leaved species naturally installed through maintenance/helping seedling works; completing holes through plantations or direct sowing.

Extracting damaged trees will be realized without harming the remaining trees, the seedling or the soil. The harmed natural regenerated seedlings will be cut back.

The interventions will be differentiated through their spreading within the stand, consistency, age and presence of natural regenerations, as follows:

-if the damaged trees are uniformly or relatively uniformly distributed, the ones that can no longer be maintained will be extracted, keeping only the samples that present damages/drought under 40 %.

-if the damages were produced focused (in bunches or clusters), the extraction of damaged trees is mandatory. The intention is to level as much as possible the growth space for the remaining trees within the holes; in stands with already existing holes, the affected samples will still be extracted; in both cases, plantations or direct sowings will be realized in the resulted holes (larger than 300 m^2), with species proper for the station; for the rest of the stand, the growing spaces will be levelled, encouraging broad-leaved species and/or natural regenerations;

-in the situations with a strongly developed sub-stand, the eradication of stubs from arbustive species is necessary in the holes destined for afforestation.

M*oderately damaged* stands where the damaged trees percentage varies between 11 and 25% of the total number of trees, can be managed by applying maintenance cuttings, followed by promoting broad-leaved species and opening regeneration holes (conservation cuttings).

CONCLUSIONS

In 75% of the analysed situations, the presence of naturally regenerated broad-leaved species was observed. They originate from the substituted stands and have an important role in ensuring the consistency and structural diversity of pine cultures; the higher diversity of pine stands in mixture with broad-leaved species manifests in an increased stability, adaptation to site conditions and a capacity for natural regeneration.

Evaluating the vulnerability of resinous stands from outside their habitat is necessary in the conditions of climatic changes in order to know the evolution direction of the stands and for prioritizing future interventions of managing and regenerating pine stands.

The urgency of interventions and means of ecological reconstruction were established based on the stand’s structure and degree of damage. The establishment of ecological reconstruction solutions was realized based on site conditions, requiring different compositions and techniques.

Ecological reconstruction works for pine stands located outside their habitat are necessary both for improving the current situation (consistency, composition, etc), as well as for their capacity in ensuring regeneration and for a transition towards other forest types.

The ecological reconstruction of pine stands must take into account the naturally regenerated species as belonging to “the biocenosis memory” as well as the need for creating more stable biocenosis with a higher ecological value.

The recommended ecological reconstruction solutions target the recursion to the natural forest type by substituting pine stands from lands located in “natural” stations or slightly changed and steadily moving towards a natural forest type. This can be achieved by reshaping-substituting pine stands located in moderately eroded degraded lands with improved vegetation conditions. In the case of lands with extreme site conditions (with an advanced degradation, superficial, skeletal soils, high slopes, drought, etc.), reshaping-improving solutions with pine and broad-leaved or shrub species (where the pine has a percentage of 25-50% were proposed), while switching towards a natural forest is postponed for a future stage.

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STUDY ON THE INFLUENCE OF PROPHYLACTIC TREATMENT WITH PRODUCTS FROM THE T+ TOXICITY GROUP UPON WHEAT QUALITY, DURING POST-HARVEST STORAGE

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Abstract

Harvested wheat is a complex ecosystem with a rich enzymatic activity, located in the germ, contaminated with microorganisms and potentially infested with insects. Wheat quality assurance during storage represents a set of technical measures which are applied to direct the physical-chemical and biological processes within the mass of grains, to the purpose of maintaining them under good conditions, with minimum quality and quantity losses.
This work presents a study on the influence of common wheat (Triticum aestivum, ssp. vulgare) belonging to the Romanian variety Dropia, intended for the obtaining food-grade flour. The prophylactic treatments were conducted using groups from the T+ toxicity group (K-obiol EC 25), in view of preserving the wheat under optimal conditions.
The obtained results prove the efficiency of the post-harvest prophylactic treatments, which contribute to the preservation of wheat quality during extended storage. The applied treatment ensured protection from pests and, according to the determinations, it did not significantly change the initial values of the quality indicators for the stored wheat.

Key words*: *wheat, prophylactic treatment, storage, quality indicators

INTRODUCTION

The wheat intended for the manufacture of flour for bread products influences the value and the quality of food.
Wheat is harvested in a relatively brief period of time and it is consumed in approximately constant quantities over the course of the year. That is the reason why its storage is required, to ensure that the necessary quantities are provided from one harvest to the next. The quality of grain milling products depends, to a large extent, on the storage and grain milling conditions [6].
Wheat preservation properties are determined by the pre-harvest pedoclimatic and agro-technical conditions, by the harvesting and handling method which ensure the integrity of the grains, by the botanical features of the species and by the grains’ health status.
The harvested wheat does not always meet the quality conditions necessary for adequate storage. The most frequent deviations are increased humidity and infestation [1]. The pest attack most often starts in the germination period and it causes significant damage to small or large agricultural operations [10].
In view of storage, the preparation of the facilities also involves cleaning, disinsection and deratization.
The main parameters to adjust in the silo, for an optimal preservation, are related to the temperature and moisture: over 25°C temperature leads to over-heating of the wheat and over 16% wheat moisture leads to the moulding of cereal, [5].
Moisture content is one of the most important factors for the storage period, as it influences the multiplication of insects and of fungi.
During the cold season, when temperatures are around the value of zero degrees Celsius and moisture is low, the products are preserved without any problems. Starting with the temperature of 10 degrees Celsius, the occurrence of specific insects is noted, and at 25-30 degrees Celsius, the infestation rate (when no preventive treatment is conducted) is high. The targeted pests are the following: *Sitophilis Granaris, Oryzaephilus*

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Surinamensis, Plodia Interpunctella, Rhizoperta Dominica, Tribolium Castaneum, Sitotroga Cerealella, Callosobruchus Chinensis, Drosophilia Melanogaster [3].

The prevention of the potential major hazards which may occur upon storage is achieved using preventive measures (monitoring procedures, procedures for the selection of providers, maintenance and repair plans for the machinery, hygienisation plans, pest control procedures), having in view the HACCP Principles, in compliance with the law in force and with the Best Practice Guidelines for work and hygiene. Aspects such as the ones below are taken into account:

(i)the existence of hazard/risk identification modalities by technological stages;

(ii)the mode in which each technological stage ensures the elimination of risks or their mitigation to an acceptable level;

(iii)the existence of possibilities for the excessive development of an identified risk, which exceeds the maximum accepted level;

(iv)whether the subsequent stages may determine the elimination or the reduction of its effects to an acceptable level.

Hazard analysis represents the basic principle of the HACCP system. In order to implement it, is necessary to identify and assess the potential hazards, in association with the steps of the production process. A further stage is the identification of the measures needed to control these potential hazards. It may take several measures to control a single hazard or, alternatively, a single specific measure can control several hazards [4].

MATERIALS AND METHODS

The research was conducted on the Romanian variety of wheat (*Triticum aestivum, ssp. vulgare)* Dropia, harvested in 2016.

The quality indicators of the harvested wheat are synthesized in Table 1.

The prophylactic treatment was applied by means of a very fine spraying of the cereal, before it was stored [9], immediately following the harvesting. A product from the T+ toxicity group was used, K-Obiol EC 25, which is the only pyrethroid insecticide approved by Directive 91/1414/EU, recommended by WHO (World Health Organisation) and approved by FAO (Food and Agriculture Organization).

Table 1. Quality indicators of the wheat harvested in 2016

Quality indicator	U. M.	Obtained values, acc. to SR 13548/2013
Organoleptic and sanitary features		Appropriate
Moisture	%	12.3
Hectolitre mass	kg/hl	80.4
Total impurities	%	3.26
Grains attacked by pests	%	1.08
Wet gluten content	%	23.2

Source: Author's results.

The insecticide has a shock effect and it ensures protection to agricultural products stored for a period of up to 12 months. The stored products, treated with K-Obiol EC 25, acquire, as a result of the treatment, a microscopic film of active substance which protects them against subsequent pest attacks.

The treatment may be conducted on the surface of the warehouse where the agricultural products are to be kept, as well as directly on the products (for long-term protection) or on the materials in which the storage is to be achieved (sacks, boxes etc.).

For the treatment conducted by direct spraying, low-pressure pump spraying is employed, directly on the cereal, before it is loaded in the silos.

Preparation of spraying solution [9]:

(a)Approximately 1/3 of the spraying equipment volume is filled with water.
(b)The necessary quantity of product is added and it is shaken very well, until the insecticide is fully dispersed, and afterwards the container is filled up with water.

When treating the cereal by direct application, the dose of 1,000 ml of product is added in 99 litres of water and it is sprayed on an area of application fit for 100 tonnes of cereal (according to the specifications from the product’s technical data sheet) [8].

The cereal treated with K-Obiol EC 25 by direct application may be consumed

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immediately, without any hazards to human health, without requiring a 7-10 break period, which is indicated in the case of organophosphorus insecticides [2]. With the recommended dosage, the product is not phytotoxic for the crops which it is endorsed for [7].

After the application of the treatment by spraying, directly on the wheat lot, wheat samples were taken, which were subject to the qualitative analysis, according to SR 13548/2013, at 1-year intervals, for 3 years (2017, 2018, 2019).

RESULTS AND DISCUSSIONS

The samples taken after applying the post-harvest treatment, intended to ensure protection from pests specific for straw cereal, were preserved under hygiene, moisture and temperature conditions identical to the ones existing in the wheat storage silos. The quality indicators were in agreement with the Consumption Grain Grading Handbook, published by Order of the Minister of Agriculture and Rural Development No. 2/07.01.2003, including further amendments and additions incurred by Minister’s Order No. 321/12.05.2009, respectively Minister's Order No. 228/2017.

After each year of storage, a comparative study was conducted between the quality, reference indicators of the year 2016 and the quality indicators corresponding to each storage year (2017, 2018, respectively 2019).

According to the chart in Figure 1 and Figure 2, the samples saw no significant changes in the first two storage years. Variations of hectolitre weight were registered, which dropped by 0.40 kg/hl in the year 2017 as compared to the year 2016, respectively by 0.70 kg/hl in the year 2018 as compared to the year 2016. The higher percentage of impurities and of the grains attacked by pests remained relatively constant for 2016-2017 and 2017-2018.

Figure 3 shows changes in the quality indicators for the treated and then stored wheat. A 3.04% increase of impurities was registered, respectively a 1.92% increase in the grains attacked by pests. The variation of the other quality indicators in the period 2016-2019 is within the admissible values, according to SR 13548/2013, and it is presented in Table 2.

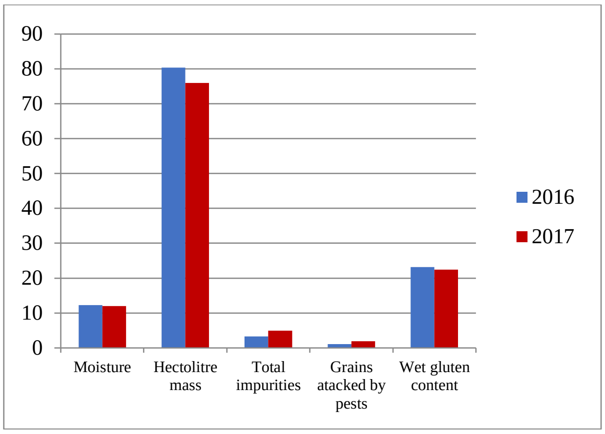

Fig. 1. Quality indicators for the treated and stored wheat, in the period 2016-2017
Source: Author's results.

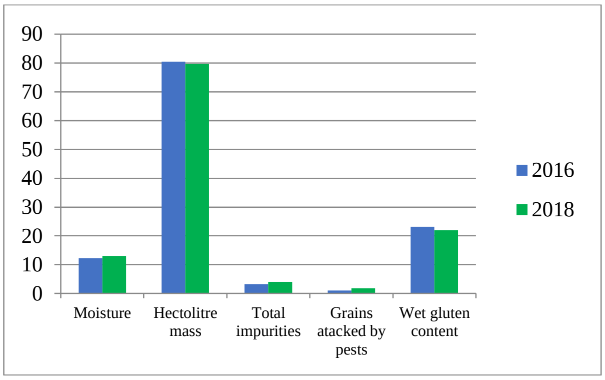

Fig. 2. Quality indicators for the treated and stored wheat, in the period 2016-2018
Source: Author's results.

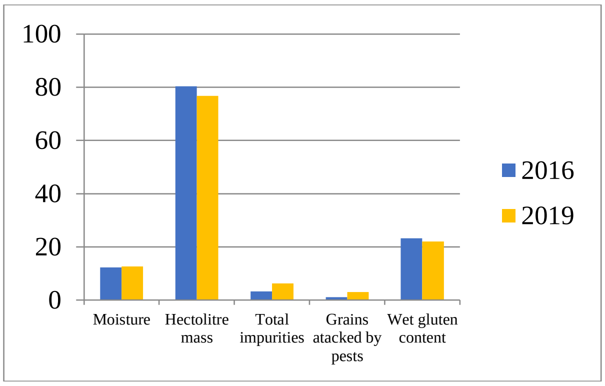

Fig. 3. Quality indicators for the treated and stored wheat, in the period 2016-2019
Source: Author's results.

Table 2. Variation of wheat quality indicators in the storage period (2016-2019), after the application of the prophylactic treatment

Quality indicators	UM	Acceptable values according to SR 13548/2013	Va-ria-tion 2016-2017	Va-ria-tion 2016-2018	Va-ria-tion 2016-2019
Moisture	%	*the moisture depends on the storage conditions, it is not analysed by comparison with the previous years, it must be of max. 14% throughout the storage period	-	-	-
Hectolitre mass	Kg/ hl	* hectolitre mass decrease: maximum 5 kg/hl	-0.40	-0.70	-3.70
Total impurities	%	*total impurities increase: maximum 4%	0.67	0.79	3.04
Grains attacked by pests	%	*increase in grains attacked by pests: maximum 3%	0.57	0.60	1.92
Wet gluten content	%	*decrease in wet gluten content: maximum 2%	-0.80	-1.20	-1.30

Source: Author's results.

CONCLUSIONS

The obtained results prove the efficiency of the post-harvest prophylactic treatments, which contribute to the preservation of wheat quality during extended storage. The data proves that the recommended wheat storage period, under post-harvest treatment conditions, is of 12-24 months, with an optimum 12-month period.

The applied treatment ensured protection from pests and, according to the determinations; it did not significantly change the initial values of the quality indicators for the stored wheat.

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NATURAL FIBRE COMPOSITE PANELS FOR THERMAL INSULATION OF BUILDINGS: A REVIEW

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Abstract

In this paper natural fibre composite panels were analysed, regarding their thermal performance. Four categories of vegetal fibres were assessed, namely bast fibres, seed fibres, leaf fibres, and fruit fibres. In total, 13 types of natural fibres were studied. In each category of fibres, the individual types were compared according to the values of the coefficient of thermal conductivity, the most performing fibres being highlighted. It was concluded that among the studied fibres cork, jute, kapok, pineapple leaves, tea leaves, and coconut husk are the most performing organic materials, being suitable to be used as thermal insulation materials.

Key words**:** *natural fibre, composite, thermal conductivity, sustainability*

INTRODUCTION

Sustainable production is one of the most serious issues today's industries are facing. In the area of building materials it is increasingly advisable the use of materials that are not dependent on non-renewable resources. Such materials might be formulated with natural fibres, which have a fast regeneration.

Natural fibres have several advantages, such as they are easily recycled and eliminated, with beneficial effects on health [1], and by using natural fibres the non-renewable natural resources are protected [8], plus, in some cases the agricultural waste materials are being reusedmn[16] Moreover, the fibres can be burned to recover heat [10], have low cost, low density and low energy consumption, are renewable, the fibres are not abrasive and do not cause skin irritation, they present low health risk, are biodegradable [17], highly available [24], do not emit toxic substances, are permeable, non-radioactive and are electrically neutral [5].

Besides these qualities, natural fibres and natural fibre composites have some disadvantages, including low fibre-matrix compatibility, reduced impact resistance, long-term stability of composites installed outdoor is also reduced [13], high risk of attack of microorganisms, the fibre quality should be monitored regularly, and the processes of harvesting, processing, manufacturing and use must be carried out with care [20].

According to [10], vegetal fibres can be divided in several classes, based on the portion of the plant that is used. Thereby, the following categories can be distinguished: seed fibres, leaf fibres, bast fibres, fruit fibres and stalk fibres. Seed fibres form around the seeds, leaf fibres can be obtained from leaves, bast fibres are found in the outer layer of the stem, fruit fibres surround the fruit of the plant or can be harvested from the fruit itself, and stalk fibres are collected from the stalk of the plant.

In this paper, natural fibre composite materials are assessed from the perspective of thermal performance, namely composite panels based on bast fibres, seed fibres, leaf fibres, and fruit fibres, respectively.

MATERIALS AND METHODS

This paper is based on the study of several scientific articles regarding the use and valorisation of natural fibres. The articles were selected according to various criteria, such as year of publication, number of citations, type of fibre that is studied, conducted experiments, and relevance of findings.

Each relevant article was analysed, and the main conclusions were synthesized.

In this paper two parameters of thermal performance are assessed: thermal conductivity (λ [W/m·K]) and thermal resistance (R [m2K/W]). Thermal conductivity is a parameter that measures a material's ability to conduct heat, a low value implies that the material is an excellent thermal insulator, which is to be desired in the field of construction materials.

Thermal resistance is inversely proportional with thermal conductivity and depends on the material's thickness, so in the field of thermal insulations a high value is seeked.

Bast fibre composite panels

Banana

The banana (Musa) is a tropical plant that has the aspect of a tree. The plant is grown in abundance in many countries (India, China, Philippines), and after harvesting its fruit, the plant becomes an agricultural waste.

Banana fibres show high compatibility with polymer matrices, so fibres are used as a reinforcement [17]. The density of banana fibres is 750-950 kg/m3, the water absorption is 60%, the fibre's Young's modulus is 23 GPa and its tensile strength is between 180-430 MPa [10].

Thermal insulating capacity of the bio-composite consisting of banana fibres and epoxy resin was investigated in [24], in accordance with the density of the specimen. The lowest λ-value was measured for the specimen with a density of 0.08 g/cm3, but in general, the value of thermal conductivity of the composite was not satisfactory for a thermal insulating material.

Thermal insulating foam from glass waste and banana leaves has acceptable thermal insulating properties [2].

These composites have a porosity between 58.5-87.5%, compressive strength between 1.17-3.50 MPa and thermal conductivity between 0.06-0.15 W/m·K.

Cork

The bark of the cork oak (*Quercus suber*), a tree characteristic of the Mediterranean area, is the source of cork grains. Cork has interesting properties, such as impermeability to gases or liquids, low weight, low burning rate, durability or thermal and sound insulation [33]. Because of these properties, cork is being used in many applications, such as in the composition of composite materials based on polyester [34], gypsum [11], or cement, and in the manufacture of insulating panels (Fig.1.) [14].

Fig.1. Insulation boards made of cork
Source: [14].

The λ-value of cork is approximately 0.045 W/m·K. The density of insulation boards ranges between 110-170 kg/m3 [31], [12]. The influence of cork powder on the insulating properties of phenolic foam-based composites was studied by [22]. The best λ-value was obtained for the sample with 1% cork, the value being 0.0294 W/m·K.

Flax

Flax (*Linum usitatissimum*) is a plant cultivated in colder regions of the Earth and it is valorised in the food and textile industries. Due to the high mechanical strength of flax fibres, these are being used more often in the field of constructions. The fibres are characterized by porosity and elasticity, being suitable to be used as thermal insulation and impact sound insulation [29]. Among several natural fibres, for example hemp and jute, flax fibres could successfully be used to replace glass fibres in various composites, when

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considering the cost, mechanical performance and yield of the fibres [37]. The density of flax fibres is 1.4-1.5 g/cm^3, their modulus of elasticity is 27.6 GPa, and the tensile strength is around 850-1,500 MPa [35].

The porous structure of flax fibres consists an advantage if they are being used as thermal insulation. In respect of the thermal conductivity values of the fibres, it varies between 0.035-0.046 W/m·K, depending on the material's density, which can have values of 20-100 kg/m^3 [20]. These values are comparable with those of conventional thermal insulating materials.

Hemp

Industrial hemp (*Cannabis sativa*) is a plant whith a reduced content of psychoactive substances, and it can be cultivated efficiently due to its tolerance towards drought. Different parts of the plant can be harnessed, the exterior bast fibres, the interior wooden part, or its seeds. In the field of construction materials, both hemp fibres and particles can be mixed with different binders, such as lime, clay, starch or sapropel, in order to obtain insulating materials or masonry elements. The density of hemp fibre is 1.48 g/cm^3, its modulus of elasticity is 70 GPa, and its tensile strength is 52 MPa, respectively [35].

Long term studies, carried out by [25], concerning a building with walls made of hemp-lime composite, show that this material has an excellent capacity to regulate indoor temperature and humidity. In a similar way, hemp particles bonded with wheat starch, studied by [9], contribute to the regulation of indoor humidity. Moreover, this composite has a λ-value between 0.06-0.07 W/m·K, for densities ranging between 126-143 kg/m3. The value of the thermal conductivity coefficient of lime-hemp samples varies between 0.0899-0.1408 W/m·K, this value being dependent on particle size, particle concentration, and sample density [5]. For a different type of composite material, consisting of sapropel and hemp [4], thermal conductivity has values between 0.059-0.073 W/m·K.

Thermal properties of hemp-based composites are influenced by a series of external parameters. The value of thermal conductivity is negatively influenced by the aging of the composite [6]. An almost linear increase of thermal conductivity is registered for an increase of humidity content of the material [15].

Jute

Jute (*Corchorus*) is cultivated especially in Asia, it can reach a height of 1-4 m and it is produced in large quantities. The fibres are collected from the outer layer of the plant, having a wide range of utilization. The density of jute fibre is 1.3-1.45 g/cm3, their modulus of elasticity is between 13-26.5 GPa, and the tensile strength has a value of 51 MPa [35]. Due to the high availability of fibres, studies were performed regarding the capacity of fibres to form composite materials, applicable in the field of insulating materials.

From the perspective of a thermal insulation, jute felts in different combinations with polyester fibres have a good behaviour. The λ-value ranges between 0.019-0.025 W/m·K, for a density of 461-592 kg/m3 [38]. Concerning the values of thermal conductivity of commercially available materials, their value ranges between 0.038-0.055 W/m·K, and their density is of 35-100 kg/m3 [29].

Kenaf

Kenaf plant (*Hibiscus cannabinus L.*, Fig.2.) is cultivated mainly for its fibres. The fibres are obtained from the exterior layers of the plant. They have properties comparable to those of other fibres (namely jute fibers) and are mainly used to manufacture different products. Tensile strength and flexural strength of jute fibers have high values [28]. The density of kenaf fibres is 1.4 g/cm^3, their modulus of elasticity is 30.8 GPa, and the tensile strength has a value of 1019 MPa, respectively [35].

Fig.2. Kenaf plant
Source: [23].

Thermal conductivity of kenaf fibres is between 0.034-0.069 W/m·K, depending on the humidity content of the fibre, and their density has a value of 21.2 kg/m3 [12]. The incorporation of kenaf fibres in the formation of a cement-based composite could improve the thermal resistance of the material [40]. The incorporation of fibres in a clayey matrix influences in a positive way the mechanical performance and λ-value of specimens, an increased fibre length determining a more reduced λ-value [21]. The properties of a particleboard made from the core of the plant were studied by [36]. These boards had good mechanical strength and dimensional stability in contrast with their reduced density (0.15-0.20 g/cm^3), and the value of their thermal conductivity was similar with that of mineral wool (0.051-0.058 W/m·K).

Seed fibre composite panels

Cotton

The cotton plant (*Gossypium*) has the appearance of a shrub and it is typically found in tropical and subtropical climates. The cotton fibre, which is composed almost entirely of cellulose, grows surrounding the seeds of the shrub and it is put to use mainly in the field of textile manufacturing. The density of the fibres is 1.5-1.6 g/cm^3 and their Young's modulus is between 5.5-12.6 GPa [35]. In the field of construction materials studies were performed regarding the valorisation of cotton wastes, namely the fibres and the plant itself.

Fig.3. Cotton waste fibers
Source: [8].

The influence of cotton fibre wastes (Fig.3.) in the composition of multi-layered particleboards was investigated in [8]. It was found that using cotton wastes has a positive influence on the performance of the particleboard, obtaining a construction material with reduced weight and thermal conductivity of 2.2 W/m·K. In a cement matrix, cotton wastes contribute to decrease of thermal conductivity, without significantly reducing mechanical strength, the resulting blocks being suitable for masonry units [7].

The valorisation of cotton stalk as a thermal insulation material was studied by [41]. The particleboards were produced without binder by hot pressing. The density of the boards ranges between 150-450 kg/m^3. The λ-value of boards varies between 0.0585-0.0815 W/m·K, a comparable value with that of other thermal insulating materials, such as perlite. These board could be applied on walls or ceilings in sight of energy saving.

Kapok

The kapok tree (*Ceiba pentandra*) is characteristic of tropical areas. The tree seeds are wrapped in silky, cotton like fibres. Kapok fibres with a hollow structure, are characterized by high buoyancy and can be used in the composition of various composite materials, with thermal insulation and sound absorbing purposes [39].

The value of thermal conductivity of the individual fibres is 0.035 W/m·K [1]. Investigation of bio-composite materials made from sodium silicate and kapok fibres was carried out in [1]. The thermal conductivity coefficient of the material was 0.022 W/m·K. It has been observed that the λ-value of the fibres decreases with the addition of other types of fibres (sugarcane pulp or coconut husk fibres).

Leaf fibre composite panels

Pineapple leaves

The pineapple plant (*Ananas comosus*) is cultivated in tropical areas mainly for its fruit. One can easily obtain some fibres usable in many fields from the leaves of the plant. The fibres (Fig. 4) are smooth, white, have a medium length and a high tensile strength. On the other hand, fibres are hygroscopic, requiring chemical modification before use [3]. The density of pineapple fibres is 0.8-1.6 g/cm^3, the Young's modulus of the fibre is 1.44 GPa and its tensile strength i
s between 400-627 MPa [13].

Fig.4. Pineapple leaf fibres
Source: [3].

The value of thermal conductivity coefficient of an agglomerated panel prepared from pineapple fibres and natural rubber was determined in [32]. For densities of 178-232 kg/m^3, the conductivity value varies between 0.035-0.043 W/m·K. The best results were obtained for a fibre/binder ratio of 1/3.

Sisal

Sisal (*Agave sisalana*) is a plant cultivated in tropical areas. The fibres extracted from the plant's leaves are resistant, and are mostly used for making strings, clothing or paper. Sisal fibre density is about 700-800 kg/m^3, the water absorption amounts to 56%, the modulus of elasticity of the fibres is 15 GPa, with a tensile strength around 268 MPa [10]. It was also proposed to use these fibres in the field of constructions, with thermal and sound-insulating role.

The possibility of using sisal fibres as a thermal insulating material has been studied by [26].

The value of thermal conductivity of binderless specimens varies according to the nature of the fibres, treated or untreated. So for the untreated fibres the λ-value is 0.042 W/m·K, and for the treated fibres this value is 0.044 W/m·K.

Similar results were obtained by [30], where a composite material based on epoxy resin and sisal fibres was investigated. Untreated fibres had a better insulation capacity than treated ones, the thermal performance increasing with the increase of the fibre percentage, but the use of untreated fibres is not recommended due to mechanical reasons.

Tea leaves

The tea plant (*Camellia sinensis*) is grown for its leaves. The by-product of leaf processing has been the subject of research to exploit this waste.

The value of thermal conductivity of tea leaves was measured by [18]. It has been found that the λ-value is influenced by several factors: moisture content, density and temperature. According to these parameters, the value of thermal conductivity of tea leaves varies between 0.035-0.568 W/m·K for densities of 236-330 kg/m^3.

Fruit fibre composite panels

Beet

Beet (*Beta vulgaris* subsp. *vulgaris* var. *altissima*) is a plant cultivated for the production of sugar.

The remaining pulp after plant processing is valorized in the agricultural, food and cosmetic industries, and as a sorbent for heavy metals [19].

a) b)

Fig.5. Extruded beet pulp granules (a) and the prepared composite (b)
Source: [19].

Bio-composite based on extruded pulp granules and potato starch (Fig.5.) was assessed from the perspective of thermal and acoustic insulation by [19].

The best results were obtained for the sample with the minimum amount of binder, as the porosity positively influences the two properties considered.

The maximum acoustic absorption value was 0.72 for the 4,000 Hz frequency band, and for the medium frequencies, this value was 0.6. The thermal conductivity was between 0.069-0.075 W/m·K, a value which is similar to that of other bio-composites, with the value of density of the extruded granules being 1073.4 kg/m^3.

Coconut

Coconut palm (*Cocos nucifera*) is a tropical coastal tree. The fibres are obtained from the outer bark of the ripe nut, called mesocarp.

The coconut fibre density is between 145-380 kg/m^3, the water absorption is 130-180%, the fibre's elastic modulus is 19-26 GPa, and the tensile strength is between 120-200 MPa [10]. The λ-value of coconut fibre-based materials is satisfactory. Composite panels made of coconut fibres and polyester fibres can achieve a thermal conductivity values between 0.0279-0.0495 W/m·K [16], the panels being made by the felting method. Regarding the coconut fibre panels made by hot-pressing without the addition of fibres or resins, thermal conductivity varies between 0.046-0.068 W/m·K and density between 250-350 kg/m^3 [27].

RESULTS AND DISCUSSIONS

With regard to the thermal properties, a comparison of the presented solutions of bast fibre composites is made in Table 1. The lowest thermal conductivity values (below 0.030 W/m·K) were measured for a cork powder reinforced phenolic foam [22] and for a jute felt [38].

Table 1. Summary of thermal properties of the studied bast fibres

Bast fibre	Density [kg/m^3]	Thermal conductivity [W/m·K]	Thermal resistance [m^{2}K/W]	Ref.
Banana	310-1030	0.06-0.15	-	[2]
Cork	111.7	0.058-0.070	-	[12]
	110-170	0.037-0.050	-	[29]
	100-300	0.045	-	[31]
	34.8-36.0	0.0294-0.0415	-	[22]
Flax	5-50	0.038-0.075	-	[20]
	20-100	0.035-0.045	-	[20]
Hemp	210-410	0.059-0.073	-	[4]
	126-143	0.0738-0.0634	-	[9]
	369-611	0.0899-0.1408	-	[5]
	212-248	0.0775-0.0915	-	[5]
Jute	35-100	0.038-0.055	-	[29]
	461-592	0.019-0.025	0.20-0.35	[38]
Kenaf	21.2	0.034-0.069	-	[12]
	150-200	0.051-0.058	-	[36]

Source: authors' synthesis based on the studied literature mentioned in the table.

In order to analyse the thermal performance of the seed insulation composites an overview was realized in Table 2, where a summary of the thermal properties of the assessed different fibre panels is showed. From the perspective of thermal conductivity, the kapok fibre and sodium silicate composite [1] has the lowest λ-value.

Table 2. Summary of thermal properties of the studied seed fibres

Seed fibre	Density [kg/m^3]	Thermal conductivity [W/m·K]	Ref.
Cotton	-	2.2	[8]
	740-799	0.267-0.302	[7]
	150-450	0.0585-0.0815	[41]
Kapok	1.173-1.415	0.0106-0.0220	[1]
	-	0.035	[1]

Source: authors' synthesis based on the studied literature mentioned in the table.

From the category of leaf fibres three types of composite panels were reviewed. Table 3 aims to provide a schematic presentation of the thermal properties, obtained in the mentioned studies. Regarding the thermal conductivity, the lowest value obtained was 0.035 W/m·K, registered for an agglomerated panel prepared from pineapple fibres and natural rubber [32] and tea leaves [18], respectively.

Table 3. Summary of thermal properties of the studied leaf fibres

Leaf fibre	Density [kg/m^3]	Thermal conductivity [W/m·K]	Ref.
Pineapple leaves	178-232	0.035-0.043	[32]
Sisal	700-800	-	[10]
	-	0.042-0.044	[26]
Tea leaves	236-330	0.035-0.568	[18]

Source: authors' synthesis based on the studied literature mentioned in the table.

Table 4. Summary of thermal properties of the studied fruit fibres

Fruit fibre	Density [kg/m^3]	Thermal conductivity [W/m·K]	Ref.
Beet	≈1222	0.069-0.075	[19]
Coconut	250-350	0.046-0.068	[27]
	-	0.0279-0.0495	[16]

Source: authors' synthesis based on the studied literature mentioned in the table.

The thermal performance of different composite materials based on fruit fibres is presented in Table 4. Coconut fibres are characterized by low thermal conductivity, for a composite panel made of coconut fibres and polyester fibres [16] its value being around 0.030 W/m·K.

CONCLUSIONS

Thus, on the basis of thermal properties it can be concluded, that there are several natural fibre composites that are suitable for use as a thermal insulation material. Among the studied fibres cork, jute, kapok, pineapple leaves, tea leaves, and coconut husk are the most performing organic materials.

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STUDY ON THE IMPORTANCE OF MACHINERY MANAGEMENT IN A MODERN FARM

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Abstract

In the conditions of integration of Romania in the European Union, a profitable and modern agriculture is one of the main conditions for having a competitive economy. That is why, the management of agricultural farms, no matter what their size, is very important in achieving this goal. The paper presents studies and researches made on farm processing machinery management, which is a very important step in a good farm management. We analysed the measures processing operations which are required before the crop may be fed or stored, especially reducing machinery and drying machinery. In what concerns the reducing machinery, we have presented all the types of these machines with their particular characteristics and advantages. We also analysed their mechanisms and the possible adjustments that can be made and presented the importance of drying machines in the final result of farm management and have found the time limits for safe storage of shelled corn.

Key words**:** *machinery management**,** processing, machinery, adjustments, machine performance*

INTRODUCTION

In every economy, agriculture is a very important part of it, that is why its modernisation, inovation and competitiveness is a continue goal to be fullfilled [10]. In many european countries, modernisation of agriculture consists in improving production organisation and technology and asistance from the IT domain. [7]. In the process of modernisation of agriculture, a fundamental role is kept by the machinery of the farm and also to the management of processing machinery. It is known that labour productivity in agriculture, as well as in industry, has a strong impact on the farming system. [1] From this point of view, another aspect of a modern and competitive agriculture is that of using the most recent technology by the farmers [5] and also increasing the efficiency of the activity through human resources [8].

A best machinery management can only improve the farm performances and therefore improve their efficiency [3], [4].

In a farm, not all crop work is completed in the field. Thus, many times, various processing operations are required before the crop may be fed or stored.

Processing machinery can be classified as stationary and portable. The stationary types are designed primarily for large, permanent installations. These machines lend themselves well to electric power.

The portable types of machines are designed for more diversified farm operation. In most cases, they are driven by a tractor.

In this paper, we will study the following machinery: reducing machinery and drying machinery.

MATERIALS AND METHODS

The materials for study were the reducing machines and drying machines. In what concerns the reducing machinery, these farm crop machines may be classified as it follows:

-Hammer mills
-Attrition mills (or burr mills)
-Roller mills
-Cutter mills.

The first category of machines, hammer mills make reduction due to impact, as their name suggest. Attrition mills make reduction by twisting pressure, and the diference between attrition mills and roller mills reduction is normal pressure in the mlate case.The last one

machine category, cutter mills , as its name suggest, make reduction through cutting.
We must emphesize that all these 4 types can be found into one machine, in different combinations. The power consumtion of these machines is different, depending on the size of the obtained particle.

RESULTS AND DISCUSSIONS

The most important aim of a farmer is the farm productivity, and if we compare this productivity to another european countries, we can see that in this respect, Romania is situated lower than the average EU countries productivity, but it can also be observed that in the last 10 years there is a significant improvement of productivity [9].
Under these conditions, we consider that machinery management (study, adjustments, improvements) is very significant.
In what concerns the mechanisms of the reducing machines, we made studies on hammer mills, attrition mills, roller mills and cutter mills.
Hammer mills may use either free- swinging or fixed hammers. The rotor speed must be kept relatively high (2,500-3,500 rot/min) to produce pulverization. A screen that determins particle size is placed bellow the rotor, as it can be observed in Fig.1.
Attrition mills consist of 2 hard- surfaced circular plates rotating with relative motion. The material is reduced as it passes between the 2 plates.
The common burr mill has one fixed plate and the other rotates (Fig.2). In the lower part of fig.2 is presented a set of burrs.
A roller mill is a very simple reducing machine. Two rollers, spaced with a small clearance, crush the material as it passes between them.
The cutter mill mechanism is similar to that in the field harvester. The cutter mill alone will not produce a very small particle, but it is used to reduce forages to a size that other reducing mechanisms can handle.
Mills are fed by gravity or by conveyor. A cyclone separator is needed if a blower is used. The blower floats the processed material in an air stream. The cyclone separator is made to separate the heavier feed particles from the air by centrifugal force (Fig. 3).

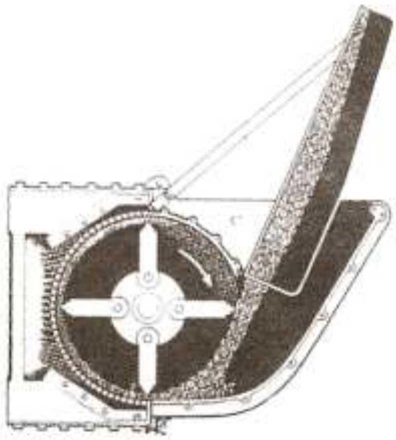

Fig. 1. Hammer mill principle
Source: [6].

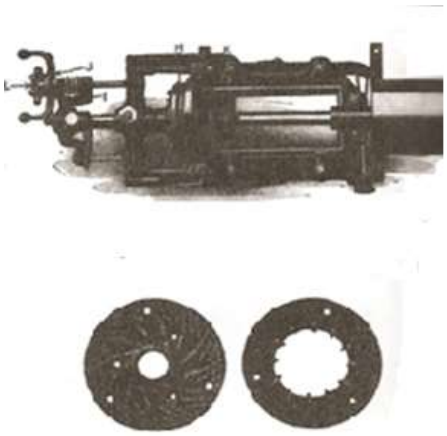

Fig. 2. Burr mill reducing mechanism
Source: [6].

Fig. 3. Cyclone separator
Source: [6].

We also analysed the adjustments that can be made to these machines.

In all cases, the particle size adjustment is the most important. In selecting a reducing machine, a buyer should be sure that the reduction mechanisms are easily replaced or sharpened. Grains and especially corn cobs have a definite abrasive effect on the hardest of chilled cast irons. The particle size is varied for each particular machine, in the following way:

- Hammer mill: vary the size of the screen openings
- Burr mills: vary spring pressure on the burrs
- Roller mills: vary openings between the rolls
- Cutter mills: vary the rate of feeding material connected to the cutter rot/min.

The power requirements for reducing machines depend on the feed rate and the fineness of grind. In Table 1 are presents the energy requirements independent of feed rate for mills.

Table 1. Energy requirements for feed grinding [kWh/t]

	Hammer mills	Burr mills
Shelled corn	6.6- 7.4	3- 5.8
Oats	11.5-14	5-14
Barley	9-14	4- 10
Ear corn	4.5- 8	-
Hay	8- 16	-
Round bales	3- 9.1	-

Source: own determination.

From Table 1 we can conclude that fine grinding requires more power than course grinding. Also, that moist grain requires more energy than dry grain. Roller mills require slighter more power than burr mills.

Considering these aspects, we can conclude that a wise machinery management also includes the adjustments and combinations of machine operations. [2].

Drying machinery

Stored farm crop materials can be spoiled and consumed by microbiological growth. Such growth can be reduced to insignificance with cool storage temperatures and low crop moisture content. The farm manager has the alternative of using natural field drying before harvesting the crop or using drying machinery after the crop has been harvested. The most probable choice will be the least total costs.

After observations, we have found the time limits for safe storage of shelled corn, as it is shown in Fig. 4.

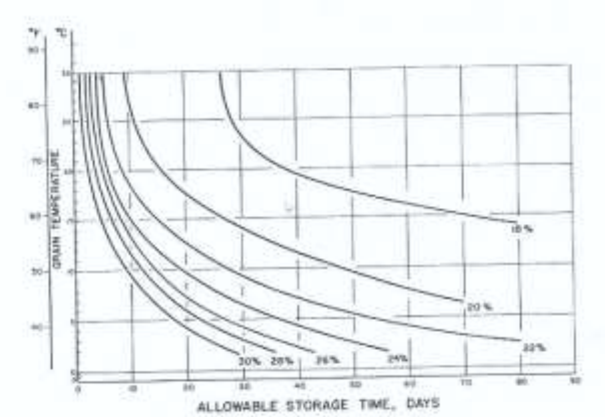

Fig. 4. Time limits for stored shelled corn at different moisture contents
Source: own determination.

In Fig. 4 is presented the dependence between storage time, measured in days and grain temperature. From this diagram we can find the time limits for safe storage of shelled corn. For long time storage, grains need to have less than 13 % moisture content wet basis. The farm manager has the alternative of using natural field drying before harvesting the crop or using drying machinery after the crop has been harvested. The least total cost choice will be probably the most attractive.

Drying principles

Stored hay and grain will lose moisture to the surrounding air as long as the air is relatively drier. The equilibrium moisture content of a crop is that content at which there is no tendency for moisture to leave the crop and enter the surrounding air. Relative humidity need to be lower than 70 % for air at 21^0 C to be in equilibrium with most grains at 12 -13 % moisture content.

CONCLUSIONS

In the first place, we concentrated over the mechanisms of the reducing machines and then we analysed the adjustments that can be made to these machines. On the other hand, we studied the drying machines and principles. Drying machinery management problems are similar to field machinery

problems and have the same importance in the final end of obtaining a good crop. Estimates of costs are used to measure the efficiency of operation and to make management decisions. As with field machines, drying machines have fixed costs and variable costs. Their fixed costs percentage would be about 13 % of the purchase price annually if the 15years life can be realized. Repair and lubrication can be estimated as 2 % from this price. Labor costs may be quite small if the dryer is automatic.
In this paper we analyzed reducing machinery and drying machinery, presenting the importance of each of them in the general processing machinery management.
In what concerns the drying machines, we showed that it is important to find an equilibrium moisture content of a crop.
All the studies made in this paper showed the importance of machine management in the increase of productivity of the farm.

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MANNOPROTEIN PRODUCTION FROM *CANDIDA APICOLA* IN THE FORMULATED BEAN SPROUT EXTRACT MEDIA

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Abstract

"Candida apicola" is an osmotolerant ascomycetes yeast. Yeast in general produces secondary metabolic substances in the form of bioactive substances that can be utilized in biotechnology field, besides that yeast also has antimicrobial properties. "Candida apicola" has a cell wall that contains mannoprotein, a bioactive substance that can be used as an emulsifier in the process of making food. Beansprout extract is used as the media formula for the growth of "Candida apicola" so secure for food production. The media formula used for the growth of "Candida apicola" is derived from bean sprout extract so it is safer for food production. This study aims to determine the growth curve of "Candida apicola" on media formulated and the value of the emulsification activity of mannoprotein obtained from the extraction process. The research begin by looking at the growth curve of "Candida apicola" with an incubation time of 0 to 70th hours and observing several parameters such as optical density, pH and biomass cells. The optimal incubation time in the growth of "Candida apicola" in obtaining mannoprotein occurred at 70th hours with absorbance value of 1.5817, pH 5.69 and biomass cell 0.0271 gr/ml. The incubation time of 70th hours in 500 ml of the formulated media produced a mannoprotein of 1.5982 gr and had a 50% of emulsification activity.

Key words**:** *yeast, "Candida apicola", formulated media, mannoprotein, emulsifier*

INTRODUCTION

Indonesia is a tropical country with a wide diversity of microorganisms that includes land, water, and air consisting of protists, monera, and fungi include yeast (Kanti, 2007) [15]. Yeast genus *Cryptococcus*, *Candida* and *Debaryomyces* is a group of yeast that is often found in soil ecosystems (Kanti, 2005) [14]. Yeasts have important enzymes including phosphatase, lipase, zymase and proteinase which function in the decomposition of organic compounds and are used in industrial purposes (Spencer and Spencer, 1997) [22].

Utilization of yeast caused by the bioactive component existence such as proteins and antimicrobial compounds. Protein produced have proteolytic activity with a molecular weight of 97 kD (Balia, *et al.*, 2011) [2]. Some species of yeast such as *Candida* have proteolytic abilities (Roostita and Fleet, 1996) [19] and can produce extracellular proteases (Fleet, 1990) [11]. *Candida apicola* can generate biosurfactants, fatty acid membranes and several enzymes such as proteases, glucanases, and proteinases (Vega *et al.*, 2015) [26].

Yeast generally has cell walls with dry weight ranging from 23-32% of cells (Saeed *et al*. 2017) [20] consist of polysaccharides in the form of beta-glucans and mannan sugar polymers 20-60%, proteins 15-30%, fat 5-20% and slightly of chitin. Proteins contained in cell walls are mostly bind to mannan-oligosaccharides (MOS) called mannoproteins (Eurasyp, 2011) [8]. Other references state that the content of mannoprotein in cell walls is 40% of the dry weight of cells (Klis *et al*., 2002; Uscanga and François, 2003) [16, 25].

Mannoprotein constitutes of bioemulsifier of the glycoprotein groups that can be used in stabilizing oil in water in food products (Farahnejad *et al.*, 2004) [10]. Several studies have been carried and stated that mannoprotein can be utilized as an emulsifying agent in the manufacture of foods such as salad dressing and mayonnaise. Mannoprotein obtained when the cell undergoes an autolysis process in the cell wall with the help of heat extraction (FAO, 2017)

[9]. The process of autolysis, glucanase and proteinase enzymes will degrade cell walls containing mannoproteins so that they can be released from the surrounding medium (Alexandre and Gulloux-Benatier, 2006; Martinez, et al., 2016) [1, 17]. The number of cell walls influenced by the growth curve of yeast, which is a young yeast has thin cell walls whereas an aged yeast has thick cell walls (Balia, et al., 2017) [3, 4].

Media for yeast growth can use ingredients that have high nutritional value and support yeast growth by utilizing bean sprout extract. Bean sprout extracts have macronutrient and micronutrient elements as well as several other materials in media formulas such as vegemite, sugar, and antibiotics that can supply yeast needs and inhibit the growth of bacteria. This research aims to determine the growth curve of *Candida apicola* on media formulas by observing optical density, pH and cell biomass so that obtained the optimal time to produce mannoprotein and determine the emulsification activity value of the obtained mannoprotein.

MATERIALS AND METHODS

Materials

This research was conducted using several instruments including Petri dish, ose, plastic wrap, parafilm, incubator, beaker glass, micropipette (1,000 µl), blue pipette, bunsen, laminar, falcon tube, Erlenmeyer, schoot, pan, Raypa Sterilclav-75 autoclave, Termo Scientific hot plater stirrer, stirring rod, cuvvet, spectrophotometer, oven, 18,000M N-Biotek centrifuge, Eutech pH 700 pH meter, Sartorius TE2145 scale and Raypa Mixtube vortex.

The materials used in this research are bean sprouts, vegemite, antibiotics and sugar as ingredients for making media. Yeast *Candida apicola* isolate was obtained from Prof. Roostita L. Balia's collection. The media used in the rejuvenation process of *Candida apicola* were Oxoid CM0920 Yeast and Mould Agar (YMA) and Himedia M255-500G Malt Extract Broth Base (MEB). Furthermore, other materials are used in the testing process such as buffer solution, blank solution, and oil. Mannoprotein extraction process is carried out using materials namely aquades, 0.1M potassium citrate, and 90% chilled ethanol.

Methods

Yeast strain

Candida apicola isolates were obtained in the form of yeast and mold agar (YMA), so it was necessary to isolate cultivation in malt extract broth (MEB) or liquid media by collecting 2 ose of *Candida apicola* in YMA, afterward transferring them to beaker glass containing 5 ml of MEB. The beaker glass is closed tightly, then stored in an incubator at 25°C for 48 hours (Ukit, 2013 - modification) [24].

Media Formula

The main ingredient in making media formulas is bean sprout extract. Heats 3 liters of distilled water that has been added by 1 kilogram of bean sprouts as fas as 1 liter of water volume. Afterward, sugar, vegemite, and antibiotics were added. The mixture of ingredients sterilized at 121°C for 15 minutes. The media formula is ready to use (Balia *et al.*, 2018) [5].

Growth of Yeast in Media Formula

Candida apicola that has planted on MEB is taken as much as 1% (50 µl) then transferred to 5 ml of the media formula, incubated at 25°C with incubation time 0^{th} to 70^{th} hours, carried out testing of optical density. pH measurement and cell biomass in every 5 hours the incubation time.

The Growth Curve of *Candida apicola*

The growth curve testing consists of optical density, pH and biomass. The testing of optical density was performed by using a 600nm spectrophotometer. The measurement of pH was carried out on *Candida apicola* isolates using a pH meter and biomass testing was carried out by drying at 40°C for 12-16 hours (Garcia and Casas, 1999 - modification) [12].

Extraction of Mannoprotein

Extraction of mannoprotein was started by separating of precipitate using a centrifuge, the outcome of precipitate was added 0.1 M potassium citrate then sterilized by autoclaving at 121°C for 15 minutes to 2 hours. Furthermore, the isolate was centrifuged at 6,000 rpm for 15 minutes at

4°C, the supernatant was added with 90% chilled ethanol and stored at 4°C for 12-16 hours until the precipitation process completed. The results of precipitation obtained were centrifuged at 6,000 rpm for 15 minutes at 4°C followed by washed twice with chilled ethanol (Torabizadeh *et al*., 1996) [23].

Measurement of Emulsification Activity

Measurement of emulsification activity started with taking mannoprotein that had diluted with 1 ml of distilled water and oil into the Eppendorf tube, then conducted agitation using vortex for 3 minutes and stored for 24 hours to measure the Emulsification Index by following formula (Cooper and Goldenberg, 1987) [6]:

Emulsification Index

$$= \frac{\text{Total height of the emulsified layer}}{\text{Total height of the liquid layer}}\ x\ 100\ \%$$

RESULTS AND DISCUSSIONS

The Growth Curve of *Candida apicola*

The result of *Candida apicola's* growth shows that the lag phase occurs at 0^{th} to 5^{th} hours. The lag phase is the adaptation time of cell in growth media so that nutrient in media affects the growth of yeast. The lag phase in *Candida apicola* has a pretty short time because it is caused by media formula, which is originated from bean sprouts extract with nutrient content such as protein, fiber, vitamin C, K, thiamin, riboflavin, and folate. These nutrient contents are the main component, which should be filled in yeast media as carbon source and nitrogen. Carbon sources can be dextrose, raffinose, and glycerol. This can be supplied by the presence of vegemite added into bean sprouts extract. Besides, there is an antibiotic with the type of penicillin as the inhibitor of bacteria growth in media. The exponential phase occurs in $10t^{h}$-$45t^{h}$ hours, where the growth curve happens to increase. According to Gonzales (2010) [13] explains that the exponential phase is at 12^{th}-36^{th} hours. After experiencing the maximum growth by utilizing nutrients in the media, the cell will occur in the stationary phase. The stationary phase occurs at 50th-60th hours and is followed by the death phase at 65th -70th hours with an absorbance value of 1.5267 to 1.5817. The death phase is marked by decreasing the amount of cell, observed from its absorbance. According to Wahono et al. (2011) [27], the time of death phase is ranging from 48th to 78th hours. The death phase causes mannoprotein degradation in the cell wall by enzymes such as glucanase and proteinase so that the incubation time at 65th - 70th hours is the best in yielding mannoprotein.

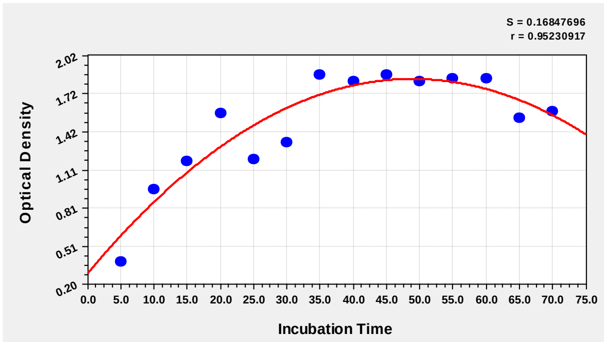

Fig. 1. The growth curve of *Candida apicola*
Source: Own results in the laboratory.

The Growth Curve of *Candida apicola*'s pH

pH decreases at 0^{th} to 55^{th} hours and increases at 60^{th}-70^{th} hours. The decrease of pH becomes more acid because of the high nutrient content in growth media so that it happens the degradation of glucose and arises the activity of the fermentation process to produce amino acids.

The incubation time of 0-15 hours possesses pH 6 so that it causes the growth of yeast and is also followed by decreasing pH until 5.5 at 55th hours. At the incubation time of 60^{th}-70^{th} hours, pH increases to 5.7. It is due to nutrients at growth media decreasing so that there is no fermentation activity, which is led to increasing pH.

The death phase of the cell happens at the incubation time of 70 hours and can be used as the harvest time of *Candida apicola* to extract mannoprotein.

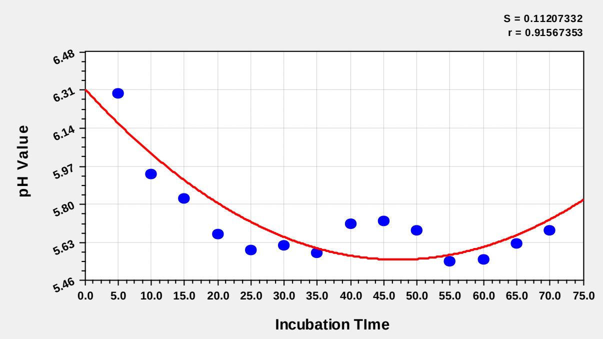

Fig. 2. The growth curve of pH from *Candida apicola*
Source: Own results in the laboratory.

The Growth Curve of *Candida apicola* Biomass

Biomass from *Candida apicola* is obtained by drying at 40oC for 12-16 hours. The growth phase of yeast can be determined by biomass concentration. The stage of lag phase to exponential phase will lead to increasing biomass concentration and will experience a deceleration stage until it reaches a maximum biomass concentration point in the stationary phase of up to 48 hours (Nur Utami and Dwi, 2016) [18].

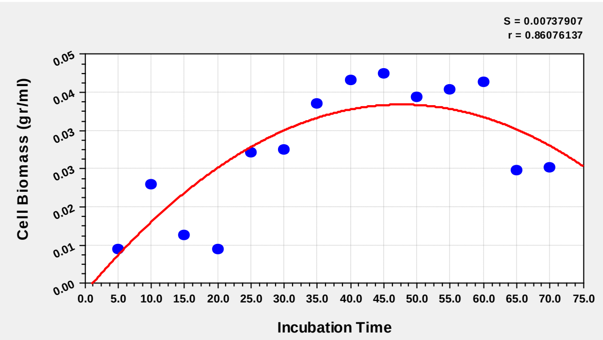

Fig. 3. The Growth Curve of Biomass From *Candida apicola*
Source: Own results in the laboratory.

Based on the measurement of biomass in Figure 3 shows that at 0^{th} – 20^{th} hours, the growth of biomass is pretty low. This reflected that the growth of the cell has not increased or is still in the lag phase. The growth at the lag phase tends to be slow because of the adaptation period in the growth media. The exponential phase from *Candida apicola* happens at 25^{th} to 60^{th} hours where *Candida apicola* has utilized nutrients contained at growth media for its growth. This can be seen from the amount of dry biomass which is around 0.03 to 0.04 gr/ml. The increase of biomass cell is caused by the presence of substrate at growth media so that it happens cell division and cell growth. After 65^{th} and 70^{th} hours, cell biomass decreased to 0.02 gr/ml. The decrease of dry biomass can be caused by the low content of glucose at growth media for growing cell so that yeast can not convert carbon and decreases biomass (Setyati, et al., 2015) [21].

Mannoprotein Extraction of *Candida apicola*

Mannoprotein extraction can be done to *Candida apicola*, which has experienced the incubation process for 70 hours. This is due to the measurement of the growth curve has shown that the death phase occurs at 70th hours. Extraction with lye is carried out by using potassium citrate, which can express protein and polysaccharides from the yeast wall and continue with the heating process. The death phase can generate the secondary metabolism that is expressing mannoprotein at the cell wall so that degradation by glucanase enzyme and proteinase. The expressing of mannoprotein from the cell wall can be done by extracting heat-treatment by lye.

Extraction with lye is carried out by using potassium citrate, which can release protein and polysaccharide from the yeast wall. Mannoprotein deposits are produced including 1.5982 gr/500ml, 0.07202gr / 1.5ml, and 0.7507gr/500ml. Mannoprotein from *Candida apicola* can be used as an emulsifier at food products. Balia et al (2017) [4] have stated that mannoprotein from yeast cell walls can be used as an emulsifier, which safe for food, is non-toxic, and environmentally friendly.

Emulsification Activity of Mannoprotein

The emulsification activity is done to know the quality of biosurfactant by measuring the ability of mannoprotein in degrading the oil. Emulsifier property from mannoprotein is obtained from mannose, which binds with protein. Protein has a function in activating emulsification as the amphiphilic structure used as a surface-active agent (Amaral *et al.*, 2008) [2], and mannose, which is a monosaccharide, has a function as hydrophilic polymer (Dikit *et al.*, 2010) [7]. The result shows that emulsification activity for 1 hour as much as 50% (EA) and 24 hours as much as 50% (EA24). The emulsification activity of

50% shows that mannoprotein extracted from *Candida apicola* can emulsify the oil with good enough. The prior study from Dikit *et al.* (2010) [7] generates the emulsification activity of 41%.

The utilization of mannoprotein as emulsifier obtained from yeast extract has been carried out, one of that is the utilization of mannoprotein at salad dressing by using *Saccharomyces cerevisiae*. The utilization of mannoprotein from yeast can be utilized in the food making process and non-toxic (Dikit *et al.*, 2010) [7]. According to Amaral *et al.* (2008) [2], *Candida utilis* can be used as an emulsifier in salad dressing and gives good results in addition to mannoprotein extracted from *Saccharomyces cerevisiae* in making mayonnaise.

CONCLUSIONS

Mannoprotein can be obtained from the extraction process of *Candida apicola* on the media formula with an incubation time of 70th hours that produces a precipitate weight of 1.5982 gr/500ml with an emulsification activity value of 50%, and an optical density value of 1.5817, pH 5.69 and cell biomass 0f 0.0271 gr/ml.

Mannoprotein than has been obtained from the extraction of *Candida apicola* is necessary further testing of the characteristics and levels of the protein contained.

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EFFECT OF HARVESTING AND DESICCATION METHODS ON QUALITY OF OIL FLAX PRODUCTS AND ECONOMIC EFFICIENCY OF THE CROP IN CASE OF ITS USE BOTH FOR SEED AND FIBRE

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Abstract

The five-year research devoted to the study of harvesting methods and desiccation effects on the yields and quality of oil seed flax of dual use was conducted in the field conditions on the dark-chestnut soil in the South of Ukraine during 2013-2017. The study defined the highest effectiveness of pre-harvesting desiccation of the crop by glufosinate ammonium in the dose 2 L ha^{-1} followed by direct harvesting that can increase the yield of flax seeds by 0.15 t ha^{-1} or by 11.9%, and the yield of flax straw – by 0.22 t ha^{-1} or by 12.7%. At the same time, the increase in the yield is accompanied by the improvement of qualitative parameters of the straw through better orientation of the stems in a roll, the share of fibres, which are longer than 200 mm, in comparison with the separate harvesting increases by 8%, and the contamination of the straw decreases 3 times in comparison to the variant without desiccation. Desiccation conducted by using glyphosate preparation in the dose 3 L ha^{-1} allowed increasing of the net profit by 15.67 euro ha^{-1}.

Key words: *direct harvesting, net profit, oil flax of dual use, quality of straw, seed yield, separate harvesting*

INTRODUCTION

Cultivation of flax (*Linum usitatissimum*) in the South of Ukraine is mainly directed on the production of oilseed. However, the straw of flax is suitable for use as a bast raw material but this opportunity is ignored [2].
However, scientific researches and experience of some countries testifies about industrial, economic and ecological feasibility of the use of oil flax straw for the production of fibrous materials and cellulose-containing products [4, 8].
This situation results in many problems and causes insufficient profitability of oil flax production not contributing to further development of flax growing in the area. The use of the stems of oil flax are not widely used in the industry because of low quality indicators, to the improvement of which very little attention is paid both by plant breeders and agricultural engineers. For example, there are no varieties of flax for dual use in Ukraine until now.
The yield and quality both of seeds and straw depends on the ways and conditions of harvesting. The main problem in harvesting of flax is in the difficulties connected to the achievement of balance between two processes – the formation of high yields of qualitative seeds and fibre, especially in unpredictable weather conditions [13, 16, 17].

For long-fibred flax, which is collected in the stage of early yellow maturity, these issues are insufficiently explained in scientific literature [10]. For oil flax, the issues of harvesting are studied and explained much less. According to some reports, the highest yields of seed and fibre were provided by harvesting in the stage of yellow maturity [16, 17]. The 10–day delay with harvesting gradually decreased the yield of bast. The same tendency was mentioned by Rovna [19].

Conventional harvesters used for harvesting of cereal crops obtained the most spreading in flax harvesting. The harvesting could be performed by two methods: separate harvesting in the stage of biological maturity, and direct harvesting in the stage of full maturity [20]. Dudariev proposed four technological schemes of harvesting flax: conventional combined harvesting, conventional separate technology for getting qualitative seeds, combined and separate technologies aimed to obtain both seeds and bast [6].

The above-mentioned recommendations are actual mainly for the zone of long-fibred flax cultivation [11]. Shuvar & Voitovych recommend separate method of harvesting in the zone of Polissya if there is a lot of precipitation in the pre-harvesting period. They propose mowing of flax by the means of the machine Z–169 with further harvesting by the means of grain harvester. However, the least losses of seed yield (by 32.2%) were reached by the direct harvesting [21].

Recommendations to harvest flax in a separate way are connected both with the direct losses of the yield and the need of the primary refinement of seeds, because in direct harvesting there is an incomplete threshing and larger danger of warming of wet seeds, especially if rainfall during the ripening and harvesting of the crop takes place.

However, the drying of the plant mass of flax can be performed by chemical means, which is especially important for the rainy conditions [9]. As Zaluzhnyi et al. claims, the application of diquat and glyphosate even in comparatively low doses provides significant drying of the crop vegetative mass, improves working conditions of harvesters, provides an opportunity for direct harvesting and obtaining the highest yield of seeds (0.85–0.89 t ha-1) [24]. Application of diquat in the dose of 3 L ha-1 resulted in the highest seed yields of 1.28 t ha-1 under the direct harvesting in the study by Makhova et al. [14, 15].

In the Steppe zone there is a lack of the specialized flax harvesting machinery, and therefore the technology is based entirely on the use of the existing grain harvesting machines, and should take into account the need for the crop desiccation. Under such conditions, the question of the yield and quality of the side products is not only unsolved, it even did not arise a scientific problem for the researchers. Therefore, the issue of the quality of oil flax straw was insufficiently studied both in Ukraine and abroad [3]. But the side products of oil flax cultivation could be used as a bast and cellulose raw material and increase the crop profitability by 30%.

Our study is directed to the investigation of the possibility of use of oil flax for dual (seed and fibre) purposes in the conditions of the Steppe zone through the improvement of its harvesting method and application of desiccants to obtain the greatest net profits from the crop production.

MATERIALS AND METHODS

Field experiments on the effectiveness of the terms and methods of harvesting were carried out at the scientific research farm Askaniyska (46°33``N 33°49``E) of the Institute of Irrigated Agriculture of NAAS of Ukraine during the period of 2013–2017. The scheme of the experiment included 2 methods of harvesting flax: direct harvesting and separate (double-phase) harvesting. Direct harvesting was carried out without desiccation and with desiccation by using diquat in the dose 3 L ha^{-1}, glyphosate in the dose 3 L ha^{-1} and glufosinate ammonium in the dose 2 L ha^{-1}.

The desiccation was carried out by the syringe OHN–200/10 with the spraying rate of the working solution at the level of 200 L ha^{-1}. At the two–phase harvesting mowing was performed by a self–propelled mower E–303 equipped with grain reaper E-309, the cut height was set at the level of 12–15 cm. For the collection of rollers and direct harvesting we used John Deere S–660 self–propelled harvester with the switched off shredder. Straw packing was carried out by the means of Pottinger 3120 GA–CR12.

The technology of cultivation of oil flax was based on the recommended one for the zone of the study conduction. The basic tillage involved disking on 8-10 cm and mouldboard ploughing on 20–22 cm after the application of mineral fertilizers $N_{45}P_{30}K_{30}$. Before sowing, harrowing and combined tillage with the aggregate unit APB–6 on 3–4 cm was performed. The sowing was conducted by a seed drill Klen–6 with the sowing rate of 6 million seeds ha^{-1}. At the stage of stem extension a mixture of herbicides was applied (MCPA in the dose 1.0 L ha^{-1} mixed with metsulfuron-methyl in the dose 0.008 kg ha^{-1}).

The field experiment was conducted in four replications using the method of incomplete randomization in the variants placement. The area of the accounting plot was for the seeds – 300 m^2, for the straw – 50 m^2. Laboratory tests were conducted through sampling 10 plants in two nonadjacent replications on each variant to create representative samples of the studied plants. The complex of additional researches was aimed mainly to revealing the influence of elements of harvesting technology on the yield and quality of the both products. Contamination of the straw was determined by organoleptic method in accordance with GOST 28285–89 using the laboratory apparatus LM–3.

The strength of the bast in the previously obtained samples was measured according to DSTU 5015:2008 using a dynamometer DKV–60. Segments of the tape were twisted by the device KV–3. The measurements were performed with a ten-time repetition with 0.1 daN accuracy.

Conventional losses of the bast were determined by the calculation and balance method. The share of fibres was determined by hand-parsing of the samples into individual fibres with the least damage according to GOST R 53483–2009. The groups by the length were formed with the step of 20 mm.

The orientation of the stems in the rolls was carried out in five replications manually. The stems of the plants more than 100 mm long were divided into 5 groups according to their location with further weighing. All studies were accompanied by mathematical data processing to determine the significance of the defined differences. The analysis of variances was performed at $P < 0.05$ using the Agrostat New program [23], standard deviation was calculated in Microsoft Excel 2010. The differences significance was evaluated by using the least significant difference (LSD_{05}).

RESULTS AND DISCUSSIONS

Yields of flax seed and fibre

The results of the five-year study showed that the method of harvesting and application of pre-harvesting desiccation created conditions for the obtaining of different yields both of main and side products of oil flax (Table 1).

Table 1. Oil flax yield depending on assembly technology, t ha^{-1}

Desiccation	Year					Average
	2013	2014	2015	2016	2017	
Direct harvesting						
without desiccation	1.24^1	1.06^1	1.30^1	1.21^1	1.49^1	1.26^1
	1.98^2	1.40^2	1.86^2	1.53^2	1.87^2	1.73^2
glufosinate ammonium, 2 L ha^{-1}	1.35^1	1.29^1	1.43^1	1.36^1	1.61^1	1.41^1
	2.15^2	1.73^2	2.06^2	1.79^2	2.02^2	1.95^2
glyphosate, 3 L ha^{-1}	1.31^1	1.26^1	1.40^1	1.33^1	1.58^1	1.38^1
	2.05^2	1.68^2	1.99^2	1.72^2	1.97^2	1.88^2
diquat, 3 L ha^{-1}	1.34^1	1.23^1	1.43^1	1.36^1	1.63^1	1.40^1
	2.10^2	1.65^2	2.03^2	1.75^2	2.02^2	1.91^2
Separate harvesting						
without desiccation	1.11^1	1.18^1	1.19^1	1.14^1	1.41^1	1.21^1
	1.58^2	1.38^2	1.53^2	1.29^2	1.58^2	1.47^2
LSD_{05}, t ha^{-1}	0.08^1	0.06^1	0.08^1	0.06^1	0.07^1	
	0.17^2	0.07^2	0.08^2	0.09^2	0.09^2	

Source: Own study; [1] Seed yields, [2] Straw yields.

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Both in terms of seed productivity and the straw yield there was an advantage for the crops, where flax was harvested by the direct harvesting method. Average for five years seed yield in this variant was 1.40 t ha^{-1} against 1.26 t ha^{-1} in the variants without desiccation. The type of desiccant had no significant effect on the yield, but there is a tendency to the advantageous use of glufosinate ammonium, which in some years created the advantage and contributed to the best yield of flax straw (1.95 t ha^{-1}).

If we compare the methods of harvesting without the use of desiccants, the advantage of direct harvesting is quite evident. The yield of seeds was by 0.05 and the straw yield was by 0.26 t ha^{-1} higher than in the case of separate harvesting. This could be explained by the fact that due to the two-phase way of harvesting there is an increasing loss of the yield due to mowing and subsequent collection of the rolls for further threshing.

These features predetermined various output and objective loss of the bast. The highest nominal yield of the bast was ensured by the use of desiccation – 334–344 kg ha^{-1}, comparing to the harvesting of untreated crops – 302 kg ha^{-1}, and two-phase harvesting – 272 kg ha^{-1}. In comparison with direct harvesting, separate harvesting resulted on one hand to the decrease in the conditional yield of the bast (by 10.2%), and on the other hand – to the increase of losses (by 61%).

Quality of the obtained products

One of the key differences between the stem mass of long-fibred flax and oil flax is that in the latter it is a highly disoriented totality of the intact and damaged stems of different length. The break of the stems in technological lines during primary processing requires perpendicular placement of stems to the flutes of the working bodies [22]. This requires consideration of the orientation level of stem mass (Table 2). The studies show that in the process of cutting the stems are placed in the roll chaotically, which affects their orientation in the roll. By the deviation angle, the stems were divided into four groups: 0–10; 10–30; 30–50 and more than 50 degrees from perpendicular to the central axis of the roll to one side or another.

Table 2. Angle orientation of oil flax stems in the roll

Harvesting technology (A)	Segment relative degree to the longitudinal roll line (B)				Contamination,%
	0–10	10–30	30–50	> 50	
Location of the stems in the roll,%					
direct harvesting: without desiccation	17.3	27.3	29.8	25.5	0.91
desiccation with glufosinate ammonium in the dose 2 L ha^{-1}	16.2	27.2	29.3	27.3	0.3
desiccation with glyphosate in the dose 3 L ha^{-1}	15.8	26.7	30	27.5	0.35
desiccation with diquat in the dose 3 L ha^{-1}	16	27.5	29.7	26.8	0.32
two-phase harvesting	11.2	28.8	30.5	29.5	0.44
LSD_{05}: A – 1.2; B – 1.0; interaction of the AB – 2.3					
The average angle of the stems location in the segment ± standard deviation					Average
direct harvesting: without desiccation	5.1 ± 2.7	20.6 ± 5.8	40.6 ± 5.5	64.4 ± 9.0	32.6
desiccation with glufosinate ammonium in the dose 2 L ha^{-1}	5.3 ± 2.8	20.5 ± 5.8	40.3 ± 5.6	63.5 ± 9.0	32.4
desiccation with glyphosate in the dose 3 L ha^{-1}	5.4 ± 2.8	19.8 ± 5.7	40.8 ± 5.6	64.3 ± 9.3	32.6
desiccation with diquat in the dose 3 L ha^{-1}	5.5 ± 3.0	20.4 ± 5.7	40.6 ± 5.7	63.9 ± 9.8	32.6
two-phase harvesting	5.7 ± 3.2	21.5 ± 5.8	41.4 ± 5.4	66.0 ± 9.7	33.7

Source: Own study.

The number of stems with minimal deviation increased from 11.2% – at two-phase harvesting, up to 17.3% – on the crops that matured in natural way. In the application of desiccation, the proportion of such stems, compared with the control, was less by 1.1–1.5 points.

At the two-phase harvesting, the share of the stems in the groups with a deviation of more than 10 degrees was the highest in comparison to other variants.

At the direct harvesting of the crops, which matured in natural way, the proportion of stems, which deviated more than 50 degrees, was significantly lower than in the variants of desiccation. In other cases, and between the technologies, which provided chemical drying of the plants, the differences were within the error of the experiment. This testifies that under the double effect of mowing and threshing on the plant mass, the disorientation of the stems has got the highest values.

In all the groups of location and on average, the largest average angle of the stems was at the two-phase harvesting of the crops. The differences between the rests of the variants were insignificant and were observed only within individual segments of the angle of location. The presented data show that the additional technological mowing operation with the roll formation and its collecting has increased the chaotic location of the stems, the reduction of the share of those that are located along the work of the roll pick, which is undesirable for the following technological operations of the straw processing.

An important indicator of the quality of flax straw is the presence of impurities, which are the plants of weeds. The norm of contamination of oil flax is not provided by the normative documents, however, it is limited for long-fibred flax to 5%. Depending on the technology of harvesting, the contamination changed from 0.3 to 0.91%, and was significantly lower than the basic level. Previous desiccation resulted in the reduction of weed fraction in 2.6-3.0 times, to the smallest values in the study – 0.30–0.35%. At the two-phase harvesting, the mass of weeds was higher – 0.44%. This is partly due to the grinding of dried weed plants that do not have powerful mechanical tissues during the threshing process.

Peculiarities of distribution of technical fibres of oil flax by the length are represented in Table 3.

Table 3. Distribution of the share of fibres by the length depending on oil flax harvesting technology, %

<table>
<tr><th rowspan="3">Indicators</th><th colspan="5">Harvesting technology</th></tr>
<tr><th colspan="4">direct harvesting</th><th rowspan="2">two-phase harvesting</th></tr>
<tr><th>without desiccation</th><th>glufosinate ammonium, 2 L ha^{-1}</th><th>glyphosate, 3 L ha^{-1}</th><th>diquat, 3 L ha^{-1}</th></tr>
<tr><td>average length, mm</td><td>150</td><td>152</td><td>151</td><td>153</td><td>139</td></tr>
<tr><td>fibre share:
0-100 mm</td><td>32</td><td>31</td><td>32</td><td>32</td><td>37</td></tr>
<tr><td>100-200 mm</td><td>38</td><td>37</td><td>38</td><td>36</td><td>39</td></tr>
<tr><td>200-300 mm</td><td>23</td><td>26</td><td>23</td><td>23</td><td>22</td></tr>
<tr><td>> 300 mm</td><td>7</td><td>6</td><td>7</td><td>9</td><td>2</td></tr>
<tr><td>standard deviation</td><td>92.4</td><td>90.5</td><td>89.9</td><td>93.8</td><td>80.7</td></tr>
<tr><td>Fibre share:
< 200 mm</td><td>70</td><td>68</td><td>70</td><td>68</td><td>76</td></tr>
<tr><td>> 200 mm</td><td>30</td><td>32</td><td>30</td><td>32</td><td>24</td></tr>
</table>

Source: Own study.

The oil flax fibre is much shorter, and in most cases does not exceed 300 mm in length. Regardless on harvesting technology, the largest share is of fibres with the length up to 200 mm, with some dominance of the fibres of the fraction 100-200 mm. For two-phase harvesting, the proportion of 0–100 mm fibres increased by 5–6%, relatively both to direct harvesting and desiccation. The difference between the fibres groups of 100–200 and 200–300 mm in length was less pronounced and did not exceed 4%. As a result, the average length of the fibres varied from 139 mm in the variant of two-phase harvesting, to 150–153 mm at the direct harvesting with the use and without the use of desiccation.

The economic efficiency of flax cultivation

Flax harvesting schemes require different number and content of technological operations that affect economic results. Therefore, the difference in production costs between the variants of the experiment was substantial and reached 16.7%. During cultivation of oilseeds at the direct harvesting without desiccation, the costs amounted to 298 euro ha^{-1}. In case of two-phase harvesting, the total production costs increased by 2 euro ha^{-1}. The most expensive is the cultivation of oil flax using preliminary desiccation.

The results of our researches are connected with the works of other scientists. For example, Onyukh claimed that direct harvesting by the means of harvester cannot be considered universal for the zone of Western Polissya [18]. Its application is reasonable in favourable years in the stage of early yellow maturity after processing of desiccation of the crops.

Dumych concludes that in the climatic conditions of oil flax cultivation in western region of Ukraine, it is advisable to use direct harvesting at the condition of desiccation [7]. The least loss of seeds of 1.6% was obtained at the use of a harvester Palesse GS12. At the same time, the author came to the conclusion that the separate harvesting can be considered as one of the ways of yield collection, which provides the dual use of oil flax – for fibre and seeds. Cut height, which was 8.9 cm, provided less loss of stems, compared with single-phase harvesting with grain harvester Challenger 647 and Palesse GS12 where the cut-off height was 12–15 cm.

The results of Makhova et al. agree with the results obtained in our study that the best way of harvesting oil flax is direct harvesting [14, 15]. Besides, there is information that desiccation effect on the flax yields and quality does not depend on the desiccant used [12]. The obtained results have a confirmation in other scientific researches and show that in the conditions of the corresponding technology of harvesting the straw of oil flax can be positioned as industrial bast material [1, 5].

Unfortunately, due to the lack of standards and regulations, we have not considered changes in the cost of straw depending on qualitative indicators. However, we can predict that prices will be higher for high-quality products. This fact will make the direct harvesting using desiccation more attractive and profitable.

CONCLUSIONS

According to the corresponding cultivation technology and harvesting of oil flax, its straw can be used for the production of fibrous and cellulose-containing materials. Two-phase harvesting and desiccators positively influences the quality of the straw and the oil flax fibres compared to the direct harvesting. Desiccation of flax crops reduces the conventional losses of seeds and straw during harvesting, decreases contamination of straw with weeds and positively influences on its physical and mechanical parameters. Two-phase harvesting increases the disorientation of the stems when they are rolled. Harvesting of flax for dual use should be anticipated with desiccation of the crops in the yellow maturity and mowing stage at the minimum possible cut-off height, with stacking the straw in the rolls.

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FACTORS INFLUENCING PRODUCTION COST OF COW MILK IN BULGARIAN DAIRY FARMS

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Abstract

This research is aiming at exploration of some factors, influencing production cost of cow milk in Bulgarian dairy farms. Seventeen dairy cattle farmers in Bulgaria were enquired. Pearson correlation coefficients between the following variables were calculated and analyzed: cow number, average milk yield, clinical mastitis, calves' mortality up to 6 months of age, endometritis, expenses for medications per 1 cow, cows per 1 worker, and production cost per 1liter milk. Also a regression model with an application of the Ordinary Least Squares Method was developed. The model has the represented form: $Pc = c + c_1.Cw + c_2.My + c_3.Em + u$, where: Pc – natural logarithm of the production cost per 1 liter of milk; Cw – natural logarithm of cows per 1 worker; My – natural logarithm of average milk yield; Em - natural logarithm of expenses for medications per 1 cow; c_1, c_2 and c_3 – coefficients in front of the regressors; c – constant; u - error of the regression. Growth in clinical mastitis leads to drop down of milk yield while the medication expenses per cow become larger. Medication expenses per 1 cow also increment with the rise of calves' mortality and endometritis. The production cost is influenced significantly from the cows' number per worker and average milk yield: with the increment of one of them, a decline in production cost per liter is observed.

Key words: *Bulgaria, production cost, correlation, cow milk*

INTRODUCTION

Cost of dairy production has a direct relation to farm's efficiency. Consequential task for managers of dairy cattle farms is to decrease the production cost per 1 l of milk. This aim can be reached either by reducing the amount of production costs on a farm level, or by improving average milk yield.
Forage cost is of a great importance and it can take 50-60% from total dairy costs in small farms [9].
Health problems in dairy cows is another important factor, which lead to economic losses due to increased cost for treating animals and through falling in milk production and increased culling rates [4], [5], [6], [12].
The omissions in farm hygiene as a whole lead to health problems in dairy herd [13]. It is established that clinical mastitis demotes milk yield in dairy cows [7], [11] and lameness is interconnected with higher level of mastitis occurrences [14]. The lame animals have poorer body condition and diminished milk yield [10].
Thus the medication expenses for treating health problems are an integral part of milk production cost.
Another substantial expenditure is the cost of labour: the gross salaries of workers and social securities. Labour costs take substantial part of total costs [2], [8] and influences the cost of dairy production. Besides labour amount fluctuates under the adopted milking system in the farm [1]. Pursuant to some authors [3] expansion of dairy farms improves labour efficiency.
This research is aiming at exploration of some factors, influencing production cost of cow milk in Bulgarian dairy farms.

MATERIALS AND METHODS

In order to achieve the aim, 17 dairy cattle farmers in Bulgaria were enquired. Pearson correlation coefficients between the following variables were calculated and analyzed: cow number, average milk yield, clinical mastitis, calves' mortality up to 6 months of age, endometritis, expenses for medications per 1 cow, cows per 1 worker, and production cost per 1liter milk. Some of the farmers didn't provide information about a few of the studied indicators, that's why in the correlation table the number of observations varies.

Also a regression model with a confidence level of 95% was developed, on the basis of 6 observations, with an application of the Ordinary Least Squares Method. The model has the represented form:

$$Pc = c + c_1.Cw + c_2.My + c_3.Em + u$$

where: Pc – natural logarithm of the production cost per 1 liter of milk; Cw – natural logarithm of cows per 1 worker; My – natural logarithm of average milk yield; Em - natural logarithm of expenses for medications per 1 cow; c_1, c_2 and c_3 – regressors' coefficients; c – constant; u - regression error. F-statistic, probability, standard error, determination coefficient and adjusted determination coefficient are presented.

RESULTS AND DISCUSSIONS

Table 1 displays coefficients of correlation, found between the researched indicators. The coefficient, computed between clinical mastitis and average milk yield has moderate and negative correlation (-0.507), significant at 5% level.

Medication expenses per cow and percentage of clinical mastitis demonstrate highly significant correlation (+0.771), showing that these indicators are positively and strongly connected.

Medication expenses per cow and calves' mortality up to 6 months of age also show significant link (5% significance level), indicating positive and strong relation (+0.709).

Medication expenses per cow and endometritis is significantly correlated at 5% level (+0.673), showing positive and moderate relation.

Correlation coefficients between production cost of 1liter milk and: cow number (-0.535), medication expenses per cow (+0.604) and cows per worker (-0.678) are higher than 0.5 (or smaller than -0.5), but insignificant.

The conclusion from Table 1 assumes that the increment of clinical mastitis' percentage, leads to significant decline in milk yield while the medication expenses per cow become significantly larger. Medication expenses per cow also significantly increment with rise of calves' mortality and endometritis percent.

Table 2 displays F-statistic of the Pc equation, which is 36.987 with probability of 0.026; R^2 is 0.9823 and the adjusted R^2 is 0.9557.

The negative coefficient in front of the cows per 1 worker (Cw) is significant (-0.218), meaning that the growth of number of cows per worker leads to cutback in the production cost per 1 l of milk (Pc). The same tendency is observed between the average milk yield (My) and production cost (significant coefficient of -0.645) – with the increment of average milk yield the production cost per 1 liter drops down. The coefficient of medication expenses per cow (Em) is positive, but insignificant.

Therefore we can conclude that the production cost per 1 liter of milk (Pc) is influenced significantly from the cows' number per 1 worker (Cw) and the average milk yield (My). The logic behind the significance of the cows per one worker is that: the smaller the value of cows per worker, the higher number of workers in the farm, which reflects on the higher sum of salaries and social securities and enlarges the production cost of cow milk. If we substitute the actual values with the calculated coefficients in front of the regressors in the model, the next equation is obtained:

$$Pc = 5.590 - 0.218. Cw - 0.645.My + 0.032.Em$$

Table 1. Correlation coefficients between the variables in the studied dairy farms

Variable		Cow number	Average milk yield (l)	Expenses for medications per 1 cow (BGN)	Cows per 1 worker	Production cost per 1 liter milk (BGN)
Cow number	Correlation coef.	1	0.472	-0.406	0.153	-0.535
	Number of obs.	17	17	10	12	6
Average milk yield (l)	Correlation coef.	0.472	1	-0.383	0.102	-0.010
	Number of obs.	17	17	10	12	6
Clinical mastitis (%)	Correlation coef.	-0.165	-0.507*	0.771**	-0.120	0.270
	Number of obs.	17	17	10	12	6
Calves' mortality up to 6 months of age (%)	Correlation coef.	0.030	-0.261	0.709*	0.120	0.181
	Number of obs.	17	17	10	12	6
Endometritis (%)	Correlation coef.	-0.118	-0.405	0.673*	0.048	0.196
	Number of obs.	17	17	10	12	6
Expenses for medications per 1 cow (BGN)	Correlation coef.	-0.406	-0.383	1	-0.101	0.604
	Number of obs.	10	10	10	9	6
Cows per 1 worker	Correlation coef.	0.153	0.102	-0.101	1	-0.678
	Number of obs.	12	12	9	12	6

* 5% significance level, ** 1% significance level
Source: Own calculations.

Table 2. Estimation of the regression model for the production cost per 1 liter of milk (Pc)

Variable	Coefficient	Standard error	t-statistic (probability)
Constant	5.590	1.228	4.5533 (0.045)
Cows per 1 worker (Cw)	-0.218	0.030	-7.2825 (0.018)
Average Milk yield (My)	-0.645	0.130	-4.9514 (0.038)
Expenses for medications per 1 cow (Em)	0.032	0.011	2.8780 (0.103)
R^2	0.9823		
Adjusted R^2	0.9557		
Standard error	0.0191		
F-statistic (probability)	36.987 (0.026)		

Source: Own calculations.

Figure 1 represents the actual and fitted production cost per 1 l cow milk in the studied dairy farms. The actual and fitted values match well, showing that the model is suitable for analysis of production cost in the studied dairy farms.

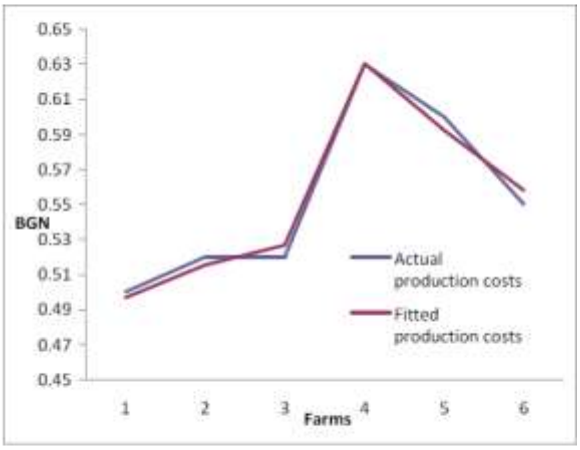

Fig. 1. Actual and fitted production costs (in BGN) of cow milk in the studied dairy farms.
Source: Own calculations.

CONCLUSIONS

Growth in clinical mastitis leads to drop down of milk yield while the medication expenses per cow become larger. Medication expenses per 1 cow also increment with the rise of calves' mortality and endometritis.

The production cost per liter is influenced significantly from the cows' number per worker and the average milk yield: with the increment of one of them, a decline in production cost per liter is observed.

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DYNAMICS OF TOURIST CIRCULATION IN ILFOV COUNTY FOR THE TOURIST AREA PLANNING

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Abstract

This paper is based on the analysis of the evolution of the demand and the tourist offer from Ilfov county, at a type of accommodation unit, respectively tourist pensions. The statistical indicators considered were: tourist accommodation capacity (as number and places), number of tourists, number of tourists per month of 2017, number of overnight stays, resident population and area. The statistical data regarding the tourist circulation in Ilfov county were taken from the National Institute of Statistics. The accommodation unit, at which the study was carried out, was the tourist pensions, for a period of 5 years, 2013-2017. As a research method, we used the analysis of the dynamics of indices and indicators regarding the tourist circulation. The most representative tourist indicators, calculated and interpreted, were: the change of the global tourist demand, the evolution of the domestic and external tourist demand, the evolution of the overnight stays, the average tourist stay, the density of the tourist circulation in relation to the population of the county and with the surface and the evolution, the occupancy degree of the accommodation unit, the coefficient of the monthly tourist concentration in 2017. The objective of this study is to establish what is the tourist evolution in the tourist pensions of Ilfov county, so that we can propose and adopt strategies of tourist arrangement in the area. Harnessing and promoting tourism potential and existing tourist attractions, is another deciding factor in the tourism development of an area.

Key words: *tourism, attractiveness, indicators, tourist traffic, tourist density, tourist traffic coefficient, average stay*

INTRODUCTION

Tourism traffic is one of the important components in establishing a strategy for tourism development in a country or region [3, 4, 5].

The promotion of natural tourist attractions, architectural, historical and cultural vestiges, as well as the facilities for organizing events, fairs or festivals, is another link in attracting more potential tourists, in the respective area. They spend their free time and spend money to benefit from these advantages, leading to the growth and economic development of the area, on the tourism segment [8, 9].

According to some opinions expressed by specialists, we can say that a satisfied tourist, of the stay spent in an area, transmits the information to other potential tourists, who will plan a vacation in that place, but a tourist dissatisfied with the services offered, by the behaviour of the staff employed in that location, negatively influences other potential tourists, interested in that area [6, 7].

Tourism is the most important activity for any country, which could have a major advantage, by exploiting the natural and anthropic potential of each area. [10].

The development and diversification of tourism activities created new jobs, increased family incomes, increased the standard of living of the local population, increased the turnover in the field of tourism, so much so that it stimulated the field of constructions, by modernizing the existing buildings and by building new tourist locations, as well as investments and tourism infrastructure have been developed [11].

The tourism potential of the county is related to its settlement on the site of the old Vlăsia district and the remaining forest areas, as well as the presence in the region of lakes and old Orthodox monasteries along with their museums. A special attraction is the possibility of fishing, water sports, hunting and access to cultural heritage values [15].

As main points of *attraction in this county*, I will list a few of these: Căldăruşani, Râioasa, Cernica, Snagov, and Mogoşoaia, which represent complexes consisting of forests, lakes, and monasteries. The monasteries were built from the Middle Ages on the banks and islands of lakes. Most of them have museums in which old manuscripts, religious objects and sacred art are exhibited [12].

The natural area superimposed on the Natura 2000 site - *Grădiștea-Căldărușani-Dridu* represents a humid area (rivers, marshes, lake of water, peat bogs, forests and meadows with flora and wildlife) in the area in which several species of birds (migratory, were identified). of passage, sedentation) rare, some protected by law [15].

The Snagov Lake Nature Reserve is of particular archaeological, historical, cultural and natural importance, being located at a short distance from the capital of the country and preferred as an eco-leisure area for both Bucharest and Ploiesti people. It is composed of terrestrial and aquatic habitats with a significant plant and animal biodiversity [15].

Snagov Forest is a protected area for the conservation of some trees, for scientific research, comprising natural elements of special value from a dendrological point of view, offering the possibility of research for scientific purposes and the visit for educational purposes [2]. It is possible that the existing tourist pressure will increase in the future, endangering the natural, wild aspect, unaltered by the human presence. The management plan was elaborated with a view to an integrated planning of the activities to be undertaken in order to achieve the major objective of the reservation, namely the conservation of biodiversity [1].

MATERIALS AND METHODS

Data collection

The data were taken from the statistical database, the Tourism section, from the INSSE website, from 2013-2017. These data are officially provided by the National Institute of Statistics for all regions / macroregions / counties of the country.

The statistical data regarding the tourist movement indicators used in this study were the following:

(a) Statistical indicators regarding the tourism offer for the accommodation capacity, in Ilfov county: the number of accommodation units by type, the number of accommodation places for each type of tourist accommodation unit;

(b)Statistical indicators regarding the tourist demand, from Ilfov county: tourist arrivals (for total tourists, Romanian and foreign tourists) for each type of accommodation unit, number of nights spent (for total tourists, Romanian and foreign tourists) for each type of accommodation unit, tourist arrivals (for total tourists, Romanian tourists and foreign tourists) in each month of 2017, for each type of accommodation unit;

(c)Statistical indicators reflecting the demography of Ilfov County: the resident population of Ilfov County, between 2013-2017 and the surface of the county.

The used methodology

Dynamic analysis of tourism indicators was run in the period 2013-2017.

The main indicators and indices calculated and interpreted were: Changing global tourism demand, Index of variation in tourist demand (domestic and foreign), Distribution index of global tourism demand, Night stay evolution index, Average tourist stay for Romanians and foreigners, Occupation rate of tourist pensions, the coefficient of the monthly tourist concentration at the level of 2017, the tourist density indicator in relation to the population, the tourist density indicator in relation to the surface [3, 4, 5].

RESULTS AND DISCUSSIONS

The objective of this study is to analyze the evolution of the tourist circulation in the tourist pensions in Ilfov county, so that we can determine whether the promotion and the services offered to tourists can be improved.

The analysis of the dynamics of these indicators of the tourist circulation helps us to determine the level of tourism development in Ilfov county, what is the current degree of tourism valorization of this area and what strategies for tourism development and planning can be adopted.

1). ***Index of global tourist demand change*** [3, 4, 5]:

Δ***CG*** *= [Total tourists (Romanians + foreigners) in current year/Total tourists (Romanians + foreigners) previous year]* 100* [3, 4, 5]

Table 1. Results regarding the change in the global tourism demand

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. total tourists (Romanians + foreigners) at tourist pensions	3,589	5,007	5,777	6,062	15,101
No. Roman tourists	3,213	3,836	4,693	5,091	13,606
No. foreign tourists	376	1,171	1,084	971	1,495
ΔCG for total tourists (%)	-	139.50%	115.37%	104.93%	249.11 %
ΔCG for Romanian tourists (%)	-	119.39%	122.34%	108.48%	267.56 %
ΔCG for foreign tourists (%)	-	319.08%	92.57%	89.58%	153.96 %

Source: www.insse.ro data and own processing.

As a result of the calculations we observe that ***the global tourist demand*** has had an oscillating evolution, both for the total tourists, as well as for the internal and external demand.

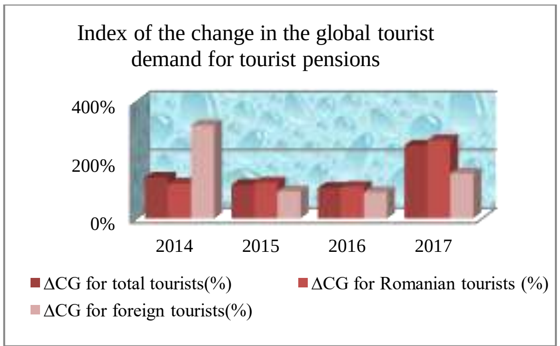

Fig. 1. Evolution of the Index of the change of the global tourist demand for tourist pensions
Source: Own calculation.

The highest percentage was registered in the last period, 2016-2017, of 167%, for the Romanian tourists, and for the foreign tourists, the maximum percentage was registered in the period 2013-2014, of 219%. For both internal and external circulation, minimum values were registered for the period 2015-2016, with an increase of only 8% for Romanian tourists, and for foreign tourists, the decrease was 11%.

Evolution of the Index of the change of the global tourist demand for tourist pensions is also illustrated in Fig. 1.

2.*Index of (Romanian and foreign) tourist demand variation in time* [3, 4, 5]

Δ***CI*** *= [No. Romanian tourists per current year / (No. Romanian tourists + No. Foreign tourists) current year]*100* [3, 4, 5]

Δ***CE*** *= [No. Foreign tourists per current year / (No. Romanian tourists + No. Foreign tourists) current year]*100* [3, 4, 5]

Table 2. Results regarding the distribution of global tourism demand

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. total tourists (Romanians + foreigners) at tourist pensions	3,589	5,007	5,777	6,062	15,101
No. Roman tourists	3,213	3,836	4,693	5,091	13,606
No. foreign tourists	376	1,171	1,084	971	1,495
ΔCI (%)	89.52%	76.61%	81.23%	83.98%	90.10%
ΔCE (%)	10.47%	23.38%	18.76%	16.01%	9.90%

Source: www.insse.ro data and own processing.

The dynamics of the ***index of (Romanian and foreign) tourist demand variation***, both for the internal demand and for the external demand, at the tourist pensions, was oscillating, during the analyzed period. For the Romanian tourists, the maximum value was registered in the last calculation year, of 90%, and the minimum value in 2014, of 76%. For the external demand, the maximum percentage was registered in 2014, and the minimum value of 10%, in the last year, 2017.

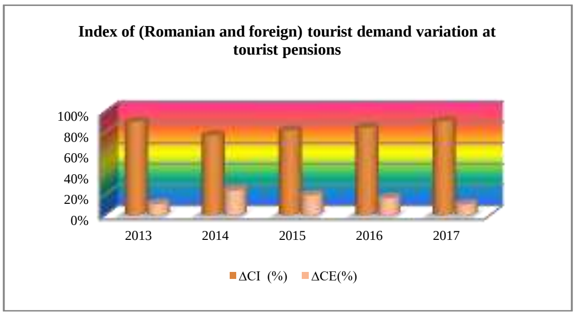

Fig. 2. The evolution of the Index of (Romanian and foreign) tourist demand variation to tourist pensions
Source: Own calculation.

3. *The average length of stay* [3, 4, 5]

Total average stay *= No. Total overnight stays (foreign + Romanian)/No. Total Tourists (Romanian + foreign)* [3, 4, 5]

$$S_H = \frac{NH}{T}$$ (days) [3, 4, 5]

where: *NH* - number of recorded overnight stay;

T - number of tourists arriving;

S_H - average stay in the tourist pension.

Table 3. Results regarding the average stay

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. overnight Total tourists	6,590	9,021	10,398	10,355	24,875
No. total tourists arriving	3,589	5,007	5,777	6,062	15,101
Total average stay (days)	1.83	2.51	1.79	1.70	1.64
Average stay for Romanian tourists (days)	1.51	1.72	1.73	1.74	1.64
Average stay for foreign tourists (days)	4.54	2.05	2.06	1.52	1.70

Source: www.insse.ro data and own processing.

The total average stay at the tourist pensions registered, during the analyzed period, an oscillating evolution. The total average stay was 2 days, representing the average number of days the tourists stay. The maximum value of the total average stay was recorded in 2013 for 5 days, for foreign tourists, and the minimum value was 1.51 days, respectively in 2013, for Romanian tourists.

Fig. 3. Evolution of the average stay at tourist pensions
Source: Own calculation.

4. *The monthly concentration coefficient* [3, 4, 5]

Cc *= [No. Tourists per each month / (No. Romanian tourists + No. Foreign tourists) per year of calculation]*100*

$C_c = \frac{LM}{A_t}$, will be calculated for each month of 2017 [3, 4, 5].

Table 4. Results for the monthly concentration coefficient for 2017

Mounths/ Indicators	No. total tourists / month	No. of total tourists (Romanians + foreigners) 2017	Cc
January	830	15,101	0.05
February	997	15,101	0.07
March	1,107	15,101	0.07
April	1,135	15,101	0.08
May	1,413	15,101	0.09
June	1,400	15,101	0.09
July	1,578	15,101	0.10
August	1,542	15,101	0.10
September	1,220	15,101	0.08
October	1,201	15,101	0.08
November	1,535	15,101	0.10
December	1,143	15,101	0.08

Source: www.insse.ro data and own processing.

The coefficient of the monthly concentration for the tourist pensions, during the analyzed period, had an oscillating evolution.

The coefficient of the monthly tourist concentration had the maximum tourist traffic in the July-August monthly range of 0.10, and the minimum tourist traffic was registered in January of 0.05.

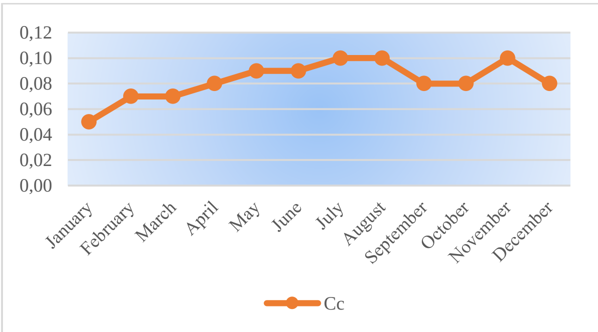

Fig. 4. Evolution of the coefficient of the monthly concentration in tourist pensions
Source: Own calculation.

5. *Index of overnight stay evolution* [3, 4, 5]

ΔN *= (No. overnight stay per current year / No. overnight stay per previous year)*100* [3, 4, 5]

Table 5. Results regarding the index of overnight stays

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. total tourist overnights (Romanians + foreigners)	6,590	9,021	10,398	10,355	24,875
No. overnight Romanian tourists	4,882	6,615	8,161	8,875	22,331
No. overnight foreign tourists	1,708	2,406	2,237	1,480	2,544
ΔN for total tourists (Romanians + foreigners) (%)	-	136.88%	115.26 %	99.58%	240.22 %
ΔN for Romanian tourists (%)	-	135.49%	123.37 %	108.74 %	251.62 %
ΔN for foreign tourists (%)	-	140.86%	92.97%	66.16%	171.89 %

Source: www.insse.ro data and own processing.

The evolution of the overnight stays index was an oscillating one, during the analyzed period.

Thus, between 2015-2016, the trend decreased, by 34%, for foreign tourists and with a maximum increase of 72% in the last period.

For the domestic demand, the maximum growth was reached in the period 2016-2017, of 151%, and in the period 2015-2016, registering an increase of only 9%.

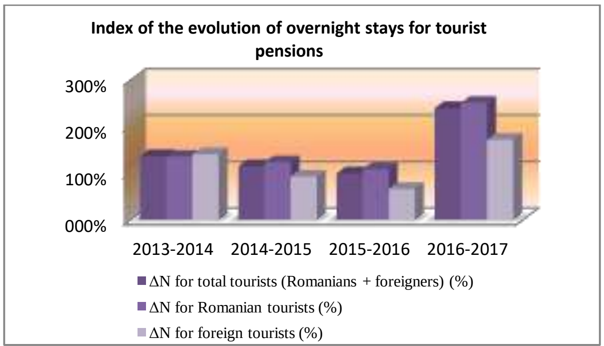

Fig. 5. Evolution of the Index of the evolution of overnight stays for tourist pensions
Source: Own calculation.

6. ***The occupancy indicator*** [3, 4, 5]

G₀* *= [No. overnight stays (no. tourist days)/(No. beds * no. days running)] * 100

$$G_0 = \frac{NH \cdot 100}{LH \cdot Z} = \frac{NT \cdot S}{LH \cdot Z} \cdot 100 \text{ [3, 4, 5]}$$

where:
G_o - occupancy, percentage;
NH - number of overnight stays;
LH - number of beds in hotels;
Z - number of supply days = 365 days;
NT - number of tourists;
S - average length of stay [3, 4, 5].

Table 6. Results regarding the degree of occupancy in tourist pensions

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. overnight stays (NH) total tourists (Romanian + foreign) at tourist pensions	6,590	9,021	10,398	10,355	24,875
No. accommodation units (LH) at tourist pensions	132	145	161	157	228
G_0 (%)	13.67 %	17.04%	17.69%	18.06 %	29.89%

Source: www.insse.ro data and own processing.

The occupancy rate for tourist pensions during the period analyzed has increased, from about 14% in 2013 to about 30% in 2017.

In the analyzed period, the occupancy rate of the tourist guesthouses varied between 14 % in the year 2013 to 30 % in the year 2017, as illustrated in Fig. 6.

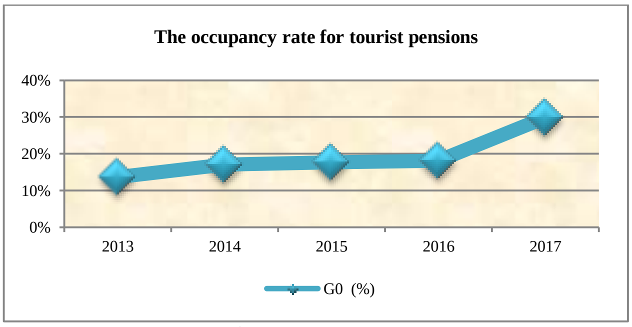

Fig. 6. Evolution of the occupancy rate in tourist pensions
Source: Own calculation.

7.***Tourist density indicator in relation to population*** [3, 4, 5]

$$D_{t_{i-0}} = \frac{T_{t_{i-0}}}{Population}$$ (*tourists/ no. inhabitants*) [3, 4, 5]

where:
T_{i-0} *– no. total Romanian + foreign tourists;*

Pop – the population of Ilfov county [3, 4, 5].

Table 7. Results regarding the tourist density in relation to the population

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. total tourists (Romanians + foreigners)	3,589	5,007	5,777	6,062	15,101
Population of Ilfov county	352,466	364,954	376,607	390,919	407,50 5
Dt (tourists/ no. inhabitants)	0.010	0.013	0.015	0.015	0.037

Source: www.insse.ro data and own processing.

The indicator of the tourist density in relation to the population at tourist pensions, during the analyzed period had an increasing evolution, from 0.010 tourists/no. Residents in 2013 reached 0.037 tourists/no. Residents in 2017. The evolution of the indicator of tourist density in relation to the population at tourist pensions is illustrated in Fig. 7.

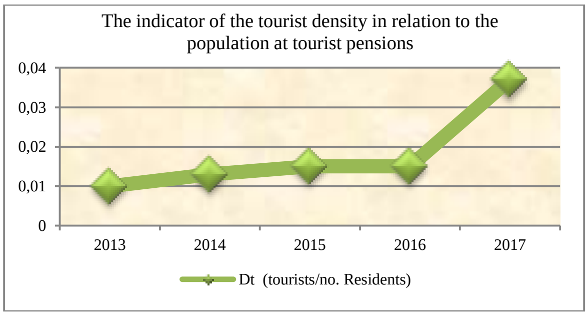

Fig. 7. Evolution of the indicator of tourist density in relation to the population at tourist pensions
Source: Own calculation.

8.Tourist density indicator in relation to area [3, 4, 5]

$$D_{t_{i-0}} = \frac{T_{t_{i-0}}}{Surface} \quad (tourists/km^2)\ [3, 4, 5]$$

where:

T_{i-0} – no. total Romanian + foreign tourists; [3, 4, 5]

S – Ilfov county area. [3, 4, 5]

Table 8. Results regarding the tourist density in relation to the area

Tourist pensions/ Indicators	2013	2014	2015	2016	2017
No. total tourists (Romanians + foreigners)	3,589	5,007	5,777	6,062	15,101
Ilfov County area (km^2)	1.583	1.583	1.583	1.583	1583
Dt ($tourists/km^2$)	2.26	3.16	3.64	3.82	9.54

Source: www.insse.ro data and own processing.

The indicator of tourist density in relation to the area for tourist pensions, during the analyzed period, had an increasing evolution, from 2.26 tourists/Km^2 in 2013 reached 9.54 tourists/Km^2 in 2017 (Fig.8).

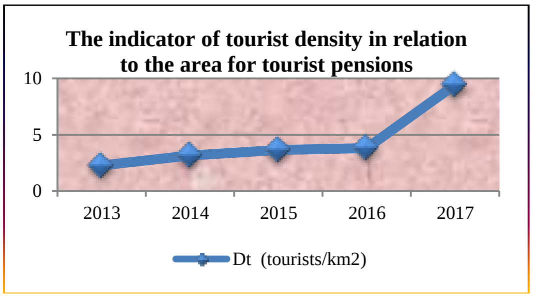

Fig. 8. Evolution The indicator of tourist density in relation to the area for tourist pensions
Source: Own calculation.

CONCLUSIONS

The analysis of the existing situation regarding the dynamics of the tourist circulation in Ilfov county, highlighted the fact that in this area, it had an upward trend, regarding the total number of tourists, for the period 2013-2017.

Following the analysis, we observe that ***the global tourist demand*** has had an oscillating evolution, both for the total tourists, as well as for the internal and external demand. The highest percentage was registered in the last period, 2016-2017 for Romanian tourists, and for foreign tourists, the maximum percentage was registered in 2013-2014.

The dynamics of ***the index of the distribution of the global tourist demand***, both for the internal demand and for the external demand, at the tourist pensions, was oscillating, during the analyzed period. For the Romanian tourists, the maximum value was registered in the last year of calculation, and for the external demand, the maximum percentage was registered in 2014.

The total average stay at the tourist pensions registered, during the analyzed period, an oscillating evolution. The total average stay was 2 days, representing the average number of days the tourists stayed, and the maximum value of the total average stay was recorded in 2013 for 5 days, for foreign tourists.

The coefficient of the monthly tourist concentration for the tourist pensions, had a maximum tourist traffic in July-August of 0.10, and the minimum tourist traffic was registered in January of 0.05.

The evolution of the overnight stays index was an oscillating one, during the analyzed period. Thus, between 2015 and 2016, the trend decreased, by 34%, for foreign tourists, and for domestic demand, the maximum increase was reached in 2016- 2017, by 151%.

The occupancy rate at the tourist pensions during the analyzed period has increased, from about 14% in 2013 to a percentage of about 30% in 2017.

The dynamics of ***the indicator of the tourist density in relation to the population and the area***, in tourist pensions, during the analyzed period had an increasing evolution.

Therefore, through a sustained promotion at tourism fairs, at national and international level, through the media and promotional materials, Ilfov County can benefit from an increase in tourist circulation year by year.

Tourism can be an important source of income for a potential area, but it requires investment.

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FACTORS AFFECTING EXTENSION GRADUATES' WILLINGNESS TO PRACTICE PRIVATE EXTENSION SERVICE DELIVERY

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Abstract

The study identified factors affecting extension graduates' willingness to practice private extension service delivery in Oyo State, Nigeria. Using Taro Yamane sampling formula for finite population, extension graduates were selected from universities, public research institutes, state ministry of agriculture. The results of the factor analysis revealed that five factors affected the willingness of extension graduates to practice private extension service delivery. All the factors were isolated from twenty-eight variables with 69.5% contributions to the willingness of extension graduates to practice private extension service delivery in the study area. These include the institutional factor, extension personnel factor, economic factor, experience factor and association factor. The study concluded that institutional factor of the private extension system was the most important factor affecting extension graduates' willingness to practice private extension service delivery. Therefore, a well legislated extension policy and institutional framework of operation should be developed by policy makers in order to facilitate a successful private extension practice.

Key words**:** *private extension, factors, willingness, service*

INTRODUCTION

In recent years, private extension service has been sought as an alternative to the public extension system. This is as a result of challenges facing the public extension service in Nigeria. These weaknesses could be summarized as follows: poor and erratic funding, ineffective extension supervision, unsatisfactory change agent/farmer ratio, duplication of organization and services which resulted in extension agents performing none-extension duties, inadequately trained extension agents who were not properly motivated due to poor service conditions and ineffective extension supervision as well as improper job descriptions [4]. In the same vein, [5] noted that these challenges can be attributed to their lack of adequate financial resources, inability to effectively increase farm income and improve the livelihoods of the rural poor. Several stakeholders including farmers and researchers have questioned the effectiveness and relevance of the extension message in meeting the needs of the farmers. [1] opined that the Nigerian public extension system has been criticized for its lack of purpose and ineffectiveness in delivering extension services to the farmers.

The most prominent argument against public agricultural extension services is that of high and unsustainable public costs [9]. Additionally, the withdrawal of the World Bank sponsorship of the Agricultural Development Programmes (ADP) and decline in government funding for extension service delivery has posed a serious challenge to the future of the public good in Nigeria. Most of the challenges identified in the public extension system have revolved round the problem of inadequate funding of extension services and the effectiveness of the services currently been delivered with the public system. Therefore, it might not be possible to continue to have a completely free of charge extension system that would meet the diverse needs of the clientele. Hence, a well-developed private extension system would be timely in compensating for the defects of the public system.

Even though private extension service delivery is being considered as a viable

alternative to the public service system, it is not without its own challenges. As identified by [1], some of the challenges facing the privatization of extension services in Nigeria include: farmers' willingness to pay for the services, institutional framework, professionalism and competence of the extension system, corruption, availability of infrastructures and environmental imperatives. Previous studies have extensively researched issues relating to privatization of extension services in Nigeria. [2] stated that farmers can pay for services and are willing to pay if their income from farming would increase and the extension messages be made relevant to them. Also, the issue of professionalism and competence of the current extensions system have been the subject of several debates. [1] stated that farmers in the past have often complained of the relevance of the extension messages to farmers' current need and incompetence on the part of the extension agents for they lack adequate knowledge. [10] pointed the fact that it will take time to bring private extension into the planning process of agricultural development programmes. This is because private extension is an unknown quantity for many extension development experts and it is not always clear how it fits into the previously existing system. However, none of these research have identified factors affecting the willingness of extension graduates to practice private extension service delivery, hence this study.
The study aims to identify factors affecting the willingness of extension graduates to practice private extension service delivery in Oyo, State, Nigeria.

MATERIALS AND METHODS

Extension graduates who were enrolled into the university postgraduates' studies and those practicing the profession in the public extension system were selected for the study. Applying Taro Yamane formula [12] for finite population, data was collected from 169 respondents using structured questionnaire.

$$n = N/(1+(e)^2)$$

where n = sample size
N = population under study
e = margin of error (0.05)

Factor and component analyses were used to isolate the crucial factors affecting extension graduates' willingness to practice private extension. Twenty-eight variables were subjected to the factor analysis; with the selection of variables that have their scores above the critical value of 0.30. These variables were inter-correlated and run with varimax factor rotation pattern.

RESULTS AND DISCUSSIONS

Personal and Socio-Economic Characteristics of Extension Graduates

This session present the socio-economic characteristics of the respondent. Table 1 shows the descriptive statistics of some socio-economic characteristics of respondents.

Table 1. Descriptive statistics of some socio-economic characteristics of respondents.

Variable	Mean	Standard deviation
Age (years)	38.9	9.12
Years of formal education	18.33	2.417
Years of extension experience	8.86	7.58
Monthly income (Naira)	85,860.29	69,945.34

Source: Field Survey, 2016.

The mean age recorded in this study is lower than the mean age recorded by [8] in a study involving agricultural extension agents in Ondo state, Nigeria. However, the mean age revealed that many extension graduates are middle-age individuals who are part of the active workforce in the country.
More than half of the respondents (50.9%) had Bachelor's degree, 28.9 per cent possess masters' degree, 5.3 per cent had doctoral degree (Ph.D) while the rest 14.8 per cent and 0.6 percent of respondents had Higher National Diploma (HND) and Ordinary National Diploma (OND) degrees respectively. Majority of these extension graduates (67.5%) were employed, 10.7 per

cent were self-employed (had their own businesses), 21.3 per cent were unemployed and 0.6 per cent were retired. As rightly identified by [11], the prevailing high rate of unemployment is one of the reasons for increased enrolment for post-graduate studies. Consequently, the unemployed extension graduates might have enrolled for post-graduate studies as one of the coping strategies against unemployment in the country. Therefore, private extension practice is an avenue for job creation for the unemployed extension graduates

Additionally, majority of the extension graduates (65.7%) were civil servants while 21.3 per cent of the respondents were full time post-graduate students with no other employment engagement. Other occupations indicated by respondents were agro-processing, petty trading, livestock rearing, private extension practice and farming. As few as 16 per cent of respondents have had no extension practice experience, 69.2 per cent of respondents have had between 1-15 years of extension practice experience, while 14.2 per cent of respondents have had 16-30 years' experience and 0.6 per cent have had more than 31 years of experience.

A high proportion of extension graduates (73.4%) indicated that the farthest they have ever travelled is outside the state while 23.1 per cent of extension graduates have travelled outside the country before and just 3.6 per cent of extension graduates have travelled only within the state. Majority of the respondents (78.1%) belong to one social organisation or the other, while 23.1 percent of them do not belong to any organization whatsoever. It was observed that Agricultural Extension Society of Nigeria (AESON) is the most popular professional association among the extension graduates. More specifically, it was revealed that 41.7 percent of respondents that belonged to professional associations belonged to AESON, 30.0 percent belong to Rural Sociology Association of Nigeria (RUSAN), 15.0 per cent belong to management associations such as CIPM, NIM and so on.

Factoring and willingness of extension graduates to practice private extension

Five factors were isolated from the analysis which had its Eigen value of greater than one. Three criteria identified by [6] were employed to name the group of factors isolated in the study. These were:

(I)The researchers' subjective interpretation of experiences from literature,

(II)Picking synonyms of the highest loaded variable on each factor; and

(III)Joint interpretation or explanation of the meaning of the positive and highly loaded variables on each factor.

Group of factors isolated from variables

Tables 2 show the result of the varimax rotation of the variables included in the factor analysis and the principal components subsequently extracted for the extension graduates. Five factors were isolated from 28 variables with the measures that were highly loaded on each of them.

Factor 1 was named institutional factor which accounted for 42.32 per cent variation; factor 2 was named extension personnel factor with 9.51 per cent variation; factor 3 was named economic factor with 7.15 per cent variation; factor 4 was named external orientation factor with 6.12 per cent variation and lastly factor 5 was named association factor with 4.41 per cent variation.

Factor one: Institutional factor

Several variables had high loading on factor one name institutional factors. These include: capacity building for extension professionals (L=0.892), linkage between research and extension (L=0.878), innovations to be disseminated (L=0.872), access to research institutes (L=0.843), recognition of importance of extension (L=0.826), competence in areas of agricultural extension specialization (L=0.818), favourable agricultural extension policy (L=0.817), monetary value attachment to extension (L=0.804), government support (L=0.774), availability of market for increased output (L=0.757), legal support (L=0.749), social prestige associated with extension work (L=0.743), access to farmers (L=0.742), presence of other extension graduates (L=0.735), political stability (L=0.693), prevailing system of farming (L=0.668), farmers' need for extension services

(L=0.661), amount farmers are willing to pay (L=0.464) and demand for extension (L=0.34).

All these variables make up the institutional factors in the private extension service system that can affect graduates' willingness to establish the private extension services in the study area. This finding confirms the previous identified features of an extension system that may influence graduates' willingness to establish private extension services. This also implies that a good institutional arrangement for the private extension service system would be a favourable factor in affecting the willingness of extension graduates to partake in the private extension service delivery.

Therefore, a favorable institutional framework must be put in place. This must be free of the 4 impediments identified by [7] namely: policy, strategic, structural and financial impediments hindering the realization of agricultural policy objectives.

Table 2. Result of varimax rotated component matrix showing extracted factors associated with extension graduates' willingness to establish private extension service

Variables	Factors				
	1	**2**	**3**	**4**	**5**
Age in years		0.906			
Household size		0.371	0.524		0.519
Years of formal education				0.777	
Years of extension experience		0.86			
Monthly income		0.54		0.631	
Perception			0.755		
Knowledge of extension		0.608	0.3	-0.478	
Favourable agricultural extension policy	0.817				
Legal support	0.749		0.39		
Political stability	0.693		0.387		
Monetary value attachment	0.804				
Amount farmers are willing to pay	0.464		0.624		
Government support	0.774				
Farmers' needs for extension services	0.661				
Prevailing system of farming	0.668				
Access to farmers	0.742				
Demand for extension	0.34		0.687		
Recognition of importance of extension	0.826				
Availability of market for increased output	0.757				
Access to research institutes	0.843				
Linkage between research and extension	0.878				
Innovations to be disseminated	0.872				
Presence of other extension graduates	0.735				
Capacity building for extension professionals	0.892				
Competence in areas of agricultural extension specialisation	0.818				
Social prestige associated with extension work	0.743				
Cosmopoliteness				0.744	
Association membership					0.843

Figures in bold fonts indicate variables with high loading
Source: Field survey, 2016

Factor two: Extension personnel factor

Variables that loaded very high on factor 2 were age (L=0.906), years of extension experience (L=0.86), knowledge of extension (L=0.608), monthly income (L=0.54) and household size (L=0.371). All these variables put together are personal and peculiar to an extension graduate, hence, the factor was named extension personnel factor. This is a very crucial factor for the willingness of an extension graduate to establish private extension service. For instance, an extension graduate might feel he/she is too old to set up private extension outfit or on the other hand, an extension graduate might feel he/she possesses vast experience in extension practice to provide private services.

Factor three: Economic factor

Perception (L=0.755), demand for extension (L=0.687), amount farmers are willing to pay (L=0.624), household size (L=0.524), legal support (L=0.39), political stability (L=0.387) and knowledge of extension (L=0.3) had the highest loading on factor 3. The perception and knowledge of extension the economy avails a graduate might stimulate an interest in the private extension system. Similarly, the demand for extension services and amount farmers are willing to pay are strong economic indicators that may affects a graduate's willingness to establish such services. The legal support and political stability are very important to the economic stability of a service system, hence, very crucial.

Factor four: Experience factor

Years of formal education (L=0.777), cosmopoliteness (L=0.744), monthly income (L=0.631) and knowledge of extension (L= 0.478) were the variables that made up the external orientation factor. This implies that the experience an extension graduate might have gained through years of formal education, and through external exposures to training, research, conferences and networking might be favourable in affecting the willingness to establish private extension services. Also, in many organisations, the monthly income is often a function of years of work experience. Consequently, this might also affect a graduates' willingness to establish private extension services.

Factor five: Association factor

The highest loaded variable for factor 5 were: association membership (L=0.843) and household size (L=0.519). Through social organisations and family members, people often enjoy mutual support and opportunity for idea sharing. This belongingness can stimulate the kind of thoughts on new business ideas, in this case private extension service provision. Also, graduates can obtain support for the establishment of a private extension outfit from their professional network and family members. This finding implies that the social capital of an extension graduate would go a long way in affecting the willingness to establish private extension services.

Contributions of groups of factors isolated from extension graduates-related variables to willingness

Results in Table 3 show the contribution of each of the groups of factors to willingness of agricultural extension graduates to practice private extension.

Table 3. Factors name, Eigen values and percentage variation accounted for by each factor associated with extension graduates' willingness to establish private extension service

Factors	**Name**	**Eigen value**	**% variance**	**Cumm. % var**
1	Institutional factor	11.851	42.324	42.324
2	Extension personnel factor	2.662	9.506	51.831
3	Economic factor	2.002	7.150	58.980
4	External Orientation factor	1.712	6.115	65.095
5	Association factor	1.234	4.408	69.503
6	Others		30.497	100.00

Source: Field survey, 2016.

Factor 1- institutional factor was the highest contributor to willingness which accounted for 42.33% variance. This is followed by factor 2- extension personnel factor with 9.51% contribution to willingness of extension graduates to practice private extension service. Factor 3- economic factor contributed 7.15% while factor 4- external orientation factor and factor 5 had 6.12% and 4.41% contributions respectively. To sum up, all the five factors identified accounted for 69.51 per cent contribution to willingness of extension graduates to establish private extension.

These factors identified are quite similar to the challenges of private extension service delivery noted by [1] which includes institutional framework, agricultural extension policies, farmers' socio-economic factor, corruption, professional competence, infrastructure availability and environmental imperatives. The are some other factors not investigated in this study but had 30.5% contribution to willingness of extension graduates to practice private extension delivery system are equally important for investigation for future development of private extension system in Oyo state, Nigeria. Following the recommendation of [3], adequate attention should be given to factors identified before embarking on any form of privatization and commercialization arrangement.

CONCLUSIONS

The study concludes that majority of the extension graduates are middle age individuals actively involved in the Nigerian labour market. Most of them are civil servants in the public extension system. Also, institutional factor of the private extension system was identified as the most important factor affecting extension graduates' willingness to practice private extension service delivery in the study area. Therefore, a well legislated extension policy and institutional framework of operation should be developed by policy makers in other to facilitate a successful private extension practice. Lastly, all other factors identified in this study should be considered when deploying extension personnel for private extension practice.

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AGRIENT - USING A 3D VIRTUAL WORLD TO ENHANCE AGRICULTURE ENTREPRENEURSHIP EDUCATION

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Abstract

The paper presents an educational platform and provides a systematic approach to train and support young people to succeed in formulating, starting and running their own agribusinesses. The educational platform uses 3D virtual reality (VR) to teach entrepreneurship focused on the agriculture domain (AGRIENT). The 3D virtual world allows users to navigate and interact with different multimedia content, such as slideshows, notecards, quizzes, non-player characters, multimedia presentations, 2D/3D simulations as well as interacting with other learners and instructors. The virtual interaction through chats and document sharing is available leveraging the constructivism. The virtual world is composed of islands of knowledge representing topics related to entrepreneurship and technologies that can be used in the agriculture domain.

Key words**:** *virtual reality, 3D virtual world, virtual education, learning technologies, teaching environment*

INTRODUCTION

Youth entrepreneurship is a key priority in the EU policy agenda for creating employment opportunities, fighting youth unemployment, social exclusion and also stimulating innovation among young people. The "Entrepreneurship Action Plan 2020" of EC highlights the important role of entrepreneurship education as a key strategy to stimulate economic growth in all sectors in the European level. On the other hand, agriculture is a strategic sector and pillar for the development in European countries. It's important for economic growth and society. Studies have shown that it is four times more effective than other sectors in reducing poverty. It is acknowledged that young people agriculture entrepreneurship skills and spirit are necessary more than ever before. Agriculture entrepreneurship can create jobs, foster wealth for society as a whole and contributes to community development, and produces social capital. In addition, with high levels of youth unemployment in Europe, entrepreneurship is increasingly seen as a vital way for young people to be active in the labour market, get income and realize their potential.

Technology evolution changes the way we think about education. Advances in the Internet and mobile devices make people adopt self-learning approaches through e-learning [6]. Nowadays, the use of virtual reality (VR) in education is becoming increasingly common as a new way of leveraging the interaction among the students and educators. VR is used for education on many different fields of expertise like renewable energy [1], civil engineering [3], mathematics [5], surgical training in medicine [12] and others. The motivation for using such technology either immersive or not has already been studied [13].

VR is considered to be an interesting tool for applying new strategies, and practices. This is because of the different advantages that are affordable with the use of this kind of technology. For instance, the use of VR in education can enhance the exploration of some phenomena which cannot be visualized in real life. Moreover, VR enables students to do experiments which can be dangerous or causes serious health problems [8]. In some learning fields such as engineering, biology, physics, there is a need to use very expensive equipment, facilities, chemicals, etc. for effective and efficient in teaching. However, using VR in teaching will enable both teachers and students to acquire new experience and skills. Teachers can acquire skills that are related to integrating and utilizing VR technology in the teaching process in activities inside and outside classes. Furthermore, teachers will be able to share and publish their experience in the literature related to the use of VR in education. On the other hand, students will be able to enhance their learning process by using the VR modules developed for their courses. Also, students can collaborate in performing tasks, assignments, homework inside the virtual world.

Education using virtual worlds and its traditional way share characteristics with each other. However, virtual world differs from these systems since it provides a 3D virtual environment that provides a spatial dimension, different 3D objects that users can interact with them, 3D avatars and the sense of immersion that puts the users in a learning world with other users. This way, these specific properties can enrich traditional systems.

The remaining of this paper is structured as follows. Section 2 presents the theory and approach used in AGRIENT project. Section 3 describes two knowledge islands, one related to the theory of entrepreneurship and the other related to drones. Section 4 concludes this paper and presents future works.

MATERIALS AND METHODS

The solution here presented is based in the technological pedagogical content knowledge (TPACK) framework, an emergent form of knowledge that goes beyond three "core" components: technology, pedagogy, and content [10]. A graphic representation of this framework is shown in Fig. 1.

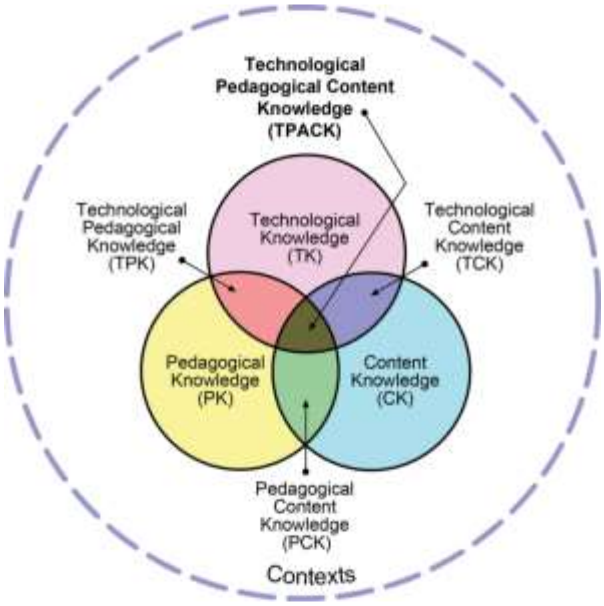

Fig. 1. TPACK framework.
Source: reproduced by permission of the publisher, © 2012 by tpack.org.

The 3D virtual world was designed using OpenSimulator which is an open source 3D application server that can be used to create a virtual environment, accessible through a variety of clients [11]. Authors can create a huge variety of 3D objects, define regions, terrains, 3D graphics, avatars, and textures. It supports real time physics simulation, with multiple engine options. It also offers an interface to define interactivities among avatars and the interaction between avatars and 3D objects. Moreover, OpenSimulator allows authors to program complex behaviour using scripts.

The development of the training path of each virtual world scenario requires the collaboration of numerous experts with professional roles, such as content experts, pedagogical experts, software developers and teachers. Fig. 2 illustrates the scenario development cycle with the interaction of these parts. Each knowledge island is formed by a combination of scenarios. The scenarios are the places which the users can interact with the 3D objects, other users, all the multimedia content and non-player characters (NPC). NPC's are avatars programmed to interact with users in order to help on executing tasks or accessing the content.

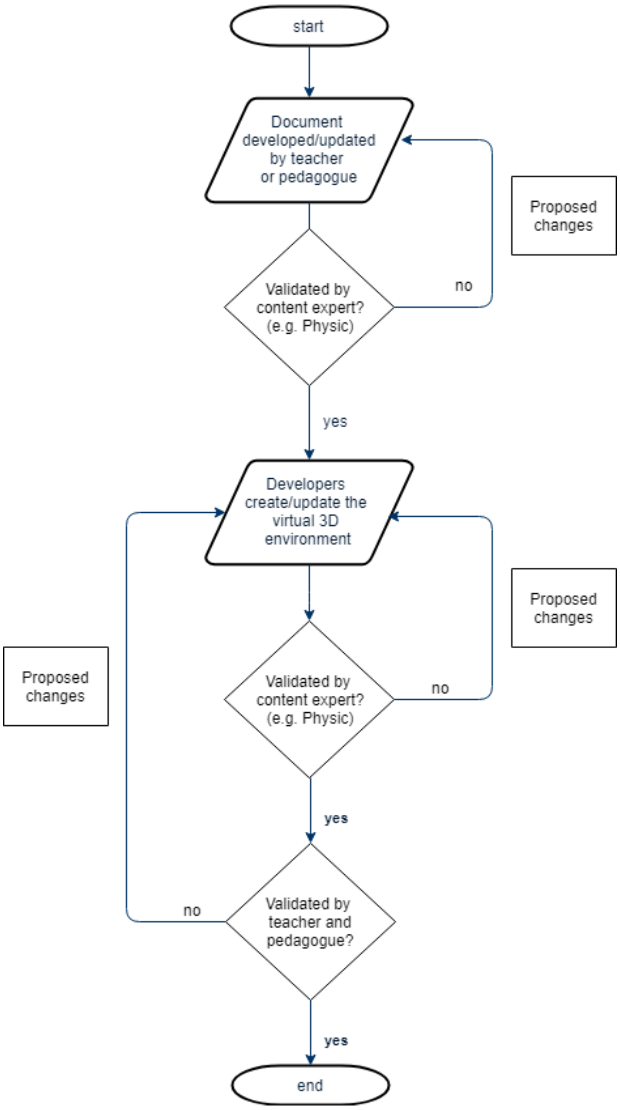

Fig. 2. The flow of interactions to develop a scenario in the 3D world
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

In order for the users, teachers and students, be able to enter the virtual world, they should use 3D viewer software such as Firestorm [4]. Once inside the virtual world, the user can choose how to begin its learning experience from different options.

In a previous work [9] detailed a virtual world called VR4STEM (Virtual Reality for Science, Technology, Engineering and Mathematics). This world was formed by many knowledge islands and aimed to assist young people to gain entrepreneurship skills. The lessons learned in the VR4STEM project with respect to results and experience served as basis to the development of the AGRIENT project. Our project aims at producing an innovative educational platform and providing a systematic approach to train and support young people to succeed in formulating, starting and running their own start-ups or agribusinesses. In order to succeed in this goal, several courses and training procedures were designed to teach entrepreneurship, focused on the agriculture domain. Also, introductory parts of the courses cover entrepreneurship in general.

The main idea is to apply state of the art information and communication technologies (ICT) to education, particularly for work training with simulations, taking advantage of the immersion capabilities of virtual worlds [7].

The 3D virtual reality educational environment developed can be accessed from anywhere. This way, it will promote distance learning based on self-learning ideas, in order to support young people with fewer opportunities like the ones facing financial difficulties or living in isolated areas. All the mentioned characteristics are aimed to respond also to the need of attracting young people in agriculture education.

RESULTS AND DISCUSSIONS

The 3D world is being developed in the AGRIENT project, which has in view to produce an innovative educational platform and to provide a systematic approach for training and supporting young people to successfully implement entrepreneurship ideas by using advanced ICT technologies (like Virtual Reality). For instance, one idea is to construct a knowledge island for drones with several presentations, videos and links to gather more information about each topic. It is important to point out that the 3D world has an embedded web browser which maintains the user always in the same learning environment. In this way, Youtube videos, Wiki pages and other learning resources are accessed directly from the 3D world. There is no mandatory learning path in the 3D environment, so each user can access the topics in the order they like.

In the AGRIENT project, the authors have in view to prepare an island of drones with specific applications for Agriculture. This is a

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technology already in use in some practical aspects of agriculture and with many potential applications that can be developed in the near future. In this island, the content is separated into three topics of interest. The first is an introduction to drones, the second explains its components and the last one shows a series of applications of drones in many areas including agriculture.

Fig. 3 shows the user avatar reading panels of information in the introduction to drones scenario. In the same scenario, another kind of interaction is allowed.

Fig. 3. Avatar of a user in front of a panel related to the drone knowledge island
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

The user can access quizzes to test the knowledge acquired at any time. It is only necessary going to the interactive 3D box with the question mark (Fig. 4). After accessing a quiz, the user is prompted with a series of multiple choice questions that he has to answer correctly to receive some pieces of information, an object or a reward. An example is shown in Fig. 5, where a question about which device is used to rotate the drone. Four options are presented for the user to select. Another question sample about the definition of drones is presented in Fig. 6. A score is associated with the number of questions answered correctly and the time that the user spent on answering them.

The darker environment of Fig. 3 in relation to Fig. 4 aims to improve the immersion sense for the user, by introducing different sunlight levels related to each specific time of day.

Fig. 4. The 3D box object that represents the quiz
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

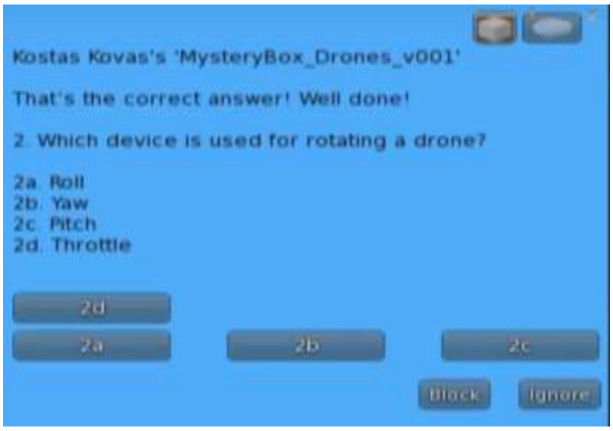

Fig. 5. Sample of a quiz about the drone operation
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

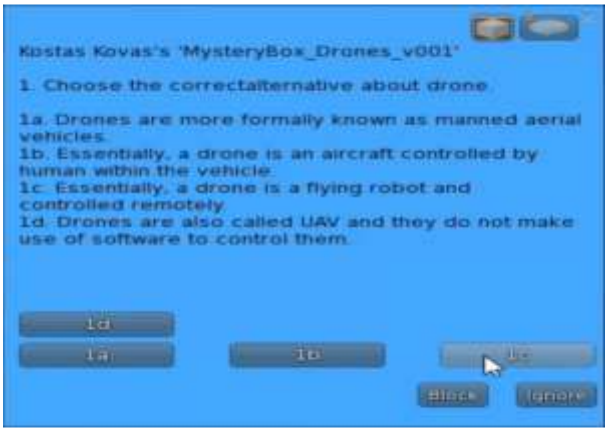

Fig. 6. Sample of a quiz about the drone description
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

Fig. 7 shows a video about components that could be included in drones in order to, for e.g. detect obstacles. The video is part of the second scenario of the drones knowledge island.

Fig. 7. Sample of a video regarding the functions of drones and its components
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

Fig. 8 shows the scenario of drone applications in another kind of interaction. It is a gamified approach related to the application of drones in agriculture domain. This is done using a 3D simulation where four fruit and vegetable crops are presented. The user must activate the drone to identify problems in these crops. After this, the user must choose the best treatment for each crop problem, based on the four options presented to the four crops. Then, the drone flies above the crop that makes part of the association and sprays the selected product. The score works as the quiz, the user will have higher scores making the correct associations in lesser time.

Fig. 8. Sample of a 3D simulation game based activity in the drone application scenario
Source: project AGRIENT, © 2019 by agrient.eu, Accessed on Nov.10, 2019 [2].

The approach of using new technologies like 3D Virtual Reality, can both offer new, more efficient ways of teaching, suitable for the agro-entrepreneurship domain. In this way, AGRIENT approach can attract many young people to take the designed course and gain valuable knowledge that will allow them to put their own ideas into practice and have successful careers as entrepreneurs in agriculture domain.

CONCLUSIONS

In this paper, we presented the main idea of the Erasmus+ project AGRIENT, Enhancing Youth Entrepreneurship Skills, Careers Guidance and Competences in Agriculture Thought a Game based Virtual Reality Platform, which already started preparations for a 3D virtual reality educational environment rich in a wide spectrum of advanced educational contents, that will provide efficient training procedures. The authors hope that most of all, it will be widely used at European level. This virtual environment aims at supporting the learning activities of young people to gain entrepreneurship skills.

Another major advantage from using VR is the positive impact on the motivation of young students, who are familiar to using this technology for entertainment.

The outcome of the project will support self-learning as well as formal learning.

The idea for future development is to continue adding more technology instruments in the form of islands of knowledge to the agriculture domain in the AGRIENT 3D world learning environment.

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BIZ4FUN - 3D VIRTUAL WORLD AS A MOTIVATOR FOR YOUTH ENTREPRENEURSHIP EDUCATION

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Abstract

The education environment proposed in this paper aims to motivate, train and support people by increasing the competitiveness of young, mostly inexperienced people, on the job market. For this purpose, a 3D virtual world will be created as a tool to help to teach entrepreneurship through a social game focused on the business domain (Biz4Fun). Everyone having access to Biz4Fun will be able to interact with many kinds of multimedia content without an established predefined plan. Videos and presentations about successful start-ups are among these contents. The environment will also offer the possibility to all learners to be connected simultaneously and to interact with each other in order to exchange information, life experiences and documents. Biz4Fun will create and publish courses content and open educational resources (OER), supporting young practitioners in learning topics related to business and acquiring the skills needed to establish and successfully manage a business company. The next step will be to construct the virtual world, composed of knowledge areas comprising topics related to entrepreneurship. The Biz4Fun project has applications suitable for helping youth to develop start-ups and grow their business in agriculture and offers them innovative tools for learning and training to become successful entrepreneurs.

Key words: *virtual Reality, 3D virtual world, entrepreneurship, virtual education, learning technologies, teaching environment*

INTRODUCTION

Youth unemployment in Europe remains a serious concern: 8.7 million young Europeans cannot find work and the proportion facing long-term unemployment or involuntary part-time work remains high. In total, 13.7 million are neither employed nor in the education system or in training (NEETs). Close to 27 million are at risk of poverty or social exclusion [5]. Stimulating youth entrepreneurship is seen as a strategic effort for creating employment opportunities, fighting youth unemployment and social exclusion.
Start-up companies offer a solution to the situation mentioned above. Start-ups and technology incubators provide the proper environment to help and assist young entrepreneurs to kick-off technology companies in the early stages by offering entrepreneurship education and training along with low-cost and low-risk access to technical resources used in shared-environments and specific to commercial and industry sectors. The aim is to help the growth of the local economy through the creation of a support community for technology entrepreneurs and through stimulating and cultivating a dedicated environment, where youth and start-ups can create, test, learn, scale and thrive.
One of the main objectives of the Biz4Fun project is to support and increase the competitiveness on the job market for the young (most of the times inexperienced) people. It provides an answer to the previous mentioned challenges by enhancing the young people’s knowledge in economics and by broadening the basic knowledge of entrepreneurship and the ability to plan their career paths to become successful entrepreneurs.
With the development of new technologies, people are always changing how they interact

with the world around them. The same occurs on the education level, regarding self-learning approaches through e-learning [8] and also through the use of virtual reality (VR) in education [3]. The use of VR on training and education is available in many different knowledge areas like renewable energy [1], civil engineering [4], mathematics [7], language [18], surgical training in medicine [14] and many others. The motivation for using such technology either immersive or not, has already been studied [15].

Agriculture is a specific field where VR may have multiple applications designed to enable farms managers and employees to use modern agricultural production tools and modern management methods. However, agriculturists and farm managers' training in VR is restricted by the limited availability of time and place where they could benefit from the 3D virtual world suitable to their experience and available hardware equipment. For this reason, virtual and augmented reality interactive training platforms could be created and adapted to each agricultural field such as: Agriculture, Horticulture, Animal Husbandry, Land reclamation and environment protection etc. In this way, farm managers and agriculturists could get knowledge, skills and experience in developing their business by combining "digital image processing, computer graphics, artificial intelligence and multimedia technology" [17].

VR is considered as an interesting tool for applying new strategies, and practices. This is because of the different advantages that are becoming affordable with the use of this type of technology. For example, the use of VR in education can enhance the exploration of some phenomena which cannot be visualized in real life. Moreover, VR enables students to do experiments which can be dangerous or causes serious health problems [10]. In some learning fields such as engineering, biology, physics, there is a need to use very expensive equipment, facilities and chemicals for effective and efficient teaching processes. By making use of the VR instruments and learning materials, teachers and students are improving both ICT skills and benefit of a whole new learning experience. Teachers can integrate and use the new VR technology in learning activities, both in face-to-face and in distance learning classes. They can also benefit from a VR environment as an instrument to publish learning materials online and share teaching experiences in using VR in education at a whole new level. Students can benefit from using the VR technology to improve their learning process in their courses. They can use the immersive learning environment from a virtual world to collaborate with other students in online group learning activities, to interact with each other to solve more complex tasks and assignments and to benefit from a more attractive, interactive, fun and dynamic learning experience.

The traditional way of education shares some characteristics with the education that uses virtual worlds. A virtual world is different from a traditional educational system, first of all because it offers a virtual 3D environment with a totally different spatial dimension, 3D objects and specific activities through which users can interact with them and between themselves. Users are using 3D avatars as their representation in the virtual world and may have a different experience of immersion depending on the hardware equipment used to connect and interact with the 3D virtual world. By doing new things, being able to work in teams to solve tasks, being able to reset experiments and simulations, create various scenarios of problems to solve, having access to virtual instruments and systems that are accurate replicas from real world, using virtual worlds in education can significantly enrich the traditional learning systems.

The next sections are structured as follows: Section 2 presents the theory and the approach used in Biz4Fun Project. Section 3 describes the strategies that will be used to teach entrepreneurship and presents some samples of a 3D world related to the topic. Section 4 gathers the conclusions to this paper and presents future potential developments.

MATERIALS AND METHODS

First of all, the target groups which are the focus in the Biz4Fun project were identified as: young people who have an interest in setting up and running their own business; unemployed young people, who could gain useful skills to increase their employability or start businesses of their own; already employed young people, but who are looking for chances to increase their skills and entrepreneurship capabilities; educational centres, career counsellors and agencies, institutions and organizations involved in VET; and policy makers and umbrella organisations, which can provide help and resources for incubators, start-ups and spinoffs.

The framework used in the project is based on the technological pedagogical content knowledge (TPACK) [12].

Biz4Fun uses a 3D virtual world, designed and built using OpenSimulator, basically an open source 3D application server on which learning courses are implemented based on scenarios developed in the project. The 3D virtual world is used as a virtual learning environment, that users (teachers and students) can access by using different software applications called clients [13]. Designers and developers of the Biz4Fun 3D virtual environment can create various 3D objects, can define interactions, build virtual regions with different purposes for each learning topic, design terrains, apply 3D elements, textures and graphics, and customize avatars. Real time physics simulation is supported with multiple engine options. It also offers an interface to define interactivities among avatars and the interaction between avatars and 3D objects. OpenSimulator also allows the creation of complex behaviour through scripts.

In the process of creating the 3D virtual world, the first step is to make the description of the learning scenarios. This step is done through the collaboration of experts with different roles and professional background (e.g. pedagogical experts, scientific learning content experts, designers, programmers and teachers). The result of their work is a collection of learning scenarios that form the knowledge area. The learning scenarios are then implemented in the 3D virtual world as special customized places for each learning topic, where users can interact with each other, with the 3D objects, can access all the multimedia content and also interact with the Non-Playable Characters (NPC). NPC’s are avatars that are not controlled by a player and are programmed to interact with the players to provide guides, hints and help to perform tasks in the 3D virtual worlds and access the learning content.

Using a 3D viewer software, such as Firestorm [6], teachers and students may access the 3D virtual world. The user that enters the 3D virtual world, will have its own personalized learning experience based on its own different actions and decisions taken each time in the 3D virtual world.

Previous research and works from the project group members [16] and [11] comprise the design and development of learning virtual worlds, such as World of Physics (WOP) and Virtual Reality for Science, Technology, Engineering and Mathematics (VR4STEM) projects. WOP implements the strategy of having several knowledge islands used to teach various topics in physics, while VR4STEM is aiming to assist young people to gain entrepreneurship skills. The lessons learned from the WOP and VR4STEM projects offer a great added value along with the pedagogical experience of the project members, in the development of the Biz4Fun project. This project aims to have a significant positive impact on youth, on the young students and on the young individuals, in order to improve their situation on the job market. Furthermore, trainers, teachers, tutors, school and youth educational centers will benefit by implementing the tools developed in the Biz4Fun project in their own educational activities. The innovation factor in the project is based primarily on the intention to present possibilities of self-employment and own business offers for young people through an attractive and popular form. For this purpose, the project will make use of information and communication technologies (ICT), mobile devices and a custom designed social game. Project partners, universities and small to medium enterprises, have experience in developing and working with incubators and start-ups. These partners are translating

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their experiences into innovative educational materials and the social game. This will make the education of young people more attractive, assertive and motivating.

The developed open educational resources (OERs) and the social game will be the first of their kind. These will cover not only topics like the development of a successful business plan, how to establish business company, how to manage financial affairs, forms of support, but also topics like feasibility analysis, collaborative approaches, equipment provisioning, business models, including finance, sources of finance, management, added-value services and marketing as well.

RESULTS AND DISCUSSIONS

A 3D virtual world will be developed in Biz4fun project as a social game to increase the competitiveness on the job market for the young (often inexperienced) people.

Since the beginning of the project, we completed the evaluation stage based on the questionnaire and reached some important conclusions regarding what is considered to be a “must” in becoming an entrepreneur and developing a business. We collected more than three hundred answers which were classified by countries. Four different questionnaires were distributed for each type of stakeholder with shared interested with the project regarding successful entrepreneurs, youth, education centers and policy makers. The distribution of answers is shown in Table 1.

Table 1. Distribution of answers by group of stakeholders

Country	Successful entrepreneurs	Youth	Educational Centres	Policy makers
Romania	5	33	2	1
International	0	9	0	0
Greece	2	21	0	0
Slovakia	13	21	5	5
Italy	3	38	0	0
Turkey	3	66	7	5
Czech Republic	2	54	5	1
Total	28	242	19	12

Source: project BIZ4FUN, © 2019 by www.biz4fun.eu, Accessed on Nov.10, 2019 [2].

The idea for the next step in development is to construct a knowledge island for entrepreneurship with several presentations, videos and links with important information. Some images are presented in this article to demonstrate some of the ideas. The user is able to have access to the outside information like websites and videos without having to leave the 3D world.

Fig. 1 shows the welcome scenario on the knowledge island of entrepreneurship, under the form pf an entrance to a building, that presents a panel of topics to be learned inside. These are important topics, on how to build a team, get funding for a project, making a business plan and developing marketing strategies.

The user can access the topics in any way that suits him best. Once a topic is selected, the user has access to the content, such as the slides of the presentations, showed in panels as well as documents with information structured in tables.

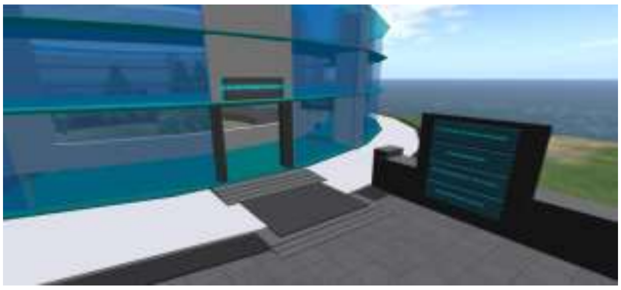

Fig. 1. The welcome scenario on the knowledge island of entrepreneurship
Source: project BIZ4FUN, © 2019 by www.biz4fun.eu, Accessed on Nov.10, 2019 [2].

Fig. 2 shows the avatar of a user between a table with readable and collectible documents and panels.

Fig. 2. An avatar of a user exploring an area with presentations and documents
Source: project BIZ4FUN, © 2019 by www.biz4fun.eu, Accessed on Nov.10, 2019 [2].

Fig. 3 illustrates the section of the building with information about the business plan.

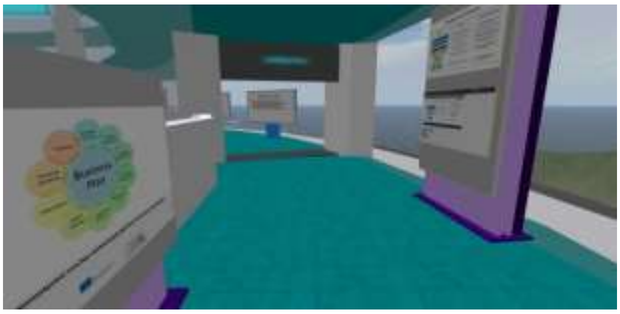

Fig. 3. Presentation of the content related to the business plan
Source: project BIZ4FUN, © 2019 by www.biz4fun.eu, Accessed on Nov.10, 2019 [2].

Fig. 4 shows the use case of the Happy meals, a sample of the marketing strategy used by McDonald's in order to improve their sales. All tips and information learned in the environment could be added by the user as notecards to future reference.

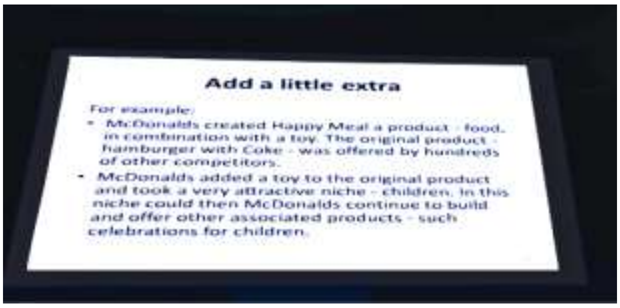

Fig. 4. Sample of use case related to the marketing strategies
Source: project BIZ4FUN, © 2019 by www.biz4fun.eu, Accessed on Nov.10, 2019 [2].

Fig. 2 and 4 look darker than Fig. 1 and 3, because the users were accessing the content in different hours of the day. This kind of details get the virtual environment closer to the real world and aim to improve the immersion level and experience for the user.
Young people usually became attracted by technologies like 3D Virtual Reality [9] and social games. Through Biz4Fun entrepreneurship learning becomes a more fun experience for them. This approach can present valuable knowledge to youth public with a huge impact in their professional life.

CONCLUSIONS

This paper presents the main idea of the Erasmus + project Biz4fun *Let's have fun with the business start-up* - 2018-1-SK01-KA202-046271. The process of creating the entrepreneurial social game using 3D virtual reality has already started. This social game aims at supporting the learning experience of young people to gain and enhance their entrepreneurship skills.
Questionnaires were made and distributed through the community and valuable information was gathered from several stakeholders. Samples of a virtual 3D environment with information related to the theme were illustrated in order to give an idea of the possibilities that can be explored with this technology.
The next steps include the creation and publishing of a guide on how to develop successful Biz4Fun "Course curriculum & Content", the creation and publishing of course content and an OER, supporting young practitioners in learning topics related to business and acquiring the skills needed to establish and successfully manage a business company. Another important step is to finish the development of the social game that supports and links back to the OER to reinforce the learning outcomes.
The learning and training tools from the Biz4Fun project offer a great opportunity to youth to develop start-ups and grow their business in the agriculture field to become successful entrepreneurs.

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THE INVESTIGATION OF THE LITHUANIAN BEEF MEAT SUPPLY CHAIN

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Abstract

This paper aims to investigate the transmission of beef meat prices along the supply chain in Lithuania. A set of econometric techniques allows studying relationships between prices on the farm and at the retail store level during the period from 2010 to 2017. The Johansen co-integration test confirms the presence of the long-run co-movement of prices on upstream and downstream levels of the beef meat supply chain. In the short-run, the price on the farm Granger causes the development of prices on the downstream level and findings suggest an evidence of the price-setting leadership on the upstream level. The error correction model shows the adjustment of the analysed prices towards the equilibrium with a rate of speed 25%.

Key words**:** *beef, market, meat, price transmission, supply chain*

INTRODUCTION

During the period from 2010 to 2017, the Lithuanian cattle sector survived dramatic transformations, while the development direction of the same sector in the European Union (EU) differed. According to Eurostat, during the above-mentioned period, the number of live bovine animals in Lithuania decreased from 748.0 to 676.9 thousand heads, while the situation in dairy sector was even more dramatic: the population of dairy cows fell from 359.8 to 272.8 thousand animals.

However, according to Eurostat data, in EU-27 the opposite development direction was obvious and the number of live bovine animals increased from 87,387.2 to 88,367.8 thousand heads. It should be noted that the growth rate in EU-15 was slower and the number changed from 74,898.5 to 75,197.5, i.e., in fact, the growth rate in EU-12 was higher than in EU-15. The EU dairy sector also showed signs of the moderate enlargement, but the contribution of EU-15 countries was more significant. Over the period 2010–2017, the number of dairy cows in EU-15 increased from 17,552.5 to 18,188.8, while in EU-27 from 23,107.4 to 23,171.8. Thus, the shrinking of dairy sector in Lithuania goes in lines with a common development trend for EU-12 countries.

Although Lithuanian cattle sector is shrinking, the switch from dairy to meat production is obvious. The driving forces of this transformation become an important research objective. In fact, many important factors influence farmers' decision to stay in, start up or exit this business, for example, the outbreak of animal diseases, changes of business environment after access to the EU market, trade bans or restrictions, changes in the support model, input of food price spikes in growth of production cost, unfair purchase prices, and etc.

An important factor is a functioning of domestic supply chains. Although it covers many components, this paper focuses on vertical price transmission issues that could contribute to market efficiency problems and encourage exit from livestock production if farmers believe that other agricultural niches are more attractive.

The conducted literature review shows a huge academic interest towards research on vertical price transmission in dairy sector [22], while the research on beef meat price behaviour is not covered sufficiently.

The academic research on vertical beef meat price changes mainly targets the investigation of the situation in individual countries and evidences quite diverse situation around the world. The most recent research on beef meat price transmission covers studies of domestic chains in Costa Rica [14], Ireland [15], Hungary [1], France [15], Germany [15], Netherlands [15], Poland [13], Slovenia [3], Finland [16], Iran [18], the United Kingdom [15], USA [7, 8, 23], Australia [10], and etc.

A separate research direction covers studies that investigate the impact of particular factors on price behaviour. For example, [2] and [21] pay special attention to aftermaths of diseases on vertical price transmission and market efficiency failures, [17] investigates links between export price volatility, cattle prices paid to farmers, and marketing margins of exporters.

Studies on horizontal price transmission also bring valuable knowledge and contribute to the understanding of beef price development on regional level. The example of such studies is the analysis of price transmission between Chinese, Australian, and Southeast Asian markets [6].

The aforementioned research on price transmission covers quite diverse methodological frameworks allowing to investigate short- and/or long-run price behaviour (for instance, the Johansen co-integration and the Granger causality tests, autoregressive distributed lag models, different types of error correction models (ECM), including Bayesian multiple-regime vector ECM, and etc.). It should be pointed out that the most recent study on the evolution of methods is represented in [24].

This paper contributes to scientific studies adding the Lithuanian case of price transmission along the beef meat chain. It is important to note that previous Lithuanian case studies on beef meat supply chains mainly focused on the structure of supply chain and driving forces of changes, while the investigation of relations between prices on different chain levels was not covered.

Thus, the paper aims to investigate the transmission of beef meat prices along the supply chain in Lithuania. The results of this study create an important knowledge for policy makers constructing both national agricultural policy and the Common Agricultural Policy that provides the general framework for the EU agriculture.

The remainder of this paper is organized as follows. In the next section, we describe data and explain the methodology. Then, we discuss the empirical results. In the final section, we provide some conclusions, policy implications, and suggestions for the further research.

MATERIALS AND METHODS

Data. The estimation of vertical price transmission relies on weekly producer and retailer prices collected by SE ‘Agricultural Information and Rural Business Centre’ (AIRBC). Retail prices show an average price of ham with bones for the main supermarket networks in Lithuania, while the assessment of producer price relies on an average purchase price of bovine (young bulls) carcasses at enterprises for the conformation classes S–P. This paper investigates the period from January 2010 to December 2017 (Fig. 1).

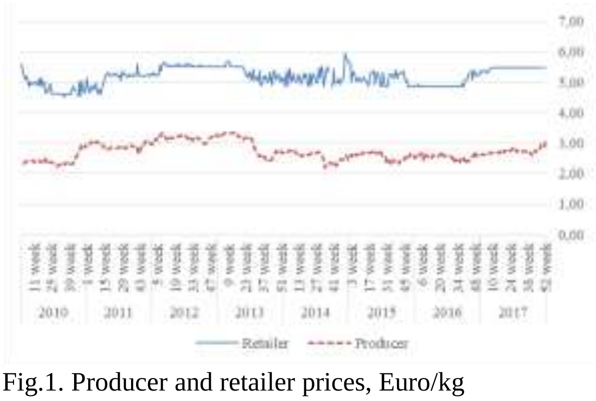

Fig.1. Producer and retailer prices, Euro/kg
Source: AIRBC, own calculations.

Fig. 1 demonstrates that price fluctuations on retail level are more visible during the periods 2010–2011 and 2013–2015, while price changes on producer level are less dramatic. Although some periods with visible changes of the gap between producer and retailer prices could be identified, the overall development of price series, on the long term, does not show dramatic changes on the Lithuanian market.

Methods. Price transmission is analysed employing a set of econometric methods. Natural logarithms are used to overcome common statistical problems [4]. A first compulsory step is to examine whether the series are stationary or not. The Augmented Dickey-Fuller (ADF) test [5] allows judging about stationarity of price series and their position around the mean [19].

The next step examines the long-run relation (or the absence of co-movements) between beef meat prices on different supply chain levels. The absence of the co-movement alarms about possible market efficiency problems and reports about the deviation from the traditional price mark-up concept presuming that price changes at any level must be transmitted along the supply chain. The Johansen co-integration test [11, 12] verifies the co-integration or the absence of the long-term relation between producer and retailer price series. In this regard, the results of Trace and Maximum Eigenvalue tests are combined to draw conclusions.

The third step employs the Granger causality test [9] allowing to explore the direction of causality between examined series. The results of this test allow identifying a price-leading stakeholder or confirming the presence of the bidirectional causality when all stakeholders have similar impact on market in the short-run.

Finally, vector ECM is estimated in order to examine the speed of adjustment of producer and retailer prices on the Lithuanian market. The most recent developments of ECM types and their applications for price transmission estimation are described in [13, 24].

RESULTS AND DISCUSSIONS

Results. This section provides the main results of the conducted study on vertical beef meat price transmission at the Lithuanian market. The discussion on the main issues of the Lithuanian market efficiency and results of other studies related to the similar topic is provided.

First, the ADF test investigates the presence of unit root in beef meat producer and retailer price series. The results (Table 1) show that the analysed beef meat price series are non-stationary in levels; however, both producer (LPP) and retail (LRP) prices are stationary in first difference.

Table 1. Results of ADF tests for beef meat price series

Null hypothesis:		**LPP has a unit root**		**D(LPP) has a unit root**	
	Level	*t*-stat	Prob.	*t*-stat	Prob.
ADF test statistic		-0.1480	0.6321	-30.6176	0.0000
Test critical values:	1%	-2.5705		-2.5705	
	5%	-1.9416		-1.9416	
	10%	-1.6162		-1.6162	
		Lag Length: 1 (SIC, maxlag=17)		Lag Length: 0 (SIC, maxlag=17)	
Null hypothesis:		**LRP has a unit root**		**D(LRP) has a unit root**	
	Level	*t*-stat	Prob.	*t*-stat	Prob.
ADF test statistic		0.2390	0.7551	-7.7959	0.0000
Test critical values:	1%	-2.5712		-2.5712	
	5%	-1.9417		-1.9417	
	10%	-1.6161		-1.6161	
		Lag Length: 11 (SIC, maxlag=17)		Lag Length: 10 (SIC, maxlag=17)	

Source: Own calculations.

Secondly, the Johansen co-integration test without deterministic trend is run in order to verify the presence or absence of long run relationship between the investigated beef meat price series. The results of Trace and Maximum Eigenvalue tests complement each other and support the same conclusion (Table 2).

Table 2. Results of the Johansen co-integration test for beef meat price series

Null hypothesis	**Eigenvalue**	**Statistic**	**Critical Value (0.05)**	**Prob.**
	Trace test			
No CE*	0.0395	16.4140	12.3209	0.0098
At most 1 CE	8.89E-05	0.0361	4.1299	0.8764
	Maximum Eigenvalue test			
No CE*	0.0395	16.3779	11.2248	0.0057
At most 1 CE	8.89E-05	0.0361	4.1299	0.8764

* rejects the null hypothesis at the 0.05 level
Lags interval (in first differences): 1 to 1
Source: Own calculations.

According to the results of both tests, the null hypothesis of no co-integrating equations (CE) between producer and retailer price series can be rejected and *p*-values are significant at 1.0% level. In the longer term, both tests support the conclusion that beef meat prices on upstream and downstream levels move together.

Thirdly, the horizon for the short-term relations of the investigated beef meat price series is studied applying the Granger causality test (Table 3).

Table 3. Results of the Granger causality test for beef meat price series

Hypothesis	F-Statistic	Prob.
LPP does not Granger cause LRP	7.5325	0.0006
LRP does not Granger cause LPP	2.6353	0.0729

Lags: 2

Source: Own calculations.

Based on the outcomes of the test, in the short term perspective, the causality goes from the farm to downstream beef meat supply chain level, while the leading stakeholder is producer.

Finally, the ECM is estimated to demonstrate the relations between retailer and producer prices.

Table 4. Estimation of ECM for beef meat price series

Co-integrating equation for Lithuanian case	
LRP(-1)	1.0000
LPP(-1)	-0.3803 (0.0644) [-5.9018]
Error Correction:	D(LRP)
ECT	-0.2468 (0.0462) [-5.3443]

Source: Own calculations.

The estimated Error Correction Term (ECT) value shows that retailer price adjusts to the equilibrium at the speed of adjustment 24.7%.

Discussion. The cross-country comparison of achieved research findings with other countries identifies both similarities and differences; thereby the price behaviour in individual countries, such as Lithuania, makes results a valuable contribution to academic discussion.

In Lithuania, as in the case of most studies the unit root test on raw data evidences that beef meat prices are not stationary. The similar results were found for the Australia, China, Costa Rica, Indonesia, Hungary, Finland, Vietnam, and the USA [1, 6, 14, 16, 23]. However, the Slovenian case [3] provides an interesting outlook on the issue of stationarity. The study identifies both stationary and non-stationary beef meat price series during the selected periods and argues that in case of price transmission analysis the stationarity is not a feature of price variable, but rather an attribute of the sample selected for the current research. Thus, it underlines the significance of data properties and justifies differences in findings of individual studies.

During the period from 2010 to 2017, the Lithuanian beef meat price series are co-integrated in the long-term perspective. The similar behaviour was found in [3, 16]. Hence, the case studies in other countries show that the longer research period could result in higher number of co-integrating equations. For example, the study of the USA identifies even three vectors over the investigated period from 1974 to 2001 [23]. The absence of the co-movement or multiple breaks and co-integrating equations within a relatively short period show possible market efficiency problems that could alarm about failures of mark-up concept leading to the serious damage of welfare on the certain beef meat chain levels. The aforementioned structural breaks could be an outcome of different factors, for example, [21] and the case of the United Kingdom in [15] put stress on the influence of mad cow disease on the appearance of such breaks in beef meat price series.

Results of the Granger causality test allow focusing on the nature of the short-term relation between beef meat prices on different supply chain levels. In case of Lithuania, in the short run, producers are responsible for price changes. This finding goes in lines with previous research for beef sector [1, 10] and an argument that farm prices should lead the changes of retail prices [10].

According to the conducted literature review, the selection of the research model depends on the nature of investigated data and research objectives. Different types of error correction models remain among the most common econometric techniques applied in price transmission studies. Autoregressive distributed lag models [8, 13] and relatively new and promising copula-based analysis [7] are also widely applicable techniques allowing to investigate the behaviour of price series. Yet this list of methods is not final.

The more detail description of wide range of applied models and their application peculiarities is provided in [13, 24].

Lithuanian study relies on ECM; however, the cross-comparison of the analysed case studies [1, 3, 13, 14, 15, 16, 18, 23] with the results of the previously conducted research shows that the models established for individual countries differ significantly. Even results for the same country will strongly depend on the selected time period, data frequency, and included into analysis framework stakeholders.

CONCLUSIONS

The results of the Johansen co-integration test do not highlight serious market efficiency problems, because Lithuanian beef meat prices on producer and retailer levels move together in the long term.

However, in the shorter term, the Granger causality test does not confirm the bidirectional beef meat price movement between upstream and downstream levels. In the Lithuanian case, the one-way causality comes from the farmer that produces beef meat to the downstream level of the supply chain, while the hypothesis of absence of Granger causality for the opposite movement is not rejected. This result does not challenge for any particular action protecting the upstream level of the supply chain, because the welfare of farmers is not violated.

ECM estimation shows that the beef prices on domestic market returns to the general equilibrium at the speed rate of 24.7%.

Hence, some notes concerning the further necessary academic research could be done. According to the previous studies, the number of stakeholders included into the analysis of the supply chain is an important factor improving the knowledge about the situation. Consequently, a more detailed investigation could capture the hidden problems of the market. For example, [20] link market efficiency with price transmission asymmetry. Furthermore, studies on (a)symmetric behaviour along the beef meat supply chain or policy-orientated regimes-dependent price behaviour investigations with a focus on the impact of particular factors could assist in the development of the well-functioning cattle sector and beef meat supply chains in the EU.

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COMPETENCE AND INTERNET USAGE AMONG AGRICULTURAL EXTENSION WORKERS IN DELTA AND EDO STATES, NIGERIA

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Abstract

The purpose of the paper was to identify the competence level in internet usage among agricultural extension workers is required for assessing effective information dissemination between agricultural extension workers and farmers in Delta and Edo States in Nigeria. This will be useful in improving the productivity of farmers. To solve the proposed topic, it was a paired t-test was used to determine the difference in the competence of agricultural extension in Delta and Edo States, Nigeria. We find that significant difference (t= 6.968 p≤ 0.05) exists in the competence between agricultural extension workers in Delta (Mean =26.59) and Edo States (Mean = 35.48) at p≤0.05. Respondents recorded high competence level only in searching for research based information with a mean of 2.69 and 3.10 for respondents in Delta and Edo States, respectively. Unstable power supply, unavailability of internet facilities in offices and poor connectivity among others were most significant constraints that hinder the usage of internet related activities. The limited number of agricultural extension workers in the study areas was a major limitation. The few extension workers were difficult to locate and this make data collection unnecessarily time consuming. Agricultural extension workers may find internet useful in sourcing and processing information. However, their competence level in the use of internet in Nigeria is unknown.

Key words**:** *competency, internet related activities, extension workers*

INTRODUCTION

Internet penetration in Africa has been gathering pace over the last half-decade, as the continent seeks to close Information and Communication Technology (ICT) gap with the western world. To further confirm this trend, three African countries have made the world's top 25 countries by internet users (2013 – 2018) (source). This growth is expected to continue over the next five years. Nigeria, the Africa's most populous country, is ranked 10th on the list of world's top internet users, according to eMarketer with 57.7 million users at the end of 2014, which is predicted to rise to 84.3 million by 2018 (Internet Live Stats, 2008) [4]. Nigeria is a nation that needs to grow agriculturally. The growth of agricultural sector will reduce food importation, increase exportation and ensure that the nation is food secured. For this growth to happen the communications infrastructure should be able to meet the demands of modern day life and reliable connections are the key to this growth.

The use of internet can be very useful in promoting the said growth. Internet platform can be used by agricultural extension agents to seek new ideas that could be useful to their clientele. Salau and Saingbe (2008) [8] opined that frontline agricultural extension workers, who are the direct link between farmers and other stakeholders in the agricultural knowledge transfer and information management system should be well positioned to make use of internet to access expert knowledge and other types of information that could be beneficial to farmers. As a result of the numerous information resources on the internet, it is essential that extension services should be able to have better access to innovations. It will be fascinating if the agricultural extension workers can use the internet to access and exchange new ideas which could enhance the extension service delivery thereby improving farmers' knowledge about agricultural technologies and better their attitude towards innovation adoption. Despite the advantages of internet to research, many developing countries continue to have very low internet penetration rates (United Nations Reports, 2005) [9] and consequently the nation's goal in providing food security and self-sufficiency has not been attained. Meanwhile, there is an avalanche of information available in the internet to help boost the quality of extension service delivery. Is it that they lack the skill of accessing the internet or they are not accessing the information adequately? In light of this, this study was conducted to examine agricultural extension workers' competence in internet usage in sourcing for information that are disseminated to farmers with a view to increasing farmers' productivity in food production in Delta and Edo States, Nigeria. The study hypothesized that there was no significant difference in the competence of agricultural extension workers in Delta and Edo States, Nigeria.

MATERIALS AND METHODS

The study was conducted in Delta and Edo States of Nigeria. Multi stage sampling procedure was adopted for sample selection. The population of this study comprised of extension workers in the two States with similar coordinates and climate conditions. Each of the States has three Agricultural Development Programme zones. In the first stage, two Local Government Areas from each of the three ADP zones in the States were purposively selected based on level of rurality and intensity of farming, to make a total of twelve Local Government Areas. The population of the agricultural extension workers in the selected LGAs was five hundred and twenty (520), with Delta (180) and Edo (340). Krejcie and Morgan (1970) [5] sample size determination formula was used to determine the representative sample for the population to be 226. At the second stage simple random sampling was used to sample 226 respondents (136 from Edo and 90 from Delta). However, only about 125 and 75 copies of questionnaire used in Delta and Edo States were found analyzable. Thus, 200 respondents were used for the study. This forms a response rate of 88.5%. Data collected were analyzed using descriptive statistics such as means, frequency counts, percentages while logit and paired t-test were used to make inferences.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Respondents

Table 1 revealed that 52.80% of the respondents were male in Edo State while 53.33% were female in Delta State. This implies the low involvement of women in extension service delivery in Edo state as against Delta State where majority of the respondents were female. This result agrees with Omoregbee and Ajayi (2009) [7] which revealed that there were more male extension workers than female extension workers in extension services in Edo State. The mean age of the respondents was 40 and 48 years in Edo and Delta States respectively. This indicates that extension workers in the study area were predominantly young people who are still very active in their career. This finding is similar to that of Odoemelam and Alocha (2015) [6] who reported that extension workers within this age were in their active years and still have more productive years to put into the extension work. With regards to job experience, the result indicated that close to half of the respondent (45.60%) in Edo had a job experience of 11-20 years and in Delta States 45.33% had job experience of 21-30 years. This implies that the extension workers have the knowledge to analyze between how it was without internet and what the present scenario is with the use of internet. This finding agrees with that of Salau and Saingbe (2008) [8] who reported that extension workers in Nasarawa State had longer working experience. The result also revealed that half of the respondents(Edo = 59.20%, Delta = 49.33%) had a household size of between 5-8 persons The results suggest that the household size of respondents in Edo and Delta States are similar and perhaps increase in the household size can negatively influence extension workers use of internet as they may tend to spend more time to the family needs. 56.80% of respondents in Edo State had B. Sc as their highest academic qualification and 58.67% of the respondents in Delta State had OND as their highest academic qualification. This means that most of the respondents were literate and that could contribute to their ability to use the internet. This finding conforms with that of Yakubu (2013) [10], who reported that extension agents in Kano State were literate and could utilize ICTs to improve their work as change agents.

Table 1. Distribution of the socio-economic characteristics of extension workers

Socio-economic characteristics		Edo Freq	Edo %	Delta Freq	Delta %	Total Freq	Total %
Sex	Female	59	47.20	40	53.33	99	49.50
	Male	66	52.80	35	46.67	101	50.50
	Total	125	100.00	75	100.00	200	100.00
Age (range)	≤ 30	23	18.40	4	5.33	27	13.50
	31 – 40	43	34.40	6	8.00	49	24.50
	41 – 50	40	32.00	41	54.67	81	40.50
	51+	19	15.20	24	32.00	43	21.50
	Total	125	100.00	75	100.00	200	100.00
Marital status	Single	21	16.80	12	16.00	33	16.50
	Married	96	76.80	58	77.33	154	77.00
	Divorced	6	4.80	5	6.67	11	5.50
	Widow(er)	2	1.60	0	.00	2	1.00
	Total	125	100.00	75	100.00	200	100.00
Job experience (range)	≤ 10	49	39.20	11	14.67	60	30.00
	11 – 20	57	45.60	27	36.00	84	42.00
	21 – 30	19	15.20	34	45.33	53	26.50
	31+	0	.00	3	4.00	3	1.50
	Total	125	100.00	75	100.00	200	100.00
Religion	Christian	87	69.60	62	82.67	149	74.50
	Muslim	29	23.20	9	12.00	38	19.00
	Traditional worshipper	7	5.60	3	4.00	10	5.00
	Others	2	1.60	1	1.33	3	1.50
	Total	125	100.00	75	100.00	200	100.00
Household size (range)	≤ 4	45	36.00	35	46.67	80	40.00
	5 – 8	74	59.20	37	49.33	111	55.50
	9+	6	4.80	3	4.00	9	4.50
	Total	125	100.00	75	100.00	200	100.00
Education	OND	23	18.40	44	58.67	67	33.50
	BSc	71	56.80	24	32.00	95	47.50
	MSc	16	12.80	6	8.00	22	11.00
	Ph.D	15	12.00	1	1.33	16	8.00
	Total	125	100.00	75	100.00	200	100.00

Source: Field survey, 2017.

Work Characteristics of Extension Workers

Results in Table 2 shows that most of the respondents in Edo (94.40%) and Delta States (92.00%) had full time appointment. This may be adduced to the policy of the organization that is responsible for the employment of these worker. Only 40.00% and 37.33% of the extension workers in Edo and Delta States respectively were Subject Matter Specialist (SMS) while 20.80% and 25.33% were Block Extension Officers in Edo and Delta States. This implies that majority of the respondents were specialist in the field of extension and could need vital information from the internet to enhance their job performance.

Table 2. Work characteristics of respondents

Work characteristics		Edo		Delta		Total	
		Freq	%	Freq	%	Freq	%
Nature of employment	Full time	118	94.40	69	92.00	187	93.50
	Part time	7	5.60	6	8.00	13	6.50
	Total	125	100.00	75	100.00	200	100.00
Training background	CRP	27	21.60	23	30.67	50	25.00
	ANS	16	12.80	14	18.67	30	15.00
	Fisheries	7	5.60	15	20.00	22	11.00
	Forestry & wildlife	19	15.20	4	5.33	23	11.50
	AGE/Rural sociology	19	15.20	6	8.00	25	12.50
	AGE & Farm Mgt	37	29.60	13	17.33	50	25.00
	Total	125	100.00	75	100.00	200	100.00
Present rank/position	VEA	15	12.00	6	8.00	21	10.50
	BES	26	20.80	19	25.33	45	22.50
	SMS	50	40.00	28	37.33	78	39.00
	ZEO	18	14.40	10	13.33	28	14.00
	CEOZ	10	8.00	6	8.00	16	8.00
	DES	6	4.80	6	8.00	12	6.00
	Total	125	100.00	75	100.00	200	100.00
	GLO	23	18.40	16	21.33	39	19.50
	Others	22	17.60	12	16.00	34	17.00
	Total	125	100.00	75	100.00	200	100.00

Source: Field survey, 2017.

Internet Activities Used by Extension Workers in Edo and Delta States

Results in Table 3 showed that extension workers in Edo State mostly use the internet to communicate with colleagues on recent innovations (Mean= 3.11). This could be an indication that there is an established good relationship among extension workers that may encourage team spirit in proffering solutions to farmers' problems rather than huddling. This is in agreement with Ezeh (2013) [2] who reported that extension agents with the use of internet can access and source for varieties of information that could benefit farmers and also improve their extension services delivery. Meanwhile in Delta State, most prominent use of the internet by extension workers was to search for research based information (Mean=2.69).

Table 3. Internet activities extension workers use

Areas of use	Edo		Delta		Total	
	Mean	SD	Mean	SD	Mean	SD
To search for research-based information	3.10*	.62	2.69*	.77	2.95	.71
To source for agricultural news	3.05*	.74	2.53*	.78	2.86	.79
To disseminate ideas to farmers organization	3.07*	.70	2.48	.66	2.85	.74
To send videos and images of technologies to other extension workers and farmers	2.96*	.72	2.65*	.69	2.84	.72
To communicate with colleagues on recent innovations	3.11*	.67	2.33	.66	2.82	.77
To source for information while preparing for presentations	3.09*	.75	2.36	.78	2.82	.84
To communicate with other extension workers in other countries on improved technologies	3.10*	.75	2.33	.53	2.81	.77
To source for innovations	3.06*	.77	2.23	.48	2.75	.79
To source for information on farmers livelihood and possible ways of improving their living standard	2.71*	.92	2.28	.67	2.55	.86
To source for market locations to help farmers sell produce	2.62*	.97	2.37	.69	2.53	.88
To determine the current price of agricultural produce	2.63*	1.02	2.32	.62	2.51	.90

Source: Field survey, 2017.
**High (mean > 2.50)*

This may imply that even though the extension workers in Delta State are less competent with respect to the use of internet tools as at the time of this study, this did not limit their effort to source for information online. This finding therefore contradicts that of Adetumbi *et al* (2013) [1] who reported that the use of internet was not popular among extension agents in performing their job.

Competency in Internet Usage by Extension Workers in Edo and Delta States

Table 4 shows the respondents competency in internet related activities usage in Edo and Delta States. It shows that in Edo State, the respondents were competent in all the listed areas mostly were their ability to use search engine like google and yahoo with a mean score of (Mean=3.37), except for the use of video conferencing among expert (Mean= 2.23). However, their counterpart in Delta State were less competent in all the listed areas. This shows that the extension workers in Edo state are more internet compliance than their counterpart in Delta State. Perhaps this may be attributed to the fact that there are more OND Graduate employed in Delta State (Table 1). This means that degree value have an influence on professional development Based on the finding in Delta State, it is obvious that there is an urgent need to train staff on skills acquisition required to properly use the internet.

Table 4. Extension workers' competency in internet use

	Edo		Delta		Total	
Areas of use	Mean	SD	Mean	SD	Mean	SD
Know how to download from a website	3.36*	0.85	2.35	0.88	2.98	.99
Know how to find a particular web page	3.37*	0.85	2.32	0.92	2.97	1.01
Can use search engines like google and yahoo	3.37*	0.91	2.29	0.90	2.96	1.04
Can download instructional videos from the internet	3.07*	0.97	2.36	0.90	2.81	1.00
Can connect to the internet using any internet browser	3.33*	1.01	1.92	0.80	2.80	1.16
Can Reply to, delete or forward e-mail	2.92*	1.09	2.28	0.89	2.68	1.06
Can attach a word document or picture to an e-mail and send as attachment	2.86*	0.98	2.28	0.83	2.64	.97
Can Create and send e-mail to other people	2.82*	1.08	2.17	0.86	2.58	1.05
Know how to download softwares	2.75*	1.06	2.19	0.85	2.54	1.02
Know how to install softwares	2.65*	1.03	2.27	0.92	2.50	1.00
Know how to update softwares	2.62*	1.05	2.16	0.82	2.45	.99
Can use the video conferencing among expert	2.37	0.98	2.00	0.77	2.23	.92

Source: Field survey, 2016.
**Competent (mean > 2.50)*

Extension Workers' Constraints to Internet Use

Table 5 shows constraints that impedes respondents' use of internet. Results from the table reveals that unstable power supply (Mean=3.47), unavailability of internet facility in the office (Mean=3.30), poor network reception (Mean=3.16) were the major constraints to internet usage as indicated by extension workers in Edo State. Also very similar in Delta State, unstable power supply (Mean=3.11), unavailability of internet facility in the office (Mean=2.97), poor network reception (Mean=2.69) were the major constraints to internet usage by extension workers. This implies that unstable power supply is really a hindrance to internet use which could affect the productivity of extension service delivery. This finding is accordance with Fadiji (2011) [3] who opined that network issues, funds for accessing the Internet as well as epileptic power supply were the major challenges faced by extension workers.

Difference in internet competency between ADP extension workers in Edo and Delta States

Table 6 shows the difference in internet competency between extension workers in Edo and Delta States. The result revealed that a statistical significant difference exist between extension workers in Edo ($\bar{X}$ = 35.48) and Delta States ($\bar{X}$ = 26.59) with respect to internet competency (t= 6.968 p= 0.05). The null hypothesis was therefore rejected.

Table 5. Extension workers' constraints to internet use

Constraints	Edo Mean	Edo SD	Delta Mean	Delta SD	Total Mean	Total SD
Unstable power supply	3.47*	.72	3.11*	.95	3.33	.83
Unavailability of internet facility in the office	3.30*	.82	2.97*	.85	3.18	.85
Poor network reception	3.16*	.81	2.69*	.84	2.98	.85
Time constraint	2.85*	.95	2.59*	.72	2.75	.88
Inability to access full text	2.63*	.88	2.53*	.79	2.59	.85
Subscription to latest e-journal is expensive	2.67*	.91	2.39	1.00	2.56	.95
Financial constraints	2.54*	.91	2.40	.77	2.49	.86
Shortage of latest e-books	2.46	.80	2.51*	.74	2.48	.78
Network congestion	2.36	.73	2.60*	.77	2.45	.76
Lack of awareness of the availability of materials	2.45	.69	2.43	.89	2.44	.77
No access to internet facilities	2.32	.79	2.59*	.89	2.42	.83
Poor eye sight	2.30	.71	2.37	.78	2.33	.74
Payment to access useful materials online	2.22	.98	2.51*	.78	2.32	.92
Lack of knowledge about internet information retrieving techniques	2.20	.66	2.48	.86	2.30	.75
Information scattered in two many sources	2.13	.77	2.59*	.81	2.30	.81
Fear of fraudsters	2.27	.79	2.33	.84	2.29	.81
No patience to learn	2.18	.80	2.48	.76	2.29	.80
Display of undesirable content	2.13	.85	2.51*	.81	2.27	.85
Overload of irrelevant but useful information	2.05	.78	2.36	.78	2.16	.79
Low level of internet literacy	1.94	.90	2.43	.79	2.12	.89
I always lost track of time when using internet	1.97	.73	2.33	.72	2.11	.75

Source: Field survey, 2017.
**Serious (mean > 2.50)*

Table 6. Difference in internet competency between extension workers of ADPS in Edo and Delta States

Competency	Edo Mean	Edo SD	Delta Mean	Delta SD	an Difference	T	Prob. Level
Extension workers	35.48	9.33	26.59	7.64	8.893	6.968	0.00

Source: Field survey, 2017.

CONCLUSIONS

The study examined the comparative analysis of internet competency among extension workers in Edo and Delta States. Meanwhile there was a significant difference in the competency level among extension workers in Edo and Delta States. Though there are constraints confronting respondents in the study but a very serious constraint was unstable power supply which is a peculiar problem encountered by everybody in Nigeria. It is therefore recommended that sustainable internet connectivity and high powered generator should be made available to serve as a backup incase of power failure. Extension workers in Edo and Delta State should be trained on the competency of internet use in the acquisitions of instructional materials to optimize their job performance and better services.

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FOOD SECURITY: PROBLEMS AND PROSPECTS IN RUSSIA

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Abstract

The growth in agricultural and food production has not completely solved the problem of food security in Russia. Consumption of certain food products (milk, vegetables, fruits) is below rational consumption standards. A significant proportion of food provision is imported products. Since the imposition of international sanctions and the counter-embargo, imports have declined. For 2013-2017, imports of food and agricultural raw materials declined from USD 43.3 bln to USD 28.8 bln, or by 33.5%. The proportion of imports in the formation of food resources is about 25%. An indicator, characterizing food security is the level of self-sufficiency of the country in basic agricultural products. In recent years, this indicator is growing, but for some types of products (fruits, milk, and vegetables) it is not high enough. The authors reveal the risks in the food security sphere and offer measures to minimize them. In solving the food problem, important is import substitution based on increasing the proportion of domestic resources in the production of agricultural products and food (seeds of sugar beet, sunflower, vegetable crops, breeding animals, breeding eggs, veterinary drugs, machinery, and equipment). Particularly acute is the problem of food security in the production and consumption of fruits, vegetables, and milk. The solution to this problem can be achieved by the improvement of state support, the concentration of production in agricultural organizations and peasant (farmer) households, where there are favorable conditions for the innovative development of these industries, as well as the organization of agricultural products storage and processing in the places of its production, and the creation of consumer cooperatives.

Key words: *food security, economic and physical availability of food, imports, level of self-sufficiency, import substitution, agricultural policy, Russia*

INTRODUCTION

In the context of international sanctions and the retaliatory embargo, the food security of Russia is an urgent problem. Food security implies food independence, as well as physical and economic accessibility of food [2].
Physical accessibility of food means its trouble-free admission to places of consumption in volumes and the range corresponding to the demand and standards established for consumers. In Russia, the percentage of availability of basic food products in retail trade is high (over 80%), so there are no problems with the physical availability of food.
Economic access to food is characterized by the possibility of purchasing food products by different groups of the population in the standard size in the food market at the prevailing level of prices and incomes, as well as through their receipt from farms, private farms, and garden plots (bypassing market channels). In Russia there are 18.7 mln private subsidiary farms with a total area of about 10 mln hectares; about 90 mln people provide themselves with potatoes from this source, 60 mln – with vegetables, and 30 mln people – with milk and meat. At the same time, a significant part of the country's population (about 20 mln people) are below the poverty line and are unable to purchase food products that meet the quality and range of physiological standards [8].
In order to increase the economic availability of food products, the state should take measures to increase the effective public demand of the population, reduce poverty and support the neediest segments of the

population. In order to increase the physical accessibility of food products, it is necessary to develop interregional integration in the sphere of food markets, increase the transport accessibility of certain regions for the food supply of their population, and create conditions for the development of market infrastructure.

Food independence is a sustainable domestic production of food products in volumes not less than the established standards of its proportion in the commodity resources. The share of most food products in the total volume of commodity resources exceeds the threshold level; only for milk and food salt, it is below the normative level.

MATERIALS AND METHODS

Monographic, statistical and economic, computational and constructive, abstract and logical, as well as other methods, were used when conducting present research. The statistical and economic method allows characterizing comprehensively the studied phenomenon by means of mass digital data. Therefore, it was used for the analysis of a condition and tendencies of agro-industrial complex development, and the efficiency of its performance. The monographic method allows studying the individual units of the total population, which are quite typical for the characteristics of the phenomenon under study. This method was used to study the activities of commodity producers with high economic results. The calculation and constructive method allows determining the ways of solving the problem for the future. It was used to substantiate the development of certain sectors of agriculture for the future in order to solve the food problem.

RESULTS AND DISCUSSIONS

Food security is characterized by the level of the provision of population with environmentally friendly and healthy food of domestic production at scientifically sound standards and affordable prices. However, in Russia, the consumption of certain food products is lower than the dietary intake levels (Table 1).

In 2017, the consumption of milk and dairy products per capita amounted to 231 kg, or was below the dietary intake level by 28.9%, of fruit – 59 kg, or was by 41.0% lower, of vegetables, and cucurbits – 107 kg, or was by 23.6% less than the norm. The population of Russia consumes bread products much more than the norm (117 kg at a norm of 96 kg), potatoes (96 kg at a norm of 90 kg), and sugar (39 kg at a norm of 24 kg).

Table 1. Food consumption in Russia (kg per capita)

Foodstuffs	**Dietary intake levels ****	**2013**	**2014**	**2015**	**2016**	**2017**
Meat and meat products	73	75	74	73	74	75
Milk and dairy products	325	248	244	239	236	231
Eggs	260	269	269	269	273	279
Sugar	24	40	40	39	39	39
Vegetable oil	12	13,7	13,8	13,6	13,7	13,9
Potatoes	90	111	111	112	113	96
Vegetables and cucurbits	140	109	111	111	112	107
Fruits	100	64	64	61	62	59
Bread products	96	118	118	118	117	117

Source: Data of Rosstat; Order of the Ministry of Health of the Russian Federation No 614 of 19.08.2016.

A significant proportion in the consumer basket of Russians is occupied by imported products. Import of some agricultural products and finished food products tended to grow. Imports of cattle meat, dairy products, fruits, and vegetables were growing at a particularly rapid pace. Overall, imports of food and agricultural raw materials increased from USD 7.4 bln to USD 28.8 bln between 2000 and 2016, or by 3.9 times.

However, in recent years, after the imposition of sanctions and the implementation of import substitution measures, the volume of imports decreased (Table 2). During 2013-2017, imports of meat and meat products decreased from 2,480 to 1,103 thousand tons, or by 55.5%, of milk and dairy products – from 9,445 to 7,129 thousand tons, or by 24.5%, of vegetables and cucurbits – from 2,817 to 2,670 thousand tons, or by 5.3%, and of fruits – from 7,201 to 6,677 thousand tons, or by 7.3%. Imports of potatoes increased from 749

to 1,500 thousand tons, or twice, of eggs – from 1,206 to 1,226 mln pieces, or by 1.7%.
In 2017, as compared to 2013, the volume of imports of agricultural products and food decreased by $ 14.5 billion (34%). The share of these goods in Russia's import structure amounted to 12.7%.

Table 2. Import of basic food products to Russia, thousand tons

Foodstuffs	2013	2014	2015	2016	2017
Meat and meat products	2,480	1,952	1,360	1,246	1,103
Milk and dairy products	9,445	9,155	7,917	7,544	7,129
Eggs, mln pcs.	1,206	1,235	1,236	1,238	1,226
Potatoes	749	1,045	928	737	1,500
Vegetables and cucurbits	2,817	2,992	2,636	2,321	2,670
Fruits	7,201	6,680	6,511	6,518	6,677

Source: Rosstat data.

In the structure of agricultural imports in value terms, the following prevail: fruits and nuts (16.2%, including citrus fruits – 4.1%, and bananas – 4.0%), meat and meat products (9.3%, including beef – 4.3%, and pork – 2.8%), milk and dairy products (8.3%, including cheeses and cottage cheese – 3.2%), vegetables (6.2%), and the products of vegetables and fruits processing (4.1%).
The proportion of imports in the formation of the country's food resources is about 25%. In the commodity resources of milk powder and cream, the proportion of imports is 52.7%, beef – 40.9%, cheese – 27.3%, and animal oil – 24.2%. According to the standards adopted by authoritative international organizations, to ensure food security of the country, it is necessary that the import of food in the total volume of its consumption took no more than 20%. In Russia, this standard is higher, which creates a real threat of loss of food independence.

Table 3. Import of basic food products to Russia, thousand tons

Foodstuffs	2013	2014	2015	2016	2017
Meat	78.5	82.8	88.8	90.7	93.3
Milk	77.5	78.6	80.4	81.2	82.0
Eggs, pcs.	98.0	97.6	98.2	98.6	98.8
Potatoes	99.4	101.1	105.1	97.3	87.0
Vegetables and cucurbits	88.2	90.2	93.7	94.6	85.9
Fruits	33.0	33.6	32.9	39.9	36.6

Source: Rosstat data.

An important indicator of food security is the level of self-sufficiency in basic agricultural products (Table 3).
In 2017, the level of self-sufficiency in meat was 93.3%, milk – 82.0%, eggs – 98.8%, potatoes – 87.0%, vegetables and cucurbits – 85.9%, and fruit – 36.6%. In recent years, this figure has been growing for all types of products, with the exception of potatoes, vegetables, cucurbits, as well as cattle meat. Despite the positive trends in the development of agriculture, in the coming years, Russia will not be able to provide fully the country's population with fruit, milk, and meat of cattle based on in-house production.
Food security Doctrine of the Russian Federation provides for the following risks of its implementation:
-macroeconomic, due to the decrease in the investment attractiveness of agro-industrial production and the competitiveness of domestic products;
-technological, caused by lagging behind advanced countries in the level of technological development of the domestic production base;
-agroecological, due to adverse climatic changes, as well as the consequences of natural and man-made emergencies;
-foreign trade, caused by fluctuations in market conditions, and the application of state support measures in foreign countries.
The following threats can be added to the above risks:
-the increasing dependence of agriculture on soil and climatic conditions with inefficient regulation of the domestic agro-food market, the remaining monopoly of producers of material and technical resources;
-deformation of intersectoral economic relations, the disintegration of individual sectors of agriculture, unstable and low profitability of many agricultural producers;
-high dependence of the country on imports of food and agricultural raw materials, machinery and equipment, seeds of individual crops, planting material, breeding products, veterinary drugs, plant protection products, and technologies;

-the imperfection of land policy and land relations, leading to inefficient use of land in agricultural production [1].

Considering measures to neutralize threats to food security of the country, one should note the improvement of state regulation to overcome the following problems: low effective demand for food products; price imbalances in the markets of agricultural products, material and technical resources for its production; low level of innovation and investment activity; reduction of artificial competitive advantages of foreign products in the market, etc. Analysis of the agriculture functioning confirms the increasing impact of these threats on the industry state and dynamics. In terms of economic risks, the most significant is the reduction of investments in fixed assets aimed at the development of agriculture.

In turn, the decline in investment has affected the technical and technological renewal of the agricultural sector. In 2017, the production of tractors for agriculture amounted to only 7.3 thousand vehicles (in 1990 – 214 thousand vehicles). As a result, the park of agricultural organizations has more than 50% of imported tractors. The situation is similar with other types of machinery and equipment for agriculture. For example, the production of seeders amounted to 8.7 and 51.1 thousand pieces, respectively, while of combine harvesters – 7.6 and 65.7 thousand pieces. This situation leads to one significant risk – the inability of agricultural producers to effectively carry out production activities.

The natural potential of the country allows for increasing the production of agricultural products and solving the food problem. Russia has 9% of the world's productive arable land, more than 50% of chernozems, and 20% of freshwater. Each inhabitant of the country accounts for almost one hectare of farmland, which is much more than the world average. However, almost 18 mln hectares of agricultural land were abandoned. Having such resources, Russia can fully ensure its food security [10].

The Doctrine defines the main directions of agricultural policy in the field of food security, which are as follows:

-increasing soil fertility and productivity, expanding sown area due to unused arable land, reconstructing and constructing reclamation systems;

-providing accelerated development of animal husbandry;

-creating new technologies of deep and complex processing of raw materials, as well as agricultural products storage and transportation methods;

-developing the scientific potential of agro-industrial complex;

-increasing the pace of structural and technological modernization of the agro-industrial complex, as well as the reproduction of natural and ecological potential;

-developing the training and advanced training system for personnel capable of implementing the tasks of the innovative model of the agro-industrial complex development;

-improving regulation mechanisms of the agricultural products and food market;

-using protective measures to reduce agricultural and food imports;

-reducing the dependence of domestic agricultural production on imports of technology, machinery, equipment, and other resources.

The most important factor in achieving the lost food security is import substitution, i.e. partial or complete replacement of imported goods with domestic ones. Import substitution does not imply complete abandonment of imports, because this would lead to a violation of existing trade relations and the agri-food market functioning principles.

Import substitution is an economic strategy of the state aimed at protecting national priorities of socio-economic development and their implementation based on the support of the national manufacturer. With the proper level of state support, import substitution will become an incentive for the development and protection of national agro-industrial production. The problem of import substitution can be solved only on the basis of the innovative development of agribusiness sectors [7].

One important area of import substitution is increasing the proportion of domestic resources in the production of agricultural products and food. In the field of agriculture, this applies to the predominance of imported seeds when sowing crops such as sugar beet, sunflower, vegetable crops, while in livestock – breeding animals, breeding eggs in poultry husbandry, veterinary drugs, as well as machinery and equipment used in agriculture and food industry.

The solution to the problem of import substitution requires significant investments, including financial ones, and largely depends on the resource provision of the state program on agriculture. The duration of import substitution varies for individual agricultural products and depends on a number of factors, both economic and technological. While for products such as pork and poultry, the import substitution problem is practically solved, for other products, such as vegetables, fruits, the cattle meat, and dairy products it will take a long time. So, according to estimations, if the dairy herd recovery process will be due to the growth of in-house livestock, the full provision of the population with domestic dairy products can be reached in 12-14 years. The situation is even more complicated with regard to the production of cattle meat. The increase in the production of basic vegetable crops is largely constrained by the low growth rate of irrigated land, while of fruit crops – by their high capital intensity.

Particularly acute is the problem of food security in fruits, vegetables, and milk production and consumption.

The achieved level of fruit production does not fully meet the needs of the population in these products. The proportion of imported fruits in the Russian food basket is almost 75%. During the period under review, domestic consumption of fruits increased from 6,501 to 8,770 thousand tons, or by 34.9% due to both the growth of their imports and the increase in domestic production.

It is possible to solve the problem of providing the population with fruits through increasing their domestic production and ensuring the import of fruits not grown in the country. Import of fruits which cannot be produced in the Russian Federation (bananas, citrus fruits, dates, figs, pineapples, etc.) amounts to about 3 mln tons, including citrus fruits – 1.5 mln tons, and bananas – 1.3 mln tons.

Import of fruits that can be grown in Russia (apples, pears, plums, cherries, strawberries, etc.) reaches 3.5 mln tons. Therefore, these products in the fruit market can be replaced by domestic ones.

To solve the problem of providing the population with fruit and berry products on the basis of import substitution, it is necessary to increase the gross fruit harvest by 3.4 mln tons, including fruits and berries – by 3.1 mln tons, or almost twice compared to the achieved level of production. At that, the area of orchards and berries should be increased from 517 to 690 thousand hectares, including those at the fertile age – from 405 to 560 thousand hectares [5].

The State program for the development of agriculture and regulation of agricultural products, raw materials, and food markets for 2013-2020 provides increase in the area of laying orchards and berry fields to 77.8 thousand hectares [3]. Indicators of the State Program for the laying of fruit and berry plantations are overfulfilled (for 2013-2017, 61.5 thousand hectares were actually planted at a plan of 44.0 thousand hectares), but their area is reducing. This is because the number of logged-of orchards and berry fields prevails over newly created ones. The implementation of the state program will not solve the food problem in terms of fruit supply. To achieve the planned volumes of fruit production, it is necessary to increase the area of annual planting of orchards and berries almost twice and bring it to 18-20 thousand hectares. The main direction of increasing fruit production is bringing horticulture to an innovative path of development, as well as the laying new intensive gardens [4, 6].

To meet consumer demand in vegetable products, it is necessary to increase the production of vegetables, and cucurbits from 15.4 to 23.2 mln tons, or by 50.6%, including field vegetables – from 16.4 to 18.1 mln tons, or by 10.4%, indoor vegetables – from 1.7 to

2.9 mln tons, or 1.7 times, cucurbits – from 1.7 to 2.2 mln tons, or by 29.4%.

The State program for the agriculture development and regulation of agricultural product, raw materials, and food market for 2013-2020 provides for the solution of this problem through the development of vegetable production in agricultural organizations and peasant farms. It is planned to increase the production of field vegetables in this category of farms to 5.2 mln tons, or by 14.0% compared to 2017; indoor vegetables – up to 1.4 mln tons, or by 81.6% that will provide import substitution of vegetables in the off-season period to 768.6 thousand tons. In order to provide the population with fresh vegetables in the off-season period, it is necessary to build more than 1.5 thousand hectares of modern energy-saving greenhouses and modernize about 1.0 thousand hectares of old ones [9].

To solve the import substitution problem in the milk and dairy products market, it is necessary to increase the number of cows by 1.4 mln heads, or by 17.5%, while to meet the consumer demand of the population in these products – by 3.4 mln heads and bring the number of cows to 11.4 mln heads.

The support measures provided for in the State program for the development of agriculture and regulation of agricultural products, raw materials, and food markets for 2013-2020 are aimed at increasing production and investment attractiveness of dairy cattle, equalizing the seasonality of milk production, the cattle growth, including cows, creating conditions for cattle breeding reproduction, stimulating the increase in the marketability of milk in all forms of economic management. The measures taken by the state made it possible to stabilize the production of milk, while not increasing the production of milk and dairy products.

It is possible to increase milk production based only on the development of dairy cattle breeding in agricultural organizations and peasant farms. It is in this category of farms that favorable conditions for the innovative development of the industry are created.

Solving the problem of food security strongly depends on the organization of agricultural products storage and processing in the places of their production, since most of the species (vegetables, fruits, berries, etc.) are perishable and low-transportable products. The development of agro-industrial integration, providing for the combination of production, storage, and processing in a single technological process allows the rational use of all grown products by reducing losses and maintaining quality at all stages of the reproductive process.

Households produce 32.5% of agricultural products. They are the main producers of certain kind of products. Thus, the proportion of produced honey amounts to 94%, of sheep and goats for slaughter– to 69.8%, of potatoes – to 68.7%, of fruits and berries – to 65.8%, of cattle for slaughter – to 56.2%, of vegetables – to 55.7%, of wool – to 47.2%, and of milk – to 40.2%. In this category of farms, the production marketability level is very low. For example, the level of marketability of vegetable production is just 15.9%, of potatoes – 17.1%, of fruit – 18.7%. In households, the losses of grown products are very high due to difficulties with the products sale.

Creation of consumer cooperatives will contribute to the rational use of products in households and increase the level of their marketability. Cooperatives will be engaged in the procurement and sale of agricultural products, as well as the supply of households with material resources (seeds, fertilizers, etc.).

CONCLUSIONS

The state agrarian policy has allowed for an increase in the production of many types of products. However, a significant proportion of food provision is imported products. The share of imports is especially high in the formation of commodity resources for fruits, vegetables and milk. Therefore, import substitution by increasing the proportion of domestic resources (seeds of sugar beet, sunflower, vegetable crops, breeding animals, breeding eggs, veterinary drugs, machinery) is important in solving the food problem.

The solution of this problem will be facilitated by the improvement of state regulation, the concentration of production in agricultural organizations and peasant farms, where there are favorable conditions for the innovative development of these industry sectors, as well as the organization of storage and processing of agricultural products in the places of their production, and the creation of consumer cooperatives.

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GENETIC ANALYSIS OF SIRES OF LEBEDYN CATTLE AND RELATED POPULATIONS

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Abstract

The population-genetic analysis wascarried outby ISSR-PCR markers of animals of the local Lebedyn breed and breeds that participated in its formation and improvement: Swiss, Ukrainian Grey and original Brown Swiss. ISSR-PCR technology showed a low level of genetic heterogeneity in all animals of investigated breeds having unique species-specific DNA fragments. The low levels of genetic polymorphy and heterozygosity, particularly in the subpopulation of Lebedyn breed animals, give evidence to the presence of genetic erosion and the threat of inbred depression. The results of evaluation of genetic differentiation between breed founders and based on them Lebedyn breed were proved to be used in the breeding programs for its gene pool restoration. Taking into account the results of population-genetic analysis, a fundamentally new scheme of reproduction of the genealogical structure of aboriginal breeds by the reciprocal population reproduction method was developed.

Key words: *Lebedyn breed, aboriginal cattle, ISSR-PCR, genetic marker, population-genetic analysis, interbreed differentiation, gene pool conservation*

INTRODUCTION

A great deal of attention worldwide is paid to the biodiversity conservation. The fundamental stage in the preservation of genetic resources involves their phenological and genetic description and its further thorough systematization. The vast majority of cattle breeds is represented by local populations, which differ significantly not only in morphology but also in the corresponding co-adapted genetic complexes that were formed under the influence of natural and artificial selection in the specific breeding conditions. Genesis, further breed improvement and selection of pedigree valuable animals require information concerning their productivity potential, genetic polymorphism level, genotype by the genes of quantitative traits, presence of unique alleles that are typical for this very breed and have adaptive value, and therefore, pay the way for its gene pool conservation [8].
Most scientists believe that genetic diversity conservation requires genetic monitoring in order to study the structure of gene pool objects that need to be preserved and protected by means of modern genetics and biotechnology methods [9].
To confirm this idea [25] states that the main tasks for sustainable conservation of national genetic resources are genetic monitoring, cataloging and certification, creation of gene pool and computer databases of collection farms, genetic banks, genetic selection plans for the conservation and management of natural resources. These studies represent the most complete data on the genetic diversity and the character of differentiation of particular populations, and should form the basis for the programs of scientifically grounded conservation of genetic resources of few in numbers and vanishing farm animals breeds [23, 29].
The problem of genetic resources conservation and breeding acceleration require a special approach to the control of their gene pools. For this purpose, various classes of molecular genetic markers are used [23]. They were created and gradually

changed with the development of scientific methods concerning the determination of polymorphism of certain DNA regions, initially at the level of proteins - their products, and then based on the identification of nucleic acids (DNA and RNA) structural rearrangements. They helped to solve the following important scientific problems: reconstruction of breeds history and genealogy, their distribution, clarification of their gene pool specifics, development of genetically grounded programs for the sustainable use of local breeds and their conservation, mapping of the main genes of quantitative traits in order to use this information in the genomic selection of farm animals [6, 21].

Researchers note that genesis of particular cattle populations and breeds can be traced and even adapted in the process of breed formation by constructing dendrograms of their phylogenetic interactions based on the productivity data as well as the molecular-genetic markers of different classes [8, 9].

Based on the analysis of the polymorphism of the microsatellite sequences for different cattle breeds, it was established that the dendrograms of genetic relatedness created on the basis of the adequately performed cluster analysis reflect the history of breed formation and their identified genealogical relationships. The first cluster includes animals of the old type Ukrainian Simmental and Ukrainian Grey cattle breeds. The author explains it by the fact that blood of Ukrainian Grey breed was added to the Simmental breed in Ukraine. The second cluster combines animals of domestic breeds: Lebedyn, Carpathian Brown and modern type of Ukrainian Simmental. The genetic similarity of these breeds, calculated on the basis of the allelic distribution of microsatellite markers, is explained by the analogy of the methods used for their formation. According to the author, Lebedyn breed was formed on the basis of Ukrainian Grey cattle breed, with Swiss sires used as an upgrading breed. This history of Lebedyn breed origin is proved by [27, 31].

The next cluster is represented by two breeds – European Brown Swiss and Austrian Simmental. The combination of these breeds can be explained by their common geographical origin (Switzerland is the native land for both Swiss and Simmental cattle [8].The similar result is given by [2]. According to his research the animals of Simmental and Alatau cattle breeds are included into the separate cluster in the evolutionary tree of Aulie-Ata cattle breed. Alatau cattle breed was formed by crossbreeding of local cattle with Swiss breed sires [30].

Further research showed [9], that Swiss cattle of European origin and American origin are characterized by certain specificity of the genetic structure. The animals of European and American origin are found in different subclusters, while the animals of Swiss and Simmental breeds of European origin come from one subcluster. By studying the similarity of the breeds of other origin roots, the author established that the animals of Swiss breed and Ukrainian Grey breed are united into one subcluster, in comparison with the cluster of Black-and-White cattle origin.

Other researchers provide the data showing that dairy breeds formed with the participation of Swiss breed (Kostroma) are in the separate cluster from such breeds as Holstein, Kholmogory, Yaroslavl and Red Gorbachovsky [32].

Thus, numerous studies of cattle according to different classes of molecular genetic markers prove the fact that population monitoring with the subsequent cluster analysis is a reliable tool for determining historical and genealogical relationships between breeds. It can be applied as a method for predicting proper combining ability of animals of different populations for the breeding purpose, obtaining the heterosis effect in offspring from these combinations with the desirable productivity traits. Besides, under the conditions of successful selection of informative and highly polymorphic marker systems, this methodological approach can be used as the basis of breeding programs for the restoration of few in numbers and vanishing animal breeds, including Lebedyn cattle breed.

The goal of the research is to conduct the population-genetic analysis of the animals of the local Lebedyn breed and breeds used for its formation and improvement in order to study their differentiation and genetic relatedness by multilocus ISSR-PCR markers.

MATERIALS AND METHODS

For molecular genetic studies, we used one sperm dosage from five bulls of each of the breeds: Brown Swiss and Lebedyn cattle and one sperm dosage from three bulls of Ukrainian Grey and the original Brown Swiss. To extract the genomic DNA, 50 μl samples from the sperm dosage of each animal of the named above breeds were taken.

The extraction of genomic DNA from sperm was carried out using the commercial standard kit Sorb-B (AmpliSens, RF) with its own modifications. The solution of mucolysin in the quantity of 120 μl per 50 μl of sperm sample was added to the selected sperm sample, the mixture was thoroughly vortexed and incubated in the solid state thermostat at +65°C for 5 min. Further procedure of the extraction of genomic DNA from animal sperm was carried out in accordance with the recommendations of the reagent kits manufacturer. The elution of the extracted DNA was carried out by adding 120 μl of TE buffer to the precipitate with the solution.

DNA amplification with primer ISSR-S1 was performed using the commercial kit Thermo Fisher Scientific (USA). The reaction mixture composition was the following: reaction buffer – 2.5 μl; 100 pM primer - (0,5-1,0) μl; from 2 to 4 activity units of Taq-polymerase – (0.1-0.2) μl; (1-2 ng) DNA sample – (1-3) μl; deionized water (to bring the volume of the mixture to 25μl). Not more than 0.5-1 ng of DNA sample (stock solution of DNA in the ratio of 1:10) was used. The primer synthesis used in the inter microsatellite analysis technique (ISSR) was performed by Fermentas (Vilnius, Lithuania) under order.

The nucleotide structure and temperature condition of the primer was: S1 3'-AGCAGCAGCAGCAGCAGCC-5 ', acting as a forward and reverse initiator of the amplification in PCR.

The amplification was carried out in the thermocycler "Biotherm" (Germany). The amplification program with the primer S1 was: 1 cycle: 94°C - 4 minutes; 2 - 31 cycles: 57°C - 2 minutes; 72°C - 4 min; 94°C - 1 minute; 32 cycles: 57°C - 3 min; 72°C - 7 minutes [23].

Electrophoretic separation of amplified DNA regions in ISSR technique was performed in 2% agarose gel in a single Tris Borate Electrophoresis buffer, according to the methodological recommendations [14]. Gels were coloured with 0.5% solution of bromide ethidium for 10 minutes. The visualization of the electrophoregram was performed on the transilluminator in the ultraviolet spectrum at the wavelength of 340 nm. The gel was photographed with Canon camera using the orange filter. The control of the size of amplification products on the gel electrophoregrams was performed with the use of the molecular weight marker 1 kb - Ledderplus ("Fermentas", Vilnius, Lithuania) and O'Range Rulertm 200 bp DNA Ladder. («Thermo Fisher Scientific”, USA). Only those PCR products were analyzed, which were clearly reproduced on the gels in the range of molecular weights relative to the marker: from 200 bp up to 3,000 bp in the course of 3 repetitive amplification reactions. The received profiles were processed in the standard computer program GenAlex6 [20]. The construction of the cladograms was carried out according to the values of genetic distances in the MEGA 4 program [18, 23, 24, 26].

RESULTS AND DISCUSSIONS

Selective breeding of certain breeds with optimal use of their genetic resource requires synthesis of information from a number of sources, including analysis of the results of molecular genetic studies, that provide objective criteria for assessing the diversity of individuals in the breed and between them. The variety of existing marker systems that are suitable for assessing the genetic variability of biological objects, sets the task for the researchers to choose an optimal type of markers or their combinations to objectively assess the state of the gene pool of breeds. The general concept of applying

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marker breeding elements in livestock farming must have a methodological basis - a universal approach to identifying the features of gene pools of any farm animals, high polymorphicity and informative value of the selected genetic markers, their stable reproducibility and low testing cost [13, 15].

This task is currently important concerning the genetic criteria for the estimation of small gene pool populations of cattle and the characteristics of the formed breeds with the aim of their further consolidation, increasing pedigree value and productivity.

The population-genetic analysis of the animals of four breeds (American Swiss, Lebedyn, Ukrainian Grey and original German Brown Swiss) in the technique of inter-microsatellite analysis with the use of the fragment of the anchored microsatellite with a trinucleotide AGC motif gave total 23 amplification products in the size from 250 to 2,000 bp (Table 1).

Table 1. Comparison of frequency and size of DNA fragments in ISSR technology with primer S1 in bulls of four populations*

№ DNA fragment	Size of DNA fragment	Populations of cattle			
		BS	OBV	L	UG
1	2,000	0.000	0.667	0.000	1.000
2	1,500	0.800	0.333	1.000	0.667
3	1,350	0.400	1.000	0.400	1.000
4	1,230	0.600	0.333	0.600	1.000
5	**1,100**	**1.000**	**1.000**	**1.000**	**1.000**
6	1,050	**0.200**	0.000	0.000	0.000
7	1,000	0.400	1.000	0.400	1.000
8	960	0.600	0.000[a]	0.600	1.000[*]
9	**900**	**1.000**	**1.000**	**1.000**	**1.000**
10	830	0.200	1.000	0.400	1.000
11	800	0.800	1.000	1.000	1.000
12	770	0.600	1.000	0.200	1.000
13	700	1.000	1.000	0.200[*]	1.000
14	670	1.000	1.000	1.000	**0.000***
15	650	1.000[a]	0.000[*]	1.000[a]	0.333
16	620	0.400	0.000[a]	1.000[*]	0.000[a]
17	560	0.000	1.000	0.000[*]	1.000
18	**530**	**1.000**	**1.000**	**1.000**	**1.000**
19	475	0.000	0.667	0.000	0.667
20	450	0.800	0.667	0.600	0.000
21	350	0.000	**1.000[*]**	0.000	0.000
22	325	0.400	0.667	0.600	1.000
23	250	0.400	1.000	0.600	1.000

Note: the difference is statistically significant upon Fisher's criterion: [*] - p<0,5; BS – Brown Swiss; OBV – original Brown Swiss; L – Lebedyn breed, UG – Ukrainian Grey breed.
Source: Own results.

The analysis of certain DNA fragments distribution enabled to determine the unique genome features of the representatives of particular breeds.

For example, we found a product of amplification in the polymerase chain reaction (amplicon) in the size of 770 bp. (Fig. 1) with a frequency of 0.60 in animals of Swiss breed [23], 100% of the examined bulls of original Brown Swiss and Ukrainian Grey, and only 0.20 in the bulls of Lebedyn breed.

It is interesting to note that in Lebedyn breed there occurred a selection of animals that were carriers of an alternative allele and its frequency significantly decreased compared with the population of Brown Swiss breed, whose sires participated in the scheme of Lebedynsky breed improvement. Among the representatives of Brown Swiss breed, we found the animals with a rare allele sized 1050 bp with the frequency of 0.2, while the representatives of other subpopulations didn't have it.

DNA fragment sized 960 bp can be considered the marker for the animals of Ukrainian Grey breed, since its frequency was 1.0 being absent in individuals of the original Brown Swiss breed (p <0.5) and having the frequency of 60% in the selection of animals of Lebedynsky and Swiss breeds.

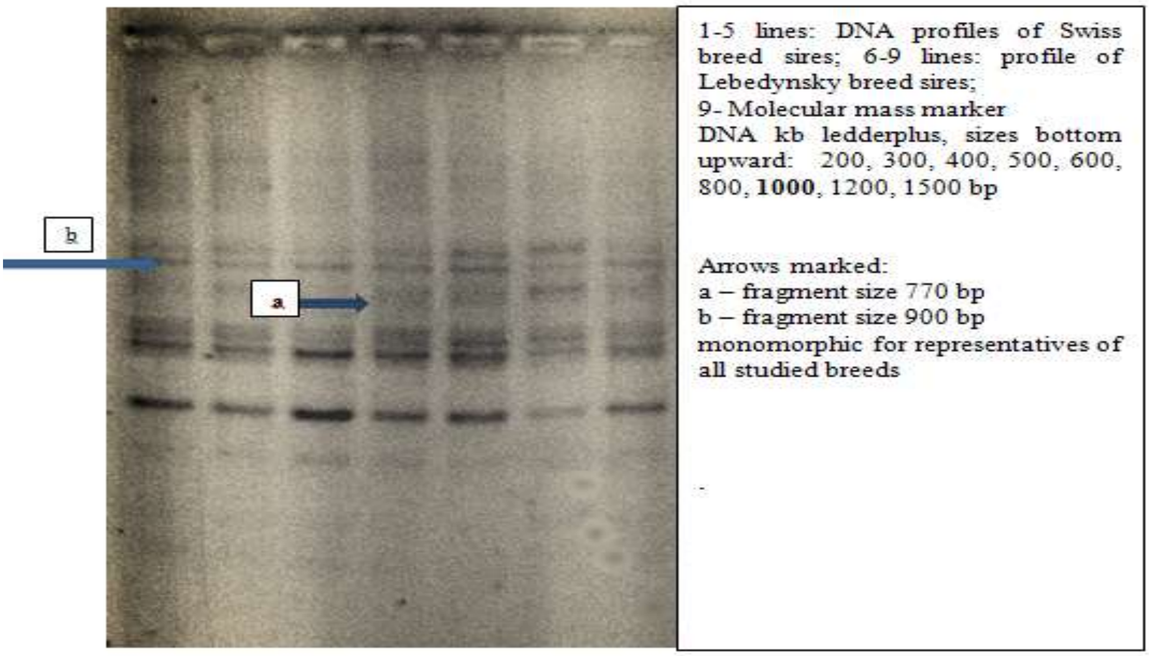

Fig. 1. Electrophoregram of DNA amplification products of animals of Swiss and Ukrainian Grey breeds obtained with ISSR-S1 primer in 2% agarose gel
Source: own results.

DNA fragment sized 960 bp can be considered the marker for the animals of Ukrainian Grey breed, since its frequency was 1.0 being absent in individuals of the original Brown Swiss breed ($p < 0.5$) and having the frequency of 60% in the selection of animals of Lebedynsky and Swiss breeds. The amplicon sized 700 bp occurred in only 20% of Lebedyn breed animals, the frequency of this allele in the individuals of other studied subpopulations was 1.00 ($p < 0.5$). A specific breed feature for the sires of Ukrainian Grey breed was the absence of the DNA fragment with a size of 670 bp, while it was found in the representatives of the other three breeds. In all sires of Lebedyn breed the allele with a size of 620 bp was identified being absent in the individuals of the original Brown Swiss and Ukrainian Grey breeds ($p < 0.5$), while in the subpopulation of Brown Swiss breed this DNA fragment was detected in 40% of individuals. A highly informative genetic marker for animals of the original Brown Swiss breed can be considered a presence of an allele of 350 bp, which occurred in all representatives of the studied selection and was absent in the bulls of other breeds ($p < 0.5$).

By the results of the conducted population-genetic analysis of the animals of different breeds by the arrangement of ISSR-PCR markers, essential statistically significant differences between them on a number of parameters were revealed (Table 2). The maximum number of amplification products obtained was characteristic of bulls of the original Brown Swiss breed – 16.667, while this indicator for animals of Brown Swiss and Lebedyn breeds was the same and significantly lower – 12.600 ($p < 0.01$). The level of calculated intra-group similarity, which in a certain way could serve as a mathematical model for assessing the degree of population's genetic consolidation, was the maximum in the animals of Ukrainian Grey breed (0.959) with the minimum value of this indicator for individuals of Brown Swiss breed (0.730), however this difference was not statistically probable. Noteworthy is the fact that the value of the theoretically calculated heterozygosity level in bulls of Ukrainian Grey breed was only 3.7%, while this indicator in animals of Brown Swiss breed was 28.3% (p <0.01).

Table 2. Main genetic-population characteristics of the sires of four subpopulations by the results of ISSR-S1 multilocus analysis

Breeds (N)	Genetic-population records				
	Average number of amplicons	Level of intragroup similarity	Heterozygosity	Number of genetic loci	Share of polymorphic loci
BS (5)[1]	12.600±0.400^{a}	0.730	0.283^{a*}	9.818	0.389
OBV (3)[2]	16.667±0.667^{a**}	0.860	0.111^{a}	14.998	0.133
L (5)[1]	12.600±0.872^{a}	0.780	0.194	10.557	0.242
UG (3)[2]	16.334±0.334^{a*}	0.959	0.037**	15.749	0.048

Note: the difference is statistically significant upon Fisher's criterion: $^{*-}$ p<0,5; BS – Brown Swiss; OBV – original Brown Swiss; L – Lebedyn breed, UG – Ukrainian Grey breed
Source: own results based on [23].

By the number of the identified genetic loci with S1 primer in the technique of inter-microsatellite analysis the animals of Ukrainian Grey and Swiss breeds also showed the biggest difference with the researched indices of 15.749 and 9.818, respectively. The genetic parameter "Share of polymorphic loci" confirmed significant differences between subpopulations of animals of Brown Swiss and Ukrainian Grey breeds with data values of 0.389 and 0.048, respectively. Thus, according to the results of the analysis, the genetic uniqueness of an aboriginal ancient Ukrainian Grey breed and a catastrophic bottleneck of genetic variability, associated with the use of a limited number of sires and a critically small effective population size as a whole, were shown.

The informative molecular markers and developed mathematical models for assessing the population situation, as shown by a number of scientists on different types of farm animals, can evaluate not only the actual contribution of genetic information, inherited by the animals of formed breed from the representatives of upgrading breeds, but also the degree of their divergence in further selection and natural adaptation [10]. One of the key research tasks was to evaluate the genetic differentiation between the breed founders and based on them Lebedyn cattle breed. The results of such an assessment should become a scientific basis for the breeding programs of rational use and restoration of the gene pool of the disappearing Lebedyn cattle breed.

The cladograms were created based on the genetic similarity indices and calculated on their basis genetic distances after the conducted cluster analysis. The evaluation findings of genetic relationships of the micro-populations of different cattle breeds are given in Table 3.

Table 3. Similarity levels and genetic distances between the representatives of different cattle populations according to the results of inter-microsatellite analysis with ISSR-S1 primer*

I / DN	BS	OBV	L	UG
BS	1.000 0.000	0.641	0.743	0.617
OBV	0.445	1.000 0.000	0.601	**0.809**
L	0.297	0.509	1.000 0.000	**0.595**
UG	0.482	**0.212**	**0.520**	1/000 0.000

Note: I – genetic similarity index, upper diagonal; DN – genetic distance, lower diagonal.
BS – Brown Swiss; OBV – original Brown Swiss; L – Lebedyn breed, UG – Ukrainian Grey breed
Source: own results.

The highest genetic similarity index according to the results of DNA typing of animals in the ISSR-PCR technique with trinucleotide anchored primer $(AGC)_6C$ was fixed between the subpopulations of animals of original Brown Swiss and Ukrainian Grey breeds (0.809), the calculated genetic distance being 0.212. The lowest level of genetic similarity by the chosen genetic marker was fixed between animal samples of Lebedyn and Ukrainian Grey breeds with the value of 0.595, the corresponding genetic distance being 0.520.

As the rate of evolution events in the populations of farm animal breeds is uneven and depends on the degree of both artificial and natural selection pressure, we chose Neighbor-joining (NJ) method for conducting cluster analysis and minimization of mistakes in the topology of constructed dendrograms [22].

The structure of the constructed cluster (Figure 2) consists of two subclusters. The structure of the first subcluster includes animals of Lebedyn and Brown Swiss breeds, the configuration of another subcluster is formed by Ukrainian Grey and original Brown Swiss breeds.

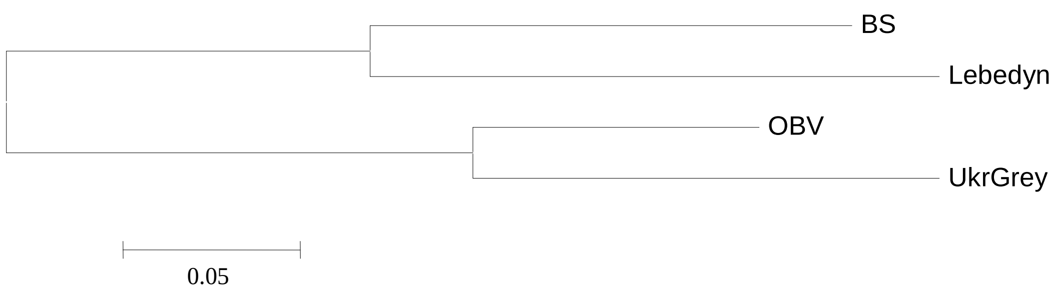

Fig.2. Dendrogram made on the basis of data from the ISSR-typing of four breeds by Neighbor-joining method in MEGA 4 program
Source: own result.

Whereas presence of animals of Lebedyn breed and Brown Swiss breed in the same subcluster can be explained by the fact that starting from 1970s the sires of the last one were used to improve Lebedyn breed, presence of animals of Ukrainian Grey and original Brown Swiss breeds in this cluster requires further research. Genetic similarity of animals without genealogical relationships can only be explained by marking of certain gene fragments that are associated with adaptation to the local housing conditions, since it is known that DNA fragments that are synthesized in ISSR technology may contain sites of structural parts of genes, located between microsatellite sequences [7]. It is possible that the detected low levels of genetic variability typical for aboriginal limited in size breeds had a significant influence on the value of the genetic distance between the unrelated breeds of Ukrainian Grey and original Brown Swiss. Besides, the results of our population-genetic analysis confirm the fact that the animals of Swiss breed of European and American selection differ significantly.

In the pedigree of some sires of Lebedyn breed (Rogiz 5002 and Final 1008) there are sires of both American and Austrian selections. In the pedigrees of sires of modern Swiss breed there are bulls of Laddi, Suprima, Vigata, Hilla, Kontsentranta, Distinkshna, Lailasana, Eleganta lines.

It was no coincidence that the original Brown Swiss breed was included in the list of studied breeds, as the sires of Swiss breed from Germany and Switzerland were brought to Ukraine in the early twentieth century for the improvement of local cattle, and such low influence of these animals on the genetic structure of Lebedyn breed was somewhat unexpected. To answer these questions and to make firm conclusions, it is necessary not only to expand the sample of animals of the above-mentioned breeds, but also to use more primers for ISSR technology and marker

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locus-specific systems of other classes for further research.

Thus, on the whole the four studied subpopulations of four cattle breeds showed a low level of genetic diversity having certain differences between them. Reduced levels of genetic polymorphism and heterozygosity, especially in the selection of Lebedyn breed animals, potentially pose the risk of genetic diversity decrease, loss of unique alleles and increase of inbreeding in the next generations. Consequently, our studies emphasized the importance of developing special breeding programs for the breeds with a small number of animals by means of genetic information needed to plan mating and therefore to prevent the loss of a unique genetic diversity of local animal breeds.

Numerous studies have shown that ISSR markers serve as a reliable methodological approach to the evaluation of phylogenetic relationships between different types of farm animals and adequately reflect the difference between them, both in terms of genealogy and productivity characteristics.

Despite the fact that the ISSR technology of fingerprinting is considered to be less suitable for conducting population studies, compared to SSR (STR), due to the dominant type of alleles and because it creates some difficulties in determining the size of amplified fragments and their separation in agarose gel, making it impossible to accurately estimate the heterozygous state of the identified loci, it at the same time permits to search for new genes of quantitative traits and create more accurate SNP markers on the basis of detected amplicons, carries a huge informative load when conducting population studies of farm animals at minimum costs and is irreplaceable especially for poorly-studied biological objects [3, 5, 16, 17, 19].

Equally important task for further research must be the choice of highly informative markers for assessing the genetic specificity of breeds using standard microsatellite panels approved by the international organizations ISAG and ICAR to conduct monitoring studies of all existing populations of each cattle breed [1, 4, 23, 28].

DNA-typing of aboriginal animal breeds to identify unique genetic adaptation complexes and alleles associated with the economically important characteristics is particularly relevant [11, 12], and in general will be defined as the main task of further research and development of effective strategies for the conservation of the gene pool of Lebedyn cattle breed.

A small number of Lebedyn breed sires, whose sperm is stored at the breeding centres, makes it impossible to avoid inbreeding, which can lead to unwanted breeding consequences. Based on the results of genetic studies, we proposed a fundamentally new scheme for the reproduction of the genealogical structure of the herds of local (aboriginal) breeds, namely, by the population reciprocal reproduction method (Fig. 3).

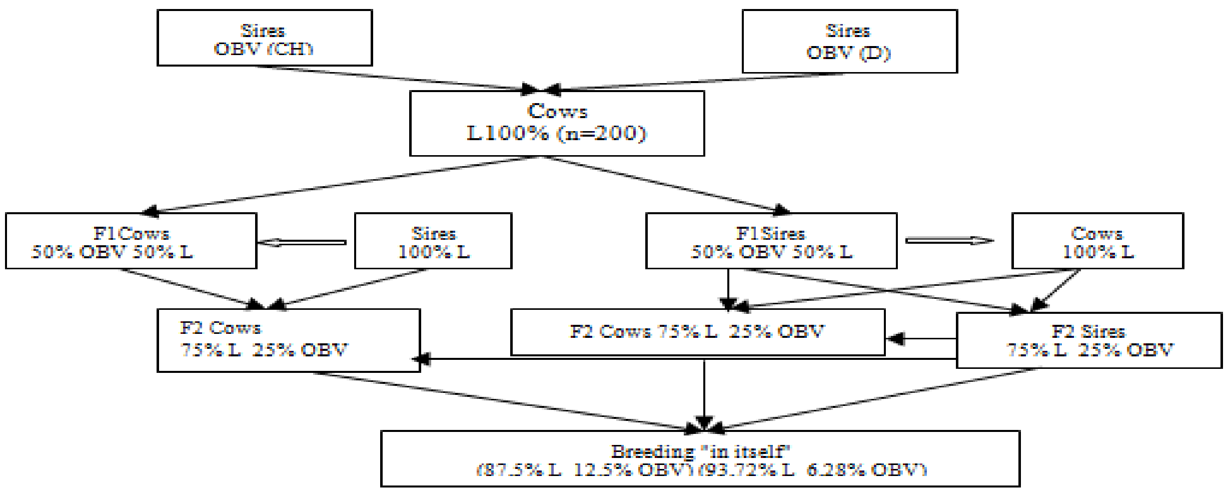

Fig.3. The flowchart of the population reciprocal reproduction method
Source: own results.

As it was mentioned, Ukrainian Grey breed and various Swiss breeds were the parental breeds in forming Lebedyn breed. Based on the results of the conducted cluster analysis with the genetic distances calculation, the use of the sires of original Brown Swiss breed will not only expand the genealogical structure of the small aboriginal breed without significantly affecting its genetic specificity and adaptive properties, but will also help to avoid inbreeding depression when using the sperm of purebred sires from the National Bank of Genetic Resources.

CONCLUSIONS

The conducted population-genetic analysis of the four subpopulations of four cattle breeds (Brown Swiss, the original Brown Swiss, Lebedyn and Ukrainian Grey) has overall demonstrated a low level of genetic heterogeneity. We note the presence of specific DNA fragments, which are detected in the technology of inter-microsatellite analysis, which completely coincides with previously obtained results [23]. We note, that reduced levels of genetic polymorphism and heterozygosity potentially create the threat of genetic diversity decrease, loss of unique alleles and inbreeding depression in the next generations of Lebedyn breed population. The importance of using the information obtained in the development of regional programs for the restoration of the gene pool of the endangered Lebedyn breed with the involvement of animals of improving breeds of foreign breeding has been proved.

The conducted genetic studies showed that Lebedyn breed and original Brown Swiss breed are combined in the same cluster, but in different subclusters, which can be a result of a single-vector selection of these breeds aimed at increasing adaptability to local breeding conditions. This fact allows the use of sperm of original Brown Swiss breed sires on the breeding stock of Lebedyn breed, making it possible to expand its genealogical structure and prevent unwanted inbreeding with the further use of the generative materials of Lebedyn breed sires stored in the National Bank of Genetic Resources.

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COMPLEX EVALUATION OF PRODUCTIVITY AND ENVIRONMENTAL PLASTICITY OF THE WINTER WHEAT BREEDING MATERIAL FOR THE CONDITIONS OF THE SUBMONTANE ZONE OF CENTRAL CAUCASUS

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Abstract

The paper reports on the results of the study of eleven cultivars and strains of winter soft wheat tested in the conditions of the submontane zone of the Central Caucasus. The average annual yield (2016-2018) varied from 0.66 to 1.05 kg/m^2. A comprehensive assessment of the parameters of environmental plasticity and adaptability using various methods was carried out. According to the results of variance analysis, the genotypes of the studied samples (the "cultivar" factor) had the highest impact on the overall variability of productivity – their proportion was 50%. The proportion of variability caused by the influence of environmental conditions (the "year" factor) was 26.5%. To identify adaptive genotypes by productivity, regression, and correlation analyses were performed and various selection indices were calculated.

Key words*: *productivity, cultivar, winter wheat, ecological plasticity, adaptability, selection indices

INTRODUCTION

The nature of the interaction of the genotype and the environment is one of the main directions of research in selection. Adaptive properties of cultivars are described by a number of parameters: plasticity, stability, resistance, etc. They reflect the dynamics of the genotype reaction to changes in environmental conditions or, in other words, the range of modification variability within the normal reaction of the genotype [13].
The value of adaptive cultivars depends not only on the absolute values of yield, but also largely on the environmental plasticity, i.e. the ability to generate productivity close to the potential in a wide range of soil and climatic conditions, to be resistant to diseases and damage by pests, to have the ability to quickly respond to improved growing conditions. For a comprehensive assessment of adaptability (a number of adaptive properties of the organism) and the selection of a valuable initial breeding material, a set of techniques is used to establish the significance of the observed differences and obtain the necessary information about the potential productivity and ecological plasticity of plants [1, 2].
Account must be taken of the fact that the assessment of sustainability parameters is, in part, relative, as it depends on the selected set of analyzed cultivars and may have a different

absolute value when compared with other strains. To identify the mechanisms of plasticity and stability of new genotypes, it is necessary to focus on known cultivars with different types of resistance and plasticity – most often, these are well-accepted regional cultivars [10].

MATERIALS AND METHODS

Studies were conducted in 2016-2018 in the laboratory of selection and seed production of grain crops of the North Caucasian Research Institute for Montane and Submontane Agriculture of the Vladikavkaz Scientific Centre of the Russian Academy of Sciences. The aim of the study was to assess the productivity and adaptability of the winter wheat breeding material to the cultivation conditions. Three recognized cultivars of winter wheat and eight strains from the collection of Vavilov Research Institute of Plant Industry were used for the research.

The soil of the experimental plot was medium-heavy clay-loam leached chernozem, underlain by pebbles.

Meteorological conditions during the years of research changed (temperature and moisture conditions were different), which made it possible to evaluate the adaptive properties of winter wheat cultivars.

The climatic conditions of 2016 (hydrothermal index = 1.5) were characterized as favorable for grain crops.

The climatic conditions of 2017 (hydrothermal index = 1.62) were hotter and more humid than usual since the spring vegetation period, which contributed to the development of diseases, including Fusarium head blight and Septoria blight.

In 2018 (hydrothermal index = 1.73), in early March and April, the moisture availability for the crops was lower than usual, the productive moisture reserves in the soil were 20-27 mm in the arable layer, which is not enough for plants during the period of ear initiation. In May, rainfall exceeded the norm by 135%. The crops were well supplied with heat and moisture.

The method of S.A. Eberhart and W.A. Russell (1966) [6] (as presented by V.Z. Pakudin and L.M. Lopatina (1984) [14]) was used to evaluate the adaptive properties, stability parameters, and environmental plasticity. The linear regression coefficient (bi) or plasticity coefficient and standard dispersion (S2i) or stability variance were calculated. Ecological plasticity means the average response of a cultivar to changes in environmental conditions, and stability means the deviation of empirical data in each environmental condition from this average response. Cultivar resistance to stress (Ymin – Ymax) and genetic flexibility ((Ymax + Ymin)/2) were determined using the method described by A.A. Rossielle and J. Hemblin (1981) [15] (as presented by A.A. Goncharenko (2005) [8]). When assessing the genotype-environment interaction using quantitative indicators of productivity, selection indices found in literature sources were used [5, 17, 19, 21]: Mexican index (Mx) – grain weight per head (g)/plant height (cm); head linear density index (HLD) – the number of grains in the head/head length; Canadian index (Ki) – grain weight in the head/head length; new plant productivity index (Vi), which is the ratio of the number of grains in the head times the grain weight in the head to the head length [11]. Homeostaticity (Hom) and breeding value (Sc) were calculated using the method described by V.V. Khangildin and N.A. Litvinenko (1981) [9], adaptive ability (Yi) was calculated using the method described by L.A. Zhivkova et al. (1994) [20], stability index (SI) was calculated using the method described by R.A. Udachin, A.P. Golovchenko (1990) [18].

To determine the nature of the correlative relationships, the ranking described by V.F. Dorofeev and A.F. Melnikov (1976) [3] was used: relationship is weak – $r < 0.30$; moderate – $r = 0.31\text{-}0.50$; significant – $r = 0.51\text{-}0.70$; strong – $r = 0.71\text{-}0.90$; very strong, close to functional – $r > 0.90$.

Mathematical processing of the experimental data was performed according to the method described by B.A. Dospekhov (1985) [4]. Field experiments, phenological observations, surveys and measurements of plants were carried out in accordance with the Methodology of State Variety Testing (1985) [7].

RESULTS AND DISCUSSIONS

For the correct calculation of the adaptability parameters using the yield parameters, we performed a quantitative assessment of the "genotype – environment" interaction using variance analysis.

The results of the variance analysis confirmed the significant influence of environmental conditions and "genotype – environment" interactions on the yield of the studied group of cultivars (Fact > Ftheor) (Table 1).

The highest contribution to the overall productivity variability was made by the genotypes of the studied cultivars (the "cultivar" factor), their proportion was 50%. The proportion of variability caused by the influence of environmental conditions (the "year" factor) was 26.5%. The proportion of other factors was 23.5%..

Table 1. The results of the variance analysis of the yield parameters for the cultivars

Type of variance	Sum of squared deviations	Number of degrees of freedom	Mean square (variance)	Factor contribution proportion, %	Ratio of variances (F)	
					actual value	reference value (P=0,95)
General	0.68	32	0.021	–		
The "year" factor A	0.18	2	0.9	26.5	112.5	5.9
The "cultivar" factor B	0.34	10	0.034	50.0	42.5	2.4
Residual	0.16	20	0.008	23.5		

Source: Compiled by the authors based on the findings from an expert survey conducted by them.

To identify the response to changes in growing conditions, we calculated regression coefficients (bi), that characterize the average response of cultivars to changes in environmental conditions and show their plasticity, as well as indicators of stress resistance, genetic flexibility of the cultivar, homeostaticity, and variance of cultivars stability (Table 2).

Table 2. Average yield and adaptability parameters of winter wheat cultivars for 2016-2018

Cultivar	Yield, kg/m2			Average Xi	Adaptability indicators				
	2016	2017	2018		Hom	Уmin–Уmax	(Уmax + Уmin)/2	bi	S2i
Alyans	0.63	0.54	0.8	0.66	4.0	-0.26	0.67	1.46	0.14
Zluka	0.6	0.73	0.64	0.66	8.7	-0.13	0.66	0.3	0.01
Gordovita	0.67	0.74	0.78	0.73	13.3	-0.04	0.72	0.46	0.03
Lazurnaya	0.65	0.6	0.91	0.72	4.0	-0.31	0.75	1.91	0.24
Areal	1.0	0.94	1.21	1.05	9.8	-0.27	1.1	1.61	0.14
Malvina	0.87	0.83	0.91	0.87	2.3	-0.08	0.87	0.41	0.01
Antonina	0.83	0.74	1.0	0.86	7.2	-0.26	0.87	1.46	0.15
Kuma	0.72	0.7	0.81	0.74	13.7	-0.11	0.75	0.67	0.03
List 25	0.6	0.64	1.0	0.75	3.42	-0.4	0.80	2.49	0.2
Don 107 st.	0.76	0.74	0.8	0.77	2.63	-0.06	0.77	0.34	0.01
Zira	0.77	0.75	0.82	0.78	20.3	-0.07	0.78	0.41	0.002
Average Xj	0.74	0.72	0.88	**0.78**	$F_{act} > F_{theor}$				
Conditions index (lj)	-0.04	-0.06	0.10						

Source: Compiled by the authors based on the findings from an expert survey conducted by them.

To characterize the growing conditions, we calculated indices of environmental conditions (lj). Indices of environmental conditions can possess positive and negative values. Positive environmental index values show the best conditions for the growth and development of genotypes, and negative values show the worst conditions. The best conditions for the formation of productivity were in 2018 (lj = 0.1), less favorable environmental conditions were in 2016 and 2017 (lj = -0.04 and -0.06) (Table 2).

Stress tolerance of cultivars and lineages is an important indicator of adaptability and environmental plasticity, which is calculated as the difference between the minimum and maximum yield. The highest stress tolerance (Ymin – Ymax) was observed in the Gordovita (-0.04), Don 107 (-0.06), and Zira (-0.07) cultivars. The Zluka cultivar is characterized by the lowest responsiveness to the improvement of environmental conditions in the studied set of cultivars.

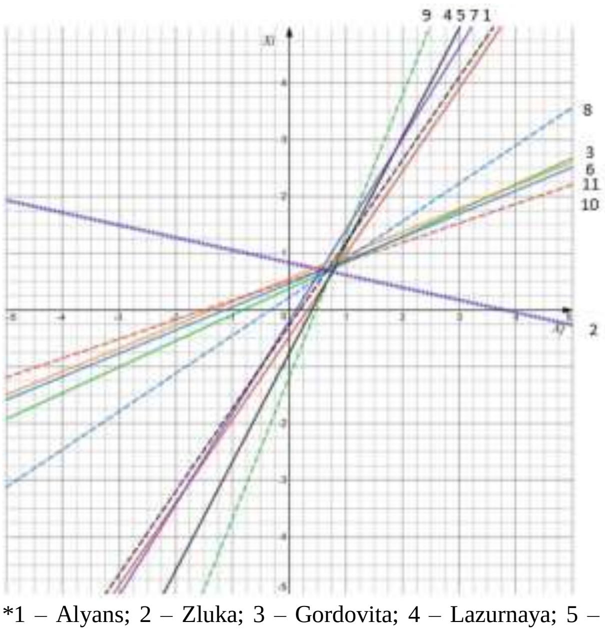
The indicator (Ymax + Ymin)/2 reflects the average yield of the cultivar in contrasting (stressful and non-stressful) conditions and characterizes the genetic flexibility of the cultivar, its compensatory ability. The higher this indicator, the higher the degree of correspondence between the cultivar genotype and environmental factors [16]. The following cultivars had the most genetically flexible genotypes: Areal, Antonina, and Malvina, with index values of 1.1, 0.87, and 0.87, respectively. These cultivars have a high degree of correspondence between the genotype and environmental factors.

The relationship between homeostaticity and variation coefficient characterizes the stability of the trait in changing environmental conditions (stability). The cultivars with high homeostaticity (Hom = 20.3, 13.7, and 13.3) include Zira, Kuma and Gordovita.

The linear regression coefficient bi of the cultivars yields shows their response to changes in growing conditions. The higher the coefficient bi > 1, the more responsive cultivar is. Such cultivars demand a high level of agricultural technology, as only in this case they will give the maximum yield. If bi < 1, then the cultivar's reaction to changes in environmental conditions is weaker. Such cultivars are best used on an extensive background, where they will give the maximum yield at the lowest cost. If bi = 1, then there is the full correspondence of changes in the cultivar yield and changes in growing conditions [12].

The slope of the regression lines provides visual information about the behavior of cultivars relative to each other and in comparison, with the average response of cultivars to changes in growing conditions (Figure 1).

Of practical interest are those cultivars, whose regression lines rise high on the right side of the graph (favorable conditions), which characterizes their high responsiveness to the improvement of conditions, and slightly decrease on the left side (severe conditions), which indicates buffering of genotypes in unfavorable conditions of cultivation.



*1 – Alyans; 2 – Zluka; 3 – Gordovita; 4 – Lazurnaya; 5 – Areal; 6 – Malvina; 7 – Antonina; 8 – Kuma; 9 – List 25; 10 – Don 107; 11 – Zira

Fig. 1. Yield regression lines (Xi) of winter wheat cultivars for environmental indices (Xj)
Source: compiled by the authors on the basis of the obtained results (Submontane zone of the Central Caucasus, average for 2016-2018)

The following cultivars are the most demanding for a high agricultural background, they can be referred to as the intensive type: Alyans (bi = 1.46, S2i = 0.14), Lazurnaya (bi = 1.91, S2i = 0.24), Areal (bi = 1, 61, S2i = 0.14), Antonina (bi = 1.46, S2i = 0.15), List 25 (bi = 2.49, S2i = 0.2). The next group of cultivars has a less plastic and stable genotype and is characterized by a fairly high yield and responsiveness to growing conditions: Gordovita (bi = 0.46, S2i = 0.03), Malvina (bi = 0.41, S2i = 0.01), Kuma (bi = 0.67, S2i = 0.03), Don 107 (bi = 0.34, S2i = 0.01), Zira (bi = 0.41, S2i = 0.002). These cultivars are best used on an extensive background, where they will give the maximum yield at the lowest cost.

At the earliest stages of the selection process, it is important to know not only the reaction of the genotype and its responsiveness to environmental conditions, but also the level of potential productivity of the selection specimen. Of practical interest in this matter are selection indices and coefficients that serve as markers of plant productivity. According to the results of the correlation analysis, the closest connection with plant productivity was shown for the SI stability index (r = 0.93), the new plant productivity index Vi that we developed (r = 0.75), the adaptability coefficient Yi (r = 0.73) and the breeding value factor Sc (r = 0.71) (Table 3).

Table 3. The relationship of the yield of winter wheat cultivars with breeding indexes

Cultivar	Yield, kg/m^2	SI	Yi, %	Sc	Vi	LED	Ki
Alyans	0.66	1.06	82.3	0.44	7.0	5.24	0.26
Zluka	0.66	1.06	91.0	0.54	6.8	4.73	0.15
Gordovita	0.73	1.31	94.2	0.63	8.4	4.12	0.17
Lazurnaya	0.72	1.26	91.4	0.47	8.0	6.9	0.3
Areal	1.04	2.63	134.5	0.81	9.7	5.4	0.22
Malvina	0.87	1.84	112.3	0.80	8.0	4.4	0.16
Antonina	0.85	1.76	115.7	0.63	7.4	4.62	0.17
Kuma	0.74	1.34	97.0	0.64	6.9	4.32	0.18
List 25	0.74	1.34	95.0	0.44	6.8	4.22	0.20
Don 107 st.	0.76	1.41	99.0	0.70	7.3	5.11	0.20
Zira	0.78	1.48	100.1	0.71	7.7	4.73	0.23
Correlation coefficient, r		0.93	0.73	0.71	0.75	0.25	0.38

Source: Compiled by the authors based on the findings from an expert survey conducted by them.

The main element of productivity that determine the yield of a particular plant in an ecosystem is the grain weight per head, which consists of the number and the weight of grains. The elements of productivity have different variability depending on the interaction of the genotype and environment factors. Based on the obtained results, the following cultivars and strains have high productivity (in descending order): Areal, Malvina, Antonina, Zira, Don 107 (standard), Kuma, List 25, Gordovita, Lazurnaya, Zluka, Alyans. Based on the specific yield of a head (Canadian index), three cultivars with the highest values (which were 0.26-0.23 g/cm, (Table-3)) were selected in comparison with the standard cultivar Don 107: Alyans, Zira, and Areal.

The grain weight per head is formed during the entire growing season and is determined not only by the number of grains, but also by the weight of each grain. Therefore, the linear density index, which is the ratio of grain weight per head (g) to the head length (cm), provides a large amount of data on the relationship between genotype and environment. Based on the linear head density index values 6.9, 5.4, 5.24, and 5.11 units/cm, the following cultivars were chosen: Lazurnaya, Areal, Alyans, and Don 107.

Based on the results of a comprehensive assessment of the parameters of adaptability for the cultivars (breeding material), the following were considered highly plastic, stable, and demanding of a high level of agricultural technology: Alyans (bi = 1.46, S2i = 0.14), Lazurnaya (bi = 1.91, S2i = 0 , 24), Areal (bi = 1.61, S2i = 0.14), Antonina (bi = 1.46, S2i = 0.15), List 25 (bi = 2.49, S2i = 0.2). Low-plastic but stable, with a weaker reaction to changes in environmental conditions than the average for the entire set of studied cultivars, were the following: Gordovita (bi = 0.46, S2i = 0.03), Malvina (bi = 0.41, S2i = 0.01), Kuma (bi = 0.67, S2i = 0.03), Don 107 (bi = 0.34, S2i = 0.01), Zira (bi = 0.41, S2i = 0.002). The following cultivars showed the highest average productivity over the years: Areal, Malvina, Antonina, Gordovita. Don 107, Kuma. Alyans and Zluka showed the smallest values.

When calculating the environmental plasticity, it should be kept in mind that the absolute values of the adaptability indicators for each studied cultivar obtained as a result of dispersion and regression analyzes, are to some extent relative, as they can change as the set of studied cultivars changes. For a more complete characterization of the economically valuable characteristics of the breeding material, one can additionally use indicators, the calculation of which does not require dispersion and average values for the whole experiment. For example, Vi is the plant productivity index (r = 0.75). In any set of cultivars, it has a close correlation with productivity; it is calculated based on “individual” plant productivity (number of grains, grain weight, and head length) and may indirectly indicate the resistance of the selection specimen to diseases.

CONCLUSIONS

The following strains are of the intensive type: Alyans (bi = 1.46, S2i = 0.14), Lazurnaya (bi = 1.91, S2i = 0.24), Areal (bi = 1.61, S2i = 0.14), Antonina (bi = 1.46, S2i = 0.15), List 25 (bi = 2.49, S2i = 0.2). The following have less plastic and stable genotypes: Gordovita (bi = 0.46, S2i = 0.03), Malvina (bi = 0.41, S2i = 0.01), Kuma (bi = 0.67, S2i = 0.03), Don 107 (bi = 0.34, S2i = 0.01), Zira (bi = 0.41, S2i = 0.002). The following cultivars and strains have high productivity: Areal (1.05 kg /m2), Malvina (0.87 kg/m2), Antonina (0.85 kg/m2), Zira (0.78 kg/m2), Don 107 (0.76 kg/m2). The closest correlation with productivity was shown for the SI stability index (r = 0.93), the new plant productivity index Vi that we developed (r = 0.75), the adaptability coefficient Yi (r = 0.73) and the breeding value factor Sc (r = 0.71). It should be kept in mind that the results of dispersion and regression analyses are to some extent relative, as they can change as the set of studied cultivars changes.

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EVOLUTION OF AGRICULTURAL TRADE IN THE PERIOD 2010-2017. CASE STUDY - ROMANIA

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Abstract

The trade deficit itself is not a danger to the economy of a country, given that it is determined by imports of equipment, capital goods or other goods that contribute to economic competitiveness. If, however, the budget deficit is determined by the import of consumer goods, then this situation can be worrying. According to the data published by the National Institute of Statistics, Romania's budget deficit resulting from the commercial activity increased in January-May 2019 by 30.1 percentage points compared to the same period last year, under the conditions in which the value of exports increased. Therefore, in this article we intend to analyze the situation of the trade deficit in Romania, focusing on the agricultural trade in order to determine the factors that have contributed to the increase of this deficit that increases from year to year.

Key words**:** *agricultural trade, imports, exports, trade deficit, Romania*

INTRODUCTION

Adam Smith has shown that international trade has positive effects on the growth and development of the world's economies [4]. These effects can be demonstrated by taking into account the value of exports, imports and trade balance. Often, this balance is deficient, and reducing the trade deficit is an objective pursued by the economy of a country. This can be achieved either by accelerating exports or by reducing imports. However, an increase in imports of equipment, capital goods or other goods that contribute to economic competitiveness may contribute to reducing the trade deficit. There may also be trade deficits with some countries, but trade surpluses with others, which leads to trade balance [6].

A favorable situation does not necessarily mean a permanently surplus trade balance, but a balanced dynamic balance. But a trade balance that is chronically deficient can be rebalanced by resorting to various restrictive trade policy measures, both in terms of exports and in terms of imports. In this way, competitiveness can be annihilated for macroeconomic reasons, which leads to the avoidance of excessive, long-term external debt as well as the pressures exerted on the respective country's currency [7].

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Romania has been confronted with a trade deficit situation since 1990, the permanent negative balance highlighting the chronic character of the imbalance situation that Romania's foreign trade suffers [8]. This deficit is also due to food imports, given that Romania is considered a producing country that would be able to produce food for 50 million people. However, Romania is an importing country. Statistical data for 2019 show that these imports provide about 60% of domestic consumption, but this situation is valid for the entire post-accession period. In these circumstances, in this paper, we set out to analyze the situation of imports and exports from 2010-2017, with the purpose of highlighting the trade balance deficit, seeking to explain the causes and to propose solutions that could contribute to the improvement of this situation.

MATERIALS AND METHODS

The working methodology consisted in taking, processing, analyzing and interpreting some indicators starting from the data published by the INS, as well as by the international databases. The indicators used were: the price of FOB (Free on Board) which is represented by the price from the border of the exporting country and is represented by the price of the good, as well as other costs related to transport, as well as the taxes related to the shipment; the CIF (Cost, Insurance, Freight) price, which represents the price used for imported goods, at the border, and which includes the FOB price, as well as international transportation and insurance costs; the balance of the trade balance (FOB / CIF) is determined that the difference between FOB and CIF may be negative, which shows the trade deficit or positive indicating the trade surplus.

RESULTS AND DISCUSSIONS

Analyzing the situation of Fob Export we find that during 2010-2017 they increased from year to year, the increases being 22 percentage points in 2011 compared to 2010, 28 points in 2012 comparedto the same year, 39 points in 2013, reaching 64 points, respectively 82 points in 2016 and 2017 (Table 1).

Table 1. Evolution of FOB Exports

Year	million lei	million euro	million USD
2010	157,436	37,360	49,494
2011	191,986	45,292	63,042
2012	200,790	45,069	57,921
2013	219,120	49,562	65,879
2014	233,247	52,466	69,886
2015	242,686	54,596	60,603
2016	257,701	57,392	63,589
2017	286,123	62,644	70,629

Source: own processing [3].

With the increase of exports, there was also an increase of imports, even though in percentage terms the increases are smaller from one year to the next, these being 18 percentage points in 2011 compared to 2010 and 53 points, respectively 75 percentage points in 2016 and 2017. From a value point of view, however, the imports exceed the value of the exports (Table 2).

Table 2. Evolution of CIF Imports

Year	million lei	million euro	million USD
2010	197,458	46,869	62,098
2011	232,868	54,952	76,540
2012	243,777	54,703	70,285
2013	244,569	55,317	73,519
2014	260,135	58,522	77,907
2015	279,867	62,962	69,852
2016	302,462	67,364	74,627
2017	345,395	75,604	85,325

Source: own processing [3].

In these conditions, the budget deficit is recorded throughout the analyzed period. However, its decrease is noted in 2013 and 2014. Thus, the smallest value of the dedicated budget was recorded in 2014 when it reached the value of 5.755 million euros, after which it started to grow to reach 12.960 million euros in 2017. Although the statistical data for the year 2018 have not been published, the monthly NIS bulletins show that in the first five months of 2019 the budget deficit deposited 5,000 million euros, when the exports had values of more than 23,900 million euros, and the imports were of over 28,000 million euros.

Table 3. Evolution of FOB/CIF trade balance

Year	million lei	million euro	million USD
2010	-40,022	-9,509	-12,604
2011	-40,882	-9,660	-13,498
2012	-42,987	-9,634	-12,364
2013	-25,449	-5,755	-7,640
2014	-26,888	-6,056	-8,021
2015	-37,181	-8,366	-9,249
2016	-44,761	-9,972	-11,038
2017	-59,272	-12,960	-14,696

Source: own processing [3].

This budget deficit is the biggest since 2010 and so far, due to less imports, but lower export dynamics. Also the depreciation of the exchange rate, as well as the rebalancing of the internal economic policy.

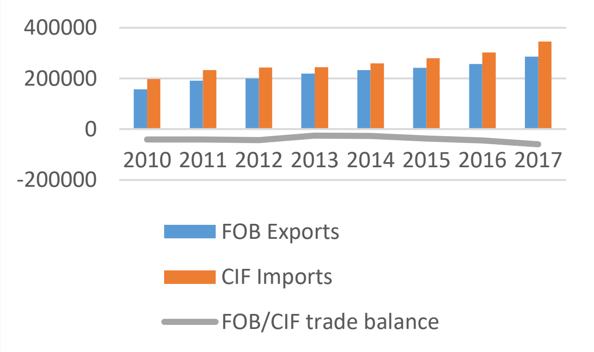

Fig. 1. The evolution of the trade deficit in 2010-2017
Source: own processing [3].

Although the development of an economy cannot be achieved only through the use of short-term invoices, such as agriculture and exports, trade in agricultural products has an important place in the Romanian economy [2] The published data show that one of the most important deficits is registered in food products. That is why we will continue to analyze the situation of agricultural trade in Romania, analyzing both imports and exports both in/from the countries of the E.U. and in/from the non-E.U. countries.

Fig. 2. Evolution of CIF import with agricultural products in E.U. and non E.U.

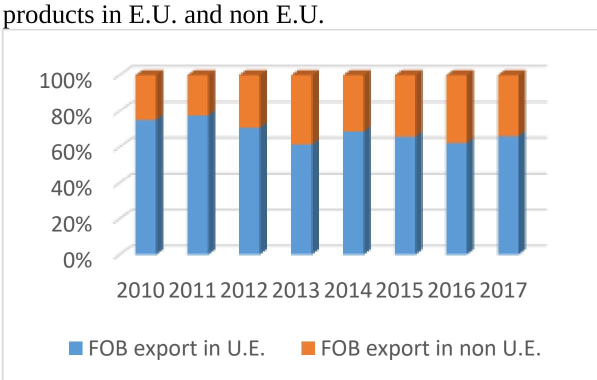

Fig. 2. Evolution of CIF import with agricultural products in E.U. and non E.U.
Source: own processing [1].

Thus it is found that the export of agricultural products to the countries of the E.U. had weights between 57-73 percentage points over the whole period analyzed, while exports to non-E.U. countries. They represented between 27-43 percentage points.

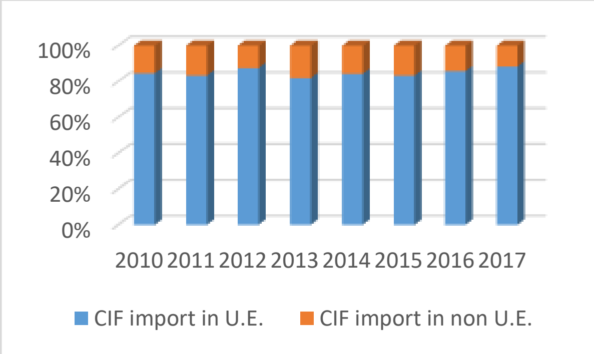

Fig. 3. Evolution of FOB export with agricultural products in E.U. and non E.U.
Source: own processing [1].

As far as imports are concerned, Romania imports a lot from the countries of the E.U. that is between 78 and 85 percentage points of the total of the imports, the difference being covered by imports made from the non-E.U. countries.
For the year 2017, the analysis for agricultural trade was carried out by product categories, in total, and broken down, in U.E and non-U.E countries.

Table 4. Situation of exports with agricultural products in 2017 (Million Euro)

Product category	**Trade with the E.U. countries**	**Trade with the non E.U. countries**	**Total trade**
Product	2,085.3	1,553.7	3,639.1
Other primary products	663.4	383.2	1,046.6
Processed products	257.1	24.6	281.7
Food	366.4	101.7	468.0
Drinks	68.7	28.4	97.2
Product no.	824.9	85.5	910.4
Total agriculture products	**6.443.0**	**2,177.1**	**6,443.0**
% of total exports	**9.0**	**14.4**	**10.3**

Source: own processing [1].

Thus we find that out of total exports, exports with agricultural products represent 10.3 percentage points. Exports to E.U. countries have a percentage of 14.4 percentage points, while exports by other countries hold 9 percentage points of total exports. The largest share is held by commodities, followed by other categories of primary products. Also non-edible products represent 15 percent of total exports. However, we find that Romania exports very few processed products.

Table 5. Situation of imports with agricultural products in 2017 (Million Euro)

Product category	Trade with the E.U. countries	Trade with the non E.U. countries	Total trade
Product	1,081.8	536.2	1,618.1
Other primary products	1,952.1	267.1	2,219.3
Processed products	826.7	56.6	883.3
Food	1,293.7	148.8	1,442.6
Drinks	296.6	26.7	323.2
Product no.	682.8	194.0	876.8
Total agriculture products	**6,133.7**	**1,229.4**	**7,363.3**
% of total imports	**10.7**	**6.7**	**9.7**

Source: own processing [1].

As far as imports of agricultural products are concerned, they represent 9.7 percentage points of the total imports, 10.7 percentage points being those imported from the USA, and 6.7 percentage points by those imported from outside the EU.

Table 6. Situation of the trade balance with agricultural products in 2017 (Million Euro)

Product category	Trade with the E.U. countries	Trade with the non E.U. countries	Total trade
Product	1,003.5	1,017.5	2,021.0
Other primary products	-1,288.6	116.1	-1,172.6
Processed products	-569.6	-32.0	-601.6
Food	-927.3	-47.1	-974.5
Drinks	-227.8	1.8	-226.1
Product no.	142.0	-108.5	33.5
Total agricultural products	**-1,867.8**	**947.7**	**-920.4**

Source: own processing [1].

The first place in which they concern the imports of agricultural products is the primary products, followed by goods and food preparations. The last place was the drinks. In total food imports, imports from the countries of the E.U. it represents 84 percentage points, the difference being covered by countries outside the E.U.
In these conditions, the trade deficit in agricultural products amounts to 920.4 million euros. This deficit is determined by the negative value of the trade balance with agricultural products from the countries of the E.U. with a value of - 1,867 million euros and a surplus balance with food products for countries outside Romania.

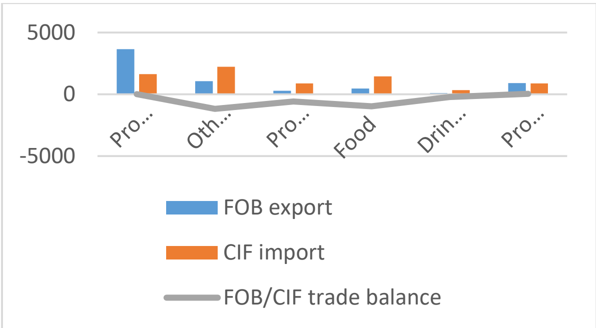

Fig. 4. Evolution of the trade deficit with agricultural products in 2017
Source: own processing [1].

Analyzing the weight of each category of agricultural products in the total of imports and exports, we find that those regarding exports made by Romania to the countries of the E.U. on the first place are the goods (48 percentage points), followed by the non-edible products (19 percentage points) and other primary products (16 percentage points) (Fig. 5).

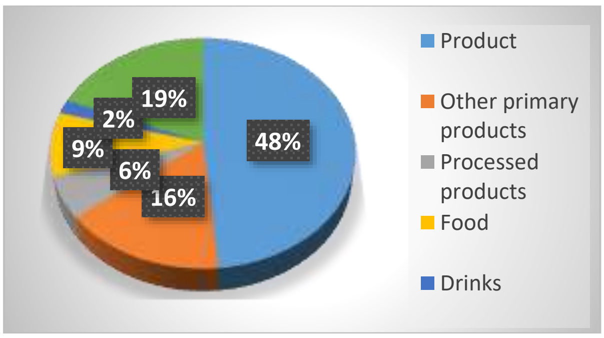

Fig. 5. Exports structure in the E.U. countries in 2017
Source: own processing [1].

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As far as exports to countries outside the EU are concerned, in the total agricultural trade, the export of goods holds 71 percentage points, and other primary products exported have the share of 18 percentage points (Fig. 6).

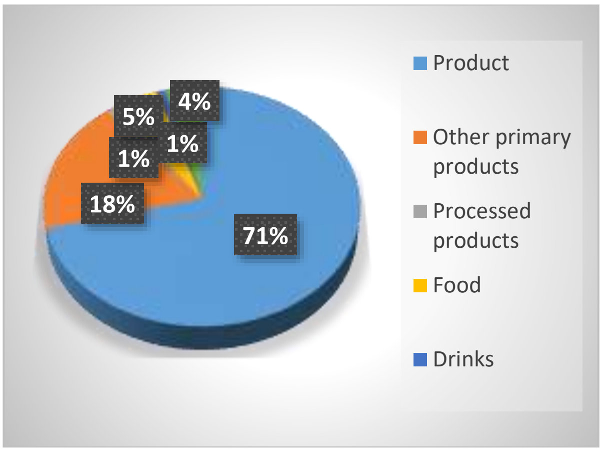

Fig. 6. Exports structure in the non E.U. countries in 2017
Source: own processing [1].

Analyzing the imports we find big differences related to the ones realized from the countries of the E.U. and those from countries outside the E.U. Thus from the E.U. Romania imports primary products representing 32 percentage points, while outside the E.U. these represent 22 percentage points. In the first place in the category of imports of agricultural products from other countries are the goods with 43 percentage points, while for those from the countries of the E.U. the percentage is 18 points.

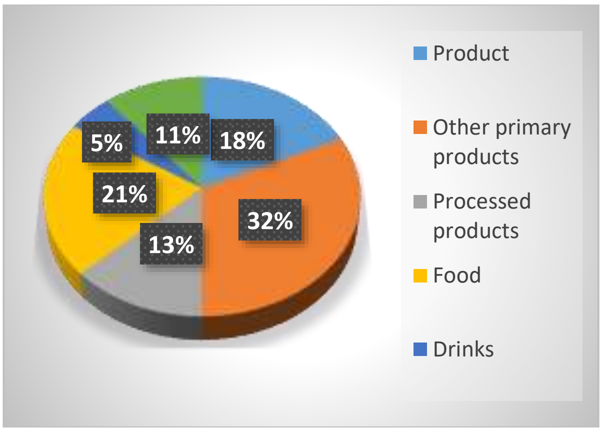

Fig. 7. Imports structure in the E.U. countries in 2017
Source: own processing [1].

Food preparations have a weight of 21 percentage points for those imported from the E.U. and by 12 percentage points for those imported from other countries.

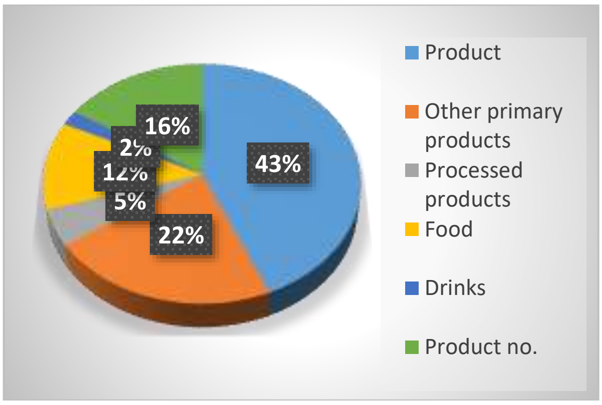

Fig. 8. Imports structure in the non E.U. countries in 2017
Source: own processing [1].

The last place in the category of imports is the drinks, both those from the E.U. (5 percentage points), respectively 2 percentage points those from non-E.U. countries.

CONCLUSIONS

What the study shows is that in the budget deficit recorded in the period 2010-2017, a high share has agricultural trade. Among the causes contributing to this are: the value of subsidies granted to Romanian farmers which are lower than those received by farmers from other countries of the E.U. and which thus generates unbalanced competition; reduced storage capacities that cause farmers to sell [5], in unfavorable conditions, agricultural products; the lack of associations between farmers to facilitate their access in the large networks of stores; the quality conditions and the provision of sufficient quantities that the farmers did not receive for sale products in certain networks of stores; low prices of imported products, which are most often manufactured under standards, and which are sold first in large commercial chains.
A reduction of the trade balance deficit can be achieved by making investments and developing the infrastructure that will contribute to a commercial development of Romania. Also the realization of some

associations of producers that can negotiate in much more favorable conditions the prices of agricultural products exported or marketed through the internal trade. In turn, the economic development could contribute to a stabilization of the exchange rate which in turn will positively influence the Romanian trade.

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CLASSIFICATION OF RISKS IN AGRICULTURAL INSURANCE

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Abstract

Agricultural insurance is rightly considered by both researchers and practitioners as one of the main methods of managing risks in agriculture. However, a unanimous conception of agricultural risk classification has not been established in the literature. There are divergences of opinion regarding the systematization of clear criteria for grouping agricultural risks, and the risk be useful for both agrarian entrepreneurs and especially for managers groups are not integrated into a classification. In the author's opinion, such systematization will of insurance companies, who provide agricultural risks. Based on this systematization, advantageous insurance offers can be developed for agricultural producers because the insurance companies in the Republic of Moldova offer separate insurance products, mostly those that are subsidized by the state.

Key words**:** *agricultural insurance, subsidy, classification, risks, Republic of Moldova*

INTRODUCTION

A modern business in agriculture can not be conceived without considering the risks to which the investor or the manufacturer is exposed. To avoid possible damage, managers of agricultural entities can opt for:
a) risk avoidance or prevention;
b) limiting the damage caused by the risks produced;
c) creation of reserves in order to cover own resources of eventual damages;
d) insurance risk.

Agriculture Insurance is treated as a specific category of property insurance, through which it is granted protection insured against a certain set of risks. Object of insurance production risks are of patrimony interests related to obtaining harvest in agriculture and raising livestock (animals, birds, honey bees, fish).

If risk events will occur, they will have a negative impact on agricultural manufacturer activities from financial point of view and that may trigger bankruptcy for agricultural entity.

Under the crop agricultural insurance contract, the insurer grants finances against total or partial destruction caused by various natural calamities, disease, injury and other damages provided by the insurance conditions [7, p.78], as well as in the event of injury or damage to animals, birds, bee families and fish.

Agricultural insurance is particularly useful for risks caused by natural disasters. These risks, by definition, can not be controlled and are the effect of several factors, among which climate change plays an important role.

Currently, science and technology achievements do not allow human intervention to avoid or manage natural phenomena. Man is able to predict the time when this will happen and the probable intensity of it. However, forecasts that warn man about the occurrence and propagation of such adverse weather conditions do not offer full protection. Property, assets, assets owned by agricultural producers can not be fully protected, especially in plant breeding. Open field plants and vineyards, fruit trees etc. are almost entirely exposed to these natural calamities. The most appropriate method of risk management is the conclusion of an insurance contract with the possibility of compensation in case of the occurrence of the risk event.

Natural and legal persons carrying out an activity in the agricultural field and is aware of the potential risks, the insurance companies offers them solutions for the safe conduct of the activities. Considering that Moldovan farmers do not use any risk management, the state grants some risks of their production, which they consider insured risks. Insured risk is one risk characteristic to agriculture, which includes unfavorable influence of weather conditions, plant and animals diseases [10].

MATERIALS AND METHODS

According to the Law on the subsidized insurance of production risks in agriculture no.243 -XV from 08.07.2004 from 08.07.2004 [10], the state subsidizes the insurance premiums in proportion of 50% in case of the crop harvest insurance and multiannual plantings of any risk or a group of risks such as: destruction or harvest decline as a result of excessive drought, hail, storm, low temperatures below the biological limit of resistance plant, flood, other unusual natural events specific for respective locality, as well as disease or pest attack.

According to the provisions of art. 22 of the Law on the subsidized insurance of production risks in agriculture no.243 -XV from 08.07.2004, the subsidies for insurance premiums refer to the following agricultural crops: wheat, autumn and spring barley, corn, sunflower, beet sugar, tobacco, vegetables, potatoes, rape, soybeans, multiannual plantings (alive, orchards, vineyards, fruit trees, lavender plantations, roses and sage plantations) as well as for grape and fruit harvest [2].

On 21 May 2017, the Government of Republic of Moldova approved Decision no. 455 on the allocation of the funds of the National Fund for Agriculture and Rural Development for the years 2017-2021 [4]. Sub-measure 1.7A. The *timing of the risk insurance mechanism in agriculture* contains references to the destination of the financial means used to subsidize insurance premiums. According to this decision, the state provides subsidies from the National Fund for Agricultural Development and Rural ensuring their production risks the amount of which is established considering the insurance premiums calculated according to the insurance tariffs provided in the special agricultural production insurance conditions and does not exceed the ceiling of 400.0 thousand MDL for one and the same agricultural producer.

The number of companies operating subsidized insurance of agricultural production risks in the Republic of Moldova is declining. If in 2017 this type of insurance was found in the portfolio of 9 insurers, in 2018 only 7 insurers issued insurance policies for agricultural risks. Accordingly, the total insurance premium decreased, but not essential (Table 1).The number of subsidized insurance policies for production risks in agriculture increased by 57, constituting 529 compared to 472 in the previous year and 221 in 2014 [3, p.82]. This increase resulted in the annual increase of insurance damages paid by insurers with 670 thousand MDL. However, we can mention that the number of subsidized insurance policies for production risks in agriculture is very small compared to the large number of agricultural producers in the Republic of Moldova.

Table 1. Indicators regarding subsidized insurance of agricultural production risks in the Republic of Moldova, millions of MDL

Insured objets	Full insurance premium, mil. MDL	Paid by:		Share of total revenues, %	Insurance compensation, mil. MDL	Share of total compensation paid, %
		Agricultural producer	state			
Harvest	7.40	3.7	3.69	72.84	2.62	98.96
Multiannual plantations	1.14	0.57	0.56	11.17	0.00	0.00
Animals, Birds	1.62	0.78	0.76	15.99	0.03	1.04
Total	10.1	5.05	5.01	100.0	2.65	100.0

Source: The NCFM Report, 2018 [2].

Table 1 shows that 80.7 percent of the insurance premiums were collected by the insurance companies for the subsidized harvest insurance. For the damages caused to the insured harvest, indemnities amounting to 1,900 thousand MDL were paid, which represents 95.96% of the total compensations paid. The livestock sector and the multiannual plantations are not subject to insurance

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necessary to extent, given the losses incurred by farmers due to risk factors.

In general, we can assume that agricultural insurance does not make an important contribution to the insurance portfolio of Moldovan companies. They had a weight of 0.74% in the total amount of insurance premiums of 1,440.9 million MDL in 2017.

We will mention that the offer of insurance companies is virtually identical to the subject of agricultural insurance. In this study the offer of 3 insurance companies from the Republic of Moldova: Klassika Asigurari S.A., Galas S.A., General Insurance S.A., have been researched, which offer 3 units of agricultural insurance.

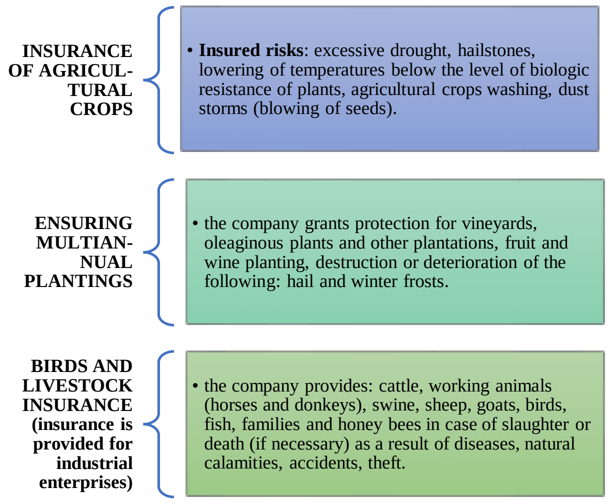

Fig. 1. The agricultural insurance offer of „Klassika Asigurari" SA
Source: elaborated by the author on the basis of „Klassika Asigurari" SA data, https://klassikaasig.md/asigurarea-riscurilor-de-productie-in-agricultura [6]

The other two companies also have in their portfolio such an offer, specifying conditionalities. For example, one of the determining factors in conditioning livestock and poultry is age. Insurance company „Galas" SA provides protection by providing animal husbandry producers with protection against death, slaughter in case of need and for theft for the following categories of animals and birds [9]:

-cattle aged between 4 months and 10 years;

-working animals (horses and donkeys) aged between 4 months and 15 years;

-swine aged between 4 months and 4 years;

-sheep (sheep, goats) aged between 4 months and 7 years.

-birds aged between one day and two years.

At the same time, the company does not undertake to pay damages for cases where the destruction or slaughter of animals (birds) was caused by:

-asphyxiation or drowning of animals due to the disconnection of electrical equipment, aqueducts, feed preparation and transport systems, if not all natural disasters;

-asphyxiation of animals (birds) that was caused by carbon monoxide poisoning as a result of damage to electrical cables from natural gas following ammonia poisoning as a result of manure decomposing process.

Galas SA provides multiannual crops for hail and winter frost, or both. These risks are characterized by the destruction not only of the foliage (hail), but also of annual and multiannual shoots. The hail, it is envisaged fall on the surface of the grains of hail with a diameter of 5 or more millimeters, the intensity of which is intensified if the drops are accompanied by raging wind speed of 50 and more km per hour (depending on the size of the hailstones). This phenomenon can cause damage to the foliar apparatus, the shoots, and depending on the intensity and duration of the hailstones can cause the plantation to fall.

The risk of „winter frosts" in multi-year planting is considered as a risk when the air temperature drops below -20 degrees Celsius, and remains at this level for at least 4 days in a row. Winter frosts affect the aerial part of vineyards and orchards, especially young ones, i.e. buds. Affecting buds on the aerial side of vineyards and young orchards implies the need for deforestation, and in case of partial damage to buds, agricultural entities will have to bear additional costs for their renewal.

General Insurance SA also offers subsidized insurance products of young fruit and wine plantations, not included in fruit and fruit for cases of: hail; winter frosts; floods (overflowing rivers). In addition to these services, the company provides for fruit and wine plantations for locusts and other hazards, but under unsubsidized conditions. The subject of the subsidized insurance may also be the harvest of spring crops (sugar beet, sunflower, corn, soybeans, vegetables, tobacco and potatoes), autumn (wheat, barley and rape (or their spring analogs) multiannual crops (fruits and grapes, vineyards and fruit trees) [1].

Large companies also offer optional insurance solutions in case of destruction, deterioration, theft of agricultural machinery: tractors, combines, forklifts, mowers, other complex equipment, chemical treatment machinery and equipment and fertilizer application, for drying and cleaning of seeds; technical and towable inventory.

RESULTS AND DISCUSSIONS

The diversity of the risks to which activities of agricultural producers and insurance companies are exposed and which assume these risks obliges to their systematization. From insurers point of view, such systematization is necessary to determine the insurance and the price of protection depending on the nature and possible damage that may be caused.

The researches regarding classification of the risk have been achieved with consideration to both the insurer and the insured person. We have identified that there are many and various classification criteria, the most important being presented below. Most often, the risk classification criterion can be met based on the nature of the source of the source [8, p. 115].

Thus, depending on the *nature of the risk* they, which may be: natural-climatic; biological; geological; social; employment; risk price/market; financial (interest rate, exchange rate); informational.

We consider appropriate to classify risks by the nature of factors in 3 categories:

a) natural-climatic;

b) agrobiological;

c) technogenic.

Depending on the *intensity* of *the impact of the risk* on the insured object:

-risks minor or accepted;

-risks critical;

-risks catastrophic.

Following *the response of the policyholder*:

-risks controllable;

-risks partially controlled;

-risks uncontrollable.

Classification of risks in controllable, partially controllable and uncontrollable is one accepted by many authors [5]. However, agricultural risks, in large part, can be considered as uncontrollable. Thus, most agricultural risks are predictable but uncontrollable. Insurance is the only method of managing them and farmers should be aware of this. An important role in promoting insurance as a method of managing agricultural risks lies with state institutions, but insurance companies, could collect major benefits from this unexploited market segment.

Another criterion for classifying agricultural risks is the „*degree of typicalness*” of the risk phenomenon for the respective territorial area. Depending on this criterion, the risks may be:

-*typical*, characterized by a high frequency of occurrence;

-*atypical*, whose probability of occurrence is very low.

The significance of typical and atypical risk delimitation is conditioned by the identification of a set of specific or typical risks of a field of agricultural activity or an area that is produced for objective reasons. For example, producers in the southern region of the Republic of Moldova are specific, so typical drought risks. Also, in recent years, can be considered typical risks - the risks of late spring frosts, hailstones. On the other hand, the risk of tornado is atypical.

In the same sense, but with another criterion formulation we find it at the Sofia Donea [10]. They outline the risks in *terms of frequency and intensity of occurrence* in:

-risks with low frequency, medium, high;

-risks with low, medium, high intensity.

There is an inversely proportional link between these two types of risk.

In turn, depending on the *frequency* of *events*, risks can also be classified into:

-moment risks;

-episodic risks;
-periodic risks;
-permanent risks.

Agricultural risks are enclosed mostly in periodic risk category (hail, frost late spring, drought) and some-episodic (floods, animal diseases etc.).

Depending on the *insurance prospects*, risks can be insurable and non-insurable. Insurable risks are those that insurers undertake them and for which they offer protection to the insurant. Non-insurable risks (excluded) are considered those risks that insurers do not accept; here are included those events which occurrence is certain or approaching certainty, or those that are caused by the insured, known by him and hidden to the insurer. This classification is applicable to the insurance agricultural risks. Usually, insurance companies state what risks are insurable and who are non-insurable. For example, the insurance company „General Insurance" does not insure: [1]

-multiannual plantations that are not maintained according to the agrotechnical requirements;
-highly rare plantations;
-losses (damage, theft) of the pillars (support) and the irrigation system.

Semen concept approach on „insured risk" is important because a number of specific risks for agricultural production can be considered as non-insurable. Thus, some companies in the Republic of Moldova do not grant protection to agricultural entities for price risk, political risk, social risk etc.). Among the causes of assigning these risks to unreliable ones is the elementary lack of a statistical database necessary to estimate as accurately as possible the probability of occurrence of a risk event.

Depending on the factors causing risk:

• *internal or specific risks;*
• *external risks.*

In our opinion, Agriculture insurable risk can be assigned to specific risks category. The degree of uncertainty may influence an individual uncertain event as:

-*unpredictable*, the occurrence of something similar;
-*predictable*, possibility to estimate the level of loss;
-*controllable*, partially or in fully, by the decision-maker.

Depending on *the risk predictability criterion*, they may be: predictable; partially foreseeable and unpredictable. Some authors omit the partially unpredictable interim category. We support this view, as a risk can be predictable or unpredictable. A „partially foreseeable" risk can be intercepted as a foreseeable risk. Most of the agricultural risks can be considered predictable but uncontrollable. In our opinion, an important criterion that insurance companies could use to justify price policy for agricultural risk insurance services is the classification of risks according to the *stage of development of crops / agricultural plantations* as follows:

-risks specific to the embryonic development stage;
-risks specific to crops, young plantations;
-specific risks at the maturity stage;
-risks specific crops, old plantations.

This classification is important for loss determination and the insurance premium for the insured risk. In general, we find that size damage increase with the development cultures of safety. It can be explained through the costs growth for the related works, technological processes, and uncollected revenues due to harvest loss. Development in stages allows the manufacturer to minimize the risk. If, for example, the risk event occurred at the embryonic development stage (sunflower or maize, sunflower seeds have perished in the soil due to torrential rains), the agricultural producer may intervene by repeating the sowing of the land with the same or another crop. At the maturity stage, it is no longer possible to repeat this technological process.

The insurance companies group the risks and offer the most often „package" as „insurance conditions" under different names, depending on the nature of the insured assets and the risks included in the insurance.

Insurance companies are free to group the risks for policyholders and company management according to their needs. At the same time, including a certain risk in one of the categories mentioned above may not have a permanent character. Depending on the criteria of insurance, the potential damage and the extent of the damage. The policy offers the possibility to change the category of the risk group.

CONCLUSIONS

Agricultural insurance in the Republic of Moldova is at a very low level of development. Neglecting agricultural insurance by the producers as a method of risk management, as well as by the insurance companies, for which they provide an opportunity for income growth, has a negative impact on the development of the Moldovan economy.

An agricultural insurance classification system would facilitate the understanding of their importance for the efficient management of an agricultural business. At the same time, the classification of agricultural risks according to certain criteria will allow insurers to diversify their insurance offers in order to make them attractive to potential insured persons.

The potential of agricultural insurance is insufficiently capitalized by agricultural producers, but also by insurance companies. Against this background, we believe that concrete measures are necessary to increase the volume of agricultural insurance in the Republic of Moldova.

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PRODUCTION OF WINTER WHEAT IN THE PHASES OF THE SOLAR ACTIVITY CYCLE

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Abstract

The impact of the phases of the solar activity cycle on winter wheat production in different physiographic zones of Ukraine: Polesie, Forest-Steppe and Steppe have been researched. Particular attention is paid to indicators of yield that have a significant impact on the development of agricultural industries. A correlation dependence between the yield of winter wheat and the phases of the cycle of solar activity was established. With a proper research of these indicators, the sectoral structures of agro-ecosystems can predict for income or prevent the growth of zonal costs in social production. The optimal periods for obtaining high and stable yields of the studied culture connected with the physical factors of nature are determined. That is why a large role is played by the scientific understanding and practical use of each individual phase of the solar activity cycle in agroecosystems, which enables a business entity to obtain a reasonable dynamic system by their periodic changes. At the same time, and is a prerequisite for control at all stages of culture production.

Key words**:** *solar activity, cycles, phases, zones, winter wheat, management, economic efficiency*

INTRODUCTION

Modern agricultural production for many years has been as a subject of intensive and multilateral research. This is because of the exceptional role that it plays in human economic activity. Especially actively conducted research about the influence of space factors on the production of crops in agriculture. Scientific research in this direction has a great importance for the crop industry, which has a high productivity potential with adaptability to high-precision production technologies of grain crops. In this aspect, the mastering of new management methods for the effective functioning of the agrarian sector has special significance.

It should be noted that the holistic management theory in agroecosystems, which includes space factors, should occupy a key place, which forms a sustainable and balanced development of its structural divisions. The importance of this task, which for many years was considered secondary or not at all posed on this issue, can be seen, for example, from the existing uncertainty of the impact of the phases of the solar activity cycle on the production of winter wheat. This is why, the process of finding of new approaches on the influence of the phases of the solar activity cycle is important condition to improve the efficiency of agricultural production. Especially when planning appropriate measures to stabilize the state of sown and harvesting areas and in predicting the further growth of social production.

Of course, the direction of such research has a certain specificity, since in the context of reforming agrarian relations at the state, regional and local levels, the search for new approaches to the system is of paramount importance to increase the productivity of agroecosystems based on the use of physical factors of nature. However, the economic practice of recent years has not fully ensured the implementation of all natural factors, which is mainly due to the socio-economic conditions of the transition period in the process of reforming agricultural production systems [14].

Joining as an integral natural factor in human economic activity, solar activity, as a physical factor, influences on the plant growing industry and its further development. Therefore, particular importance is the study of production indicators of winter wheat yields in the period of phases of the solar activity cycle.

Actually a phenomena of the cyclical nature of solar activity were researched by foreign and domestic scientists, in particular Jung, 1930; Chizhevsky, 1938; Kondratiev, 1965; Vitinsky, 1983; Maximov, 1970; Yakovets, 1999; Melnik, 2016 and others [1, 5, 15, 17]. But despite on a significant amount of theoretical developments, today there is a need to expand theoretical and methodological research on the impact of the phases of the solar activity cycle on the production of winter wheat in the zonal section of Ukraine.

The main purpose of this research was to explore the influence of the phases of the solar activity cycle on the yield of winter wheat in agricultural enterprises.

To resolve this issue, 25 regions of Ukraine were selected with different spatial-temporal measurements and climatic conditions. In the structure of sown areas of cereal crops, winter wheat takes the leading place. Therefore, the issue of yield, as an indicator obtained from a unit area, is one of the most important in these studies. In addition, the yield is a relative effective economic indicator showing the state and development of the crop industry.

In order to research the impact of the phases of the solar activity cycle on the winter wheat yield, the physical-geographical zones of Ukraine were taken: Polesye, Forest-Steppe and Steppe. Natural conditions of zones are heterogeneous in geomorphological, climatic and hydrological aspects, which have different effects on crop yields.

As a known, all areas of crop production are under the influence on individual phases of the solar activity cycle. In particular, we are talking about the functioning of the abiotic component, which has an ability to influence on the crop industry. From this point of view, the complex studies by P. Melnik [5] confirmed the impact of the phases of the solar activity cycle on the yield of winter wheat. This research presented data that reflect the functioning of the properties of the phases, especially, which continuously and unevenly affect the change in the yields of this crop in a space-time dimension. This especially concerns the continuous production of winter wheat as the main food crop.

Changes in the yield of winter wheat in various zones of Ukraine was carried out for the period from 1955-2018. In assessing statistical data, the focus was on ranking indicators characterizing the pronounced effect of individual phases of the solar activity cycle on its productivity. To study the dynamics of changes in crop yields of winter wheat in the zonal section of agroecosystems, zones of Polesia, Forest-Steppe, Steppe were taken, and four phases of the solar activity cycle (growth, maximum, decline and minimum) were determined based on Wolf numbers by year.

MATERIALS AND METHODS

Theoretical and methodological basis of research is the general theoretical methods of scientific knowledge, the fundamental provisions of the theory of management and principles of the economy of nature management, scientific works of domestic and foreign scientists on the issues of nature use in agroecosystems. To accomplish this tasks, the following research methods were used: dialectical, abstract-logical, scientific generalization - in the study of theoretical, methodological and methodological principles of the phases of the cycle of solar activity; analysis and synthesis - to establish the essence of abiotic factors in agroecosystems; monographic - in the reasearch of the specificity of nature in the phases of the cycle of solar activity; settlement-analytical and economic-statistical - for conducting quantitative and qualitative analyzes of the state of production of agro-industrial products depending on the cyclic action of abiotic factors; system approach - in determining methodical approaches to assessing the state of winter wheat production in different phases of solar activity.

RESULTS AND DISCUSSIONS

The global agroecosystem environment is under the powerful influence of the phases of solar activity. Their impact is manifested in the unique physical processes taking place on the Sun, which are inevitable, continuous and cyclically repeating. During this period, it becomes necessary to take into account the regular effects of physical factors of nature on the yield of winter wheat, the indicators of which may vary in magnitude. From these data, it is possible to determine the clearly hidden effect of phases of the solar activity cycle on the efficiency of the plant industry in the zonal section of agro and ecosystems.

If during the process of studying the phases of the solar activity cycle, negative results are obtained, they are systematized with subsequent research. Based on the analysis, the possible yield losses, lost profit are determined and measures are being taken to stabilize the financial condition of the business entity in social production.

The most important in the research is the study of winter wheat yields in the zonal section of agroecosystems and the determination of the phases of the solar activity cycle for the period 1955–2018. It is here that comprehensive studies are carried out to improve conceptual approaches in the system of managing crop production, as well as to solve the problems of the global action of physical processes on agroecosystems. And also, it should be noted that the research of the phases, especially the variability of their magnitude in the dynamics, should be carried out taking into account the production indicators of winter wheat received per unit of harvesting area.

Earlier, the study of the dynamics of the development of the phases of the solar activity cycle of researchers interest has changed in the direction of their adverse effects on the yields of this crop. However, this most deserves the attention of a theoretical approach than it finds in practice. The reasons are clear - the production of winter wheat depends on the physical factors of nature, where signs of anthropogenic destabilization are manifested.

The most important features of the manifestation of these signs are in the functional criteria of indicators of destabilization of ecosystems, such as [11]:

-violation of ecological relations in all their diversity (material, energy, information);

-violation of the cybernetic mechanisms of ecosystem self-regulation, namely: low effectiveness of feedbacks that cannot fully perform a regular function, compensating for negative external impacts;

-reducing the degree of assimilation of energy subsidies (solar energy)

-reducing the wealth and availability of life-supporting components of the environment;

-low efficiency of use of resource components of the environment;

-imbalance of functional groups (producers, consumers of different levels, decomposers)

-weakening the environment of the conversion function of biotic components;

-violation of the trophic structure of groups;

-intensification of intraspecific and interspecific competition;

-restructuring a balanced configuration of ecological niches;

-going beyond the ecological tolerance of the main types of biotic grouping;

-reduction of biotic potential;

-an increase in the sensitivity of biotic components to the action of secondary factors;

-accumulation of toxicants in the body and habitat.

Despite the above, the research of the impact of the phases of the solar activity cycle on the yield of winter wheat in the zonal section of agroecosystems of Ukraine has been finished.

Growth phase

The research of the growth phase of the solar activity cycle is determined by the collection of indicators of W numbers (Wolff) and the yield of winter wheat. It is these indicators that are increasingly becoming important components of the socio-economic development of agroecosystem industries. The variation of the indicators of the number W makes it possible to establish the changes that occur in the growth phase and the duration of its development period. Obviously, the changes that occur in this phase are no less important than the statistical indicators of the yield of winter wheat per unit of harvested area.

This phase of the solar activity cycle contributes to increase in the yield of winter wheat in social production. During the analyzing the data obtained, it can be said that the indices of the number W in the phases of growth of the solar activity cycle for the period 1955–2008. fluctuate within 15.1–141 W, while winter wheat yield in the Polesia zone is 0.92–3.73 t / ha, Forest-steppe zones - 0.94–4.23 and Steppe zones - 1.22–3.44 t / ha. Also, each phase of growth over the study period has its own indicators of the number of W. This is due to the formation of various amounts of sunspots, which are formed as a result of an increase in the activity of the magnetic field and their total area.

The duration of the development phase of growth in the cycle of solar activity is two to three years. All this suggests that the period of its development depends on the occurring physical processes on the Sun. Therefore, to impart high specificity phases influence on the yield in the test culture period is determined and the number average value for the number W.

Long-term researchs for the period 1955–2008 showed a variation in the indicators of winter wheat yields in the zonal section of agroecosystems. The cyclical dynamics of the uneven distribution of the weighted average yield data of this crop in the spatial dimension are displayed in (Table 1).

Table 1. Dynamics of winter wheat yield in zonal section for the period 1955-2018

Spatial dimension	Phases of the solar cycle							
	growth		maximum		recession		minimum	
	q / ha	GJ / ha	q / ha	GJ / ha	q / ha	GJ / ha	q / ha	GJ / ha
Polesie	24.8	46.56	21.7	40.82	23.7	44.54	26.9	50.62
Forest-steppe	30.1	56.62	26.5	49.88	27.6	51.87	30.3	56.97
Steppe	25.9	48.71	25.9	48.76	24.2	45.22	24.3	45.74

Source: [5].

The data presented in Table 1 indicate favorable and unfavorable periods of the growth phase of winter wheat production in the zonal section of the solar activity cycle. Thus, the forest-steppe zone is characterized by a stable resultant yield indicator, which amounts to 30.3 q / ha. It should be noted that the steppe zone, where the winter wheat yield is less than the forest-steppe by 4.4 q / ha and is 24.3 q / ha, remain sensitive in the growth phase, and the Polesie zone, by 3.4 q / ha and 26.9 q / ha This is based on the different intensity of the impact of physical processes on the zonality of winter wheat production. The most negative impact is observed precisely in the Polesia zone.

Considerable theoretical and practical interest is the question of a study on the spatial influence of the phases of the solar activity cycle on the yield of winter wheat. For the study there were taken annual international sunspot number W and the number of statistical indicators of this crop yields over the period 1955 – 2018 years.

The study of this issue was carried out in a single phase in the areas of agroecosystems of Ukraine: the Polesie, Forest-Steppe zones and Steppe zones. As a result of the studied parameters, we obtained models that have the following form:

Phase of solar cycle maximum

Growth phase of solar activity cycle

growth phase of the Polesye zone

$$y = -0.5557x^2 + 65.935x - 192.8$$
$$R^2 = 0.8959; \quad ....(1)$$

growth phase of the Forest-steppe zone

$$y = 0.9369x^2 + 111.85x - 3{,}298.8$$
$$R^2 = 0.9816; \quad ....(2)$$

growth phase of the Steppe zone

$$y = 0.0083x^2 - 1{,}889x + 68.001$$
$$R^2 = 0.8831 \quad ....(3)$$

Phase of solar cycle maximum

growth phase of the Polesye zone
$y = –0.0057x^2 + 1.6114x – 88.578$
$R^2 = 0.7753$; ....(4)

growth phase of the Forest-steppe zone
$y = –0.0075x^2 + 2.1616x – 122.99$
$R^2 = 0.8527$; ....(5)

growth phase of the Steppe zone
$y = 0.0066x^2 + 1.9141x – 108.55$
$R^2 = 0.8482$ ....(6)

Phase decline of the solar cycle

the decline phase of the Polesye zone
$y = 182.58x^{–0.518}$
$R^2 = 0.7384$; ....(7)

decline phase of the Forest-steppe zone
$y = 0.1567x^{–0.44}$
$R^2 = 0.7453$; ....(8)

the decline phase of the Steppe zone
$y = 76.128x^{–0.289}$
$R^2 = 0.6706$ ....(9)

Solar cycle phase of minimum

the minimum of the Polesia zone
$y = –0.0396x^2 – 0.503x + 39.386$
$R^2 = 0.9276$; ....(10)

the minimum of the Forest-steppe zone
$y = –0.0832x^2 + 0.1848x + 42.119$
$R^2 = 0.853$; ....(11)
the minimum of the Steppe zone
$y = – 0.0513x^2 + 0.513x + 30.893$
$R^2 = 0.8326$ ....(12)

So, as a result of the described data, under certain conditions in a zonal section of agroecosystems, regression models of winter wheat yield are obtained.
Comparison of the values of winter wheat yields with phases of the solar activity cycle showed that there are a rather high relationship between indicated by the parameters (Table. 2).

Table 2. Summary results of the analysis of the coefficients of determination in regression models of the phases of the solar activity cycle, 1955-2018

Spatial dimension	Phases of the solar cycle			
	growth	maximum	recession	minimum
Polesie	0.8959	0.7753	0.7384	0.9276
Forest-steppe	0.9816	0.8527	0.7453	0.853
Steppes	0.8831	0.8482	0.6707	0.8326

Source: [2].

Phase maximum

The second phase - the maximum phase is characterized by the maximum number W, which depends on the spot-building activity on the sun. The duration of the phase is from one till two years. During the period under study, the phase of the solar disturbance maximum is repeated 5 times, with the value of indicators 104.0–190.2 of W numbers by graduation Yu. Vitinsky [15]. In the maximum, the coefficient of determination was within 0.7753–0.8527, solar activity 104–190.2 W numbers and winter wheat yield in the Polesie zone – 11.6–36.1 q / ha, Forest-steppe zones – 15.5–42.8 and Steppe zones – 16.7–39.8 q / ha.
The presented data of the developed regression in models of the phase of the maximum of the solar activity cycle show a significant influence of the phases of the solar activity cycle on the production of winter wheat. The obtained coefficients of determination of regression models of the phase of the maximum cycle of solar activity has been reflected in Table 2, and confirmed the close relationship of yield with the maximum value of indicators of the number W. However, a zonal variation in yield is observed. Thus, the winter wheat yield in the Polesia zone is higher compared to the growth phase by 3.1 q/ ha, in Forest-Steppe - decreased by 3.6 q / ha and in the Steppe zone increased by 1.3 q / ha. The results of our research show that the maximum phase of the solar activity cycle is not always favorable for

the production of high yields of winter wheat in the Forest Steppe zone, but results in its increase in the zones of Polesia and the Steppe of Ukraine.

Recession phase

The phase of the decline of the solar activity cycle in the space-time dimension is also clearly distinguished. For the study period 1955–2018 . the duration of the phase is three to four years, with a repeatability of five times and a value of indicators 15.2–159.0 W. The coefficient of determination in models is calculated and ranges from 0.6707–0.7453 (Table 2). The winter wheat yield over the study period in the dynamics of the years is in the Polesia zone – 13.1–46.0 q/ha, Forest-steppe – 16.3–47.3 and the Steppe zone – 9.3 – 34.2 q/ ha.

As can be seen from Table 2, the coefficients of determination in the regression equations are 0.6707–0.7453, which is evidenced by the close connection between the yield of winter wheat and the decline phase of the solar activity cycle . Also admitted a variegation of winter wheat in a spatially-hour measuring table 1, of which varies by zones. Thus, the average yield in the Polesia zone is 23.7 q/ha, Forest-steppe – 27.6 and in the Steppe zone – 24.2 q/ha. These calculations showed that the winter wheat yield in the decline phase of the Polesia zone, compared with the maximum phase, is 1.1 q/ha higher, the Forest-steppe – 2.5 q/ha and decreased in the Steppe zone by 1.9 q/ha.

Phase minimum

It is characterized by the minimum value of solar activity . The duration of the phase is from two till three years with a repeatability in the study period five times and a score of 2.9–27.9 Wolf numbers. The coefficient of determination in regression models is 0.8326 (Table 2). The winter wheat yield in the phase at least for the period studied in the years section is in the Polesia zone – 13.7–47.0 q / ha, Forest-steppe – 14.0–46.9 and the Steppe zone – 12.3–34.7 q/ ha.

In addition, it should be noted that the coefficients of determination in regression models indicate a high degree of connection between the winter wheat yield and the minimum phase of the solar activity cycle . There is a change in the average wheat yield winter in the zonal hourly measurement table.1. So, in the Polesia zone, it is 25.4 q/ha, Forest-steppe – 30.0 and in the Steppe zone - 24.3 q/ha.The results of the analysis show that the winter wheat yield in the minimum phase of the Polesia zone is higher than the decline phase by 3/2 q / ha, the Forest-steppe – 2.7 q/ha and decreased in the Steppe zone by 0.1 q/ha.

A significant difference in the yield of winter wheat is observed in the minimum phase between the zones of Ukraine. Comparative characteristics of indicators of wheat yield in the winter zone of the Forest-steppe showed that it is significantly higher compared to the Polesia zone by 3.4 q/ha and Steppe zone by 6.0 q/ha. The yield of the Polesia zone compared to the Steppe zone is higher in 6 q / ha (Table 1).

From a global perspective on the production of winter wheat in the zonal space-time dimension impact phase of the cycle of solar activity, which should not be overlooked in all management decisions. Not taking them into account now and in the long run will lead to significant fluctuations in the yield of this crop. This is shown in Fig. 1.

An important aspect of understanding the nature and direction of the processes of phases solar cycle is the consideration of such exposure parameters as frequency (constant, unpredictable effects) and intensity. To a certain limit, the influence of destabilizing factors of the phases of the solar activity cycle can be neutralized by the action of evolutionarily developed mechanisms of natural self-regulation. However, in some cases (when the negative influence of the phases of the solar activity cycle is excessive in duration, scale or intensity) the functional potential of these mechanisms is insufficient . In the case of the primary natural system, which is an important structural and functional components agroehkosistem legally quantitative conversion into qualitative changes, enters one of the destabilizedvariant s status as individual components and system [1, 3, 5, 7, 10, 11].

It should be noted that when performing research, quantitative and qualitative indicators of the cycle phase are formed. solar activity that are able to interact with other factors [6, 12, 13].

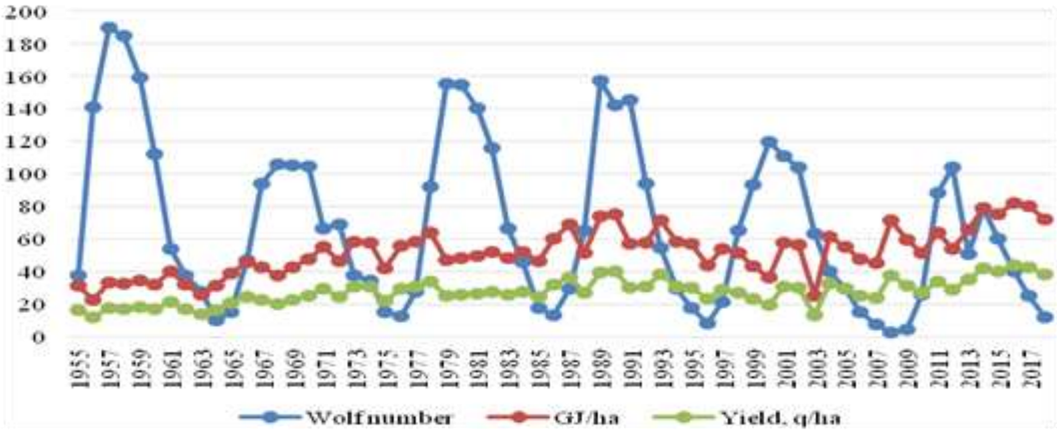

Fig. 1. Dynamics of productivity of winter wheat for the period 1955–2018 of Ukraine
Source: [5].

Therefore, define indicators in space-time dimension. By analyzing this data, you can determine to what extent it affects the efficiency of production of winter wheat, including the timely implementation of thosehnologicheskih operations, saving material and technical resource and others.

It is important to study the manifestations of "negative" effects that create side effects for sectors of agriculture. The data obtained during this period must be taken into account when planning the production of agricultural products.

Ecological and economic assessment of the influence of solar activity phases on the production of winter wheat in an agroecosystem

At each stage of its development, agricultural production presented science with fundamentally new approaches to solving problems. Now an important and far unresolved issue is the problem of the impact of the phases of the solar activity cycle on agroecosystems, which should be taken into account in crop production. This is one of the important components of the system of environmental-economic management, complex in structure and in the space-time dimension. Most of the decisions made by the management system regarding the influence of the phases of the solar activity cycle on the economy of agricultural production were ignored.

As noted V. Volodin [16] Numerous attempts to improve farming have failed, in our opinion, due to the lack of criteria for evaluating this improvement from the point of view of fully taking into account the objective laws of the development of society and nature, above all the law of compliance with environmental safety and environmental expediency. Therefore, from this point, the exclusive attention of researchers should be directed. It is precisely in the course of the operation of the management system that it creates immediate step-by-step transformation risks in the development of material,technical, environmental, economic, financial and other means in the production sectors. .

Now, the problem of the influence of the phases of the solar activity cycle on agroecosystems remains little studied in the areas of production economics . This problem is extremely complex and covers many different aspects . Especially in making management decisions on the effective use material and natural resources . Acting in a comprehensive manner, they reflect the productive activities of agro-ecosystem industries by type of production. At the same time, they have inherent individual characteristics that characterize an objective

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knowledge of the interaction of human social production with nature.At the same time, natural makrofizich EQF s factor of the solar activity cycle phases may adversely affect the level of harmony that creates a variety of productive indicators of economic efficiency of agro-ecosystems.

F. Ken, A. Marshal [2] noted that the source for human wealth is not only and not so much the additional cost according to Karl Marx, as the result of the Sun, whose energy quanta through plants, soil and microorganisms turn into food. F. Kene proposed distribution of the resulting product for the year in the community according to his calculations 2/5 of this product should be returned to the earth is, in order to maintain her fertility, 1/5 to the needs of farmers, 1/5 on the processing industry (in modern parlance -. in food th industry) and 1/5 for the needs of the state.

The economic efficiency of industries in the production of agricultural products is an integral part of agroecosystems as a whole. This is achieved by the rational use, reproduction and conservation of natural resources, as an important factor in obtaining high profits in production. However, the performance indicators of economic entities depend not only on the use of material and technical resources, but also on the effective action of natural geophysical factors, which are adjusted in accordance with the phases of solar activity cycles, despite the fact that the system of environmental and economic management of human activity controlled by.

No modern technology is able to contain the negative influence of the phases of the solar activity cycle. An example is the depletion of large areas of agricultural land, prolonged droughts and you fall intensive rainfall and others. Currently, the management system still does not take into account natural factors, especially space factors, in the space-time dimension of production. In particular, affecting the effective indicators of economic efficiency in the process of production of winter wheat grain.

According to the results of our research (1955–2018), we have proposed a model for determining the economic effect in the process of winter wheat production, taking into account the action phases ofsolar activity cycles [5]:

$$[Y_a \cdot S \cdot P - (\Sigma T_a + \Sigma T_e)] + [\Delta Y \cdot S \cdot P - (\Sigma\Delta T + \Sigma\Delta T'_r)] \rightarrow \max, \qquad \text{............(13)}$$

where:

Y_a – the average crop yield in the phase of the solar activity cycle, q/ha;

S – is the harvesting area, ha;

P – the unit price of the crop, UAH/q;

ΣT_a – the average amount of total expenses in the phase of the solar activity cycle, UAH/ha;

ΣT_e – the sum of expenses for the reproduction of eroded land resources, UAH/ha

ΔY – additionally harvested crop, q/ha;

$\Sigma\Delta T$ – the sum of expenses for the reproduction of eroded land resources, UAH/ha;

$\Sigma\Delta T'_r$ – the sum of expenses for reproduction of eroded land resources, additionally obtained crop volume, UAH/ha;

q – quintal (= 100 kg).

The presented model is used to calculate indicators of the economic effect of winter wheat production during the phases with the highest yield levels in the agroecosystem. The duration of such a period in production depends on the nature of the physical transmission processes on the sun, where there are changes solar cycle phases.

Level of average crop yield in the phase of solar activity cycle, t / ha:

$$(Y_a \cdot S \;\; P) - \Sigma T_a \rightarrow \bar{x}, \qquad \text{..................(14)}$$

The second model is used to calculate the economic effect of winter wheat production with low yields of the current year, in comparison with the previous or average yield for the last two to three years of the same phase. This applies to phases with unequal duration of years in the cycle of solar activity.

$(Y_a \cdot S \cdot P) - \Sigma T_a \rightarrow \min$ **..................**(15)

This model reflected the phases of the solar activity cycle with unfavorable conditions for the production of winter wheat. It was established that this period is characterized by a sharp decline in yield and unprofitability of its production. An example is the year 2003, where the average yield of winter wheat was 13.6 q/ha in Ukraine. This is why, it is important to correctly assess the damage in individual manufacturing sectors, as well as to foresee their consequences in the future.

It should be noted that it is extremely important to obtain the achieved economic effect from the production of winter wheat. Analyzing the yield in the dynamics for the study period, it should be noted that it is physically related to the phases of the solar activity cycle , which have different effects on the size of the economic effect. In essence, this is a comprehensive integrated criterion for assessing the economic effect in agroecosystems, which is a function of individual quantitative and qualitative indicators of the phases of the solar activity cycle in the production of winter wheat.

Because in the real world most of the management decision-making is based on a comparison of data related to product manufacturing income, there is a question of formation approach to the process of evaluating the cost-effectiveness of the sectors of agriculture's zyaystva [4, 17].

From economic point of view, especially on the issue being studied, indicators of economic efficiency in branches of agriculture are the amount of profit and level of profitability. From their objective assessment depends on the rhythm of the industry. However, the magnitude of these indicators is affected by a significant number of factors that are of great scientific and practical importance. From an economic point of view, the unit cost of production of agricultural production plays a big role . So, according to the method D.N. Parmacli the cost per unit of production is determined by the formula [8]

$Z = FC/q + AVC$, q/ha ....(16)

where:
FC - is conditionally fixed costs per 1 ha, UAH;
AVC - variable costs per 1 ton of products, UAH.;
q - yield, q / ha.

The next stage in determining performance indicators is profit, the value of which depends on the influence of physical phenomena of the phases of the solar activity cycle on winter wheat production processes and, as a result, a significant growth or unprofitability of the economy of the crop industry in a whole.

Due to determine the indicators of the efficiency of winter wheat production in different phases of the solar activity cycle, we have proposed an algorithm for calculating profits (P) from the sale of grain per unit area and unit of production. The definition of this indicator is carried out according to the methodology [9], followed by its improvement, by means of the formulas presented below:

$G = y(p - AVC) - FC$, UAH/ha; ....(17)

$G = p - Z = p - AVC - FC/q$, UAH/q.......(18)

Accordingly, the increase in profit per unit of the harvested area depends on the increase in yields in the phase relative to the base (average annual yield in the phase of the solar activity cycle over the study period:

$\Delta G_3 = (p - AVC) \cdot (q_b - q_n)$, UAH / ha, ...(19)

where:
q_b - base yield, q/ha;
q_n - yield phase of the cycle, q/ha

As a result of the research, changes in the yield gain of winter wheat between the phases of the solar activity cycle were found. Therefore, when establishing an additional profit or loss for the production of winter wheat per hectare between phases of the solar activity cycle , is determined by the formula:

$\Delta G = (p_n - p_b) - \Sigma B_n$, UAH/q, ...(20)

$\Delta G = [q_f \cdot S \cdot (p_n - p_b) - \Sigma B_n]$, UAH/ha, ...(21)

where:
q_f - additional yield in phase, q/ha;
p_n - new purchase price, UAH/q;
p_b - the basic purchase price, UAH/q;
ΣB_n, - total expenses in the phase of solar activity cycle, UAH / q, UAH / ha.

These approaches in research have sufficient theoretical and practical importance in agroecosystems. The proposed process of studying the interaction of the phases of the solar activity cycle and the efficiency of winter wheat production opens up more realistic possibilities for improving the management system. Now this interaction leads to continuous improvement of social production processes with the spatial and temporal action of the physical factors of nature. Therefore, the objective and the optimal test winter wheat economic efficiency of production can be obtained in dependence on the period of the vital cycle phases of solar activity.

The study of the influence of the phases of the solar activity cycle determines the search for optimal management solutions to maximize the development of the economic activities of the agricultural production sectors. Accordingly, the ability to predict a decrease in the maximum allowable level of production, its output in terms of value per hectare of land area and compare the results of activities of business entities. The criteria for economic evaluation of efficiency in the phases of solar activity are price, profit, profitability, and others.

CONCLUSIONS

The research shows that the production of winter wheat in agro-ecosystems depends on the state of the development phases of the solar activity cycle. Since each phase is individual, unique, has its own characteristic features on the impact on the yield of this crop , there is a need to improve the management system of its production in the zones of Polesia, Forest-Steppe and Steppe of Ukraine.

The theoretical and methodological concepts about the phases of the solar activity cycle showed that there are solutions to the problems in the crop industry that overlap each other, having a reciprocal resonating effect that affects the efficiency of agro-ecosystem industries of both the separately considered region and the country as a whole.

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THE EFFECT OF THE USE OF LOCAL MICROBIAL-BASED FERMENTATION MEAT WITH *LACTOBACILLUS PLANTARUM* ON PHYSICAL QUALITY OF FUNCTIONAL SAUSAGE

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Abstract

Sausages are a popular food product based on meat, are generally high in cholesterol which has a negative impact on health. One effort that can be done is to make functional sausages by adding cooked meat to the processed products. Bekasam is a traditional fermented product made from fish, but can be replaced with meat because it has a high enough protein of 16-22%. The starter used in making bekasam is Lactobacillus plantarum which is a homofermentative lactic acid bacteria. The role of lactic acid bacteria during the fermentation process can hydrolyze proteins and produce bioactive components in meat that function for health so it is expected to become functional food. The purpose of this study was to determine the effect of the comparison of the concentration of beef and bekasam meat on the physical quality of sausage products. The study was conducted experimentally, using a Completely Randomized Design (CRD) with 5 treatments comparing the concentration of beef and used meat as follows: P1 (100% beef), P2 (75% beef and 25% Bekasam meat), P3 (50% beef and 50% meat used), P4 (25% beef and 75% bekasam meat) and P5 (100% bekasam meat). The results showed that the giving of bekasam meat in making sausages had an influence on the water holding capacity, cooking losses, tenderness and pH of sausages.

Key words*: *"Lactobacillus plantarum", water holding capacity, cooking losses, tenderness, pH, sausages

INTRODUCTION

According to Indonesian Standard 3820-2015, sausages are products made from meat which is mashed with or without the addition of other food ingredients and food additives that are permitted and put into sausage casings with or without the cooking process. Characteristics of a good sausage has a chewy texture, does not contain preservatives, is free of harmful chemicals and does not contain synthetic dyes that can be dangerous if consumed. Meat-based sausages are generally high in cholesterol which has a negative impact on health (Rahardjo, 2003) [9]. One effort that can be done is to make functional sausages by adding cooked meat to the processed products.

Bekasam is a traditional fermentation product usually made from fish, mixing rice, and salt in a closed container and then anaerobic fermentation process is carried out so as to make this processed product has a distinctive taste. In addition to using fish, spices can be made using beef which has a high enough protein content of 16-22%. The starter is used in making the bekasam is Lactobacillus plantarum which is a homofermentative lactic acid bacterium, producing almost 90% lactic acid as its main product and producing antimicrobial compounds that can inhibit harmful bacteria and pathogenic bacteria in meat (Fardiaz, 1992) [4].

Lactobacillus plantarum produces bacteriocin or protein compounds that have a bactericidal effect against other microorganisms. The role of lactic acid bacteria, among others, improves the taste of fermented products, provides preserving properties and can increase the digestibility of nutrients. Lactic acid bacteria during the fermentation process also hydrolyze proteins and produce bioactive components in meat that function for health so that they are expected to become functional food.

This research uses traces taken from the bekasam to be used as sausages. Bekasam meat is pieces of meat separated from rice, this is because rice serves as a carbohydrate so that it is no longer used in making sausages. The function of bekasam meat in sausage mixture is that it can break down meat protein due to the fermentation process of the meat which produces bioactive peptides so that it is expected to affect the physical quality of sausages. Bioactive peptide is a type of peptide that has a definite amino acid sequence by working very actively and has health effects on the human digestive tract, besides it functions as an antioxidant, anticholesterol, antimicrobial and antihypertensive (Olugbuyiro and Oseh, 2011). Therefore, the addition of bekasam meat in the production of sausages is expected to increase functional value and positively influence physical quality characteristics that are closely related to consumers' attractiveness of functional food products from meat.

MATERIALS AND METHODS

Research Materials

The main ingredients used are beef and bekasam meat. Spices for making sausages are garlic, pepper, nutmeg, granulated sugar, salt, tapioca flour, margarine, skim milk. The chemicals used are standard solutions (buffer pH 4 and 7). The starter used is *Lactobacillus plantarum.*

Observed variables

The variables are as follows:

Water holding capacity

The measurement of water holding capacity refers to using the centrifugation method using the formula:

$$\% \text{ WHC} = \frac{\textit{the volume of water absorbed (ml)}}{\text{meat weight (g)}}$$

Cooking Losses

The calculation of cooking losses refers to Soeparno (2009) [11] as follows:

$$\textit{Cooking loss}\ (\%) = \frac{w1 - w2}{w1}\ X\ 100\ \%$$

where:

w_1 = The weight before the sausages is smoked

w_2 = The weight after smoked sausages

Tenderness

Tenderness test refers to Combes *et al.*, (2002) [2] using a mechanical device, Warner Blatzer by looking at the value of breaking the meat (g/sec).

Acidity (pH)

Acidity (pH) measurement in meat is done using a pH meter (Lukman *et al*., 2007) [6].

Statistical Analysis

The study was carried out experimentally in a laboratory using a Completely Randomized Design (CRD) with 5 treatments comparing the concentration of beef and bekasam meat as follows: P1 (100% beef), P2 (75% beef and 25% bekasam meat), P3 (50 % beef and 50% bekasam meat), P4 (25% beef and 75% bekasam meat) and P5 (100% bekasam meat). All data obtained were analyzed using analysis of variance (ANOVA) and differences between treatments were analyzed by Duncan's test.

RESULTS AND DISCUSSIONS

The quality of sausage products can be assessed from the physical, chemical, and acceptability qualities of sausages. The physical quality of sausages can be done by observing values: water holding capacity (WHC), cooking losses, tenderness and pH. The results of the physical quality of sausages in various treatments are presented in Table 1.

Water holding capacity

The water holding capacity is the ability of meat to bind water (Soeparno, 2009) [11]. Sausage water holding value from various comparisons of beef and bekasam meat shows that the highest yield was obtained at P3 (62.56%) while the lowest was at P1 (53.26%). Furthermore, to find out to what extent the binding capacity of sausage water was affected by the addition of bekasam meat, a statistical analysis was performed with variance, showing that the giving of bekasam meat had a significant effect ($P < 0.05$) on the strength of sausage water. The treatment of P1 without added of bekasam meat is significantly different from sausages added with meat because the meat has undergone a fermentation process which causes the meat texture to become soft so that the ability of the muscles to bind water is mainly caused by actomiosin, the main component of myofibril in the ability of the meat to bind water can be retained (Prinyawiwatkul *et al.*, 1997) [8].

Table 1. The Average Physical Quality of Sausages in Various Treatment

Variables	**Treatment**				
	P_1	P_2	P_3	P_4	P_5
Physical quality					
WHC (%)	53.26^a	62.41^b	62.56^b	59.98^b	60.49^b
Cooking Loss (%)	7.75^a	5.75^b	5.75^b	5.25^b	5.25^b
Tenderness (g/sec)	0.35^a	0.52^{ab}	0.46^{ab}	0.57^b	0.92^b
pH	4.8^a	4.4^b	4.3^b	4.2^b	4.2^b

Notes: The letters that are different horizontally in the treatment column show significantly different.
Source: Own results in the laboratory.

Cooking Loss

Cooking losses are the weight of meat lost during cooking. Cooking losses is influenced by temperature and cooking time (Soeparno, 2009) [11]. Sausage cooking loss values from various treatments showed that the highest yield was obtained at P1 (7.75%), while the lowest yield was equal at P4 and P5 (5.25%). The statistical analysis was then performed with variance to determine the extent to which sausage cooking losses were affected by the giving of bekasam meat, showing that adding of bekasam meat had a significant effect (P <0.05) on sausage cooking losses. The treatment of P1 (7.75%) was significantly different from sausages added with meat. This is proportional to the binding capacity of the sausage water produced, in addition, because the formulations used in sausage dough are different. This is in accordance with the opinion of Huda *et al.*, (2010) [5], Essien (2003) [3] that the cooking losses of cooked sausage has been influenced by several factors such as grinding temperature, cooking method and time, water holding capacity, water content, fat content and type of formulation used.

Tenderness

The sausage tenderness value from various treatments showed that the highest yield was obtained at P5 (0.92), while the lowest yield was at P1 (0.35). Furthermore, statistical analysis was performed to determine the extent to which sausage tenderness was affected by adding of bekasam meat, showing that the giving of bekasam meat had a significant effect (P <0.05) on sausage tenderness. P1 treatment was significantly different from P4 and P5, whereas P5 was significantly different from P1, P2, P3 and P4. This is due to the higher concentration of bekasam meat showing the tendency of tenderness also increased. The cooking process can also increase tenderness, depending on the time and temperature used (Soeparno, 2009) [11].

pH

pH is the acidity or alkalinity (Ahmed, 2012) [1]. The pH value of sausages from various treatments showed that the highest yield was obtained at P1 (4.8), while the lowest yield was equal at P4 and P5 (4.2).
Furthermore, statistical analysis was carried out to determine the extent to which the sausage pH was influenced by adding of bekasam meat, showing that adding of bekasam meat had a significant effect (P <0.05) on sausage pH. The treatment of P1 (4.8) was significantly different from sausages that were added to the fermented meat from the meat due to the fermentation process which caused a decrease in pH in sausages (Setiadi, 2001) [10].

CONCLUSIONS

The addition of bekasam meat in making sausages has an effect on the water holding capacity, cooking losses, tenderness and pH of sausages.

Further testing is needed regarding the use of local microbial-based meat (*Lactobacillus plantarum*) based on sausage quality.

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ECONOMIES OF SCALE ON THE NATIONAL MARKET OF INPUTS FOR AGRICULTURE

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Abstract

The purpose of this paper was to find a useful correlation between the costs and the size of the economic unit involved in the agricultural input supply. This relationship was analysed in the current paper in order to verify if the the practical situation on the agricultural input market in Romania allows to perform economies of scale, according to the conditions in which the economic units are operating. The research methodology consisted of analysing the first 10 firms that are agricultural input suppliers, in correlation with another 15 firms of smaller size than the first ones. The sampling was not representative for the agricultural input supply in Romania, but it allowed to highlight the impact of economies of scale on the value of costs and the management of improving and stabilizing the position on the market of these economic actors. The obtained results showed that the agricultural input suppliers take advantage of economies of scale, but they choose to use these advantages towards securing some benefits for clients (agricultural farms), in order to maximize their market share and to consolidate their brand image.

Key words: *economies of scale, input suppliers, agriculture*

INTRODUCTION

The benefits deriving from the growth in the workload depend on the efficiency of the use of factors [15, 16], this being possible to be evaluated by analyzing the modification of average costs in each production stage [10, 23]. Economies of scale are the benefits of developing major sectors [11, 20, 18]. The superior efficiency of scale includes the advantages of the positive externalities obtained by companies as a result deriving from the development of an industry or of the whole economy [21]. The operating potential on a large scale, as well as a higher technical efficiency seem to lead to the increase in size of the agricultural holdings [3, 19]. The external diseconomies are costs occurring beyond the control of firm alone and they are the result stemmed from a specific industry increase [26]. The internal economies and the diseconomies of scale are associated with the growth in the volume of firm's workload [1, 23]. Purchase-related savings are obtained when the larger enterprises purchase in bulk and they obtain better prices. The administrative savings may arise when the large firms are allocating the administrative and management costs to all sectors [5].
The large enterprises can support more efficient the business risks than the smaller firms [4, 9, 23]. A high fragmentation of the farms does not allow to obtain the benefits derived from the superior efficiency of scale [28, 29], therefore the alternative of agricultural cooperatives can be a viable method for farmers to take advantage of economies of scale [22, 25, 30].
Economies of scale are in many situations the fundamental rationale for the management of local administration [12, 13], even if, sometimes, it does not highlight clear results, mainly due to the particularities of the public systems [17, 27]. This fact occurs due to their dependence on the structure of public services-related costs, local administration structure and the governance framework at local level [5, 17].

Zetterholm J. revealed that the economic performance of the supply chain may be increased by industrial integration and growth in size [31].
Still, some studies have shown that the small-scale agriculture has the same potential to stimulate the production increase, social equity and integrated local economic development as the large-scale agriculture [6, 7]. This type of agriculture allows for the land and crop consolidation [8] and sustains a sustainable development [2, 14].

MATERIALS AND METHODS

The present paper aims to show that there are several reasons why the economies of scale generate smaller costs per unit, but also the fact that this does not occur each time.
The purpose of the current study consisted of identifying the economies of scale-related impact on the activity of the agricultural input suppliers. The research objectives have been represented by the brief diagnosis of the studied units and the determination of the impact of yield efficiency on their activity.
The assumption sustaining the conducted research has been stated as follows: if economies of scale are identified, then the ratio between expenses and sales decreases as the size of the companies increases. The value of sales has been estimated by turnover and company size has been measured by the volume of total assets.
The implications of this assumption consist in the fact that, if there is evidence of it, the barriers to entry on the agricultural input market are particularly high. Thus, the small investors cannot be competitives on this market and, consecquently, they cannot achieve performance at small sizes. On the other hand, the economies of scale may generate positive externalities on the branch where they are registered.
The reseach material consisted of two parts: the bibliography, based on which was explained the topic that represents the object of the analysis, and the information related to the analyzed companies, which formed the basis for evaluating the relation between efficiency and firm's size.
Thus, the conducted research included several research methods: scientific documentation, comparison, statistical analysis, economic analysis and case study.
The research involved a number of 25 economic units operating in the delivery of agricultural input on the Romanian market. SPSS software was used to determine the determination of the relation existing between certain economic indicators and the business economic size. The units' economic size has been assessed using the market shares owned by the analyzed companies. The market shares have been determined based on the turnover. The used economic information has been taken out from the online database of the Ministry of Public Finances for the period 2015-2018 [24].

RESULTS AND DISCUSSIONS

The sampled economic units are characterized by non-current assets that registered a maximum level of 136,7 mil. lei and a minimum level of 0.8 mil. lei, resulting in an average value of 35.9 mil. lei. The current assets registered a maximum level of 553.5 mil. lei, with a minimum level of 1,3 mil. lei and an average of 137.9 mil. lei. Hence, the total assets have been determined as having a maximum value of 644.8 mil. lei and a minimum of 2.2 mil. lei, resulting in an average of 173.8 mil. lei.
The net turnover had an average value of 334.3 mil. lei, with a maximum level of 2,661.7 mil. lei and a minimum of 1.3 mil. lei. The maximum total income reached 2,695.3 mil. lei and the minimum one 0.3 mil. lei, the registered anverage being about 343.4 mil. lei. Under these conditions, the total expenses registered a maximum level of 2,672.1 mil. lei and a null minimum, resulting in an average value of 336.6 mil. lei.
Consequently, the highest gross profit obtained during the last 4 years on the input suppliers' market in Romania amounted to 34.5 mil. lei, while the highest loss reached 12.7 mil. lei. As average per year and per sampled economic unit has been registered a

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gross profit of 6.8 mil. lei, at an average number of employees of 150.3 persons.

From the analysis of the relatio between the total expenses and the turnover, the polynomial function in the form of f(x) = 1.01x - 0.22, with R^2 0.999 and the Pearson coefficient 1.00**, indicates the possibility to reduce expenses after a maximum level of the turnover of 2,661.7 mil. lei, as it is graphically displayed in the Fig. 1.

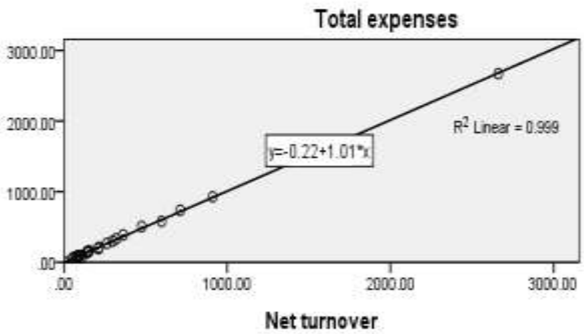

Fig. 1. Relation between the total expenses and the turnover (mil. lei)
Source: own calculation.

Still, we consider that this correlation is due especially to the fact that the obtaining of a certain turnover's level should be sustained by expenses. In other words: the firms should pay more to obtain higher income.

For this reason, there has been undertaken the determination of the correlation among the turnover, total expenses and total assets. For the correlation between the turnover and the total assets (Fig. 2), the Pearson coefficient was 0.840**.

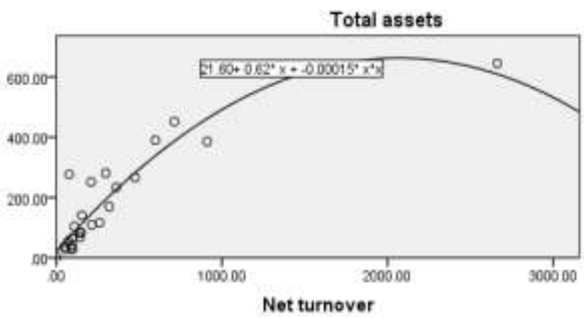

Fig. 2. Relation between the total assets and the tunrover (mil. lei)
Source: own calculation.

The value of regression coefficient was 0.852. The regression function in the form of f(x) = $0.00014x^2$ + 0.62x + 21.6 shows that the minimum threshold to qualify for a real increase of turnover is given by the free coefficient of 21.6 mil. lei.

This value is representative for at least 95% of the 25 firms studied within the sample. From this threshold, the turnover increases significantly and the maximum level is not obvious yet at the sample under consideration.

In order to establish the relation between the total expenses and the total assets (Fig. 3), it has been established the Pearson coefficient with a value of about 0.86, similar with the previous one, and a regression coefficient with a value of 0.845**. The regression function in the form of f(x) = $0.00014x^2$ + 0.60x + 25.42 is very similar to that of the turnover in relation with the total assets, but this expresses the dependence between the necessary consumption and the potential of economic unit.

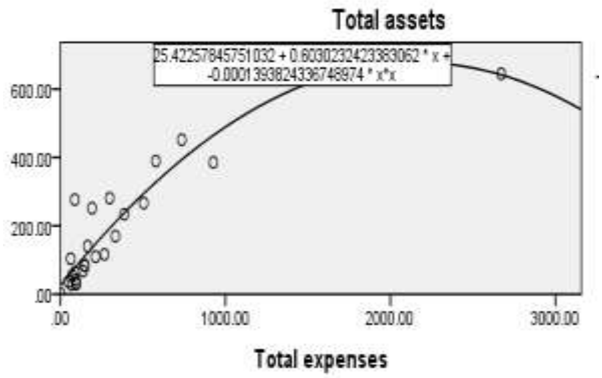

Fig. 3. Relation between the total assets and the total expenses (mil. lei)
Source: own calculation.

The graphic suggests that the volume of fixed expenses could register values of about 25.42 mil. lei, while the variable expenses have a multiplication degree of about 0.6. These relations indicate that the used data are correct and in line with the economic principles.

It is further necessary to establish if the volume of the average consumption per sold unit decreases in the same time with the increase in size of the economic unit.

Under these conditions, it has been determined the average cost per charged currency unit, after the relation:

Average cost = Total expenses / Turnover

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In this case, the Pearson coefficient of correlation between the average cost and the total assets registered a value of 0.24, and this indicates a very weak correlation. The regression relation does not suggest any real dependence between the two economic indicators. Thus, the obtained results can not be used.

For safety, determination between the total assets and all the other economic indicators has been undertaken. The Pearson correlation coefficient for different parameters were as follow: non-current assets 0.22; current assets 0.23; total assets 0.24; stocks 0.14; claims 0.26; company cashier and bank accounts 0.18; advance expenses 0.11; debts 0.24; advance income 0.15; provisions 0.11; total capitals 0.11; paid-in capital 0.04; net turnover 0.14; total income 0.15; total expenses 0.15; gross profit 0.01; average number of employees 0.29. The obtained values show the existence of very weak correlations.

On the other hand, has been determined the relations between the number of employees and other economic indicators, when the Pearson coefficient registered values were as: non-current assets 0.83; current assets 0.71; total assets 0.78; stocks 0.63; claims 0.64; company cashier and bank accounts 0.37; advance expenses 0.38; debts 0.78; advance income 0.13; provisions 0.20; net turnover 0.52; total income 0.53; total expenses 0.53. These correlations are strengthening the assumption that the performance of agricultural input suppliers is dependent on the number and performance of employees.

Under these conditions we can appreciate the yield efficiency with respect to the most important capital: the human resources. Thus, it was necessary to determine the economic efficiency of the sampled companies in correlation with the number of employees (Fig. 4).

For the correlation between the profit rate and the average number of employees, the Pearson coefficient was 0.54 and the regression coefficient had a value of 0.49**, indicating a weak but significant dependence, having regard to the reduced size of the sample. Despite that fact, during the analyzed period, some economic units registered losses, very likely determined by the increasing evolution of the level of capitalization.

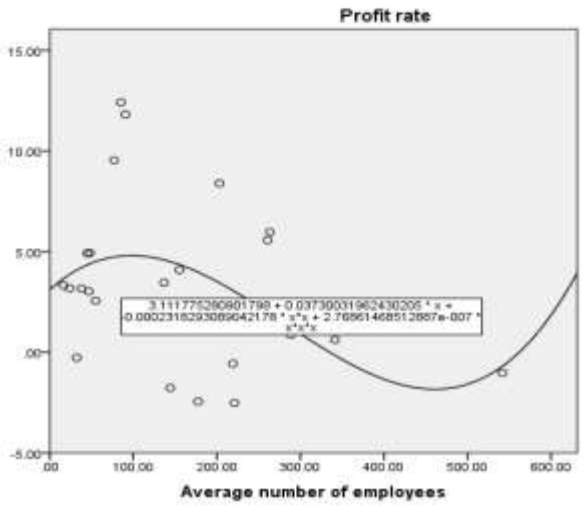

Fig. 4. Relation between the number of employees and the profit rate (%)
Source: own calculation.

The previous result recommends increasing the number of employees and their potential performances.

This phenomenon is also highlighted by the correlation between the turnover and the number of employees, where the Pearson coefficient was 0.68 and the regression coefficient was 0.63 ** (Fig. 5).

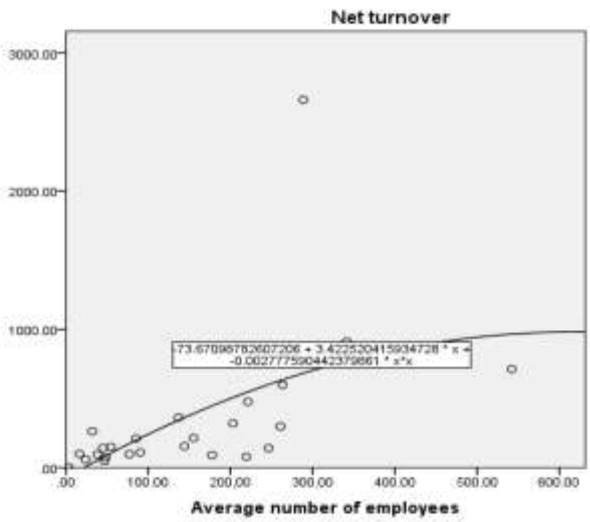

Fig. 5. Relation between the number of employees and the turnover (mil. lei)
Source: own calculation.

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Still, the assumption supporting the cost theory has not been confirmed, in this situation being necessary to verify several derived assumptions:
a. the agricultural input market does not benefit from the efficiency of the scale yields;
b. this market is characterized by efficiency of the scale, but advantages are used to reach other performance objectives of the company, such as market position.
These assumptions shall be mutually exclusive and, for this reason, we simulated possible tools for using yield efficiency as: financing of agricultural production, sales strategies with credit instruments and price strategies correlated with the purchase level. These has led to the reduction of total expenses (by decreasing claims and stocks from the volume of expenses) and, consequently, to a decrease in average cost. The Pearson coefficient of correlation between the corrected average cost and the total assets has the value of 0.67, displaying a close relation between these two indicators (Fig. 6), while the regression factor R^2 had a value of 0.64 at an error of 5%.

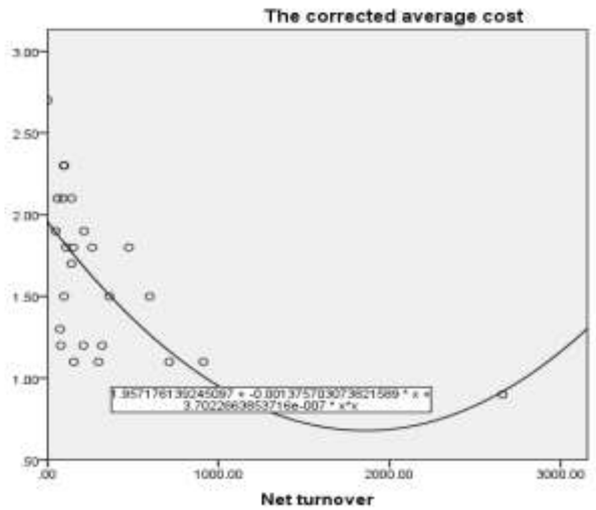

Fig. 6. Relation between the corrected average cost of stocks and of claims (lei expenses/lei total assets) and the total assets (mil. lei)
Source: own calculation.

The function in the shape of $f(x) = 3.702x^2 - 0.0014x - 0.196$ indicates the possibility to reduce the price according to the increase in size of the economic unit. But these economies are used to finance the farmers, to secure advantageous prices and other strategies aimed to lead to the increase in turnover. These results lead to the conclusion that the firm performance may be improved and the market advantages may be more efficiently used.

CONCLUSIONS

Close correlations have been obtained between total expenses and turnover, on the one hand, and between total assets and turnover, on the other hand. The correlations between total assets and average cost are non-significant.
Therefore, at first sight, there is no evidence to confirm the assumption according to which the increase in size of the economic unit determines savings at the level of average costs. In contrast, strong correlations were obtained both between the average number of employees and turnover, as well as between the average number of employees and the profit rates.
Then, after correcting the level of expenses with claims and stocks, a satisfactory correlation has been obtained between the average cost and the total assets. The obtained regression function indicates the possibility to reduce costs according to the increase in size of the economic unit. The research assumption is finally confirmed.
In turn, these economies of scale obtained by the agriculture input suppliers are probably used to finance farmers, to secure advantageous prices and other strategies leading to the increase in turnover.

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BIOCHEMICAL ACTIVITY OF *SACCHAROMYCES CEREVISIAE* YEAST IN THE FORMATION OF MANNOPROTEIN ON PHYSICAL PROPERTIES OF SAUSAGE PRODUCTS

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Abstract

Saccharomyces cerevisiae is a yeast that is rich in protein, carbohydrates and fat, can be used for human consumption. The alternative media can be used as S. cerevisiae growth media, with the condition that the contents in it, meet the requirements of yeast growing media, so it can reduce the use of commercial media. One alternative media is a formula consisting of bean sprouts and several other ingredients. S. cerevisiae growth curves on formula media based on optical density, pH and biomass of yeast, have a 0 to 5th hour lag phase, log phase 5th – 30th hour, stationary phase 30th – 60th hours and death phase 60th- 70th hours. In the death phase at 60th- 70th hours, there was an overhaul of the cell wall. Mannoprotein precipitate produced from yeast cell wall extraction can be used as bio-emulsifier. Emulsification activity of mannoprotein from the yeast at the 1st and 24th hour is 50%. The appropriation of S. cerevisiae yeast mannoprotein has an effect on water holding capcity, while cooking loss and tenderness of sausage had no effect.

Key words*: *Saccharomyces cerevisiae, growth curve, media formula, mannoprotein, sausage

INTRODUCTION

Saccharomyces cerevisiae is included in yeast which contains lots of protein, carbohydrates, and fat, so it can be consumed by humans. *S. cerevisiae* is very easy to be cultivated in various media as long as there are sources of carbon, nitrogen, hydrogen, oxygen, sulfur, calcium, vitamins, minerals and water (Erna *et al.*, 2004) [7]. The medium commonly used to grow *S. cerevisiae* is Yeast Malt Extract Agar (YMEA), but it is also possible to grow this yeast on alternative mediums of easily available materials and at a more economical price and environmentally friendly. One ingredient that can be used is bean sprouts which have high nutritional content such as protein, fat, fiber, phosphorus, vitamin B, energy, calcium, iron, ash, water, and carotene. The nutritional content of the bean sprouts can be used as a yeast growth media with the addition of several other supporting materials.

S. cerevisiae consists of capsules, cell walls, cytoplasmic membranes, nucleus, vacuoles, fat globules, and mitochondria. In the yeast cell wall can be used for bioethanol and as an emulsifier. Yeast cell walls consist of glucan, mannan, protein, chitin, and lipids. The glucans in the cell walls will form microfibrils while the mannan, which is generally associated with proteins, will form mannoproteins. Mannoproteins are formed from polypeptide chain molecules with short links, while long links with mannose. The number of cell walls is influenced by the growth curve of yeast, where young yeast has thin cell walls, while old yeast has thick cell walls (Balia, et al., 2017) [2].

Mannoprotein can be extracted from the yeast cell wall has bioemulsifier properties used in food and beverage processing due to the nature of the active surface of mannoprotein, so that it can stabilize the emulsion process in a product, and produce bioemulsifier products which is safe (food grade), non-toxic and environmentally friendly. Food products that use emulsifiers are found in some products such as sausages, meatballs, ice cream, and mayonnaise.

Emulsifier is a substance that can be used to maintain the stability of a product (Pawlik *et* *al*., 2014) [14]. Sausage is one product that uses an emulsion process. Problems that often occur in making sausages are emulsion rupture, low water holding capacity due to bad emulsification process, and texture that are not compact, too hard or too soft, so need another alternative to overcome the problem. Sausage quality can be improved by increasing the binding capacity of water and fat emulsions using appropriate binders and fillers (Dewi *et al.,* 2013) [5].

MATERIALS AND METHODS

Research Materials

Research materials used in this study are instant dry yeast, bean sprouts, sugar, antibiotics, vegemite, oil, beef, ice cubes, tapioca flour, skim milk, margarine, salt, sugar, garlic, pepper, nutmeg, aquadest, alcohol, spiritus, Yeast Malt Extract Agar (YMEA), Malt Extract Broth (MEB), tripotassium citrate ($C_6H_5K_3O_7$), and ethanol.

Research Methods

The study was conducted experimentally in a laboratory using Completely Randomized Design (CRD) with 3 treatments, namely sausages without mannoprotein, giving mannoprotein as much as 0.8% and 1.6% with each treatment repeated 6 times. All data obtained were analyzed using analysis of variance (ANOVA) and differences between treatments were analyzed by the Tukey test.

Research procedures

Making Formula Media

The process of making media formulas using the method of Balia *et al.* (2018) [3] is as heats 3 liters of distilled water that has been added by 1 kilogram of bean sprouts as fas as 1 liter of water volume. Afterward, sugar, vegemite, and antibiotics were added. The mixture of ingredients sterilized at 121°C form 15 minutes. The media formula is ready to use.

Implantation Yeast on Formula Media

S. cerevisiae that has planted on MEB is taken as much as 1% (50 µl) then transferred to 5 ml of the media formula, incubated at 25°C with incubation time 0^{th} to 70^{th} hours, carried out testing of optical density. pH measurement and cell biomass in every 5 hours the incubation time.

The Growth Curve

The growth curve testing consists of optical density, pH, and biomass. The testing of optical density was perfomed by using a 600 nm spectrophotometer. The measurement of pH was carried out on *S. cerevisiae* isolates using a pH meter and biomass testing was carried out by drying at 40°C for 12-16 hours (Garcia-Ochoa and Casas, 1999 modifications) [9].

Mannoprotein Extraction

Mannoprotein extracted from *S. cerevisiae* cells by the modified Torabizadeh, et al., (1996) [19] in Dikit *et al*., (2010) [6]. Extraction of mannoprotein was started by separating of precipitate using a centrifuge, the outcome of precipitate was added 0.1 M potassium citrate then sterilized by autoclaving at 121°C for 15 minutes to 2 hours. Furthermore, the isolate was centrifuged at 6,000 rpm for 15 minutes at 4°C, the supernatant was added with 90% chilled ethanol and stored at 4°C for 12-16 hours until the precipitation process completed. The results of precipitation obtained were centrifuged at 6,000 rpm for 15 minutes at 4°C followed by washed twice with chilled ethanol

Making Sausages

The procedure for making sausages uses the modified Suryaningsih Lilis (2006) [18] method. Prepare 2 kg of meat, each treatment 100 g, then ground in a food processor. Add ice cubes 5 g, tapioca flour 10 g, skim milk 3 g, margarine 3 g, salt 2 g, sugar 0.5 g, garlic 1.5 g, pepper 1 g, and nutmeg 0.5 g, milled until the dough becomes homogeneous. Add diluted mannoprotein according to treatment, milled again. Put the mixture into the sleeve and tie the end using a string. Then sausage boiled for 45 minutes at a temperature of 60°C, when cooked drain.

Measurement of Emulsification Activity (EA)

Measurement of emulsification activity uses a modified method according to Cooper and Goldenbery (1987) [4], which is taking mannoprotein has diluted with 1 ml of distilled water and oil into the Eppendorf tube, then conducted agitation using vortex for 3 minutes and stored for 24 hours.

Measurement of the Physical Quality of Sausages

Water-holding Capacity

Measurement of water-holding capacity by the method of Soeparno (2011) [17]. Sausage samples weighed as much as 0.3 g. Place the sample on Whatman filter paper No. 42 then the sample is given a weight of 35 kg between two glass plates for 5 minutes. After completion, mark the area covered by the sample and the area of the surrounding wet area on paper. Calculate the sample wet area, free water content, sample water content, and water holding capacity.

Cooking Loss

Cooking loss is an indicator of nutritional value related to meat water content, namely the amount of water bound in and between muscles (Soeparno, 2011) [17]. Sausage dough that has been put in a sheath weigh first for the initial weight, then boil the sausage at 60°C for 45 minutes then drain it, and weigh it again as after cooking weight.

Tenderness

This test uses a penetrometer with the method according to Muchtadi and Sugiyono (1992) [13]. Sausages are chopped 3 cm long, 3 cm wide, and 2 cm thick. The sample is placed at the tip of the penetrometer needle. The needle is adjusted until it touches the sausage surface. Press the needle lock for 10 seconds, then released and press the scale slowly until it touches the penetrometer needle. The stabbing is done 10 times in 10 different places.

RESULTS AND DISCUSSIONS

Growth Curve

The growth curve can be obtained by either relating the incubation time to optical density or to biomass (Acourne *et al.,* 2007) [1]. The growth curve which based on optical density, pH, and biomass showed that the lag phase of *S. cerevisae* is relatively short (Fig. 1 (a,b,c). This phase was occurred at 0 to 5 hours of culture. At 5 hours of culture, it has an OD of 0.3394, a pH of 6.30, and a biomass of 0.0026 gr/ml. The lag phase is relatively short because the yeast grows on media containing a composition that is almost the same as the initial media, so self-adjustment to the new environment takes place quickly (Wahono *et al.*, 2011) [20].

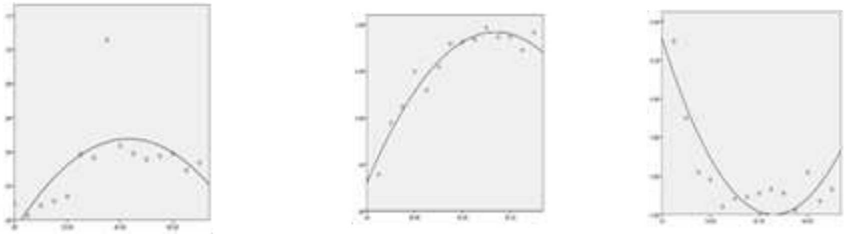
The growth curve also shows that at 5 to 35 hours of culture, the log phase has been characterized by significant growth, and the log phase lasts for 30 hours. At 35 hours of culture, it has the OD of 1.7950, pH of 5.49, and biomass of 0.1057 gr/ml. At the log phase, the microbes grew rapidly. The cell log phase produces many metabolic substances needed to meet their needs in the context of growth (Kosim and Putra, 2010) [1].

At the 35 to 60 hours of growth, *S. cerevisae* experienced a relatively fixed growth phase because it began to enter the stationary phase. At 60 hours of culture, it has the OD of 1.8694, pH of 5.62, and biomass of 0.0388 gr/ml. The size of the cells in the stationary phase will be smaller because the cells continue to divide even though the media nutrients have started to run out (Setyati *et al*., 2015) [16].

Figure 1 present the growth curve of *Saccharomyces cerevisiae* yeast on biomass (a), OD (b), and pH. (c).

The next phase of death occurs at 60 to 70 hours of culture, with a decrease in the rate of growth caused by a lack of growth nutrients such as vitamins and mineral elements, and a reduction in some essential nutrients in the media or due to the accumulation of autotoxins in the media, or a combination of both (Gaman and Sherrington, 1994) [8].

In the death phase, which is at 60 to 70 hours of culture, there is an autolysis process that degrades mannoprotein from the cell wall by glucanase and proteinase enzymes so that the mannoprotein is released from the cell wall.



(a) Biomass (b) OD (C) pH

Fig.1. The growth curve of *Saccharomyces cerevisiae* yeast on biomass (a), OD (b), and pH. (c).
Notes: The vertical direction shows the time of growth and the horizontal direction shows the results of growth.
Source: Own results in the laboratory.

The cell wall of newly formed yeasts is very thin and when it gets older it will get thicker (Madigan *et al.*, 2012) [12]. Mannoproteins that have been released from cell walls can be used as bioemulsifiers. The presence of a mannose hydrophilic polymer binding to a protein provides mannoproteins with an amphiphilic structure for its surface. This amphiphilic structure is effective as emulsifiers (Dikit *et al.*, 2010) [6].
In this study, the extraction process of *S. cerevisiae* yeast mannoprotein was using a 500 ml medium formula with an incubation period of 70 hours at 25^{o}C. Mannoprotein sediment which was obtained from the extraction process were 3.2 grams which were then diluted with a ratio of 1:20 ml. The results obtained from EA 1 hour is 50% while the 24-hour time is 50%. Mannoprotein which has been diluted and tested for its emulsification activity is then used as an emulsifier in sausages.

Sausages

Fresh meat can be processed into ready to serve products, such as sausages (Prayitno *et al*., 2009) [15]. The main component of sausages consists of meat, fat, and water, while other additives such as salt, phosphate, preservatives (nitrites/ nitrates), coloring agent, ascorbic acid, protein isolates, and carbohydrates (Soeparno, 2011) [17]. The results of using *S. cerevisiae* yeast in the formation of mannoprotein on the sausages physical quality in various treatments are presented in Table 1.

Table 1. Average Physical Quality of Sausages in various Treatments

Treatments	**Average**		
	Water-holding Capacity (%)	Cooking Loss (%)	Tenderness (mm/g/10s)
P_0	27.39	1.45	77.02
P_1	25.91	1.79	67.83
P_2	23.26	1.57	77.17

Notes:
P_0: Sausages without mannoprotein addition (control)
P_1: Sausages with 0.8% of mannoprotein addition
P_2: Sausages with 1.6% of mannoprotein addition
Source: Own results in the laboratory.

Water-holding Capacity

Table 1 shows that the sausage at P_0 group had the highest water-holding capacity compared to other treatments (27.39% vs 25.91% of P_2 and 25.91% of P_1). Furthermore, to find out what extent the water-holding capacity of sausage is affected by the addition of mannoproteins, statistical analysis with variance, showing that mannoproteins had a significant effect ($P<0.05$) on the binding capacity of sausage water. To find out the differences between treatments, the Tukey Test was carried out.
The significant difference found in sausages with mannoprotein addition of 1.6% (P_2) compared with sausages without mannoprotein (P_0) might be caused by the addition of mannoprotein which played a role

as an emulsifier. The emulsifier itself has both hydrophilic and lipophilic groups or also called amphyphilic molecules (Dikit *et al.*, 2010) [6]. The hydrophilic group has water-holding properties which results in the more water contained therein being bound by the emulsifier (meat protein and mannoprotein) used.

Water-holding capacity is the ability of meat to hold water or water added during external treatment such as cutting, heating, grinding and processing. The less free water that comes out of meat might indicate that the meat sample has a high water-holding capacity, and vice versa (Soeparno, 2011) [17].

Table 2. Tukey Test of Water-holding Capacity of Sausages in Various Treatments

Treatment	Average	Significance
	……%.......	
P_2	23.26	A
P_1	25.91	AB
P_0	27.39	B

Notes: Different superscripts vertically in significance column shows a significant difference
Source: Own results in the laboratory.

The significant difference found in sausages with mannoprotein addition of 1.6% (P_2) compared with sausages without mannoprotein (P_0) might be caused by the addition of mannoprotein which played a role as an emulsifier. The emulsifier itself has both hydrophilic and lipophilic groups or also called amphyphilic molecules (Dikit *et al.*, 2010) [6]. The hydrophilic group has water-holding properties which results in the more water contained therein being bound by the emulsifier (meat protein and mannoprotein) used.

Water-holding capacity is the ability of meat to hold water or water added during external treatment such as cutting, heating, grinding and processing. The less free water that comes out of meat might indicate that the meat sample has a high water-holding capacity, and vice versa (Soeparno, 2011) [17].

Cooking Losses

Table 1 shows that the average sausage cooking loss in various mannoprotein treatments. Sausages without mannoprotein addition (P_0) had the lowest cooking loss percentage (1.45%). The addition of mannoprotein as much as 0.8% (P_1) seemed to increase the cooking losses (1.79%). Furthermore, the addition of mannoprotein by 1.6% (P_2) decreases the sausage cooking loss to the point of 1.57%. To find out what extent sausage cooking losses are affected by addition of mannoproteins, statistical analysis was performed by analysis of variance, showing that the mannoproteins did not have a significant effect ($P>0.05$). Sausage with mannoprotein does not have a significant effect on cooking losses, which is caused by the use of mannoprotein in liquid form, which it might cause more water evaporation by increasing water content in sausages.

Cooking loss is an indicator which shows the amount of component that is lost during cooking. During the cooking process, the loss of water is affected by the water holding capacity of the meat protein. The more water that can be retained by protein during cooking, the less water comes out, causing low cooking losses. Meat with a low amount of cooking loss has good quality because it loses less nutrients when cooked (Soeparno, 2011) [17].

Tenderness

Table 1 shows that the average sausage tenderness in various mannoprotein treatments. P_2 had the highest level of tenderness (77.17mm/g/10s), while the lowest level found in P_1 (67.83mm/g/10s). Furthermore, to find out what extent sausage tenderness is affected by mannoprotein addition, a statistical analysis was performed with an analysis of variance, showing that addition of mannoprotein had no significant effect ($P>0.05$) on sausage tenderness.

Sausage with mannoprotein did not have a significant effect on sausage tenderness due to the use of liquid form mannoprotein. Increased water content seemed to affect the water holding capacity of sausage, which seems to have a direct relation with meat tenderness. The use of mannoprotein as an emulsifier is expected to help the protein binding process with water which will affect the water holding capacity which will then help the process of meat tenderization.

Meat tenderness is influenced by several factors, including antemortem factors, postmortem factors, meat storage temperature, and methods for increasing tenderness (Soeparno, 2011) [17]. The tenderness of processed meat products is influenced by the type of fillers used, water, fat, and protein content. Increased protein levels will increase the tenderness of processed meat products because it will increase the level of bound water (Lukman, 1995) [11].

CONCLUSIONS

In conclusion, the media formula can be used as a growing medium of *Saccharomyces cerevisiae*. Mannoproteins are produced from the *S. cerevisiae* cell wall in the death phase (hours 60 to 70), resulting in sediment as much as 3.2 grams and have a value of emulsification activity for one and 24 hours by 50%. The addition of *S. cerevisiae* yeast mannoprotein has a significant effect on the water holding capacity, while it has no effects on cooking loss and sausage tenderness.

Further testing is needed regarding the type of mannoprotein extracted from *Saccharomyces cerevisiae*.

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CONSUMER PERCEPTIONS OF NON - TRADITITONAL CEREALS (BARLEY AND EINKORN) AND THEIR PRODUCTS IN REPUBLIC OF CROATIA, REPUBLIC OF BULGARIA AND REPUBLIC OF MACEDONIA

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Abstract

The aim of this paper is to study the opinion on the use of non-traditional cereals (barley and einkorn) in three different countries (Bulgaria, Macedonia and Croatia). In Bulgaria 81.90% were men and the other 18.10% were women. In Macedonia, 33% of men and 67% of women completed the survey, while in Croatia 14% of the respondents were men and the remaining 86% were women. More than half of the respondents consume cereals and cereal products. Those that consume cereals believe that whole grains have a positive impact on health. Those who do not consume cereals, do so because they are on a diet or have intolerance to cereals. In Bulgaria and Croatia, the reason listed for not consuming cereals is dieting. The most frequently consumed cereal product is bread. In Bulgaria, following closely after bread are cookies, and in Croatia and Macedonia, muesli are second used products. People from Croatia, Bulgaria and Macedonia know that barley is used in beer production, but a few people know for bread, cookies and other bakery products makes with barley flour. More than 1/4 of the respondents in Croatia and Macedonia do not know about einkorn (Triticum monococcum L.) and their products.

Key words**:** *barley, cereals, einkorn, public opinion*

INTRODUCTION

Cereals such as wheat, corn, rice, oats, barley and others are also known as "functional cereal products" [6]. According Functional Food Science in Europe, functional foods are defined with the following terms: conventional or daily foods or supplements; naturally occurring within food; with proven positive influence on certain functions of the organism [20]. WHO and the food industry are tasked with familiarizing consumers with a healthy lifestyle, as well as with the possibilities for reducing the risk of chronic diseases. In this context, functional foods have a significant impact. They refer primarily to the nutritional value of a product, but also have a preventative role – to reduce diseases by using such raw materials, which improve the health, physiological and metabolic effects [4, 12]. Whole-grain foods are part of the "healthy food" trends due to the positive influence on human health [8].

The barley's grain belongs to the family *Poaceae*, genus *Triticeae* и *Hordeum*. Currently the most used barley in the world is from the genus *Hordeum vulgare*. Barley is a cereal crop that has been used in the production of bread since the Neolithic era. It is thought to have initially been cultivated in the Southwest of Asia or North Africa, while wild barley forms can still be found in West Asia [27].

Einkorn is one of the oldest cereals, suitable for organic production. Compared to other cereals, einkorn is more resistant to disease and crude climate. This type of wheat is still cultivated in dry lands in Italy, where other cereals cannot grow. Einkorn has a significantly lower yield compared to other cereals. It is originally from Turkey's highlands and is a wild predecessor of the T. *baeoticum Boiss* [11, 14].

The aim of this paper is to study the opinion on the use of non-traditional cereals (barley and einkorn) in three different countries

(Bulgaria (BG), Macedonia (MKD) and Croatia (CRO)). The survey in Croatia was conducted in the Osijek-Baranja County, in Bulgaria - Razgrad region, and in Macedonia in the city of Skopje.

According to the latest census in the Republic of Croatia (2015) 292 494 persons live in the Osijek-Baranja county [5]. According to the last census in Bulgaria, there are 115,402 people living in the Razgrad region [18]. According to the last census, 506 926 people live in the city of Skopje [25].

MATERIALS AND METHODS

The internet survey was uploaded on the Google platform. It was an anonymous survey. A total of 401 (149 from BG, 143 from CRO and 109 from MKD) persons participated in the survey. The survey was conducted in the period from 11/01/2019 to 11/02/2019.

The first part contains questions pertaining to social-demographic data (sex, age and education). The second part deals with the use of functional foods, as well as the knowledge of non-traditional cereals (barley and einkorn). A total of 16 questions were asked, and the time needed to complete the survey was 10 minutes. The survey in the Republic of Bulgaria (Razgrad region) and the Republic of Macedonia (City of Skopje) was completed in the period from 01/09/2019 to 01/10/2019 and the results are presented by Nakov et al., 2018 [16]. This paper will compare the results from Bulgaria and Macedonia, with the new results from Croatia.

RESULTS AND DISCUSSIONS

From the data presented in Table 1 it can be seen that in BG, most of the respondents are male, whereas in MKD and CRO the majority are women (67.00% and 86.00% respectively). According to their age in BG and CRO, the majority of the respondents are aged 21-30, while in MKD the majority of the respondents are aged 31 to 40 – 31.50%. In accordance with their education, in all three states where the survey was conducted, the majority of respondents have finished their high education (68.50% in BG; 60.60% in CRO and 58.70% in MKD).

Table 1. Social and demographic characteristics of the respondents

		Bulgaria (BG)		**Macedonia (MKD)**		**Croatia (CRO)**	
		Number	%	Number	%	Number	%
SEX	male	27	81.90	36	33.00	20	14.00
	female	122	18.10	73	67.00	123	86.00
Age	under 20	10	6.70	13	11.90	4	2.80
	21-30	47	31.50	50	45.90	44	30.80
	31-40	42	28.20	22	20.20	45	31.50
	41-50	38	25.50	21	19.30	33	23.10
	51-60	8	5.40	3	2.80	15	10.50
	over 60	4	2.70	-	-	2	1.40
Education	Primary	2	1.30	5	4.60	4	2.80
	Secondary	39	26.20	38	34.90	28	19.60
	Higher	102	68.50	66	60.60	84	58.70
	Ph.D	6	4.00	-	-	-	-

Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeKFUEXCBfD-DpLtad-qQf71t3lyLH4Dnsv0wgEL4MhZESYlA/closedform, Accessed on: 15.02.2019.

In the three countries, more than half of the respondents answered positively to the question "Do you eat cereals"? In BG and CRO only 0.70% said that they do not consume cereals, while in MKD only 6.40% of the respondents do not consume cereals. The remaining percentage stated that they only consume cereals occasionally. The answers are presented in Fig. 1.

Fig. 2 presents the possible reasons as to why people do not consume cereals in the three countries. In MKD, an equal percentage of those surveyed do not consume cereals and cereal products because they suffer from celiac disease (autoimmune disease) or are on a diet.

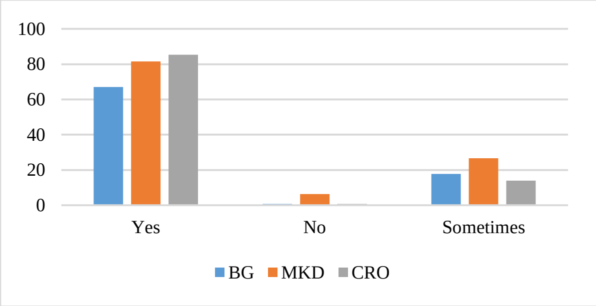

Fig.1. Answers to the question "Do you eat cereals?"
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSdv1d3P4hV45tdXuNcXxHo3bpgSv7kI9aewAwh_BEwmrC3SLA/viewform, Accessed on: 15.02.2019.

Cereal intolerance is present in 1-3% of the world's population, but this percentage is different in different countries. Proteins (gliadin and glutenin) found in the different types of wheat and similar proteins that are found in barley and rye are the main culprits for this disease, known with one name "gluten" [9]. Almost half of the respondents in Bulgaria (42.90%) and CRO (44.40%) do not consume cereals because they are on a diet.

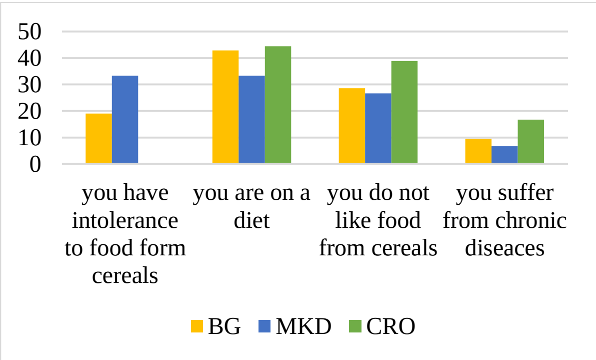

Fig. 2. Possible reasons for not using cereals
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeKFUEXCBfD-DpLtad-qQf71t3lyLH4Dnsv0wgEL4MhZESYlA/closedform, Accessed on 15.02.2019

The answers to the question "Which cereal product do you consume most often?" are represented in Fig. 3. The surveyed people in the three countries answered that they mostly consume bread, and more specifically 78.80% in Bulgaria, 78.90% in Macedonia and 85.30% in Croatia. These percentages confirm the fact that bread is an essential part of our daily diet [22]. The least consumed cereal foods in Macedonia are muffins, polenta in BG and bread sticks in CRO. One of the reasons for the low consumption of muffins may be that they are high-calorie products [23]. In recent years, consumers' opinions on the nutritional status of food and proper feeding have been increasing. Because of this, consumers are increasingly focused on a balanced and healthy diet.

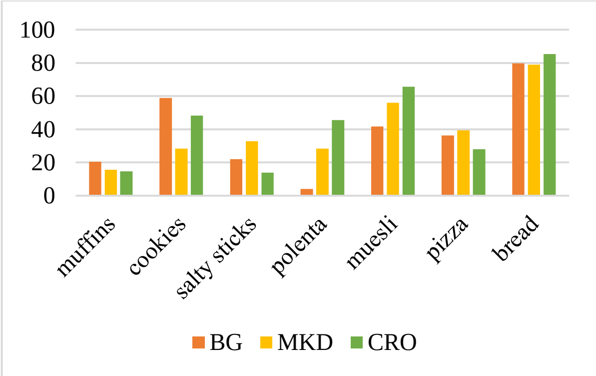

Fig. 3. Answers to the question "What do you usually consume from the food from cereals?"
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeQ47HTFYhhPUqqGd6bMg4RlKruG8O_soXGRgHyiQO-xf61Lw/closedform, Accessed on 15.02.2019.

In addition, consumers pay great attention to the labels of foodstuffs, and they require information on whether the selected foods are safe and quality [15].

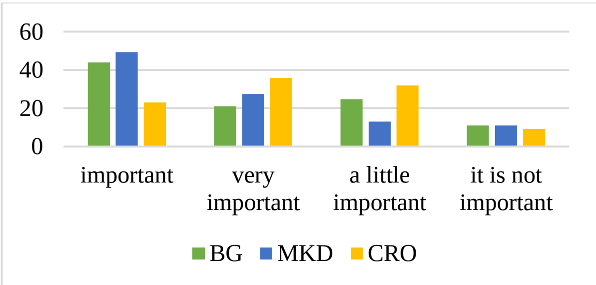

Fig. 4. Answers to the question "Is it important for you to have proper information about the ingredients and energy value of cookies?"
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSdv1d3P4hV45tdXuNcXxHo3bpgSv7kI9aewAwh_BEwmrC3SLA/viewform, Accessed on 15.02.2019.

To the question "Is it important for you to have complete information about the composition and nutritional value of the cookies?", 49.30% of the respondents in BG and 44.00% in MKD believe that it is important for them to have complete information about the composition and nutritional value of the cookies. Unlike this group, 35.70% of the respondents in CRO consider this information very important (Fig. 4).

Whole grain products are considered better regarding nutrition, but also as healthier and more natural [2, 19].

When asked "Do you think that whole grain products have a positive impact on health?" the respondents from the three countries had a positive response (Fig. 5) which means that the surveyed persons are aware of the positive impact of whole grain products on human health.

The percentage of respondents who believe that wholegrain products do not affect human health is the smallest.

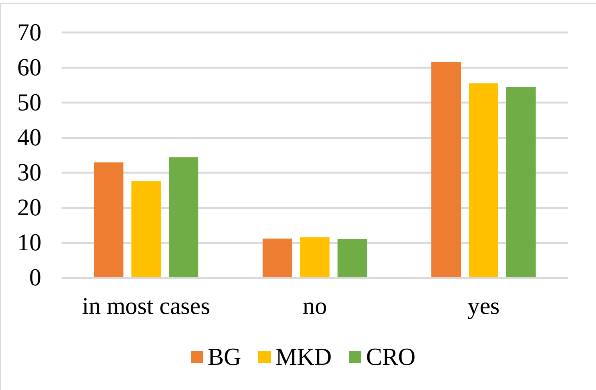

Fig. 5. Answers to the question “Do you think that wholemeal products (products from whole wheat grain) have positive effect on Your health?”
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeQ47HTFYhhPUqqGd6bMg4RlKruG8O_soXGRgHyiQO-xf61Lw/closedform, Accessed on 15.02.2019.

Cookies are popular products made from various cereals that are consumed all over the world [10, 26].

Fig. 6 presents the answers to the question “Would you buy cookies, which with regular consumption, could reduce the risk of certain diseases?”. Most of the respondents in Croatia, Bulgaria and Macedonia responded that they are willing to buy cookies that reduce the risk of certain diseases.

Barley is one of the oldest cultivated cereals in the world. It is becoming increasingly popular among manufacturers of functional foods primarily because of the high concentration of β-glucans [7, 13, 21, 24].

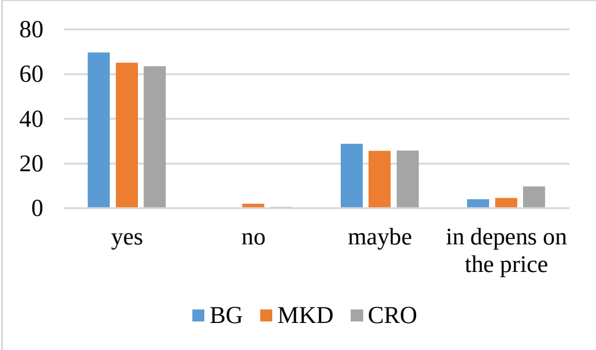

Fig. 6. Answers to the question “Would you buy cookies, which with regular consumption, could reduce the risk of certain diseases?”
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeKFUEXCBfD-DpLtad-qQf71t3lyLH4Dnsv0wgEL4MhZESYlA/closedform, Accessed on 15.02.2019.

To the question “What is barley used for?” almost all respondents in Macedonia and Croatia responded that it is used in beer production, while in Bulgaria that percentage is 79.50%. Fig. 7 shows that almost equal percentage of respondents in Croatia and Macedonia think that barley is used in the production of cookies.

Einkorn is a diploid on hard and bread wheat, significant because of the high content of proteins, carotenoids and tocols, as well as due to excellent organoleptic characteristics [3].

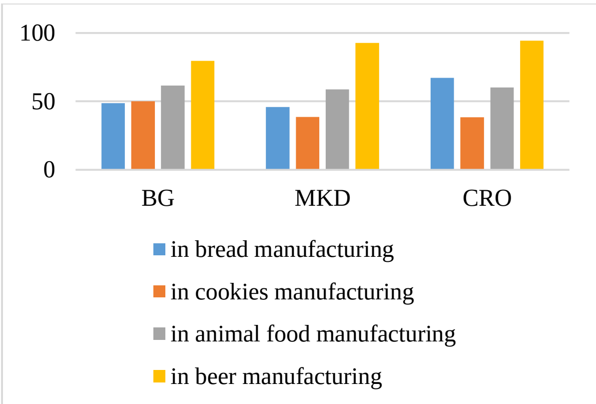

Fig. 7. Answers to the question “What is barley used for?”
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeQ47HTFYhhPUqqGd6bMg4RlKruG8O_soXGRgHyiQO-xf61Lw/closedform, Accessed on: 15.02.2019.

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Today, the single grain einkorn is cultivated in the Mediterranean region, but there is an increased interest in re-cultivating this culture due to frequent scientific theories about the nutritional aspects of this type of wheat, primarily because of the prevention of diseases like cancer, diabetes and chronic diseases. Due to the excellent nutritional composition, this type of wheat is recommended for the production of new types of food such as macaroni and other bakery products, baby foods and fortification of already existing food [1].

Fig. 8 shows that most of the respondents in Croatia and Macedonia answered that they have not heard of this type of cereal until now, while in Bulgaria this percentage is much lower.

The reason for this is that in Bulgaria this kind of cereal is very popular and products produced from it can be found everywhere. In one of our previous papers, we have proven that there is a real possibility for the production of cookies that contain 30%, 50%, 70% and 100% einkorn flour [17].

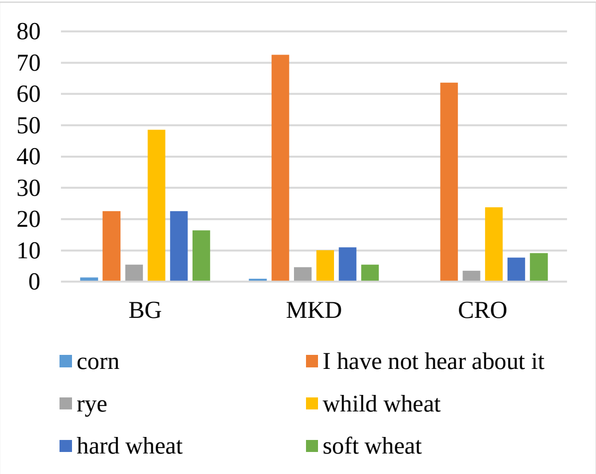

Fig. 8. Answers to the question “What type of cereal is *Triiticum monoccocum*?“
Source: Google Drive: https://docs.google.com/forms/d/e/1FAIpQLSeQ47HTFYhhPUqqGd6bMg4RlKruG8O_soXGRgHyiQO-xf61Lw/closedform, Accessed on 15.02.2019)

CONCLUSIONS

The survey shows that most of the respondents in the three countries (Bulgaria, Croatia and Macedonia) consume cereals and cereal products. The reason why some of the respondents do not consume cereals in BG and CRO is that they are on a diet, whereas in MKD the reason is due to the intolerance to the cereals and food produced by them. Bread is the product most widely used by people in all three countries. Most of the respondents consider that whole grain products have a positive impact on human health. They also consider that if these products are sold, regular consumption can reduce the occurrence of various diseases and most of the respondents would consume this type of food. In the three countries where the survey was conducted, respondents consider that barley is used in beer production, and very few of the respondents think that barley can be used in the production of cookies. Einkorn is a cereal which is not familiar to the majority of people in Croatia and Macedonia, while in Bulgaria this percentage is much lower. This is due to the fact that this type of cereal cannot be found on the markets in Macedonia and Croatia.

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THE EFFECT OF HADEJIA-JAMA'ARE RIVER BASIN DEVELOPMENT AUTHORITY ON DRY SEASON FARMING IN KURA LOCAL GOVERNMENT AREA OF KANO STATE, NIGERIA

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Abstract

The study assessed the effects of Hadejia Jama'are River Basin Authority on dry season farming in Kura Local Government Area. The Purposive sampling technique was used to select 3 villages in the area in which 120 respondents were selected using simple random sampling. Data collected were analyzed using descriptive, statistics, percentages and Net farm income model to achieve the objectives of the study. The results from the costs and returns analysis shows the dry season farming production in the study area was profitable. The average returns per Naira Invested the farmer will realize 2 Naira. Thus the net farm income obtained is higher than the total costs incurred by the dry season farmers in the study area. This indicates that there is positive effects/impact on dry season farming in the study area. Income can still be improved upon with appropriate pricing, adoption of proper management practices, uniform water fee collection policy and accessing low cost inputs through bulk purchasing by farmers cooperatives. The constraint faced by the dry season farmers are limited access to credit, irrigation pumps and accessories, marketing system, seed, fertilizer, diseases and pests. It is recommended that appropriate input pricing, access to bank loan, provision of good marketing system, formation of FADAMA users association with aim of purchasing seed, fertilizer and chemicals which will help to reduce the cost and adoption of proper management practices will improve income.

Key words: *effect of dry season farming, dams, water resources, Shadoof irrigation*

INTRODUCTION

Irrigation farming as the name implies, is an Agricultural phenomenon in which water is artificially supplied to the soil for the purpose of sustaining plants growth [2]. It has provided and continues to provide the basis of crops production in many countries. This is essentially true in areas where rainfall inadequate or unreliable [9]. Shadoof irrigation was only practiced on a limited scale via on a narrow strip of land along river; the water was used by vegetable growers. The produce was sold along the high or in the market. In Nigeria, irrigation started as a supplemental measure to natural rain, it provided on insurance against short drought spell during the wet growing season [1].
According to [2] the population of Nigeria particularly of the Northern states is growing at a faster rate. This required an intensified effort in terms of food supply employment opportunities and raising standard of living. To render this possible, attention was given to natural resources of this country, by developing water resources. The adopting of irrigation farming in Kano state was made obligatory in 1965-1968 by the United States Bureau of reclamation made a reconnaissance study of the water resource of Chad Basin which is financed by the United States agency for international development (USAID). One

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of the analysis included the possibility of construction of several dams on rivers that drain the upper the upper reaches of the Chad basin through the Hadejia and Yobe Rivers into lake Chad [7]. The Hadejia- Rivers Basin Development Authority (HJRBDA) was taken over from the Ministry of Agriculture and Natural Resources (MANR), Kano state in 1976. Operationally Hadejia-Jama’are River Development Authority (HJRBDA) covers areas in Kano, Jigawa and Bauchi States a potential irrigable space of 250,000 hectares. The objectives of the authority among include conservation, harnessing and utilization available water resources jurisdiction for increased agricultural production and domestic water supply [6]. The effect of the project on the communities included as supplemental measure to natural rain. Irrigation has played a major role in expanding the level of food production, leading to the attainment of food sufficiency and overall Agricultural development in some developing countries [5]. Irrigation farming it raised the income of the farmers, it creates greater employment opportunities, it improves the standard of living of the rural dwellers and reduces the rural urban drift to the minimum level [2].

This programmed of Hadejia- Jama’are River Basin Development has the mandate of tapping the area that has Dams and Rivers to produce variety of crops under irrigation after rain fed cropping activities. This includes mobilization of farmers into Fadama User Association (FUA) and provision of necessary infrastructures [4].

According to [3], that positive impact of irrigation on Agricultural environmental resources management worldwide has been noted. However, irrigation development has been going on amidst a variety of constraints in Nigeria. On this basis the study assessed the effect of the Hadejia – Jama’are River Basin Development Authority project in the study area.

Problem Statement

The study provides the answers to the following research questions.

(i)What are the socio-economic characteristics of the irrigation farmers in the study area?

(ii)How profitable the dry season farming production in the study area?

(iii)What are the constraints affecting dry season farmers in the study area?

Objectives of the study

Overall objective of this study was to analyze the effects of Hadejia-Jama’are River Basin Development Authority in dry season farming in Kura Local Government Area of Kano State.

The specific objectives are:

(i)To determine the socio-economics characteristics of the farmers involved in irrigation in the study area.

(ii)To determine the profitability of the dry season farming in the study area.

(iii)To identify the constraints affecting dry season farmers in the study area.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Kura Local Government Area of Kano state. It consist of eighteen villages, major villages with Headquarter at Kura town. It is about 30km south of Kano state along Kano-Zaria express road. It has average temperature of 35°C and rainfall of 1,100 mm respectively with projected population figure of 137,992. It shares boundaries with Dawakin Kudu, Bunkure, Garun Malam, Madobi and Kumbotso Local Government Areas by East, South, West and North. The area lies in Sudan savannah zone which is characterized with the abundance of grassland that makes the rearing of livestock easy and suitable; it is less prone to Tse-tse fly infestation which militates against rearing of livestock due to suitable environment with good intensity of sunshine. The area has two distinct seasons like any town in the Nigeria that is rainy season and dry season, with establishment of Rural Basin Development in the country.

Hadejia-Jama’are River Basin Development Authority established Kano River Project phase 1 almost entirely within Kura Local Government due to its suitability in irrigation development. This development makes it possible in the area to crop two times annually that is dry and wet seasons. This climatic condition is for the growing of wheat, tomatoes, onions, rice and many other vegetable crops in dry season and rice, maize, sugar cane during wet season. As such the people of Kura are predominantly farmers and traders except for the few settlers.

Sampling Procedure and Size

Purposive sampling was used to select three (3) Villages in the Local Government Area (LGA) of Kura due to high number of dry season farmers in the area. Random sampling was used in selecting the respondents from each village (Kura, Kosawa and Karfi). The villages have 60, 35 and 25 respectively. A total of (120) one hundred and twenty respondents were selected in the study areas.

Data Collection

Primary data was used for this study. Data were collected using structure interview schedule. This was used because some of the respondents were illiterates and has to be guided. The questions were both closed ended and open ended for better understanding of the questions by the respondents.

Data Analysis

Data collected were analyzed by descriptive statistics such as range, frequency distribution and percentages to achieve the first and the third objectives. The second objective was achieved using farm budget model.

Farm Budgeting Model

Farm budget model is a tool used to determine the level of resources used and output realized in farm enterprises with a view to measuring the profit level of the enterprise [8]. The farm budget model was used to compute the cost and returns in dry season farming production in the study area.

This is :

NFI = GI – TC ----------- (1)

Where:

NFI = Net farm income (Profit), refers to the difference between gross income and total cost.

GI= gross income. This represents the sum of the total value of all the cost at the end of production

TC = total cost, this represents all the enterprises incurred in production by the farmers. This include seeds (X1), fertilizer (X2), chemicals (X3), labour (X4), Tractor (X5) and sprayer (X6).

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of the Respondents

Table 1. Distribution of respondents by socio-economic characteristics

Demographic factors	Frequency	Percentages
Gender		
Male	105	87.5
Female	15	12.5
Marital status		
Married	75	62.5
Single	45	37.5
Household size		
1-5	55	45.8
6-10	65	54.16
Educational level		
Illiterate	60	50
Primary	30	25
Secondary	20	16.6
Tertiary	10	8.3
Years of experience		
1-5	40	33.3
6-10	65	54.16
11-20	15	12.5
Types of crops grown		
Vegetables and cereals	55	45.8
Vegetable only	30	25
Cereal only	25	20.8
All of the above	10	8.33
Source of water		
Open stream	10	8.33
Dam	70	58.33
Wash bore/tube well	30	25
Local well	10	8.33
Level of extension agent activities		
Participatory	75	62.5
Satisfactory by training	40	33.3
No effect	5	4.16
Source of capital		
Kano state Agricultural loan scheme	60	50
Commercial Banks	50	41.66
Cooperative society	10	8.33

Source: Field survey 2019.

The socio-economic characteristics of the respondents consider in this study include gender, marital status, household size, educational level, years of farming experience, types of crop grown, source of water extension agents level of activities in irrigation and source of capital.

The results in the table above show that, most of the respondents were males at the proportion of (87.5%) that engaged in dry season farming activities. This confirmed the popular belief about the study area that farming was the major occupation which male folks dominate in the activities. Majority of the respondents (75%) are married. This shows that the society places high premium on marriages and can be considered responsible and rational in taking decisions that affect agricultural productivity and income. Table 1 also reveals that most of the respondents have large household size. The household size plays a very important role as it serves as source of family labour requirement and cost saving. Hence, the number of people in a household determines the availability of labour in the family. The larger the family sizes the less cost of hired labour which increases profit for the farmers. The level of education of the respondent’s shows that most was illiterate indicating that if the farmers to be educated the level of their production will improved and earned more profit. The result shows 54.16% of the respondents have 11-20 years of experience in dry season farming which indicates that the higher the years of experience of the farmers the more output realized which increase higher net farm income. It is expected that the years of experience in dry season farming production usually determines the effectiveness of farmer’s decision with respect to resources allocation. Table 1 reveals that 45.8% of the respondents mostly produce vegetable and cereals that will help them to earned higher net farm income.

It indicates that if one’s fail the other one’s raised him up. Table 1 also indicates that majority of the dry season farmers (58.33%) used Dam water as their source provided by the Hadejia-Jama’are river Basin Authority Development. Also Table 1 shoes that 62.5% of the respondents get access to participatory level of extension agents’ FADAMA1 development activities that would enable them to grasp new innovation and perception. Table 1 reveals that 50% of the respondent’s access to credit that would enable them to improve their productivity and income

Net farm income analysis of dry season farming

The cost and returns analysis was employed to determine the profitability of this production, the returns to be compared with total costs, if the total return is greater than total cost, the enterprise is said to have profit. Thus, the profitability or net return of an enterprise is taken as total revenue less total production, these consist of costs incurred on inputs such as seed, fertilizer, chemicals, labour, tractor and sprayers.

From Table 2, it could be seen that average net farm income obtained from all the respondents 308,811.26 Naira. This finding is consistent on the profitability of dry season farming production. The size and the positive value of the net farm income show that the respondents were able to cover their total expenses with level of sizeable proportion as a return to farmers. This shows dry season farming production is profitable.

Table 2. Average Cost and Returns of Dry Season Farmers Per 120 Respondents in the Study Area

Cost Items (Naira)	**Amount (Naira)**	**Percentages**
Variables		
Seed	45,200	22.32
Fertilizer	75,800	37.44
Chemicals	30,000	14.82
Labour (family and hired)	48,500	23.95
Total variables costs	202,500	98.53
Fixed costs		
Depreciation on tractor	8,540	0.03
Tractor	45,261.86	0.16
Sprayers	15,400	0.05
Total fixed costs	69,201.86	0.25
Total costs	271,701.86	99.02
Total revenue	37,109.4	
Net farm income	308,811.26	
Return to naira invested	2	

Source: field survey 2019.

In the study area, the average returns per naira invested the farmer will realize 2 Naira. The implication of this is that farmers raising dry season farming will survive both in the short and long run because the resources engaged in its production were efficiently utilized.

Constraints facing the dry season farmers

The dry season farmers in the study area were faced by many problems. The problems encountered were capital, irrigation pumps and accessories, marketing system, seed, fertilizer, diseases and pests.

Table 3. Distribution of the respondents according to the constraints militating against dry season farming

S/N	Types of constraints	Frequency	Percentage
1.	Lack of capital	20	16.6
2.	Irrigation pumps and accessories	20	16.6
3.	Marketing system	40	33.3
4.	Seed and fertilizer	25	20.8
5	Diseases and pest	15	12.5

Source: Field Survey, 2019.

Table 3 indicates that 33.35 % of the respondents mostly reported that marketing system was their major problems followed by the seed and fertilizer respectively.

CONCLUSIONS

It has been concluded convincingly from the study that much income can be generated from small unit of land within shortest period of time.

Recommendations:

-Based on the technical and management skills required standard of Agricultural productivity, education of farmers must be given timely attention.

-Necessary inputs and other irrigation facilities should be available to farmers well ahead of planting season to enable farmers adopt correct planting dates.

-Government should give more emphasis to credit facilities

-Government should make provision of market environment for the farmers to sell out their products.

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SEASONALITY AND DEGREE OF CONCENTRATION OF NIGHTS IN TOURIST RECEIVING STRUCTURES, IN TULCEA COUNTY, IN THE PERIOD 2010-2018

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Abstract

Tourism represents in Romania one of the economic sectors with real possibilities for long-term development, also being a means of creating and improving the image of our country abroad. A dominant feature of tourism activity is seasonality, which must be taken into account when proposing and formulating marketing policies. This is also one of the difficulties faced by tourism companies. In order to be able to make forecasts but also lay the foundations for strategies of evolution and sustainable development of a tourist area, it is necessary to take into account all the environmental characteristics of the area in which it is desired to carry out a tourist activity, but also the evolution of its components. Seasonality in tourism can be influenced by various factors such as: the natural ones (the change of seasons or climate), the periodicity of cultural activities and manifestations, but also the organizational factors related to the periods of holidays, holidays, holidays. The main purpose of this paper was to determine the seasonality of the tourist demand and implicitly its degree of concentration throughout Tulcea County, taking into consideration the period 2010-2018. The study of the phenomenon of concentrating the tourist activity in certain months and implicitly the need to attenuate the seasonality curve in the tourist reception structures is a way to understand the evolution of the tourist activity over a period of time. The identification of the tendency of this curve for the following periods can lead to the elaboration of solutions that can eliminate the factors that influence the seasonality of the tourist activity.

Key words*: *tourist seasonality, seasonality indices, coefficient of concentration

INTRODUCTION

Tourism is characterized as an economic-social phenomenon, which is influenced by the evolution of modern society, it addresses large social segments, trying to meet their needs. Through this sector, both material and human potential are trained. Tourism can be of several forms: for recreation, rest, entertainment, religious, cultural, sports, treatment and balneoclimatic, hunting and fishing and so on [3].

Analysing the tourism behaviour in the tourism sector, different factors were identified such as: climate and weather (Scott, Mc Boyle, 2004, H. Song & Li, 2017) cited by [6, 8] but also institutional factors such as working and vacation periods, all having an important role in determining the seasons of the tourist seasons [5].

An important aspect that can affect tourism is the seasonality. Analysing and measuring the seasonality in tourism represents a complex and difficult task that involves both the determination of the causes and the consequences. An imbalance of the phenomenon of tourism that manifests temporarily can be considered the seasonality, this being expressed by the volume of tourists or visitors, the available work places, the traffic, etc. [2].

By counting the departures and arrivals of tourists from a certain tourist area, a quantitative measurement of the demand is made, while the expenses incurred during the stay represent the economic value of the demand for a certain tourist area [1].

By unequal distribution of tourist demand and consumption (seasonal variations), were identified three periods throughout a calendar year:

-The first period - the peak season (characterized by the maximum intensity registered of the tourist activity)
- The second period - beginning and ending of the season (intermediate season) - period in which there is an increase in the volume of activity and respectively a gradual decrease
- Third period - the extra season, a period that is characterized by the reduction or even the cessation of the tourist services [7].

For the tourism in Romania, the overlapping of seasonal variation curves, indicates a stronger concentration in the hot season, which is valid for all forms of tourism [9].

MATERIALS AND METHODS

The seasonality of the tourist activity can be quantified with the help of specific statistical-mathematical methods such as: seasonality indices, concentration coefficients, traffic intensity coefficients, etc.

The analysis includes data series comprising the accommodation capacity and the number of tourist nights, for the period 2010-2018 in Tulcea County, the data being taken from the Statistical Yearbooks of Romania, time series and NIS, TEMPO-online databases and processed using seasonality-specific indicators.

Specific seasonality indices can be determined by using the method of arithmetic means, based on dynamic series regarding the distribution by months, quarters of tourist arrivals [11, 12] The arithmetic mean method will be used for the calculation of the seasonality coefficients. Seasonality indices will be calculated according to the relationship below:

$$I_s = \frac{\bar{y}_l}{\bar{\bar{y}}} \cdot 100$$

Where:
$\bar{y}_l$ - represents the monthly average
$\bar{\bar{y}}$ - represents the general monthly average

The more the value of the seasonality coefficient tends to 100, the lower the seasonality, while the removal of 100 reveals an accentuated seasonality [7].

The intensity of the seasonality (or the form of the concentration degree) can be evaluated by calculating the Struck concentration coefficient (Cs). By calculating the Struck concentration coefficient (Cs), one can characterize both the intensity and the tendency of the seasonality:

$$C_s = \sqrt{\frac{n \sum g_i^2 - 1}{n - 1}}$$

where:
g_i – weight of each category in total
n - number of moments / categories

The Struck concentration coefficient (C_S) can take values in the range [0; 1]. If the value of the Struck concentration coefficient is closer to the zero value, it indicates that the concentration degree is lower, giving the possibility of an easy and comparable interpretation of it. If the coefficient value is closer to 1, the concentration level and the seasonality level tends to the maximum [8].

RESULTS AND DISCUSSIONS

The Danube Delta Biosphere Reserve, located in Tulcea County, represents an important tourist attraction for both tourists in our country and for those from abroad, transforming this area into an important tourist area on the territory of the country. By practicing tourism in the Danube Delta, will be exploited both the natural and cultural values of the area. the territory of the reservation can be practiced various forms of tourism such as: rural tourism, leisure and recreation tourism, knowledge, specialized, rural, tourism for practicing sports specific to the area (fishing, boating, sports hunting) etc.

According to the statistical data at the level of 2018, 136 thousand tourists of Romanian nationality and 25.3 thousand foreign tourists were accommodated between January and October, compared with 68.6 thousand Romanian tourists and 22.4 thousand foreign tourists of the same period of the year. 2017, with an increase of 97% and 13% respectively. During the period June-October, the occupancy rate of the tourist structures in Tulcea County is maximum, permanently occupying about 9,800 places of accommodation.

The large number of tourists as well as the increase of accommodation places in Tulcea County is due to a series of measures and promotional actions that took place at national and international level.

The tourist accommodation capacity in operation represents the number of accommodation places that are made available to tourists by the tourist reception structures that provide accommodation, taking into account the time period (number of days) in which the structures are open for tourist reception [4].

In order to measure the efficiency of the accommodation services, one of the most representative indicators of the supply-demand relationship will be used, the degree of capacity in operation. The evolution of the net use index (accommodation capacity in operation) in Tulcea County, for months of a year in the period 2010-2018 is presented in Fig.1.

Analysing the evolution of this index it can be observed that in the period 2017-2018, its volume was higher than in previous years, this fact being possible both due to the increase in the number of tourists and the implementation of policies aimed at developing tourism in the area and accessing measures of financing specific to the ITI Danube Delta area. Following the analysis of this dynamic, it can be observed that during the summer period, from June to August, the volume of accommodation capacity in operation is maximum, in the last year 2018, this doubling.

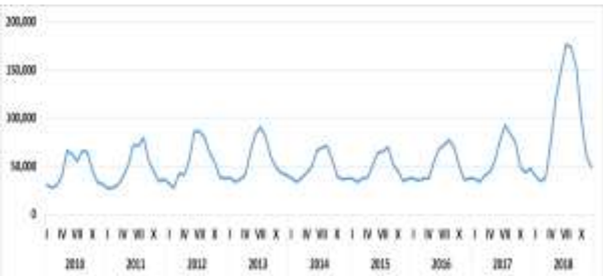

Fig.1. Evolution of accommodation capacity in operation, in the accommodation structures of Tulcea County, on Monday, for the period 2010-2018
Source: processed data.

The real demand is represented by the indicators of the tourist circulation. One of the indicators to be analysed is the number of overnight stays of tourists. The evolution of this indicator is presented in Fig. 2, this registering a growth trend.

By implementing various development programs but also promoting tourism areas in Tulcea County, with a main attraction of the Danube Delta Reservation, over the last two years there has been an increase in accommodation requests which has led to the creation of new tourist structures as well as extending them, thus increasing the accommodation capacity and this time and increasing the number of overnight stays.

The dynamics of the indicator shows a seasonal evolution, the month with the maximum number of nights registered being August of each year taken in the study, and the month with minimum nights recorded being February.

The duration of the tourist season in Tulcea County is determined primarily by the climatic and meteorological factors, thus the prolongation of the tourist season is conditioned by the policy instruments used in the tourism industry.

Throughout the analysed period, there was an oscillation in the number of overnight stays, with a minimum in 2010 of 108.7 thousand overnight stays, reaching in 2018 1,377.9 thousand nights.

If, until 2016, the number of nights was higher in May - September, this will change starting with 2017, when the number of nights increased during the off-season, up to 5 times higher than in previous years of the same period.

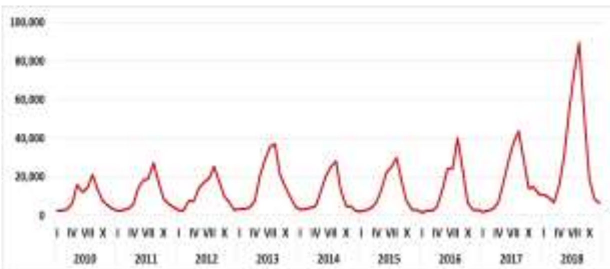

Fig. 2. Analysis of the dynamics of the number of tourist nights in 2010-2018, in Tulcea County
Source: NIS, [10].

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Specific seasonality indicators are calculated by directly applying the arithmetic mean method. By comparing the specific average of each month to the general monthly average, the seasonality indices result. These indices characterize the average deviation of each month from the general monthly average for the entire analysed period, respectively, 10 years.

In Table 1, it can be observed that the number of nights spent in the tourism structures in Tulcea County registered a maximum in August with 162% compared to the general monthly average and the number of nights minimum in January with a weight of 23.7 %.

Table 1. Evolution of the number of overnight stays, by months, by total reception structures, for the period 2010-2018 (Number)

Month/ Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	Monthly average	Seasonality index (%)
January	2,521	2,513	2,853	3,464	3,023	2,183	1,684	2,010	10,650	3,433	23.7
February	2,644	2,794	2,609	3,339	3,521	2,937	2,428	2,456	9,292	3,558	24.5
March	3,482	3,446	7,687	4,275	4,237	4,048	2,711	3,618	6,723	4,470	30.8
April	6,118	5,487	7,486	7,373	5,020	6,950	4,677	6,967	15,904	7,331	50.5
May	15,893	14,242	14,370	20,983	12,372	13,977	13,946	16,609	30,791	17,020	117.3
June	12,302	18,346	17,175	28,658	20,541	22,319	24,381	28,096	55,632	25,272	174.1
July	14,214	19,090	19,206	35,818	25,154	25,345	24,542	37,391	74,496	30,584	210.7
August	21,256	27,407	25,427	37,034	28,134	29,925	40,050	43,617	89,535	38,043	262.1
September	13,815	17,556	17,438	21,549	12,755	17,358	22,957	29,614	50,729	22,641	156.0
October	7,719	8,803	10,098	14,640	5,023	7,097	6,562	14,124	18,990	10,340	71.2
November	5,219	6,302	6,417	10,019	4,641	3,237	2,921	14,782	8,593	6,903	47.6
December	3,522	4,533	3,001	4,548	2,329	2,801	2,939	11,064	6,582	4,591	31.6
Total	108,705	130,519	133,767	191,700	126,750	138,177	149,798	210,348	377,917	14,516	1,200.0

Source: own calculations.

Following the calculation of the seasonality indexes, we observe the seasonal evolution of tourist nights in Tulcea County, so that from May to September the number of tourists who stayed overnight exceeds the general monthly average, and during the rest of the year their number is below this value environments.

Table 2. Calculation of the coefficient needed for the annual concentration for the period 2010 - 2018

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018
I	0.0232	0.0193	0.0213	0.0181	0.0239	0.0158	0.0112	0.0096	0.0282
	0.0005	0.0004	0.0005	0.0003	0.0006	0.0002	0.0001	0.0001	0.0008
II	0.0243	0.0214	0.0195	0.0174	0.0278	0.0213	0.0162	0.0117	0.0246
	0.0006	0.0005	0.0004	0.0003	0.0008	0.0005	0.0003	0.0001	0.0006
III	0.0320	0.0264	0.0575	0.0223	0.0334	0.0293	0.0181	0.0172	0.0178
	0.0010	0.0007	0.0033	0.0005	0.0011	0.0009	0.0003	0.0003	0.0003
IV	0.0563	0.0420	0.0560	0.0385	0.0396	0.0503	0.0312	0.0331	0.0421
	0.0032	0.0018	0.0031	0.0015	0.0016	0.0025	0.0010	0.0011	0.0018
V	0.1462	0.1091	0.1074	0.1095	0.0976	0.1012	0.0931	0.0790	0.0815
	0.0214	0.0119	0.0115	0.0120	0.0095	0.0102	0.0087	0.0062	0.0066
VI	0.1132	0.1406	0.1284	0.1495	0.1621	0.1615	0.1628	0.1336	0.1472
	0.0128	0.0198	0.0165	0.0223	0.0263	0.0261	0.0265	0.0178	0.0217
VII	0.1308	0.1463	0.1436	0.1868	0.1985	0.1834	0.1638	0.1778	0.1971
	0.0171	0.0214	0.0206	0.0349	0.0394	0.0336	0.0268	0.0316	0.0389
VIII	0.1955	0.2100	0.1901	0.1932	0.2220	0.2166	0.2674	0.2074	0.2369
	0.0382	0.0441	0.0361	0.0373	0.0493	0.0469	0.0715	0.0430	0.0561
IX	0.1271	0.1345	0.1304	0.1124	0.1006	0.1256	0.1533	0.1408	0.1342
	0.0162	0.0181	0.0170	0.0126	0.0101	0.0158	0.0235	0.0198	0.0180
X	0.0710	0.0674	0.0755	0.0764	0.0396	0.0514	0.0438	0.0671	0.0502
	0.0050	0.0045	0.0057	0.0058	0.0016	0.0026	0.0019	0.0045	0.0025
XI	0.0480	0.0483	0.0480	0.0523	0.0366	0.0234	0.0195	0.0703	0.0227
	0.0023	0.0023	0.0023	0.0027	0.0013	0.0005	0.0004	0.0049	0.0005
XII	0.0324	0.0347	0.0224	0.0237	0.0184	0.0203	0.0196	0.0526	0.0174
	0.0010	0.0012	0.0005	0.0006	0.0003	0.0004	0.0004	0.0028	0.0003
∑pi^2	0.1194	0.1266	0.1175	0.1309	0.1418	0.1403	0.1613	0.1323	0.1481

Source: own calculations.

In Table 2 there are centralized the calculations made to determine the Struck concentration coefficient for each year, measuring the degree of seasonal concentration.

Table 3. The annual concentration coefficient (%)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Media	St dev	Coef. of variation
The coefficient of annual concentration	0.20	0.22	0.19	0.23	0.25	0.25	0.29	0.23	0.27	0.24	0.031	13.49

Source: own calculations.

The calculation of the concentration coefficient shows a relatively uniform distribution of the number of tourists with overnight stays in the accommodation structures in Tulcea County, observing in the graph below (Fig. 3) an increase of the seasonality until 2016 when the coefficient of concentration was 29%, with a slight decrease in the following years.

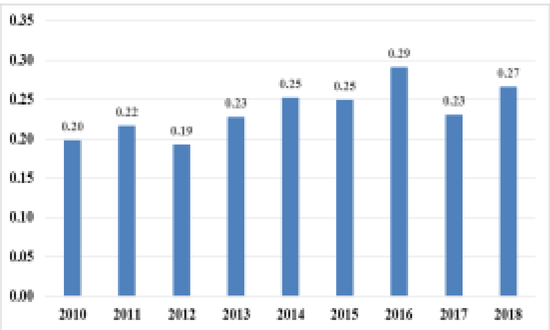

Fig. 3. Evolution of the annual concentration coefficient
Source: own calculations.

At Tulcea County is an increase in the seasonal variation of the touristic demand, as can be seen in the figure above. The intensification of the tourist concentration can cause a number of phenomena such as: increase of the number of stays; agglomeration of transport networks; the number of places of insufficient accommodation, not meeting the demand of tourists; the divergences between the applicants for tourist services and their supply units that can cause tensions; even the insufficiency of public services, as they are not sized and prepared to cope with the high demands level found in the peak season

CONCLUSIONS

The study shows a clear seasonality for the analysed period 2010-2018 of the nights in the tourist accommodation structures in Tulcea County.

The seasonal variations of the tourist demand in this area are due to the period of granting the holidays, as well as the natural factors, as it is observed the number of tourists is concentrated during the period May-September, as indicated by the calculated seasonal coefficient.

There is a tendency to increase the number of tourists in the last years of the analysed period, in the cold season, this being due to the promotion of advantageous tourist packages during the winter holidays.

The study shows that the phenomenon of seasonality must be taken into account both during the incipient phase of the tourist activity and throughout the entire activity, being used in the decisions regarding the development of this sector by maximizing the results based on the use of a given volume of resources.

In order to diminish the effects of the seasonality, a series of measures are required such as: the formulation of marketing policies of the tourist enterprise, of adapting the tourist offer to the specific needs of the tourists; diversifying the offer by offering some benefits that may attract tourists during the off-season; improving actions to promote tourism in the cold season; the involvement of decision-makers in the development of this economic sector.

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EFFECT OF CREDIT UTILISATION ON THE PRODUCTIVITY OF RICE FARMERS IN OYO STATE NIGERIA

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Abstract

Credit is an important factor in rice production and it is needed by farmers to acquire needed agricultural inputs. This paper examined the effect of access and utilization of credit on rice productivity in Oyo state Nigeria. Two hundred and two farmers were interviewed using structured questionnaire through a probability to size sampling technique. The analytical tools adopted for this study are descriptive statistics and ordinary least square regression (OLS). The socio economic characteristics of rice farmers revealed that majority (78.3%) are in their productive age (30-59). Also, more than sixty percent of the farmers can at least read or write and fifty one percent are male. For land ownership 64% of the farmers have 2-3.99 hectares of land while 74% have household sizes of between 4 and 9. 53.5%, 31.7% got their credit from formal and informal sources while 14.9% of them got their credit from both sources. To determine the effect of credit usage on productivity Ordinary Least Square (OLS) regression analysis was used. It was found out that access to credit was significant at 1% affecting the effect of credit usage on productivity while farmer's age and household size has negative coefficient with an R- squared value of 0.524. It was found out that access to credit has a positive coefficient and significant at 1 percent, implying that for every unit increase in access to credit there will be an increase of 87.3 percent in the output of the farmer. It was recommended that since farmers' age has negative coefficient implying that for every unit increase in farmers' age, there will be a decrease of 0.846 percent in the output of the farmer, thus farming should be made more attractive so that more youths will venture into farming increasing the availability of labour. For every unit increase in household size, there will be a decrease of 8.32% in the output of the farmers. Farmers should therefore be educated on family planning methods to reduce their family size, thereby having more money to spend on their farms. Credit should be made more accessible to the farmers thus increasing their productivity.

Key words: *farmers, micro credit, rice production, Oyo state, Nigeria*

INTRODUCTION

Since the mid 1970s the demand for rice has been increasing at a much faster rate in Nigeria than in other West African countries. During the 1960's for instance Nigeria had the least per-capita annual consumption of rice in the sub-region (average of 3 kg). Nigerian per-capita consumption levels have grown significantly at 7.3% per annum since then. Therefore, per-capita consumption during the 1980's was around 18kg and got to 22kg in 1995-1999. Nigerian consumption levels still lag the rest of the sub region (34 kg in 1995-1999), in spite of the catching up of per-capita consumption with the rest of West Africa. For some time to come, above average growth rates in Nigerian per capita rice consumption are likely to continue. There is the need to strengthen the financial capacity of the (rural) agricultural producers to increase the level of agricultural production and development in Nigeria [8] [2] [3]. Similarly, sufficient flow of credits into agriculture has been recognized as a critical factor in quickening incremental food production in Nigeria [13]. The difficulty that poorly capitalised farmers have (faced) in obtaining credit for inputs is the major barrier to the intensification of agriculture in sub-Sahara Africa [7]. In agreement with [4] the financial services usually available to the (rural) poor, are limited in terms of cost, risk and convenience.

The recent global food crisis which resulted in the escalation of prices of rice causing some panic in the Nigerian food market has resulted in the urgent need to strengthen the nation's agricultural production capacity. The only sustainable way to ensure national food sufficiency and security on a long term basis is in improving local rice cultivation and processing, rather than resorting to massive importation. Thus, based on 2006 population census figures, Nigeria has a population growth rate yearly of about 3.2 percent as against 2.5 for aggregate food production growth [9] [11], revealing a decrease in food production. In order to meet the nation's food requirement there is the need for an urgent call for the evolution of strategies that can increase food production.

In spite of increasing hectares being put into production annually the reality is that, Nigeria(and Oyo State in particular)has not been able to attain self-sufficiency in food crop production. Low crop yields and resource productivity seems to be mainly, the constraint to rapid growth of food production [1]. According to [5] low agricultural productivity in Africa is shown by the true yields of major crops. Government interventions at various times aimed at increasing food Production in Nigeria, has not yielded the desired results, while existing medium/large scale farms have equally been ascertained as not being able to sustain the food requirement of ever increasing population in Nigeria, the task of bulk food production, still lies with rural peasant farmers.

Some of the problems faced by rural farmers include low product price, low and unstable yields arising from unpredictable natural disasters and all these makes farming a low-return activity. [15] opined that these problems, seriously tell on food production and food security, and also that the major problems facing humans, is the alarming rate of population growth and declining availability of sufficient food to feed them. Therefore, there is the need to study the effect, access to credit facilities will have on rice productivity in Oyo state. For better appreciation for these effects, the following problem need to be examined: What is the effect of credit utilization on productivity?

MATERIALS AND METHODS

The study was carried out in Oyo state in Nigeria. Ibadan is the capital of Oyo state, which is one of six states in South West Geo-Political zone in Nigeria. From the former Western State was it formed in 1976, including Osun State, which was split off in 1991. Oyo State is uniform, inhabited mainly by the Yoruba ethnic group who are mainly farmers, but have a special liking for living in high density urban areas. Oyo state has thirtythree Local Government Areas [12] and covers approximately an area of 28,454 square kilometres, ranked 14th by size. Old hard rocks and dome shaped hills make up the landscape, reaching a height of about 1,219 metre above sea level in the northern part and rises gently from about 500 meters in the southern part. Principal rivers such as Osun river, Oni, Erinle, Ofiki, Otin, Oba, Oyan, Sasa, and Ogun river take their sources from this highland.

Data Collection

The source of data was through the administration of well-structured questionnaire among rice farmers (202). Proportion to size sampling technique was used. In Oyo state the three local governments were selected namely Akinyele, Ogo-Oluwa and Igbo-Ora. Based on the population of rice farmers 60, 60, 82 were selected respectively from the local government areas. A total of two hundred and two farmers who used credit were interviewed in Oyo state.

Proportion to size =

$$\frac{\text{No Re} \times \text{T No Ri Fa}}{\text{No Ri Fa}}$$

where:
No Re = number of respondents
T No Ri Fa = Total Number of rice farmers in the area
No Ri Fa = number of interviewed respondents.

Methods

The analytical tools used in this study include, descriptive statistics and ordinary least square regression. Descriptive Statistics include the use of tables, figures and percentages. To determine the effect of credit usage on productivity of farmers in Oyo state ordinary least regression was used. The estimated models are as specified below:

$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, e_i)$............. (1)
Implicit form

$Y_{Di} = \alpha_0 + \alpha_i \sum X_i + e_i$ …… Explicit form, or

$Y_{Di} = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_4 x_4 + \alpha_5 x_5 + \alpha_6 x_6 + e_i$...(2)

where:
a_o & a_1 = parameters,
x_i =explanatory variables,
x_1 =gender(male, female),
x_2 =marital status,
x_3 =access to credit,
x_4 = age(years),
x_5 =educational level,
x_6 =Household size,
e_i =error term.

RESULTS AND DISCUSSIONS

Socio- Economic Characteristics of Rice Farmers in Oyo state Nigeria

Presented in Table 1 was the summary of socio-economic characteristics of rice farmers in Oyo state. Seventy eight percent of rice farmers were aged between 30 and 59.They are still young and would be able to boost rice production in the years onward. Seventy five percent have household sizes of between 4 and 9 members thus having help needed to increase their production as their wives and children would help on the farm. Moreover, less money would also be used to hire Labour and more money will go to other aspects of production. Eighty nine percent are married while fifty one percent are male. More than half (68.3%) of the farmers can at least read and write. There is a reasonable level of literacy among the farmers which can make them to be willing to take more productive risks, the adoption of new technological innovations such as improved farming practices and the use of agrochemicals on the farm would be enhanced. Ninety six percent are well experienced in farming activities, having 6 - >15 years of experience. The number of years of farming (farming experience) a farmer has will serve as an indication of the practical knowledge that he has acquired over the years [3] [16]. It would likely have positive impact on his productions. Also, in Table 1, 73.3% have 2.00-4.99 hectares of land implying that most of them are still involved in subsistence farming. This has implication for the technology used as well as the scale of production.

Furthermore, majority of the farmers access their credit from formal sources (45%) against 26.7% that accessed it from informal sources. This is in agreement with [6] that, informal loan sizes are considerably lower than the matching loans sizes from formal source.

Table 1. Socio-Economic Characteristics of Rice Farmers

Variable	Category	Frequency	%
Age group (yrs)	<30-59	166	82.2
	>60	36	17.8
Gender	Male	102	50.5
	Female	100	49.5
Marital status	Single	10	5.0
	Married	180	89.1
	Widowed	12	5.9
Household size	4-9	158	78.2
	>10	44	21.8
Educational Status	No formal education	64	31.7
	Primary	104	51.5
	Secondary	18	8.9
	Tertiary	16	7.9
Years of experience In rice farming	1-5	8	3.9
	6-10	28	13.9
	11-15	24	11.9
	>15	142	70.3
Rice farm size	2.0-4.99	148	73.3
	5.0-6.99	54	26.8
Credit use status of Rice farmers	Informal	64	31.7
	Formal	108	53.5
	Informal and formal	30	14.9
	Total	202	100

Source: Author's computation, 2018.

Informal sources, especially friends and relatives, are more constrained for fluids and are not in the place to risk giving huge sum of funds. Also, informal sector provides significantly short term loan than the formal sector.

Table 2. OLS Regression: Results of the effect of credit usage on Productivity

Variables	Coefficient	Standard Error	t-value	P(T)>t
Constraint Bo	1.061	0.608	18.183	0.000
Gender	-0.807E-02	0.111	-0.073	0.942
Marital Status	0.135	0.129	1.053	0.295
Access to Credit	0.873	0.819	10.656	0.000 ***
Age	-0.846E-02**	0.187	-0.045	0.964
Educational level	-0.474E-04	0.974	-0.486	0.628
Household size	-0.832E -01**	0.104	-0.799	0.426

Source: Author's computation 2018 ***, **, *Significant at 1%, 5%, 10%

In Table 2,the R^2 of 0.524 indicates a good fit for the model. Access to credit was significant at 1% from the result in table 2 above.

Farmer's age is significant at 5% and has a negative coefficient. For every unit increase in farmer's age, there will be a decrease of 0.846% in the output of the farmer. The effective labour force of agricultural productivity is reducing as the farming population is aging [14].

Access to credit has positive coefficient and significant at 1%. This implies that for every unit increase in access to credit there will be an increase of 87.3% in the output of the farmer.

Household size has negative coefficient being significant at 5%. This implies that for every unit increase in household size, there will be a decrease of 8.32% in the output of the farmers. This means that farmers will spend more money in taking care of household members.

CONCLUSIONS

The result showed that 78.3% of rice farmers were in their productive ages (30-59) and 50.5% were male. In the study there is a reasonable level of literacy among the rice farmers. Sixty four percent have between 2-3.99 hectares of land. 53.5%, 31.7% of credit users got their credit from formal and informal sources while 14.9% of them got their credit from both sources. The Ordinary Least Square (OLS) regression analysis was used to determine the effect of credit utilization on productivity and farmers'age and household size had a negative coefficient with an R- squared value of 0.524. Also, access to credit has a positive coefficient and significant at 1 percent, implying that for every unit increase in access to credit there will be an increase of 87.3 percent in the output of the farmer. Rural farmers examined have low level of education.

Based on the findings from this study, the following were recommended:

-Farmers' age has negative coefficient implying that for every unit increase in farmers' age, there will be a decrease of 0.846 percentf in the output of the farmer, thus farming should be made more attractive so that more youths will venture into farming increasing the availability of labour.

-Access and utilization of credit has a positive coefficient and significant at 1 percent, implying that for every unit increase in access to credit there will be an increase of 87.3 percent in the output of the farmer credit should made more accessible to the farmers thus increasing their productivity.

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ECONOMIC ANALYSIS OF DEFORESTATION IMPACT ON THE YIELD OF AGRICULTURAL CULTURES IN UKRAINE

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Abstract

The role of forests in shaping sustainable use of nature is crucial. One of the main factors in regulating the effects of global warming is the positive impact of forest plantations in the formation of climatic conditions on adjacent agricultural land. The main purpose of our study was to investigate the impact of deforestation on crop yields in Ukraine on the basis of the correlation method, and to outline the economic consequences of such interaction. Deforestation leads to a deterioration of the microclimatic conditions of agricultural production, farmers have to increase the rate of fertilizer application, to solve the problem of optimizing the water regime of the soil, which ultimately has the effect of increasing the cost of growing crops. Based on the calculations, it was proved that crop yields increase with decreasing forest cover (R = 0.58 – 0.61), the reason for this being an increase in fertilizer application volumes (R = 0.72).

Key words: *analysis, deforestation, forest land, correlation coefficient. agricultural cultures*

INTRODUCTION

The role of forests in shaping sustainable use of nature is crucial. One of the main factors in regulating the effects of global warming is the positive impact of forest plantations in the formation of climatic conditions on adjacent agricultural land. Most effectively, forests affect the temperature, wind, precipitation and sunshine of large areas, as noted S. H. Sinitsyn, A. A. Molchanov, B. I. Hroshev, L. B. Zdanevych, L. T. Krushev, A. V. Malynovs′kyy, I. S. Matyuk, V. M. Pavlovo, E. S. Pavlovs′kyy, N. V. Khramov, M. H. Chervonyy, V. I. Yunov [11, p. 17 – 18]. Forest plantations offset temperature fluctuations, significantly reducing their maximum and minimum values. Also, by shading trees near agricultural land, the temperature of the soil surface decreases during the period of maximum insolation in the summer. Due to this "preserving" effect of the forest on the surrounding land, the heat loss during the night period is reduced, which in turn prevents the occurrence of frosts. According to scientists, the temperature at the soil surface near the forest lands decreases by 2 - 2.5 times in relation to the temperature regime in open fields.

Due to the fact that forests influence the formation of a favorable temperature regime for crops, collective of scientists S. E. Scott, S. A. Monks, D. V. Spreklen, S. R. Arnold, P. M. Forster, A. Rap and others [10], on a global scale, there was a direct correlation between an increase in the amount of deforestation and a decrease in crop yields.

At the same time, the destruction of large tracts of forests that regulate the climatic conditions and the water regime of the vast pools, as noted H. I. Vorobyov, K. D. Mukhamedshyn, L. M. Devyatkyn [15, p. 6], breaks the ecological balance established for millions of years, which in turn leads to the perpetual devastation of floods, mudslides, water erosion processes, dust storms, droughts or wetlands, depending on the specific climatic conditions and nature of the tree vegetation.

That is why the main task of our research is to establish a mathematical link between deforestation and crop yields in the context of Ukraine's food security.

MATERIALS AND METHODS

The main purpose of our study was to investigate the impact of deforestation on crop yields in Ukraine on the basis of the correlation method, and to outline the economic consequences of such interaction. [4, 7]. According to the State Statistics Service of Ukraine, we have determined the productivity of agricultural crops for the period 2001 – 2017 [12] (Table 1).

Table 1. The dynamics of crop yields in Ukraine

Years	Crop yields, centners per 1 ha of harvested area				
	Cereal and leguminous crops (X_1)	Factory sugar beet (X_2)	Sunflower (X_3)	Potato (X_4)	Vegetable crops (X_5)
2001	27.3	189.0	12.0	104.0	124.0
2002	18.2	201.0	11.2	116.0	139.0
2003	28.3	238.0	8.9	133.0	149.0
2004	26.0	248.0	12.8	128.0	157.0
2005	24.1	285.0	13.6	133.0	171.0
2006	21.8	294.0	12.2	131.0	152.0
2007	34.6	356.0	15.3	139.0	174.0
2008	29.8	315.0	15.2	139.0	183.0
2009	26.9	279.0	15.0	132.0	174.0
2010	37.0	363.0	18.4	168.0	195.0
2011	31.2	411.0	16.5	161.0	199.0
2012	39.9	399.0	21.7	160.0	200.0
2013	43.7	477.0	19.4	176.0	208.0
2014	41.1	436.0	21.6	161.0	206.0
2015	46.1	482.0	22.4	166.0	211.0
2016	42.5	475.0	20.2	168.0	208.0
2017	47.4	509.0	23.0	171.0	214.0

Source: generated by the authors on the basis of data from [12].

Table 2. Results of correlation analysis between yield and decrease of wood cover according to the data Forest Global Watch in Ukraine (R)

	Loss of wood cover in Ukraine - Forest Global Watch (Y)	Crop yields				
		Cereal and leguminous crops (X_1)	Factory sugar beet (X_2)	Sunflower (X_3)	Potato (X_4)	Vegetable crops (X_5)
Y		**0.58**	**0.64**	**0.56**	**0.57**	**0.61**
X_1			0.91	0.91	0.87	0.86
X_2				0.92	0.94	0.95
X_3					0.86	0.92
X_4						0.96

Source: own calculations on the basis of data from [3, 12].

Using the correlation method of economic and mathematical analysis, we compared data of the dynamics of crop yields with the loss of wood cover in Ukraine determined by the data Forest Global Watch (Y – performance indicator) (Table 2).
In this table there are calculated the correlation coefficients between the resultant indicator (loss of wood cover) and the factors that depend on it (crop yield).

RESULTS AND DISCUSSIONS

The results of the calculations indicate a direct correlation between the resultant index (Y) and the determinants ($X_1 - X_5$) – crop yields. That is, with increasing losses of the tree cover increases the yield, although scientific developments of scientists, regarding the dependence of the yield of agricultural crops on the forested territory indicate the opposite [2].
The reasons for this are the increase in the rates of application of mineral fertilizers, due to changes in the microclimatic conditions of cultivation of crops due to deforestation, scientific substantiation of such statements is given in the relevant scientific works [1, 5, 6, 8, 9, 13].
In particular, due to the change of water, temperature and air conditions in adjacent agricultural land, the efficiency of fertilizer application is always higher than in open areas. [8].
Taking into account research of I. P. Mamchenkov [8, p. 13], namely, that when fertilizers are applied the conditions of plant growth are improved, however, the doses of their application must correspond to the fertility of the soil and the soil moisture reserves. Often, when overgrowth under the influence of high temperatures and lack of moisture in the soil dramatically reduces the yield and oilseeds.
The effect of mineral fertilizers on crop yields depends on soil moisture and heat - lack of moisture in the root layer causes an increase in the concentration of soil solution, resulting in mineral fertilizers becoming ineffective or

even negatively affect the yield, according to M. M. Myloserdova [8].

Thus, with a decrease in wind speed, uniform distribution of snow in the fields and a significant reduction of runoff of meltwater in protected forest plantations during the growing season, a special microclimate is formed, which affects soil microorganisms that process mineral fertilizers into suitable fertilizers for suitable fertilizers [14]. Therefore, the introduction of mineral fertilizers into the soil in fields protected by forest plantations significantly increases the crop yield, as opposed to the application of fertilizers in open areas, which confirms the results of research O. V. Albensky [1], M. M. Miloserdov [8], V. I. Koptev [6], A. A. Lyshenko [6], V. O. Kargov [5], E. S. Pavlovsky [9, p. 78] and others.

Instead, we have made the appropriate mathematical calculations that confirm the actual dependence of the increase in rates of application of mineral fertilizers as the area of losses of wood cover in Ukraine determined by the data Forest Global Watch (R = 0,72) (Table 3).

Table 3. The calculation of the dependence between the reduction of wood cover and the volume of mineral fertilizers in Ukraine

Year	**Loss of wood cover in Ukraine according to Forest Global Watch, thousand hectares**	**The total amount of mineral fertilizers made in Ukraine, 1,000 tons N, P_2O_5 and K_2O**
2017	87.7	2,028.1
2016	110.0	1,728.9
2015	49.8	1,415.0
2014	47.9	1,471.7
2013	38.4	1,493.8
2012	56.2	1,346.6
2011	60.8	1,266.9
2010	52.7	1,064.2
2009	48.8	889.6
2008	55.0	1,068.5
2007	64.9	899.8
2006	42.7	702.0
2005	37.0	560.5
2004	50.1	521.2
2003	39.4	381.6
2002	27.6	401.7
2001	29.2	403.9
Correlation coefficient calculation (R)		
	Loss of wood cover in Ukraine according to Forest Global Watch, thousand hectares	The total amount of mineral fertilizers made in Ukraine, 1,000 tons N, P_2O_5 and K_2O
Loss of wood cover in Ukraine according to Forest Global Watch, thousand hectares	1.00	
The total amount of mineral fertilizers made in Ukraine, 1,000 tons N, P_2O_5 and K_2O	**0.72**	1.00

Source: own calculations on the basis of data from [3, 12, 14].

Due to the fact that the loss of wood cover increases the volume of fertilizer application we have developed a corresponding regression equation, the coefficient of determination of which is 0.52 (formula 1):

$$Y = 105.89 + 17.64x \quad (1)$$

Y = volume of fertilizer application for crop cultivation;

X = the area of loss of wood cover is determined by data Forest Global Watch.

Such circumstances directly affect the increase in average prices of agricultural products sold by agricultural enterprises, for consumers as evidenced by the calculation data presented in Tables 4 and 5.

Table 4. Data matrix of wood cover reduction in Ukraine according to Forest Global Watch data and average prices of agricultural products (2001 – 2017)

Loss of wood cover in Ukraine according to Forest Global Watch, thousand hectares	Average prices of sold agricultural products by agricultural enterprises, UAH / ton								
	Cereal and leguminous crops, UAH / ton	Oilseeds, UAH / t	Factory sugar beet, UAH / ton	Potatoes, UAH / ton	Vegetable crops, UAH / ton	Fruits and berries, UAH / ton	Farm animals (live weight), UAH / ton	Milk, UAH / ton	Eggs, UAH per thousand
Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
29.2	381.3	779.6	139.1	449.8	748.9	575.8	4,175.5	603.7	210.0
27.6	312.5	850.3	128.1	555.8	864.8	509.6	3,644.0	541.0	168.1
39.4	535.1	873.7	140.3	623.3	1,012.7	434.0	3,480.7	696.9	193.2
50.1	453.1	1,153.4	135.7	530.4	1,225.0	740.1	5,092.7	835.3	238.3
37.0	417.8	981.5	177.0	685.2	1,462.1	987.8	6,909.9	1,126.9	251.8
42.7	515.2	1,007.5	186.0	1,070.3	1,547.4	1,446.1	6,307.7	1,070.2	192.7
64.9	833.5	1,866.8	157.6	1,032.0	1,995.4	1,528.4	6,466.5	1,660.6	274.4
55.0	778.6	1,734.6	218.9	1,154.3	2,059.9	1,877.4	10,184.3	2,065.1	377.4
48.8	799.0	2,086.2	409.9	1,298.6	1,790.0	1,892.4	10,362.9	1,888.8	403.9
52.7	1,120.9	2,942.6	478.5	2,131.0	2,551.6	2,419.8	10,797.1	2,938.7	470.6
60.8	1,374.2	3,312.0	516.0	2,032.8	2,139.1	3,175.9	11,967.2	3,041.6	521.5
56.2	1,547.1	3,584.0	426.8	1,139.6	1,956.6	2,707.1	13,456.9	2,662.2	627.0
38.4	1,299.8	3,087.5	397.8	1,860.9	2,354.0	3,010.8	12,901.3	3,364.0	656.7
47.9	1,801.4	4,062.8	494.2	2,173.6	2,514.3	2,429.1	15,736.9	3,588.4	782.4
49.8	2,912.1	7,531.5	788.6	2,436.3	3,903.4	5,894.5	21,966.2	4,347.3	1,333.2
110.0	3,414.0	8,656.1	848.6	2,631.8	3,924.2	5,863.8	22,468.0	5,461.8	1,108.7
87.7	3,771.6	9,132.0	825.3	3,296.3	4,136.1	8,766.6	31,838.4	7,234.0	1,145.9

Source: generated by the authors on the basis of data from [3, 13].

Table 5. Calculation of the mathematical dependence between the reduction of wood cover in Ukraine and the average prices of agricultural products (correlation coefficients)

	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
Y		0.78	0.78	0.72	0.69	0.76	0.74	0.74	0.76	0.63
X_1			1.00	0.95	0.91	0.95	0.97	0.97	0.97	0.96
X_2				0.96	0.91	0.96	0.97	0.97	0.96	0.96
X_3					0.94	0.94	0.93	0.94	0.94	0.95
X_4						0.94	0.92	0.93	0.96	0.89
X_5							0.94	0.95	0.95	0.94
X_6								0.98	0.97	0.92
X_7									0.99	0.94
X_8										0.92

Source: own calculations on the basis of data from [3, 13].

In fact, we have found that the loss of wood cover in Ukraine affects the increase in average prices of agricultural products sold by agricultural enterprises, correlation coefficients vary from 0.63 to 0.78 on the respective crops.

CONCLUSIONS

Thus, according to the results of our study, the direct impact of forest lands on crop yields can be argued.

Deforestation leads to a deterioration of the microclimatic conditions of agricultural production, farmers have to increase the rate of fertilizer application, to solve the problem of optimizing the water regime of the soil, which ultimately has the effect of increasing the cost of growing crops.

Based on the calculations, it was proved that crop yields increase with decreasing forest cover (R = 0.58 – 0.61), the reason for this being an increase in fertilizer application volumes (R = 0.72).

The proposed regression model depending on the volume of mineral fertilizers for growing crops on the area of tree cover losses - according to Forest Global Watch, will be useful for agricultural professionals. The application of this model will allow us to predict the likely additional costs of growing crops in the event of deforestation in the region.

Such additional costs affect the health of agricultural products. Therefore, on the basis of economic and mathematical analysis, we have determined that deforestation ultimately affects the increase in average prices of agricultural products (R = 0.63 – 0.78), which is a negative economic factor for the population.

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THE ANALYSIS AND FORECASTING OF EFFECT FROM INTRODUCTION OF INNOVATIVE PRODUCTS IN PLANT GROWING ON AN EXAMPLE OF THE SARATOV AREA, RUSSIA

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Abstract

General concept of the formation and functioning of a forecasting model of scientific and technological development of the region's agriculture in the digital economy, which is forming in accordance with the well-known Federal program is proposed. It can be based on summary reporting tables of production processes in crop production and animal husbandry with electronic technological maps being connected to them, through which information about innovative products is passed in order to identify the expediency of their use in forecasting the development of agriculture. The calculation blocks are connected with an extensive and versatile information database, control and forecast modules. The main array of information on the activities of agricultural organizations is formed in the form of a multidimensional database (MO - LAP) and is subjected to full-format analysis by comparing data from full tables of different years or of different entities (organizations, regions, etc.) of annual financial statements for all types (groups)) crops, animals, products. A selection of the most satisfactory innovations and a forecast of a possible level of development of organizations in a certain perspective are presented. For this purpose, parameters and target indicators from the Agricultural Development Programs and other sectors of the agro-industrial complex are used. In the process of forecasting, the optimization of the available own resources of organizations and the budget funds of all levels identified in the programs is given in order to obtain the maximum financial result through the use of the most acceptable innovations.

Key words**:** *scientific and technical development, forecasting, agriculture, full-format analysis, a multivariate optimization*

INTRODUCTION

The address to the modeling of scientific and technological development of agriculture in the region is due to the fact that at the present time there exist several rather significant of federal level documents concerning scientific, technical and technological development of agriculture, while in the regions there are only subprograms "Technical and technological modernization", "Scientific - innovative development "for 2014–2020, adjusted and prolonged up to 2025 in connection with the adoption of the "Federal Scientific and Technical Program of the Development of Agriculture for 2017-2025"[4]. Within the regional programs "Development of agriculture and regulation of the agricultural products markets, raw materials and foodstuffs", in 2018 the projects of Pilot government programs with similar names for the years 2019-2025 are developed [13]. The programs are called pilot because it was made the attempt to change the process itself of forecasting the development of agriculture and the forms of participation in it by the state. So, if before the year 2018 the production volumes were being outlined at first, then a certain amount of financial resources for them were being allocated by the government, nowadays the government is projecting the amount of funding that should ensure the achievement of certain results.

Formally this goal was achieved, as the project and the process parts of the program took place, but in reality there is no certainty that the allocated budget funds will ensure the obtaining of the specified volume parameters, and all the more so economic indicators, as it is missed the most important link - the production process with its real costs and results. Thus, in fact, the starting point for working out a program development should be a working model of ensuring the reproduction in agriculture, through which it is possible to pass over information on the innovations introduced, the intended amount of funds sizes and to obtain the final results of production in the process of solving problems on their optimization. Based on the fact that under the conditions of the digital economy which is already being formed in accordance with the Program "Digital Economy of the Russian Federation" approved by the Government of the Russian Federation (dated July 28, 2017 No. 1632), to the basis of the model it will be possible and necessary to lay the accumulated in the management bodies of the agro-industrial complex a fairly large database of annual accounting reports of agricultural organizations, peasant (farmer) farms, individual entrepreneurs.

The purpose of the study is to substantiate the principles and to work out the methodology of forming a forecasting model for the scientific and technological development of agriculture in the region, ensuring the selection of the most effective innovative products for achieving in some perspective a given level (stage, degree) of agricultural production development or to determine this level under optimal use of the available resources and innovative products.

In this paper it was presented the example of the analysis and forecasting of effect from introduction of innovative products in plant growing the agricultural organizations of the Saratov Region.

MATERIALS AND METHODS

General scientific methods of economic research (monographic, abstract logical, system analysis and synthesis, etc.), as well as correlation analysis and economic-mathematical modeling, and database management elements are used. A large array of information was used in the form of a set of annual accounting reports of agricultural organizations in the region, presented in the form of a "multidimensional cube" (OLAP) using full-format analysis of tables.

RESULTS AND DISCUSSIONS

Analysis of scientific literature on the research topics [8, 9, 6], and the authors 'own previous workings in the field of modeling [11] made it possible to build the following concept of a forecasting model of science and technology development of agriculture in the region. Summary spreadsheets of production processes in crop production and animal husbandry of agriculture organizations should be taken as the basis, the source of information for which is the reporting (actual) data, adjusted with the help of connected electronic technological maps, through which information about specific innovative products (innovations) is passed. The incoming data receive the initial assessment based on deviations from the baseline, the results received at the output from the process tables are transmitted to other reporting spreadsheets, in which the final result, including financial, of the organizations' business activities is fixed. An economic appraisal of the effectiveness of innovations is given, their impact on the development of production is given. Individual innovations as well as some of their combinations are passed through the model, the most acceptable of them are selected for application over a certain perspective, and the final results are fixed.

This is quite a general idea of a model, and the user's task of the model is to search for necessary innovations, to collect as much as possible the full information about them, and to enter it into the input block of technological maps, or directly into the calculation (process) matrices (tables) of the model, and then analyze the primary (process) and final financial and economic results. A sufficiently extensive and diversified database, which possesses mechanisms of the primary processing of information about innovative products and their selection for the use in forecasting should be attached to the design schemes. Modeling is based on the developed by the authors' method of full-format analysis and the forecast of annual reproduction cycles according to the annual reporting forms of agricultural organizations.

The fundamental part of the model is the module of product reproduction and production results, which can be obtained on the basis of two forms of the annual report of the agricultural organization: No. 9-AIC "Report on production, costs, cost price and sales of crop production" and No. 13-AIC "Report on production, cost of production and sales of animal husbandry". Its initial task is to assess reproduction processes by comparing the data of the last reporting year with the previous one or with any other year from some retrospective.

At first, the two adjacent years are compared in full scale on each table to identify the changes that occurred: areas (livestock), costs in general and individual items of expenses that at the same time characterize or show the movement of working capital (seeds, fertilizers, plant protection products, feed, etc.) and fixed assets (the cost of their maintenance), as well as the energy intensity of production (the cost of electricity and the cost of petroleum products). The results of comparisons in the form of absolute and relative deviations are recorded in four similar tables (forms No. 9-AIC and No. 13-AIC). Based on the data received, the following is established: what kind of reproduction (simple, expanded, narrowed) corresponds to the processes that have occurred during the last year in the industry, culture, type of livestock, products, etc.; which type (extensive or intensive) can be attributed to reproduction in each particular case and what factors contributed to this. Based on the correlation analysis in the "multidimensional cube" [5, p. 205] of these tables, influence factors coefficients on the results and interrelations of factors are determined, which are used further in forecasting.

For forecasting similar forecast matrix tables are created. Last reporting year becomes basic. Based on its data, standard costs are calculating in one of the tables per 1 hectare (livestock) and 1 centner of production (constants C and V), for which the resource requirements for the projected areas (livestock) and the production volumes are determined with possible adjustments taken into account.

To evaluate the effectiveness and selection of innovative products information from the "Federal Scientific and Technical Program for the Development of Agriculture for 2017–2025" is used. The foreseen events and application data are skipped through the evaluation module. The "events" of the relevant regional programs, including scientific and technological development (STD), undergo a more substantive and thorough procedure in order to determine the influence on growth and production efficiency through the use of: seeds of new domestic varieties, pedigree products (material), high-quality feed, feed additives for animals, drugs for veterinary use, pesticides and agrochemicals of biological origin, etc.

Reliable information on the development of "science and innovations" is urgently needed, and moreover, in dynamics, in order to have the possibility to identify trends in the emergence and advancement of innovations, on the one hand, and to find patterns, connections, influence and mutual influence of various components of innovative activities of organizations, on the other. No doubt, information about the branch science and innovation in the field of agricultural complex is the most important, especially at the regional level. But since it is clearly not enough, indirect estimates should be resorted to. In particular, the model provides an analytical block of basic statistical information, which had already allowed to get some of the dependencies and relationships between the indicators of innovation activity in the regions of the Russian Federation and in other areas.

The estimates of the innovation indices of the RF subjects [1] accumulated by the Institute for Statistical Studies and Economics of Knowledge of the National Research University Higher School of Economics (HSE) are very interesting and important.

Since the model is called upon not only to predict agricultural development, but also to solve more complex tasks, it is necessary to evaluate available at present innovative products and to predict the possibility of their appearance in the future, to obtain the most complete characterization and to determine the effectiveness of application in the conditions of the region, taking into account the existing soil climatic diversity. The characteristic of each innovative product should be sufficiently complete so that it can be attributed to one of the categories (groups) of innovations that improve: product quality; crop yield (animal productivity); labor productivity. The effectiveness of each innovative product is primarily evaluated by the formulas developed by the authors.

In addition innovative products (innovations) are differentiated by connection with the reproduction process. In particular, if the essence of the innovation is the replacement of ordinary seeds of agricultural crops with seeds of a well-known selection, which increase the yield of a particular crop, its effect is the increase of a yield, but it requires some expenditures for more expensive seeds. It is necessary to include additional costs for new seeds and the result of their use in the reproduction process with the help of a technological map or directly through the calculation block of Table No. 9-AIC using formula 1.

$$\sum_{j=1}^{I} Q_{sSTDj} = \sum_{j=1}^{I} (Z_{sbj} + K_{sj} * S_j * (\mathrm{P_{sSTDj}} - \mathrm{P_{sbj}}) * (\mathrm{N_{sbj}} - \mathrm{N_{sSTDj}})) \quad (1)$$

where: Zsem - the cost of purchasing seeds, thousand rubles; Ps - the price of 1 centner of seeds, thousand rubles; Nssem - seed rate, c / ha; Sj is the seeding area of the jth culture; Ks - share of the area of sowing with high-yielding seeds, units. The symbols "b" and "STD" - respectively: basic, i.e. commonly used seeds (b), seeds of better quality (STD).

It means that the costs are corrected for all (although not necessarily) agricultural crops, taking into account the proportion of the area sown with better seeds (Ks), as well as the differences in price and seeding rate. The increase in agricultural crops yields is reflected in the gross yield of products according to the formula 2:

$$\sum_{j=1}^{I} Q_{tg\,STD} = \sum_{j=1}^{I} (Q_{\mathrm{tg\,j}} + K_{S\,j} * S_j * (\mathrm{U_{STDj}} - \mathrm{U_{b\,j}})) \quad (2)$$

where: Qsb - gross yield of the j-th crop, c; Ustd-Ub is the yield, respectively, of the new variety (seeds are of higher quality) and the base one c / ha.

Similarly, calculations are carried out for fertilizers, plant protection products, etc.

The next group of innovations is related to the applied technology. In this case the calculations are much more complicated. They can be performed: as for individual technological operations, and as well as on an average level for the whole range of work; both in each culture and on the whole across their entirety. The third group combines innovations in the form of individual technological operations or technologies. This is true in particular, when speaking about resource-saving technologies and precision agriculture, which can be most reliably evaluated directly in technological maps, comparing the results of calculations using new and existing technologies.

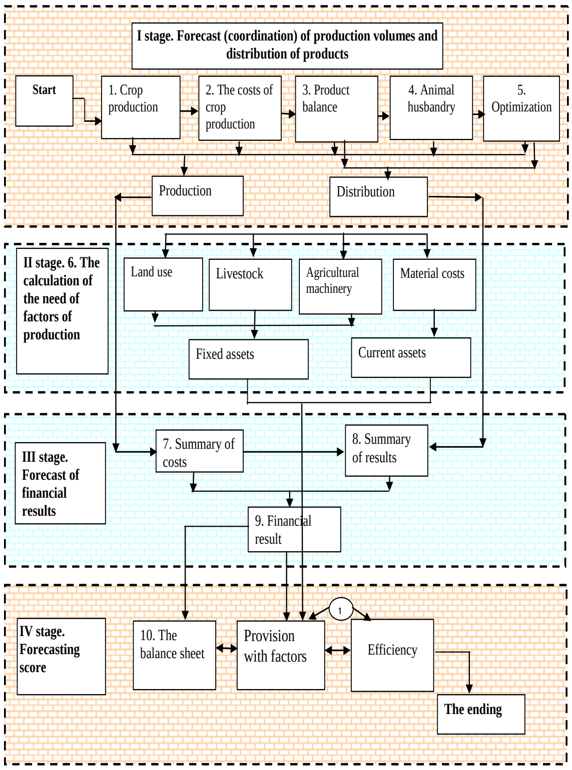

Fig. 1. A forecasting scheme of agricultural organizations scientific and technological development
Source: author’s elaboration.

The most important advantage of the model is that individual innovations and/or their summations are tested for effectiveness by applying to the operating mechanism the entire economic complex of agricultural organizations. Primary estimates obtained directly in the process tables are transferred to other spreadsheets of the organizations' annual report, adjusting the final financial result (Fig.1).

According to the authors research, it is advisable to manage the scientific and technical development of agriculture in the region with the help of adaptive economic and mathematical models, which include the family of models developed earlier by the authors, based on a technological and soil-climate basis.. The task of the control module is to find the necessary innovative products, make a characteristic of each of them and connect to the design matrices. The forecast module should fulfill: to evaluate the found innovative products, to select the most acceptable ones, form some combination of them and optimize its use [14, 15] on the basis of solving direct and inverse problems.

In this case it should be assumed that, in close-up, the purpose of the model is the transfer of modern production to a higher scientific and technical stage of its development, by applying (introducing) a certain set of innovative products. Therefore, in a direct task, you need to lay a certain level or stage (step) of development on the life cycle curve of the agro-production system [2] the direct task must be to lay and to calculate the amount of additional resources and innovative products it will be required for this purpose, while in the inverse task it is necessary to determine the level or stage (step), which producers can achieve by rationally using all available resources and innovative products.

For solving of those two tasks, it is necessary to select the necessary means and apply the method of multivariate optimization [14] of resource use and the application of innovative products.

Verification of the model’s performance was carried out on the materials of agriculture in the Saratov region. Annual reports of agricultural organizations in the region were used as a source base, and the "Federal scientific and technical program of the development of agriculture", as well as regional programs of agro-industrial development, served as guidelines for the prospects for the development of agricultural production served. In developing a forecast of innovative development the authors took as a base the results of scientific research of the elaboration of scientific institutions and researchers in the field of agricultural science and technology.

Within the given article it is not possible to demonstrate all the model capabilities in its practical use; therefore, only some fragments of the mechanism and results of the innovation assessment can be cited. In particular, the model envisages the introduction of precision farming technology, with taking into account the results of I.A. Petrova and N.S. Grigoryeva [10], which states that the most important component of precision farming is the differential application of fertilizers. Unfortunately, they only state that in the structure of the cost of crop production fertilizer costs make up a significant share, but do not demonstrate the structure itself, not going beyond the results of calculating economic efficiency. The imposition of all the available information, after some of its revision, on the results of winter crops cultivation in agricultural enterprises of the Saratov region in 2016 in the evaluation module showed that that the performance of differential fertilizer application operations only on half of the sown area of these crops makes it possible to reduce the cost of a unit of all production (grains of winter crops) by 31.4% due to faster growth of the crop compared to cost increases. The overall economic effect is estimated at more than 2.0 billion rubles.

The effect of cultivating winter crops improves general indicators of crop production, which in the working model spread to other sectors, primarily to livestock (in the form of №. 13-AIC), through form №. 16-AIC "Product Balance" in the column "allocated feed". Changes may occur in the processing of raw materials, both within farms and when it is delivered for industrial processing. Ultimately, all this will be reflected in the overall financial result (form № 2 in OKUD).

At the same time, the results of another study [3] show that the effect of the precision farming system expands due to cost savings when performing precise driving of aggregates, when re-processing of already processed plots (the so-called “overlaps”) is excluded and uncultivated areas are not allowed (“passes ").

The model reflects the results of a study by scientists of the Agricultural Research Institute of South-East Region (ARISER) A.I. Shibaev and Z.M. Azizov [12], who substantiate the efficiency of resource saving. In particular, attention is drawn to agricultural practices under which it is possible "on chernozem soils ... without reducing the productivity of winter and spring crops, in order to save resources, use small plowing, cultivating with preliminary stubble cultivation or subsurface cultivation, in the second link - plowing of different depths" [12, p. 30]. It is clear that this is only about not reducing yields, although, in fact, everything is not so simple. From the table given in the article, it can be seen that only in variant 3 with different tillage depths for different crops a higher yield was obtained, although not significantly (1.64 t/ha compared to 1.62 t/ha - within the statistical error) so it can be affirmed that only with such soil treatment it is possible “not to reduce yield”, and in the other three options it decreases. Moreover, in the fourth variant in the way, so that labor costs and fuel cost per 1 ton of grain do not decrease, but increase, i.e. specific resources are not saved, but, on the contrary, are not used efficiently.

Some transformation of the information provided, including with the assumption to obtain more prominent results of adopting the worst (fourth) variant as the base one, allowed us to obtain coefficients (correlations to the base), with which the results of the study [12] can be connected to a more complete assessment of economic efficiency of the model developed by the authors.

To evaluate technical and technological innovations, we used the results of the study of the sector of stimulating the development of industries of the Volga Research Institute of Economics and Organization of Agro-Industrial Complex (VRIEOAIC), described in [6]. In particular, the developed by the sector employees the technological map of the cultivation of early spring grain crops (wheat, oats, barley) in the western and central right-bank microzones of the Saratov region [7, p. 52] is presented in three versions: based on the use of the traditional domestic technology (variant I); with the inclusion of some types of foreign machines and implements (variant II); using the combined aggregates (variant III). It contains data per 1 ha of cultivated area on labor costs, density of mechanized work (conditional standard Ha), seed sowing rate, fertilizer dose and consumption of fuel and lubricants (oil products). It is characteristic that variants differ only in labor costs, density of work and oil product consumption. Information is given on the main periods of technological operations implementation and on technology in general. The difference between the second variant (with foreign equipment) and the first variant is insignificant: the reduction in labor costs is only 5.42%, in the oil products consumption is 2.29%, and there is no difference at all in the density of mechanized work.

A significant effect can be obtained if the third variant is applied with the use of combined aggregates that perform several technological operations in one pass. It is formed exclusively due to the saving of resources (labor and oil products) at the same level of productivity. In this case if to compare with the first variant, labor costs are reduced to 76.1%, the density of work is reduced to 63%, and the consumption of oil products is reduced to 41%. Depending on the density of work, the cost of repairing equipment can be reduced by 63%. The obtained data can be transferred into the coefficients of change of these indicators and

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input them into the developed model in order to find an economic effect of full value.

In federal and regional programs of scientific and technological development, much attention is given to the development and implementation of new domestic high-yielding varieties of agricultural crops and highly productive animal breeds, therefore, the developed model highlights the blocks of evaluating existing and newly emerging innovative products (seed varieties, animal breeds, etc.), adapted to reporting forms № 9-AIC (crop production) and 13-AIC (livestock production). Products with the highest scores are transferred to the corresponding forecast tables (Table 1).

Table 1. Forecast of the effect of introducing new varieties of agricultural crops in the form of № 9-AIC of the annual reporting of agricultural enterprises of the Saratov region (random case, variant III)

Crop	**Sown area, ha**	**Total costs, '000 rubles**	**including seeds and planting material, '000 rubles**		**Output (actually), centners**
			total	1 ha	
1	2	3	4	5	6
Winter cereals	493,483.5	6,454,751.4	588,090.5	1.19	13,252,292
Spring cereals	475,412.8	3,714,572.0	637,474.0	1.34	6,293,103
Legumes	78,685.0	950,512.0	191,711.0	2.44	711,352
Corn for grain	43,388.0	919,832.0	204,705.0	4.72	1,659,965
Soybean	16,139.0	473,142.0	50,986.0	3.16	297,020
Sugar beet	7,636.0	345,922.0	55,325.0	7.25	2,809,503
Sunflower seed	631,062.4	8,078,853.1	1,781,809.0	2.82	7,110,605
Falseflax	10,998.0	54,564.0	4,194.0	0.38	49,544
Potatoes	484.5	85,574.0	35,093.0	72.43	89,720
Open ground vegetables	1,330.6	220,476.7	43,927.0	33.01	425,574
Sheltered Ground Vegetables	84.0	1,497,172.0	40,147.0	478.18	302,465
Gourds	3,460.0	14,096.1	3,411.8	0.99	401,100
Silage corn and green feed	14,626.0	229,321.0	20,088.0	1.37	2,135,573
Silage crops	554.0	4,213.0	613.0	1.11	49,187
Total crop production	**1,938,713.0**	**24,573,443.0**	**3,757,718.3**	**1.94**	**72,072,153**

Table 1. Continuation.

Share of sown area with innovation %	**Coefficients of innovative products, units**			**The increase of seeds cost. '000 rubles**	**Output growth, centners**	**Economic effect (cost reduction)**		
	Prices	Seeding norms	Land productivity			per 1 centner, '000 rubles	total, '000 rubles	% of base cost
7	8	9	10	11	12	13	14	15
0.5	1.5	0.9	1.4	102,915.8	2,684,550.2	0.08	1,317,835.2	20.5
0.5	1.5	0.9	1.4	111,558.0	1,331,155.8	0.09	713,710.0	19.0
0.5	1.5	0.9	1.4	33,549.4	143,206.7	0.21	177,028.2	18.4
0.5	1.5	0.9	1.4	35,823.4	349,707.3	0.09	175,891.7	18.8
0.5	1.5	0.9	1.4	8,922.6	59,714.3	0.27	95,840.2	20.3
0.5	0.5	0.9	1.4	-15,214.4	574,685.4	0.03	92,601.6	28.6
0.5	1.5	0.9	1.4	311,816.6	1,438,822.3	0.17	1,490,319.1	18.1
1.0	1.2	1.0	1.1	838.8	5,609.0	0.11	6,112.7	11.3
0.5	0.5	0.9	1.4	-9,650.6	18,168.8	0.26	28,498.3	38.3
0.5	1.5	0.9	1.4	7,687.2	87,074.5	0.08	41,987.1	18.8
1.0	1.2	1.0	1.1	8,029.4	302.2	0.08	23,570.2	1.6
1.0	1.2	1.0	1.1	682.4	40,828.0	0.00	1,046.5	7.2
1.0	1.2	1.0	1.1	4,017.6	213,539.6	0.01	23,575.9	10.3
1.0	1.2	1.0	1.0	122.6	0.0	0.00	-36.0	-0.8
				203,426.9	**7,004,725.3**	**0.25**	**7,541,880.7**	**31.1**

Source: calculated by the authors according to the consolidated annual report of agricultural organizations of the Saratov region for 2016.

Table 1 shows the results of evaluating the effect of the introduction of seeds of new varieties according to a variant of the contingent example, in which the coefficients characterizing the deviations of the indicators of new varieties from those used in 2016 are placed in columns 5-8. In this case, since the calculations are demo, the coefficients for grain and leguminous crops are assumed to be the same, which is not necessary, and even, conversely, they most likely should be different. At the same time, when making comparative assessments of the reaction of various crops to an innovative product, it is better to use exactly the same coefficients, which this table confirms.

In the given example, the total scatter of the relative effect is in the range from –0.8% to +38.3%.

The table below is only a fragment of the general form (template) in which one can evaluate any innovative products and predict the possible economic results of the activity of agricultural organizations, extending them to other organizational forms of agricultural production.

CONCLUSIONS

An important result of the carried out study is the formation of ideas about the scientific and technological development of agriculture, as a set of processes: creating research and development results in the agricultural and other branches of science; their promotion and implementation in production; mastering and effective use of commodity producers, ensuring the transition of production systems to the next stage (level) of economic growth along the ascending branch of the life cycle.

The proposed model of forecasting scientific and technological development of agriculture in the region allows to accumulate volumetric parameters and target indicators from the existing agricultural development programs and other sectors of the agro-industrial sector, funds allocated for their achievement from budgets of all levels and own resources of agricultural organizations. Optimization of their use and selection of the most effective innovative products ensures obtaining the highest possible economic result necessary for the transition of agriculture in the region to a new stage (stage) of its development.

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THE EU-28 MILK SECTOR TRENDS IN THE PERIOD 2009-2018

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Abstract

The paper analyzed the EU-28 milk sector in the decade 2009-2018 based on Eurostat Database, using fixed indices, trend method and comparisons among the member states regarding number of dairy cows, number of dairy farms, average number of cows per farm, milk yield, raw milk production on farms and milk deliveries to dairies and milk price. In 2018, the EU-28 had 22.9 million dairy cows, 1.2 million dairy farms, the number of cows per farm varied between 219 heads in Czechia and 2.4 heads in Romania. Milk yield was 7,021 kg/cow/year, but the EU average was exceeded by 14 countries. The highest yield, 9,504 kg/cow was in Denmark and the lowest one, 2.877 kg is in Bulgaria. The EU produced 172.2 million tonnes raw milk of which 91 % was delivered to dairies. Average production per inhabitant is 336 kg. The results proved the decline of the number of cows and dairy farms, the growth of the average number of dairy cows per farms, milk yield, milk production and marketed milk. The main milk producing countries in the EU are: Germany, France, United Kingdom, Netherlands, Poland, Italy, Ireland, Romania and Spain. The EU has a large spectrum of farms from the most numerous subsistence farms to the largest specialized farms. The largest farms with over 30 dairy cows per farm as percentage of the total dairy farms are in: France (92.2%), Germany (70.5%), Netherlands (77.6%), Italy (32.1%) and Poland (10.65%).The specialized dairy farms have the highest production and standard output performance. The milk price crisis from 2014-2016 affected dairy farmers, despite that the EU Commission took corresponding measures to protect them. Farmers have to continue to reduce the number of farms and dairy cows, and to grow yield in order to produce and deliver more raw milk to dairies. In this purpose they have to invest more in farm modernization, to optimize nutrition and selection, to obtain a higher quality milk for getting a better return in terms of price at farm gate, income and profit.

Key words: *milk sector, dairy cows, dairy farms, average herd size, raw milk production, milk price, trends, EU-28*

INTRODUCTION

Milk is a basic food and also a strategic food for the whole population of the world [31].
About 6 billion people, that is more than 80 percent of the world's population, regularly consume fresh milk or other dairy products [12].
Milk and dairy products have a high nutritive value being an import source of protein and lactose, a large variety and minerals and vitamins, and this is a reason to be more and more produced [37].
Both in the developed countries and in the developing ones, dairy producers and processors offer a large variety of milk and dairy products which meet food safety standards for consumers [14].
The world milk production (cow, buffalo, camel, goat and sheep) in 2017 accounted for 867 ECM (energy corrected milk, standardized to 4% fat and 3.3 % protein), being produced by 118 million farms (dairy cows and buffalo) with an average hear size of 3.1 heads/farm, a milk yield (cow and buffalo) accounting for 2,200 kg/milking animal/year, and 7,300 kg milk/farm. World milk consumption was 869 million tonnes milk ME (milk equivalents), meaning 117 kg ME/inhabitant. The world average milk price was USD 35.5/100 kg ECM [40, 42].
In 2018, the world milk production increased by 2.2 % compared to 2017. This happened due to the increase of milk production in the most important producing countries.
Dairy cows are responsible of the highest part of milk produced in the world. From 996.36 million cattle population existing in the world in 2018, about 270 million are dairy cows [3, 43].
The EU is an important contributor to the world milk production and dairy farming and

processing is an important sector in the EU agriculture and food industry [4, 25].

Europe produced 226.4 million tonnes of milk, representing 26.8 % of the world production, and by 0.9 % more than in 2017 [11].

The EU-28 contributes by 28 % to the world milk production, coming on the 2nd position after Asia (30%), and being followed by Americas (27%), other European countries (9%), and Africa and Oceania, each with 5 %.

Milk production is stimulated by the population and consumption growth. In the EU, about 45 million tonnes of fresh milk and dairy products are yearly consumed [41].

Dairy sector is the 2nd important agricultural sector in the EU-28, contributing by 12 % to agricultural output.

The EU has a "colored" map of dairy farms in terms of farm size, herd size, milk yield, milk production per farm, types of dairy farming systems. Most of the specialized dairy farms are mainly situated in the North and West part of Europe but also in the Central part, while the subsistence farms are especially found in the Eastern part of the EU [8].

In this context, the purpose of the paper was to analyze the EU-28 milk sector in the period 2009-2018 using Eurostat Data and pointing out the trends of the main specific indicators: number of dairy caws, number if dairy farms, average herd size per farm, farm structure based on the agricultural land destined for forage crops, milk yield, raw milk production, raw milk delivered to milk processors and milk price. The analysis was made both the EU-28 level and also in the main milk producing countries emphasizing the differences. Finally, taking into account the obtained results, there were presented the main aspects to which dairy farmers have to be focused in the future to grow milk production and quality and be more competitive in the market.

MATERIALS AND METHODS

Data collection

The data used in this study are mainly collected from Eurostat Statistical Data base for the period 2009-2018. Also, other important sources of data such as: FAOStat, IFCN data, FADN data were used.

The specific indicators taking into account in this study have been:

(i)Number of dairy cows, (ii)Number of dairy farms, (iii)Dairy farms structure based on the agricultural land classes, (iv)Average herd size per farm, (v)Milk yield, (vi)Raw milk production, (vii) Raw milk delivered to dairies and (viii) Milk price.

Methods used for processing the data

Dynamic analysis was based on Fixed Index, $I_{FB} = (y_n - y_1)*100$, to point out the growth or decline in the last year of the analysis compared to the first one and identify the trend line.

Trend Method was used to identify the general tendency regarding the evolution of the number of dairy cows, milk production and milk price. For this purpose, there were utilized the suitable equations:

-polynomial equation of the second degree $Y= ax^2 + bx + c$ for the number of dairy cows and milk price;

-linear equation $Y = bx + a$ for milk production.

Coefficient of determination, R^2, was used to evaluate the measure of variation of each indicator.

Comparison method was used to analyze the situation among the EU member states for each indicator mentioned above.

The obtained results are presented in tables and graphics, of which just a part are included in this article.

RESULTS AND DISCUSSIONS

Number of dairy cows

In the EU-28, the number of dairy cows registered a general decreasing trend from 23,757 thousand heads in 2009 to 22,938 thousand heads in 2018, meaning by 3.5 % less than in the first year of the analysis and by 1.6% compared to 2017 (Fig. 1).

This happened because in almost all the EU member states with a few exceptions, the cow livestock declined. Important losses were noticed in the main milk producing countries and with a high number of cows: Romania (-17.7%), Poland (-14.4%), France (-5.3 %), Germany (-1.7%), Spain (-1.2 %), but also in other countries such as: Croatia (-36%), Lithuania (-31.8%), Greece (-30%), Slovakia (-27.5%), Bulgaria (-17.6%), Latvia (-13.3%), Estonia (-12.4%), Sweden (-11.6%), Slovenia (-9 %), Finland (-7.7 %), Czechia (-6.5%), and Hungary (-3.7%). In Austria the number of dairy cows remained relatively at the same level like in 2009, and in Denmark and Netherlands it was registered a slight decline (-0.7 % and, respectively, -0.1 %).

However, the dairy cows number increased in a few countries as follows: Cyprus (+34.7 %), Ireland (+33.9%), Luxemburg (+15.2%), Italy (+9.9%), Belgium (+2.1%), and United Kingdom (+1.66%).

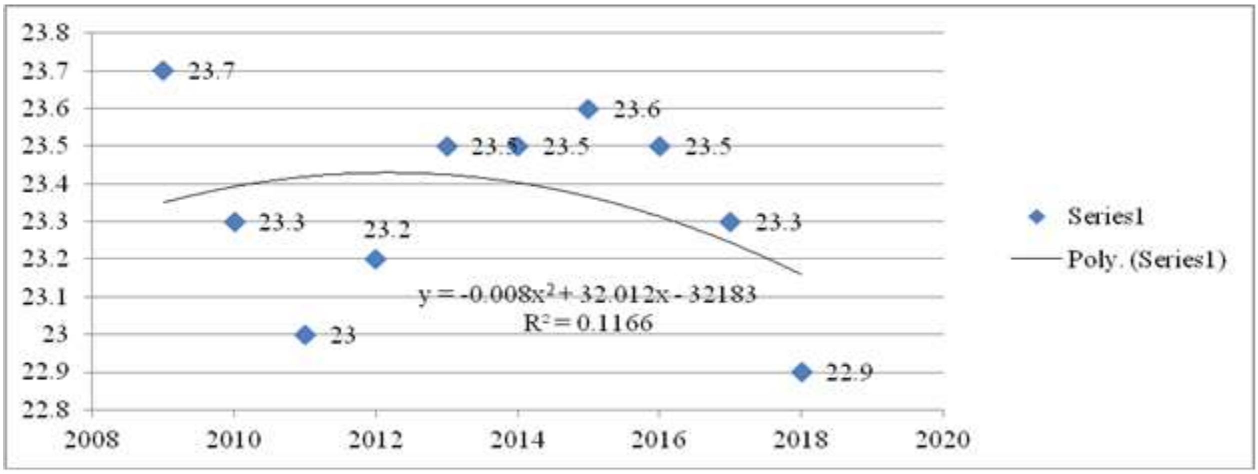

Fig.1. Dynamics of the number of dairy cows and its trend line in the EU-28, 2009-2018 (Million heads)
Source: Own design based on Eurostat Data, 2019 [1, 9].

In 2018, the highest number of dairy cows was found in: Germany (4,101 thousand heads, representing 17.8 % of the EU-28 dairy cows livestock), France (3,550 thousand heads, 15.4 %), Poland (2,214 thousand heads, 9.6 %), Italy (1,939 thousand heads, 8.4%), United Kingdom (1,895 thousand heads, 8.2 %), Netherlands (1,552 thousand heads, 6.7 %), Ireland (1,369 thousand heads, 5.9%), Romania 1,169 thousand heads, 5 %), and Spain (817 thousand heads, 3.5 %).

All these nine countries are raising 18,606 thousand dairy cows, representing 81.1 % of the EU-28 dairy cows number (Fig.2).

The lowest number of dairy cows is in Malta.

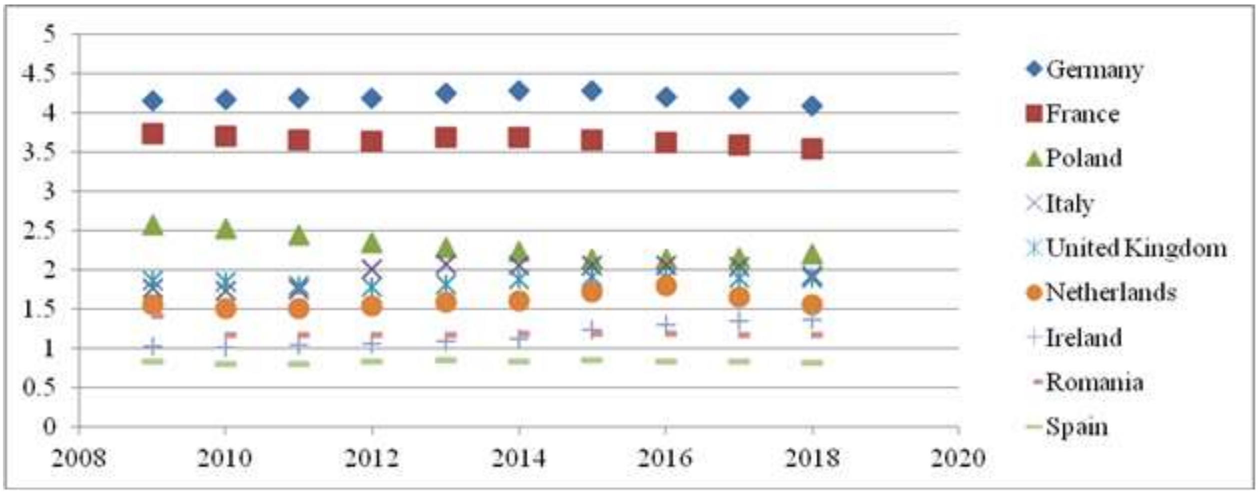

Fig.2. Dynamics of the number of dairy cows in the main milk producing countries of the EU-28 (Million heads)
Source: Own design and calculation based on Eurostat Data, 2019 [9].

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Number of dairy farms

In 2017, the EU-28 had 1,273.12 thousand dairy farms compared to 1,486.69 thousand in 2013 (-14.37%). Therefore, not only the number of dairy cows declines but also the number of dairy farms dramatically decreased dramatically.

The highest number of dairy farms is in the following countries: Romania (604 thousand heads), Poland (237 thousand), Germany (69.2 thousand), France (63 thousand), Italy (37 thousand), Nethrelands (17.9 thousand), Latvia (17.3 thousand, Ireland (16.7 thousand), Spain (16 thousand), United Kingdom (13.2 thousand, Belgium (11.8 thousand), all these eleven countries summing 1,103.1 thousand dairy farms representing 86.6 % of the EU-28 level.

The lowest number of dairy farms is in Malta (0.12 thousand) and Cyprus (0.18 thousand).

In percentages, the decreasing ranking of the main countries with farms raising dairy cows was the following one in the year 2017; Romania (47%), Poland (18.6%), Germany (5.4%), France (4.9%), Italy (2.9%), Netherlands (1.4%), Latvia (1.3 %), Ireland (1.3 %), Spain (1.2%), United Kingdom (1%) and Belgium (0.9%).

The decline of the number of dairy farms in 2017 versus 2008 is presented in Table 1. In 2017 there were by 56.1 % less dairy farms than in 2008.

In the EU-28 it is a large variety of dairy farms taking into account the agricultural land used for producing forages. There are farms with less than 2 ha and also farms with over 100 ha, and this surface is closely related to the number of cows, because it is needed to have enough land to produce forages for covering the requirements of the cows to sustain production, pregnancy, weight growth, movement etc.

Table 1. Number of dairy farms in the EU-28 member states in 2017 versus 2008 (thousand)

Country	No. of dairy farms			Country	No. of dairy farms		
	2008	2017	2017/2008%		2008	2017	2017/2008%
Belgium	12.7	11.8	92.9	Luxemburg	0.86	0.69	80.2
Bulgaria	106	33	31.1	Hungary	12.5	9.6	76.8
Czechia	2.46	1.69	68.6	Malta	0.30	0.12	40.0
Denmark	4.9	3.1	63.2	Netherlands	20.7	17.9	86.4
Germany	99.4	69.2	69.6	Austria	44	32	72.7
Estonia	5.06	1.74	34.3	Poland	575	237	41.2
Ireland	19.7	16.7	84.7	Portugal	10	5.2	51.0
Greece	7.3	3	41.0	Romania	883	604	68.4
Spain	24	16	66.6	Slovenia	13	9	69.2
France	87	63	72.4	Slovakia	9	6	66.6
Croatia	27.5	9	32.7	Finland	12.5	7.6	60.8
Italy	58	34	58.6	Sweden	6.6	4.1	62.1
Cyprus	0.4	0.18	45.0	United Kingdom	16.4	13.2	80.4
Latvia	35.6	17.3	48.5	EU-28	2,201.8	1,237.12	56.1
Lithuania	108	47	43.5				

Source: Own calculation based on [16, 17].

The largest farms based on the utilized agricultural land are in France where 41.5 % are farms with over 100 ha, 39.5 % have between 50-99.9 ha and 11.2 % have between 30 and 49.9 ha.

On the 2nd position comes Germany, where the highest weight, 29.5% belongs to the farms whose surface varies between 50-99.9 ha, the ones larger than 100 ha represent 20.1 % and the ones whose area varies between 30-49.9 ha are 20.9%.

On the 3rd position is situated Ireland, which has 42.2 % farms with a surface ranging between 50-99.9 ha and 32 % farms with an area between 30 and 49.9 ha, but also farms larger than 100 ha, representing 10.5 % of the total number of dairy farms.

Netherlands comes on the 4th position. It has 36.3 % farms with an area between 30-49.9 ha, 34.8 % farms have between 50 and 99.9 ha and 13.6 % have between 20 and 29.9 ha. But Netherlands has also 6.5% farms larger than 100 ha.

Italy is ranked the 5th taking into account that the highest share is kept by the dairy farms with a surface varying between 10 and 19.9 ha (21.5%), the farms with an area between 5-9,9 ha represent 17.2 %, the farms belonging to the class 30-49.9 ha represent 13.9 %, the farms with an aria between 50 and 99.9 ha represent 10.8 % and the largest farms with over 100 ha are only 7.4 %.

In Poland, the highest share, 28.7%, belongs to the farms whose surface varies between 10 and 19.9 ha, then 26.5 % farms have an area between 5 and 9.9 ha and 18.7 % farms are small owning just 2-4.9 ha.

However, In Poland, 10.7% farms have a surface between 20-29.9 ha, 7 % between 30-49.9 ha, 2.85 % between 50-99.9 ha and only 0.8 % are larger farms exceeding 100 ha (Table 2).

Therefore, the EU is characterized by the small-scale dairy cow farming systems in most of the member states, except France, Netherlands and Germany where the dairy farms over 30 ha are dominant representing 92.2%, 77.6% and respectively 70.5% of the total number of dairy farms in these countries [13].

Table 2. Dairy farms structure by agricultural land classes in the main EU milk producing countries in 2016 (%)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	0.63	0.36	0	0.05	0.26	0.04
Less than 2	0.12	0.20	0	0.16	2.51	4.45
2 - 4.9	0.68	0.43	0.05	0.44	13.52	18.79
5 - 9.9	1.22	3.62	0.32	1.50	17.29	26.50
10 - 19.9	2.34	14.33	4.09	6.42	21.59	28.75
20 -29.9	2.60	10.49	10.69	13.63	12.51	10.78
30 - 49.9	11.26	20.96	32.07	36.36	13.99	7.00
50 - 99.9	39.57	29.50	42.22	34.86	10.88	2.85
Over 100	41.59	20.11	10.56	6.58	7.45	0.84
Total	100.00	100.00	100.00	100.00	100.00	100
Absolute figures	64,430	69,200	18,330	17,900	53,380	243,570

Source: Own calculation based on the data from [44].

Average dairy herd size

Dairy farms, from a statistical point of view, vary in a large range, but the decline of the number of dairy farms and of the number of dairy cows has led to the increase of the herd size per farm diminishing the share of the small farms [10].

In 2017, the EU-28 had 33 dairy cows as average herd size.

Some countries have a big number of dairy cows per farm, such as; Czechia (219 heads), Slovakia (197 heads), Denmark (185 heads), United Kingdom (143 heads), Netherlands (97 heads), Ireland (84 heads), Sweden (83 heads), Luxemburg (73 heads), Germany (61 heads), France (57.6 heads), Spain (54 heads), and Italy (52 heads).

But, there are also countries with the smallest number of dairy cows per farm like: Romania (2.4 cows) and Bulgaria (8.8 cows), and Latvia (8.9 cows).

In Table 3 it is presented the distribution of the number of dairy cows by agricultural land classes in the main EU milk producing countries in the year 2016.

In Germany, the highest share of dairy cows, 49.41 %, is in the farms with over 100 ha, therefore, the largest farms. In the farms whose surface vary between 50-99.9 ha, there are only 22.89 % of dairy cows and in the farms with an area between 30 and 49.9 ha there are only 12.19 % cows. The remaining of 15.51 % cows are raised in the farms smaller than 30 ha.

In France, 56.7 % of dairy cows are in the largest farms with over 100 ha, followed by the farms whose area varies between 50-99.9 ha, and which have 34.38 % of the total

number of cows in the country. The remaining of 8.92 % dairy cows are grown in farms with a surface smaller than 50 ha.
In Italy, the largest farms with over 100 ha concentrate 22.43 % dairy cows, the ones whose area varies between 50-99.9 ha have 19.39 % cows and the ones whose surface is between 30-49.9 ha have 17.67 % cows. The remaining of 40.51 % cows are grown in farms smaller than 30 ha.

Table 3. Dispersion of the number of dairy cows by agricultural land classes in the main EU milk producing countries in 2016 (%)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	0.93	0.21	0	0.06	0.28	0.12
Less than 2	0.02	0.04	0.001	0.04	0.61	0.70
2 - 4.9	0.16	0.10	0.02	0.04	3.23	3.93
5 - 9.9	0.09	0.58	0.08	0.24	8.07	10.64
10 - 19.9	0.41	3.61	1.35	2.19	14.65	27.24
20 -29.9	0.90	3.97	4.96	7.46	13.67	18.55
30 - 49.9	6.41	12.19	22.39	30.02	17.67	17.68
50 - 99.9	34.38	29.89	48.18	44.41	19.39	11.24
Over 100	56.70	49.41	23.02	15.54	22.43	9.40
Total	100.00	100.00	100.00	100.00	100.00	100
Absolute figures	3,678,410	4,274,490	1,398,070	1,744,830	2,010,110	2,183,490

Source: Own calculation based on the data from [44].

In Ireland, the most numerous cows, 48.18 %, are found in the farms whose area varies between 50-99.9 ha, 23.02 % are grown in the farms over 100 ha and 22.39 % in farms whose surface ranges between 30-49.9 ha. The remaining of 6.41 % cows are raised in the farms smaller than 30 ha.
In Netherlands, the farms with an area between 50-99.9 ha raise 44.41 % of the dairy cows number, the ones whose surface ranges between 30-49.9 ha keep 30.02 % dairy cows and the largest farms over 100 ha grow 15.54 % of the number of cows. The remaining of 10.02 % cows is kept by the farms smaller than 30 ha.
In Poland, the most numerous cows, 27.24 %, are grown in the farms whose land dimension vary between 5-9.9 ha, 18.55 % cows are kept in farms whose surface ranges between 10 and 19.9 ha, 17.68% cows are found in farms whose land vary between 20-29.9 ha, 11.24 % cows are in farms with a dimension varying between 30 and 49.9 ha and only 9.4 % dairy cows are grown in the largest farms with over 100 ha.
Therefore, the number of dairy cows is mainly concentrated in the farms with a large land dimension, and it is normal to be so, because it is needed to correlate the cow livestock with the land surface where forages should be produced.
In the farms with over 100 ha, the highest number of dairy cows per farm is in Netherlands, accounting for 231.8 heads, followed by Ireland with 166.6 dairy cows, Germany with 151.9 dairy cows, Italy with 122.5 cows and Poland with 111.3 heads.
In the farms whose surface ranges between 50 and 99.9 ha, the number of dairy cows per farm is: 124.2 cows in Netherland and the lowest number of cows, accounting for 35.3 heads is in Poland.
In the farms whose area varies between 30 and 49.9 ha, the most numerous cows per farm in Netherlands and the least numerous cows, 22.6 heads are in Poland. The average herd size per farm in 2016 was 97.4 dairy cows in Netherlands, 76.3 cows in Ireland, 61.7 cows in Germany, 57 cows in France, 37.6 cows in Italy and 9 cows in Poland (Table 4).
Therefore, the dairy farms structure is deeply influenced by the natural conditions existing in each country and also by the technologies applied in dairy farming. In the farms where the ratio between number of cows and number of hectares agricultural land exceeds 1, this means that the productivity in forage

production is higher than in case of the farms where the ratio is lower than one.

Studying the average herd size in its dynamics, it was noticed a general increasing trend of cow per farm, while the number of farms is continuously decreasing [2, 8].

Table 4. Number of dairy cows per farm in the main producing countries in 2016 (heads/farm)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	83.5	37.2	0	100	39.7	22.5
Less than 2	8.9	13.6	0	21	7.5	1.4
2 - 4.9	13.5	15.1	36	8.5	9	1.8
5 - 9.9	4.1	9.9	17.8	15.5	17.5	3.6
10 - 19.9	10.0	15.5	25.2	33.2	25.5	8.5
20 -29.9	19.8	23.4	35.4	53.3	41.1	15.4
30 - 49.9	32.4	35.9	53.2	80.5	47.5	22.6
50 - 99.9	50.0	62.5	87.0	124.2	67.1	35.3
Over 100	77.9	151.9	166.6	231.8	122.5	111.3
Average no of dairy cows per farm (heads)	57.0	61.7	76.3	97.4	37.6	9.00

Source: Own calculation based on the data from [44].

Milk yield in the EU-28 accounts for 7,021 kg/cow/year. This average varies from a country to another, depending on the genetic potential of breeds, farming system, feeding conditions, reproduction system, cows health and wellness.

Some EU member states are able to produce a higher milk yield than the EU-28 average milk production. In 2016, the following performance in milk yield was obtained: 9,504 kg/cow/year in Denmark, 9,063 kg in Finland, 9,039 kg in Sweden, 8,981 kg in Estonia, 8,222 kg in Netherlands, 7,699 kg in Czechia, 7,684 kg in Spain, 7,651 kg in Portugal, 7,587 kg in Luxemburg, 7,574 kg in Germany, 7,482 kg in Belgium, 7,152 kg in United Kingdom, 7,150 kg in Slovakia, 7,101 kg in Italy [7].

But, there are also countries, where milk yield is the lowest one like in: Bulgaria (2,877 kg/cow/year) and Romania (3,227 kg) (Fig. 3).

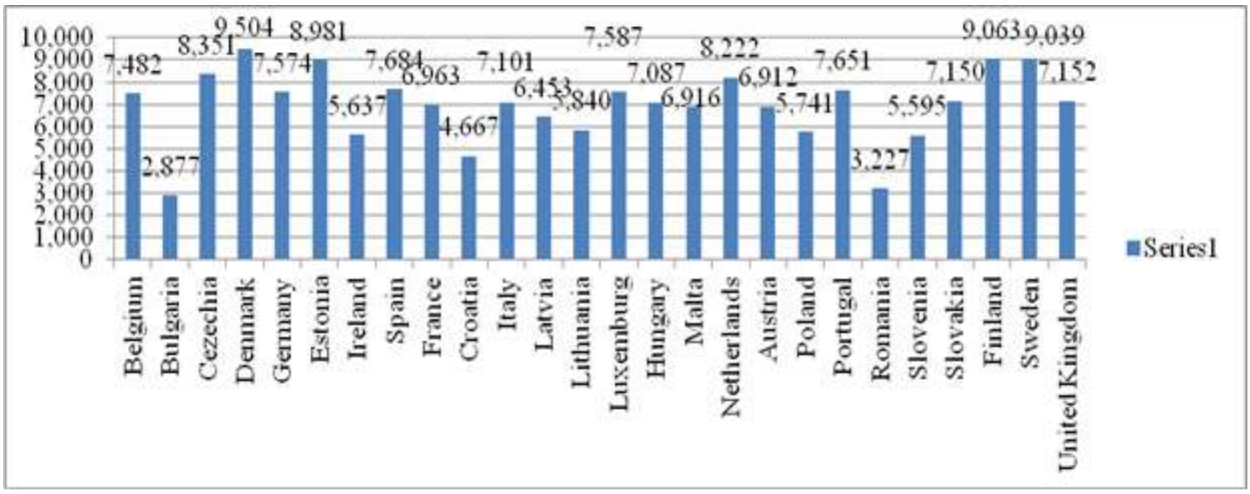

Fig.3. Milk yield in various EU member states in 2016 (kg/cow/year).
Source: Own design based on [7].

The gap between countries is caused by "natural conditions and economic and social regulatory context" as mentioned by the European Commission. The largest specialized farms have the highest performance [7].

However, milk yield in the EU countries increased because of the farmers' efforts to improve nutrition, reproduction and breeding programmes for milk production. In addition, important changes in technical endowment in dairy farms such as: automated calf feeders, monitoring systems for dairy cows activity, automated milking systems etc have also supported milk production and milk quality [2].

Raw milk production on farms

Despite that the number of dairy cows and the number of dairy farms decreased in the EU-28, raw milk production on farms increased due to the growth of the average herd size and milk yield sustained by a higher efficiency in nutrition and breeding management and farmers' association in co-operatives whose number has also grown [8].

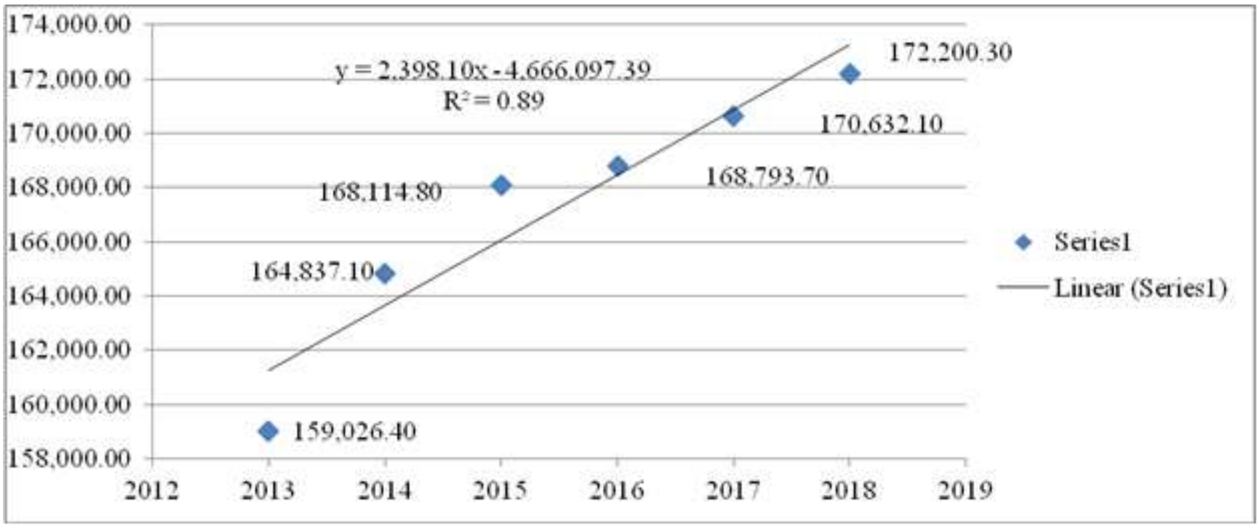

Fig. 4. Dynamics of raw milk produced on the EU-28 farms, 2013-2018 (Thousand tonnes)
Source: Eurostat Data Base, 2019 [9].

In 2018, the total raw milk produced by the EU-28 farms was 172.2 million tonnes, by 1.2 % higher than in 2017 9 170.1 million tonnes), of which 96.8 % cow milk (Fig.4).

In 2017, in the EU-28, there were achieved 119 million tonnes dairy products, of which fresh milk 30.7 million tonnes (25.7%), cheese 10.2 million tonnes (2%), milk powder 2.1 million tonnes 91.7%) etc [9].

The main milk producing countries in the EU are: Germany, France, United Kingdom, Netherlands, Poland, Italy, Spain, Ireland, Denmark, Romania, Belgium, Austria and Czechia [18].

In 2018, these countries produced 153.4 million tonnes raw milk representing 89 % of the EU-28 production.

The market share of these 13 countries in the EU raw milk production si the following one: Germany 19.2 %, France 15.1 %, United Kingdom 8.9 %, Netherlands 8.3 %, Poland 8.2 %, Italy 7.6 %, Spain 4.8 %, Ireland 4.5 %, Denmark 3.2 %, Romania 2.6 %, Belgium 2.4 %, Austria 2.2 % and Czechia 1.8%.

Most of these countries registered a surplus of raw milk production in 2018 versus 2009 level as follows: Ireland + 56 %, the highest growth rate, Belgium + 40 %, Netherlands + 20 %, Austria + 18.1 %, Denmark +16.6 %, Spain 15.1 %, Czechia + 14.2 %, United Kingdom +13.9%, Poland +13.6 %, Italy +8.2 % and France + 7.4 % (Table 5).

The success in raw milk performance was assured in the largest specialized farms with a high herd size, high surface for producing feed, a high pressure in genetic gain, high efficient dairy cows growing technologies.

The only exception is Romania, where raw milk production declined by 17 % in the period 2009-2018.

Even thou Romania is among the countries with the highest number of dairy cows (1,169 thousand heads representing 5 % of the EU-28 number of dairy cows and occupying the 8th position after Germany, France, Poland, Italy, United Kingdom, Netherlands and Ireland, and also having the highest number of dairy farms (604 thousands) for which it comes on the top position, the average number of dairy cows per farm is the smallest in the EU-28, just 2.2 cows, the last position in the EU and also the lowest milk yield, 3,227 kg/cow/year, the penultimate rank in Europe.

Table 5. Raw milk production on farms in the main producing countries of the EU-28 in 2018 versus 2009 (Million tonnes)

	2009	2018	2018/2009 %
Germany	29.2	33.1	+13.3
France	24.2	26.0	+7.4
United Kingdom	13.5	15.5	+14.8
Netherlands	12.0	14.4	+20.0
Poland	12.5	14.2	+13.6
Italy	12.1	13.1	+8.2
Spain	7.3	8.4	+15.1
Ireland	5.0	7.8	+56
Denmark	4.8	5.6	+16.6
Romania	5.3	4.4	- 17.0
Belgium	3.0	4.2	+40.0
Austria	3.3	3.9	+18.1
Czechia	2.8	3.2	+14.2

Source: Own calculation based on [9].

This situation is explained by the sprayed land into million of plots according to the Lad Law issued in 1991, the return of animals back to their owners as a consequence of the dissolution of the old state enterprises and co-operatives. The owners slaughtered a part of the low productive animals and the remaining were grown in small subsistence and semi-subsistence farms where dairy farming was made based on traditional practices. The farm size in terms of agricultural land is about 2 ha and the average herd size is 2.2 cows per farm, conditions in which it is not possible to apply modern technologies. The non corresponding dairy farm structure led to low milk performance and farmers' income [5, 23, 26, 30].

About 97% farms are family farms and just a few are specialized farms where production performance is high.

The decline in the number of dairy cows was determined by the un corresponding feeding, reproduction problems, breeders' aging, grazing taxes etc, which reduced milk yield and milk production, marketed milk and income of the dairy farmer [29, 35, 38].

Milk quota imposed after Romania's accession into the EU have also created problems to farmers who had to increase the number of cows or to raise milk yield to respect the quotas. In the biggest producing countries in the EU, milk quota caused also troubles to farmers who had to exchange or sell of quotas or to reduce the number of cows. After the dissolution of milk quotas in April 2015, the situation of dairy farming become more relaxed [21].

In addition the increase in farm inputs price, the high production cost, and low price at the farm gate made dairy farms to be unprofitable [19, 20, 22, 27, 28, 39].

Milk quality does not meet the standards in many cases, the low milk price offered by milk processors, the impossibility to deliver milk to processors and other reasons have led to a critical situation in the milk market in Romania [36, 37].

Due to the low price offered by processors, a part of the dairy farmers looked after new markets where to sell their milk for a better price, as it was in Bulgaria [32, 36].

Milk production per inhabitant

Analyzing milk production per inhabitant, it is easy to notice a continuous increase which led to an offer/demand unit over 1. Therefore, in almost all the main producing countries milk production was very high, exceeding consumption requirements. In this situation, milk price dropped creating a real crisis in the sector.

In the period 2013-2018, milk production per capita at the EU-28 level increased by 13.16 % and in 2018 reached 336 kg/inhabitant.

The highest level of milk per capita was registered in Ireland: 1,177.8 kg in 2009 and 1,625 kg/capita in 2018, meaning + 37.9 %. In Denmark, milk production per capita is also high and increased by 8.5 % from 890.1 kg in 2009 to 965.5 kg in 2018. Netherlands produced 837.2 kg milk per inhabitant in 2018 by +14.85 % more than in 2009.

Austria comes on the 4th position from this point of view. In 2018, it achieved 443.2 kg milk/capita by +12.8 % more than in 2009.

Germany carried out 361.8 kg/capita in 2009, but by +10.2 % more in 2018, that is 398.8 kg. France produced 388.6 kg/capita in 2018, a little bit more than in 2009 (+0.8%). Poland registered a boom of milk production on farms which led to 373.6 kg/capita in 2018, by 15.4 % more than in 2009. Belgium recorded a surplus of 28.4% raw milk per inhabitant in 2018 when it was reached the record of 368.4 kg.

In Czechia, the record of 2018 accounted for 301.9 kg milk/capita by 17.42 % more than in 2009. In the United Kingdom, in 2018, it was produced 233.7 kg milk per capita by 4.3 % more than in 2009. In Italy, milk per capita reached 216.5 kg in 2018 being by 5 % higher than in 2008.

Spain produced 179.9 kg milk per inhabitant in 2018 by 11.1 5 more than in 2009.

The only exception among the main milk producing countries is Romania. Even thou milk production is high, the decline by 17 % in the period 2009-2018 led to a decrease of milk per capita from 261.1 kg in 2009 to 225.6 kg in 2018 (Table 6).

Table 6. Milk production per inhabitant in the main EU producing countries, 2009-2018 (kg/capita)

	2009	2018	2018/2009 %
EU-28*	296.9*	336	+13.2
Ireland	1,177.8	1,625.0	+37.9
Denmark	890.1	965.5	+8.4
Netherlands	728.9	837.2	+14.9
Austria	392.9	443.2	+12.8
Germany	361.8	398.8	+10.2
France	385.4	388.6	+0.8
Poland	323.7	373.6	+15.4
Belgium	287.0	368.4	+28.4
Czechia	257.1	301.9	+17.4
United Kingdom	224.0	233.7	+4.3
Italy	206.0	216.5	+5.1
Spain	161.3	179.9	+11.5
Romania	261.1	225.6	+13.6

*2010 level.

Source: Own calculation based on Eurostat database, 2019.

Raw cow's milk collected and delivered to dairies

About 97.6 % of raw cow milk is collected by dairies and processed in various products such as: fresh drinking milk, yoghurt, sour cream, cheese, butter, milk powder etc.

Every year, an amount of about 45 million metric tons of fresh dairy products are consumed in the EU [41].

The remaining amount of about 2.4 % is consumed by farmer's family and animals or is processed or is directly marketed.

In 2018, raw milk collected by dairies accounted for 156.3 million tonnes at the EU-28 level. The highest amount of raw milk processed by dairies is supplied by 18 countries, whose contribution to the EU milk delivery was 150.7 million tonnes, representing 96.4 % of the total quantity of milk.

The share of the main producing countries in the EU-28 collected milk is the following one: Germany 20.6 %, France 15.9 %, United Kingdom 9.8 %, Netherlands 9.2 %, Poland 7.5 %, Italy 6.9 %, Ireland 4.8 %, Spain 4.5% [9].

In all the main producing countries the delivery of raw milk to processing industry increased except Portugal, where the delivery in 2018 stagnated at the level of the year 2009 and Sweden, where the delivery was by 3.5 % lower than in the first year of the analysis.

In the period 2009-2018, the highest milk delivery rate belongs to Ireland (+59.2), Poland (31.8%), Czechia (30.4%), Belgium (+27.2%), Spain (+24.5%), Netherlands (+20.8%), Denmark (+19.1%), Germany (+19%), Austria (+18.5), United Kingdom (+15.1%) and France (+7.4 %).

The lowest rate growth was recorded by Italy (+1.9%) (Table 7).

Ireland went up one position being ranked the 7th for raw delivered milk, while Spain went down a position.

Romania lost its 10th position occupied for raw milk production and passed on the 18th position for milk delivered to processing industry. In 2018, Romania produced 4.44 million tonnes raw milk and delivered only 1.12 million tonnes, that is 25.2 % of its production. This was caused by the deficiencies in the milk collection system, the low milk quality and direct deliveries.

Table 7. Raw milk delivered to dairies by the main producing countries of the EU-28 in 2018 versus 2009 (Million tonnes)

	2009	2018	2018/2009 %
Germany	27.3	32.5	+19
France	22.9	24.6	+7.4
United Kingdom	13.2	15.2	+15.1
Netherlands	11.5	13.9	+20.8
Poland	9.1	12.0	+31.8
Italy	10.5	10.7	+1.9
Ireland	4.9	7.8	+59.2
Spain	5.7	7.1	+24.5
Denmark	4.7	5.6	+19.1
Belgium	3.3	4.2	+27.2
Austria	2.7	3.2	+18.5
Czechia	2.3	3.0	+30.4
Sweden	2.9	2.8	-3.5
Finland	2.3	2.4	+4.3
Portugal	1.9	1.9	0
Hungary	1.4	1.5	+7.1
Lithuania	1.3	1.4	+7.6
Romania	1.0	1.1	+10

Source: Own calculation based on [9].

Milk price registered an oscillating dynamics in the EU depending on milk production and various circumstances.

In 2009, the price dropped, but it recovered in 2010 and 2011. In 2012, it fell again but it raised again in 2013 and 2014 over the level of the year 2011.

In 2015 and 2016, milk price registered the highest fall and for this reason this period was nicknamed "milk price crisis". But, in 2017, milk price rebounded due to the measures taken by the European Commission (Fig.5) [7].

Milk price varied from a country to another due to the diversity of economic, social and environmental conditions, average number of dairy cows per farm, milk yield, milk production performance, demand/offer ratio, production level per inhabitant, political circumstances connected to the embargo imposed to Russia and other factors.

In the period 2009-2010, milk price reached the maximum level in 2013 in Germany (Euro 38.15/100 kg raw milk), Netherlands (Euro 41.14/100 kg), Ireland (Euro 37.76) and Belgium (Euro 37.11) and in the year 2014 in France (Euro 38.4), United Kingdom (Euro 37.95), Poland (Euro 32.77), Italy (Euro 43.22), Spain (Euro 35.38), Denmark (Euro 40.08), Austria (Euro 39.46) and Romania (Euro 28.13).

Since 2013 and respectively 2014, milk price continued to decline in 2015 and 2016 in all the analyzed countries, but it recovered in 2017 and the increased again in 2018 in Germany, Denmark, Austria, but in other countries like France, United Kingdom, Netherlands, Poland, Italy, Ireland, Spain, Belgium and Romania it declined in 2018.

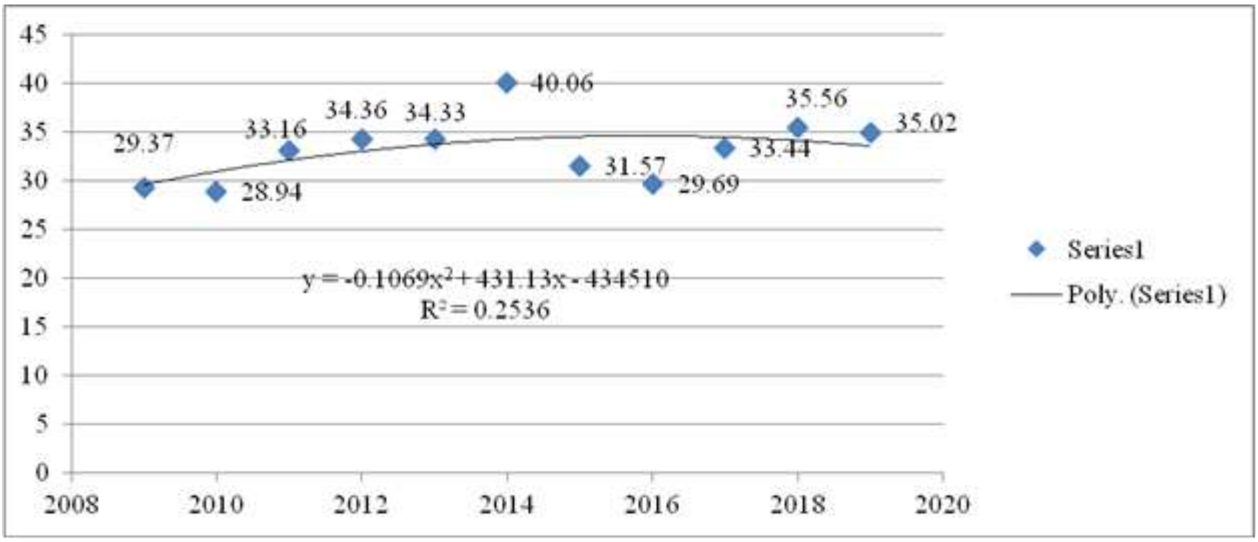

Fig.5. Dynamics of the average raw cow milk price and its trend line at the EU-29 level on 1st January, 2009-2019 (Euro/100 kg)
Source: Own design based on [6, 9].

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Analyzing the level of price in 2018 from a country to another, one may easily notice the price differences. In this year, the highest milk price was got in Austria (Euro 40.4/100 kg) and the lowest one in Germany (Euro 27.23).

However, milk price is higher in 2018 compared to 2009 in all the main milk producing countries which is a positive aspect (Table 8).

But, at the same time, the farm input price increased so that during the milk price crisis, the EU Commission had a difficult task to take corresponding measures to support dairy farmers and diminish the crisis negative effects.

In this respect, dairy farmers received incentives to reduce milk production, a public intervention was applied when milk reached the lowest level, it was supported the storage of various dairy products such as: cheese, butter, milk powder, it was launched the milk delivery to schools, special measures were destined to promote milk and dairy products on other markets, direct payments were allotted according to the CAP 1st pillar, a coupled support was given for stabilizing income in the rural areas based on the CAP 2nd pillar and milk quality was sustained as well.

Table 8. Raw milk price in the main producing countries of the EU-28 in 2018 versus 2009 (Euro/100 kg)

	2009	2018	2018/2009 %
Germany	25.25	27.23	+7.8
France	28.67	35.30	+23.1
United Kingdom	25.78	31.84	+23.5
Netherlands	26.70	36.22	+35.6
Poland	20.71	31.29	+51.0
Italy	27.07	39.75	+46.8
Ireland	21.53	33.87	+57.3
Spain	29.19	31.23	+6.98
Denmark	28.87	39.51	+36.85
Austria	29.00	40.40	+39.3
Romania	20.35	30.11	+47.9

Source: Own calculation based on [6].

CONCLUSIONS

This study confirmed that the EU-28 is an important milk producer able to meet consumers' needs and offer milk and dairy products for export on international markets.

The main trends confirmed by this research are the following ones: the decline of the number of cows and of the number of dairy farms, the increase of the average number of dairy cows per farms and of milk yield, the milk production growth and milk quality improvement.

In the EU, the largest and specialized farms keep the highest number of cows and register the highest performance in milk yield and production, delivery milk to dairies and income in terms of standard output.

The main milk producing countries in the EU are: Germany, France, United Kingdom, Nethrelands, Poland, Italy, Ireland, Romania and Spain.

The countries having larger dairy farms than 30 dairy cows are France (92.2%), Germany (70.5%), Netherlands (77.6%), Italy (32.1%) and Poland (10.65%), the percentages being from the total number of cows exiting in each country.

Milk market has been affected by milk crisis when milk price registered the lowest level in the years 2014-2016, but the measures taken by the European Commission were welcomed at that moment and dairy farmers have to be aware that they have to prevent a new unpleasant situation by taking into consideration the following measures:

(i)to increase investments for dairy farms modernization for keeping pace with new technological progress; innovations and investments in new feeding and milking technologies, cooling bigger tanks are beneficial for producing more milk and of higher quality [15, 24].

(ii)to grow the number of dairy cows per farm over 30 and much better 50 cows in order to be more market oriented and competitive;

(iii)to raise only cows of high production level and assure selection pressure by high breeding value bulls;

(iv)to keep under control reproduction activity of the cows in order to assure the flow in milk production and females calves for culled cows replacing;

(v)to continue to improve cows' nutrition by using balanced rations and sufficient and of high quality feed;
(vi)to continue to improve milk quality for assuring a higher amount of milk marketed to dairies and a higher milk price and return to farmers;
(vii)to optimize milk chain and assure more units for milk collection closer to dairy farms and milk dairies.
(viii)to apply strategic management based on their own vision regarding their future business taking into consideration the market changes and the pressure of a high competition among milk producers;
(ix)production diversification and integration for strengthen income and profit flow;
(x)to pass from extensive farming system to a more intensive dairy farming system to assure production specialization;
(xi)to grow the dimension of the farms by continuing to create new farmers' associations and co-operatives to improve the efficiency of the utilized resources and raise income and profit.

Taking into account the analyzed indicators in their dynamics in the last decade, it is expected as in the future the number of dairy cows to decline, the number of dairy farms also to decrease, milk yield and production to grow and the delivery of raw milk to dairies to raise.

Milk price prediction is subject of statistics research [33, 34], but sometimes the appearance of new circumstances could demolish the forecasts. However, forecast is based on the previous dynamics of the number of dairy cows, milk yield and production, production cost, milk price and could create a future images on what is going to happen.

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OIL SEEDS CROPS CULTIVATED AREA AND PRODUCTION IN THE EU-28 - TRENDS AND CORRELATIONS, 2008-2018

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Abstract

The paper analyzed the EU-28 oil seeds sector in terms of cultivated area, production and yield for rape and turnip rape, sunflower and soybean, based on the data provided by Eurostat for the period 2008-2018. Growth rate, index method, descriptive statistics, correlations and regression equations were used to identify the trends and connections between these indicators. In 2018, the EU-28 cultivated 11.8 million ha with oil seeds crops, of which 58% rape, 33.8% sunflower and 8 % soybean. Seeds production reached 35 million tonnes, being by 30 % higher than in 2008. The average yield accounted for 3.2 t/ha in case of rape, 2.4 t/ha sunflower and 2.8 t/ha soybean seeds. The main producers of rape seeds are France, Germany, Poland, United Kingdom and Romania, and in case of sunflower are Romania, Bulgaria, Italy and France. The correlations and regression models indicated that for increasing production, yield improvement of sunflower and rape and also cultivated surface of soybean to increase. The lack of incentives for oil seeds producers in the EU and the higher payments for protein crops in order to balance the protein deficit on the EU market and reduce imports, will affect oilseeds for sure producers and production. As a result, it is expected as soybean to be cultivated on larger surfaces and sunflower cultivated area to decline.

Key words: *oil seeds crops, cultivated area, yield, production, trends, correlations, regression models*

INTRODUCTION

Rape, sunflower and soybean are among the most important oil seeds crops in the world, and in the EU, they are on the top position.
Rape is cultivated for seeds and oil and other resulting products from oil extraction. Rape seeds are used as such or in various mixtures for birds feeding and also rape cakes remained from oil extraction are an excellent fodder. But, rape is mainly cultivated for seeds for extracting oil, which is consumed as such or for cooking and in food industry for producing margarine. In cosmetics, it is utilized for producing soaps and in chemical industry for obtaining lubricants for engines [14]. In the energy industry, rape oil is a valuable source for producing biodiesel. About 400 liters biodiesel could be produced from the rape seeds production harvested from one hectare. In animal growing, rape is considered a good forage crop, because it could be used as fresh fodder, silage, rape cakes and crushed seeds, being rich in protein, carbohydrates, minerals and vitamins. Also, "in crop rotation rape is utilized for shift wheat and maize and for green manure" [13, 17, 23].
Sunflower is cultivated for seeds and oil. The seeds are either consumed as such, but mainly dried, salted and roasted by humans. The oil extracted from seeds is used in salads and for cooks, and in industry for cosmetics, paints and lubricants. Also, the seeds are ingredients in various mixtures for birds feeding. The leaves are an excellent fodder for livestock and the flowers are decorative plants [15, 19].
Soybean is known as " the plant of which over than 1,000 products could be made" as it is rich in protein and oil, essential nutrients in human and animal diets. The seeds have a pleasant taste and could be consumed roasted. In food industry, from soybean seeds there are made soy milk, margarine, tofu cheese, say sauce, biscuits, chocolate etc. In the chemical industry, the oil is used for producing paints, adhesives and fertilizers. In medicine, the active substances from soybean seeds and oil

are useful in various treatments. In agriculture, soybean is a crop which enriches soil content in Nitrogen grace to the fixing bacteria and also soybean cakes are a good fodder [1].

The high demand for protein and oil has stimulated the cultivation of oil seeds crops which are so important for human diet and industry. The development of the renewable energy resources has also been a cause for which these crops have become more and more cultivated in the world [21].

The cultivated area with oil seeds crops increased and yield growth contributed to the development of oilseeds production at the global level [20].

In 2018, at the world level is was achieved 360.08 Million metric tonnes of soybean seeds, 70.91 Milllion metric tonnes of rapeseeds and 51.46 Million metric tonnes of sunflower seeds [22].

From the world oilseeds production in 2018, accounting for 596.73 Million metric tonnes, soybean seeds are ranked the first with 60.3 % market share, rapeseeds are on the second position with 11.8 % and sunflower seeds are on the third position with 8.6 % [24].

This reflected the differences in market share in the world oil seeds production compared to 2013, when soybean seeds represented 55%, rapeseeds 14 % and sunflower seeds 7.6 % [3]. In Europe, the most cultivated oil seeds crop is rape, followed by sunflower and soybean [5]. The demand/offer ratio encourages producers to extend the cultivated areas and increase yield for producing more oil seeds in the EU. In this context, the present paper aimed to study the evolution of the cultivated area with rape, sunflower and soybean, seeds production and yield in the EU-28 in the period 2008-2018 in order to identify the general trends and correlations existing between these indicators as well as the main cultivators and producers.

MATERIALS AND METHODS

Data collection

The research is based on the data provided by Eurostat Statistical Data base for the period 2008-2018.

The indicators analyzed in this study are:

(i)Cultivated surface with oil seeds crops, of which rape and turnip rape, sunflower and soybean;

(ii)Oilseeds production: Total and by crop: rape and turnip rape, sunflower and soybean;

(iii)Oil seeds yield by crop.

Methods used for processing the data

Dynamic analysis, using Fixed Index, I_{FB}, calculated according to the formula: $I_{FB}= (y_n/y_0)100$.

Descriptive statistics: Mean, standard deviation, coefficient of variation, maximum an dminimum values.

Comparison method, destined to compare surfaces and production among the EU countries;

Coefficient of correlation, r, in order to quantify the existing relationships between the indicators mentioned above.

Regression equations, Y= bX +a, in order to identify in what measure oil seeds production (Y) is influenced by cultivated surface and yield (X).

Determination coefficient, R^2, calculated in order to estimate how much of the variation of the dependent variable Y is caused by the variation of the independent variable X.

The results are graphically illustrated and also included in tables. In each case, the results are correspondingly commented, and finally, the main conclusions are drawn.

RESULTS AND DISCUSSIONS

Cultivated area with oil seeds crops

Rape and turnip rape, sunflower and soybean are the main oil seeds crops cultivated in the EU. Their importance for producing oil for consumption and industry and also as a resource of renewable energy especially in case of rape is higher and higher, reasons which led to the extend of the cultivated surface from 10,239.12 thousand ha in 2008 to 11,881.67 thousand ha in 2018, meaning a surplus of + 16.04%.

In the total cultivated area, the highest share is kept by rape and turnip rape, 58.07%, followed by sunflower, 33.88%, and soybean, 8.05 % in the year 2018 [3, 8, 9].

Compared to 2008, it was noticed a decrease of the weight of the cultivated area with rape and turnip rape from 60.20% to 58.07 % in favor of sunflower and soybean, whose share in the total cultivated surface increased from 37.03 % in 2008 to 33.88% in 2018 in case of sunflower, and from 2.68 % in 2008 to 8.05 % in 2018 in case of soybean.

The surface cultivated with rape remained on the 1st position and raised by 11.77 % in the analyzed period, from 6,173.61 thousand ha in 2008 to 6,900.62 thousand ha in 2018. The cultivated area with sunflower comes on the 2nd position and increased by 6.14 % from 3,792.49 thousand ha in 2008 to 4,025.65 thousand ha in 2018. Soybean cultivated land registered the highest growth rate in the studied interval, +249.93 %. From 273.02 thousand ha cultivated in 2008, in 2018, soybean was cropped on 955.4 thousand ha (Fig.1.)

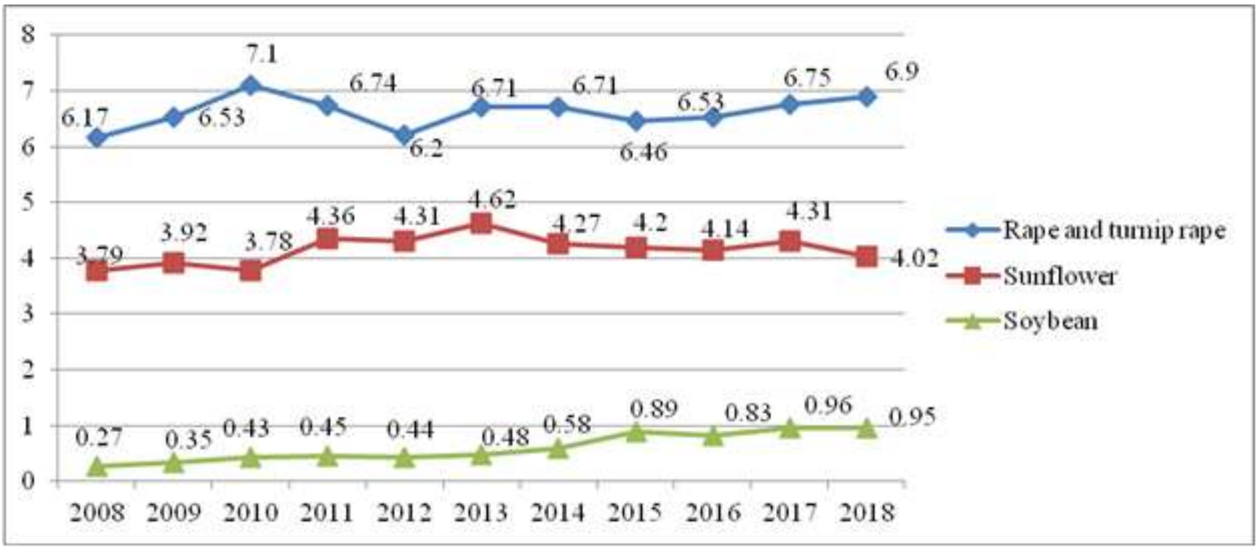

Fig.1. Dynamics of the cultivated area with oil seeds crops, EU-28, 2008-2018 (Million ha)
Source: Own design based on the data from Eurostat, 2019 [9].

In the analyzed period, the average cultivated surface by crop was 6.62 ± 0.08 thousand ha, with a maximum level, 7,105.6 thousand ha in 2010 and a minimum level, 6,173.61 thousand ha in 2008.

In case of sunflower, the mean cultivated area accounted for 4.15 ± 0.07 thousand ha, ranging between 3.78 thousand ha, the minimum level in 2010, and 4.62 thousand ha, the maximum level in 2013.

In case of soybean, the mean and the standard deviation of the cultivated area was 0.60 ± 0.07 thousand ha, varying between the minimum of 0.27 thousand ha in 2008 and the maximum of 0.96 thousand ha in 2017.

The variation coefficients of the cultivated area were very small, 6.17 % in case of rape and turnip rape, 3.78% in case of sunflower and small, 11.67% in case of soybean (Table 1).

Of the total cultivated area with rape and turnip rape in 2018 in the EU-28, accounting for 6,900.62 thousand ha, the largest surfaces are cultivated in France, Germany, Poland, Romania and Hungary, all these five countries summing 4.653.1 thousand ha, representing 67.4 %. The share of these countries in the EU area cultivated with rape is 23.4 % France, 17.7 % Germany, 12.2 % Poland, 9.2 % Romania and 4.8 % Hungary.

In the period 2008-2018, the cultivated land with rape increased by +73.3 % in Romania, +33.9 % in Hungary, +13.7 % in France, +9.5% in Poland and declined by -10.5 % in Germany [2, 3, 9].

In 2018, of the total surface cultivated with sunflower in the EU-28, accounting for 4,025.65 thousand ha, about 90.8 % is in five countries as follows: Romania 25 %, Bulgaria 19.5 %, Spain 17.2%, Hungary 15.3 % and France 13.7%. In the analyzed period 2008-

2018, the cultivated area with sunflower increased by +23.7 % in Romania, +12.2 % in Hungary, +9.2 % in Bulgaria, and declined by -12.3 % in France and by -5.5 % in Spain [2, 9].

Table 1. Mean, standard deviation and variation coefficients for cultivated area, seeds production and yield by crop, EU-28, 2008-2018

	Mean	Std. Deviation	Coefficient of variation (%)	Minimum	Maximum
Cultivated area (Million ha)					
Rape and turnip rape	6.62	0.08	1.20	6.17	7.1
Sunflower	4.15	0.07	1.68	3.78	4.62
Soybean	0.60	0.07	11.67	0.27	0.96
Oil seeds production (Million tonnes)					
Rape and turnip rape	20.72	0.43	2.07	19.02	24.13
Sunflower	8.27	0.37	4.47	6.97	10.44
Soybean	1.62	0.23	14.19	0.76	2.74
Oil seeds yield (tonnes/ha)					
Rape and turnip rape	3.15	0.06	1.90	2.85	3.59
Sunflower	1.97	0.06	3.04	1.67	2.42
Soybean	2.81	0.08	2.84	2.25	3.32

Own calculations based on Eurostat Data, 2019 [9].

In the same year 2018, of the total area cultivated with soybean in the EU-28, 83.2 % was situated in five countries: Italy 34.2 %, Romania 17.7%, France 16.1 %, Croatia 8.1 %, Austria 7.08 %. In the analyzed interval, the cultivated area with soybean registered a high growth rate in almost all these countries: + 239.8 % in Romania, + 267.5 % in Austria, +202.9 % in Italy, +115.4 % in Croatia and +26.3 % in France [2, 9].

In the near future it is expected a higher rape seed cultivated area in France and Romania, but a reduced surface in Germany and Poland. The cultivated area with sunflower is expected to continue to grow in Romania and Spain, while soybean area will be larger in Italy, France, Croatia, and Austria [24, 25].

Oil seeds production

The oil seeds production from these three crops has recorded an ascending trend in the analyzed period. From 27 million tonnes in 2008, it reached 35.09 million tonnes in 2017, being by 29.96 % higher than in the 1st year of the study.

Fig.2. Dynamics of the oil seeds production, EU-28, 2008-2017 (Million tonnes)
Source: Own design based on the data from Eurostat, 2019 [7, 10, 11].

On the top position is rape and turnip rape. But, its share in the total oil seeds production decreased from 70.44 % in 2008 to 62.43 % in 2017.

Sunflower production is ranked the 2nd, and its weight grew up from 26.74 % in 2008 to 29.75% in 2017, while the share of soybean in the total oil seeds production registered the highest increase of its weight, from 2.82 % in 2008 to 37.82 % in 2017.

All the three oil crops recorded an ascending trend of seeds production. In case oof rape and turnip rape, the production of seeds raised by 15.19 % from 19.02 million tonnes in 2008 to 21.91 million tonnes in 2017. Sunflower seeds production grew up by 44.59 % in the same interval, from 7.22 million tonnes in 2008 to 10.44 million tonnes in 2017.

Soybean seeds registered the highest production growth rate, +260.5%, from 0.76 million tonnes in 2008 to 2.74 million tonnes in 2017 (Fig. 2).

The mean for seeds production and its standard deviation in the period 2008-2017 #accounted for 20.72 ± 0.43 million tonnes in case of rape and turnip rape, for 8.27 ± 0.37 million tonnes in case of sunflower and 1.61 ± 0.23 million tonnes in case of soybean.

Rape registered the highest production of seeds, 24.13 million tonnes in 2014 and the lowest production, 19.02 million tonnes, in 2008.

Sunflower recorded the highest level of production, 10.44 million tonnes, in 2017 and the lowest one, 6.97 million tonnes in 2010.

Soybean production had the lowest level, 0.76 million tonnes, in 2008 and the highest one, 2.74 million tonnes, in 2017.

The variation coefficients were very small in case of rape and sunflower production and moderate, 14.19 %, in case of soybean (Table 1).

The main rape seeds producers in the EU-28, in the decreasing order, are: France, Germany, Poland, United Kingdom, Romania and Czechia, which all together produced 15.9 million metric tonnes in 2018, representing 79.3 % of the EU-28 rapeseed production. The contribution of these countries to the EU rape seeds production was: France 24.7%, Germany 18.3%, Poland 10.8%, United Kingdom 10.3%, Romania 8% and Czechia 7% [2, 7].

Romania is also an important producer of rape seeds taking into account their importance in biodiesel production and also for other purposes as presented above, and also for the attractive subsidies coming from the EU for this crop. Another reason is the opportunity for sustaining export to the EU market where it is a high demand [6].

The main sunflower and soybean seeds producers in the EU-28 are: Romania, Bulgaria, Italy, France and Hungary [2].

The key sunflower seeds producers are Romania and Bulgaria where the cultivated area and production registered a high growth rate during the last decade [4, 12, 16, 18, 19].

Oil seeds yield resulted from the evolution of seeds production and cultivated area by crop. Its dynamics reflected a relatively continuous ascending trend in each case.

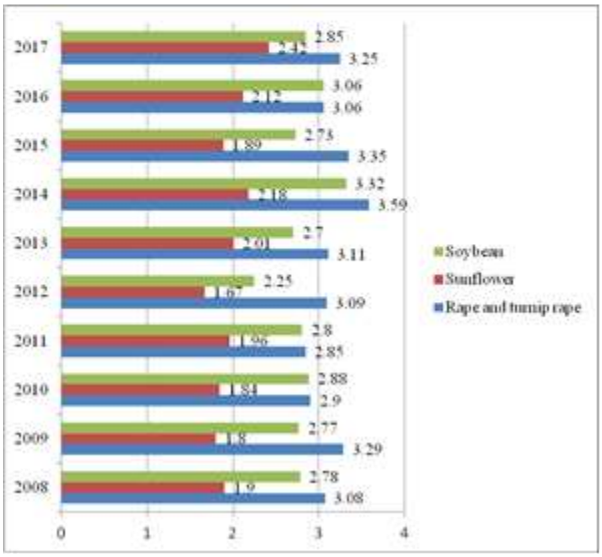

Fig.3. Dynamics of the oil seeds yield, EU-28, 2008-2017 (tonnes/ha)
Source: Own design based on the data from Eurostat, 2019.

Rape seeds yield increased by 5.35 % from 3.08 tonnes/ha in 2008 to 3.25 tonnes/ha in 2017. The maximum level was 3.59 tonnes/ha in 2014 and the minimum level 2.85 tonnes/ha in 2011.

Sunflower yield recorded the highest growth rate in the analyzed period, 27.15 %, ranging between 1.9 tonnes/ha in 2008 to 2.42 tonnes/ha in 2017. The maximum level was 2.42 tonnes/ha in 2017 and the minimum 1.67 tonnes /ha in 2012.

The lowest growth rate was 2.26 % registered by soybean seeds yield. From 2.78 tonnes/ha in 2008, it reached 2.85 tonnes/ha in 2017, but the top level, 3.32 tonnes/ha was noticed in 2014, and the lowest level, 2.25 tonnes/ha in 2012 (Fig. 3).

The variation coefficients had low values, below 3 %, reflecting a good dispersion of variables around the mean (Table 1).

Correlations between the three considered indicators: cultivated surface, seeds production and yield

In case of rape and turnip rape, the lowest correlation coefficient, r = 0.024, was found between the cultivated area and seeds yield, reflecting a very weak relationship, practically lacked of importance.

Between the cultivated area and rape seeds production it was found a moderate and positive relationship, r = 0.413, reflecting a relatively good influence of the cultivated surface on the production of seeds.

But, the highest correlation coefficient, r = 0.823 is between seeds yield and production, reflecting that the higher the yield, the higher seeds production.

In case of sunflower crop, it was found a correlation coefficient r = 0.328, positive and relatively weak, between the cultivated area and seeds yield, a moderate and positive relationship, r = 0.467 between the cultivated area and seeds production, and a high and positive connection, r = 0.913 between seeds yield and production, reflecting, like in case of rape, that the improvement of the average production is the key item which could led to a higher production of seeds.

In case of soybean, the correlation coefficients between the cultivated area and seeds production was very high and positive, r = 0.980, showing that the growth of production was deeply influenced by the extend of the cultivated land.

Between seeds yield and the cultivated area it was found a low and positive correlation, r = 0.258, reflecting that the cultivated area has a weak importance in increasing yield. Therefore, farmers have to improve yield using modern technologies to raise yield.

Between, seeds production and yield of soybean, it was found a moderate and positive correlation, r = 0.439, reflecting that yield is partially responsible of an increased production, and, obviously, the cultivated area sustained production (Table 2).

Table 2. Regression equations and correlation coefficients between the three indicators characterizing seeds production by crop

	Pair of indicators	Regression equation	Correlation coefficient, r	Determination coefficient, R^2
Rape and turnip rape crop				
1	Seeds production (Y) and Cultivated area (X)	Y= 2.045 X + 7.2418	r = 0.413	R^2 = 0.413
2	Seeds yield (Y) and Cultivated area (X)	Y = - 0.122 X+ 3.966	r = 0.024	R^2 = 0.154
3	Seeds production (Y) and Seeds yield (X)	Y = 5.136 X + 4.501	r = 0.823	R^2 = - 0.678
Sunflower crops				
1	Seeds production (Y) and Cultivated area (X)	Y = 3.018 X - 4.317	r =0.467	R^2 = 0.683
2	Seeds yield (Y) and Cultivated area (X)	Y = 0.263 X + 0.879	r = 0.328	R^2 = 0.108
3	Seeds production (Y) and Seeds yield (X)	Y = 5.027 X - 1.678	r = 0.913	R^2 = 0.834
Soybean crop				
1	Seeds production (Y) and Cultivated area (X)	Y = 2.981 X - 0.072	r = 0.980	R^2 = 0.961
2	Seeds yield (Y) and Cultivated area (X)	Y = 0.292 X + 2.647	r = 0.258	R^2 = 0.067
3	Seeds production (Y) and Seeds yield (X)	Y = 1.180 X - 1.701	r = 0.439	R^2 = 0.192

Source: Own calculation.

Regression equations where the dependent factor was seeds production (Y) depending on the independent factor, X, cultivated surface and seeds yield

The resulted equations of regression pointed out the following aspects:
In case of rape crop:
- an increase by one tonnes/ha seeds yield will determine a growth of rape production by 5.13 units;
- an increase by one ha of the cultivated area with rape and turnip rape could raise seeds production by 2.04 units.
In case of sunflower crop:
- an increase by one tonnes/ha yield could led to a seeds production by 5.02 units higher;
- the growth of the cultivated area with sunflower by one ha could also increase seeds production, but by 3.018 units.
In case of soybean:
-an increase of the cultivated land with this crop by one ha could raise seeds production by 2.981 units;
- a growth by one tonnes/ha of the seeds yield will raise production by 1.18 units.
The determination coefficients allowed to identify the percentage of variation caused by the variation of the independent factor taken into consideration, as follows:
-in case of rape crop, 67.8 % of the variation of seeds production is determined by yield;
-in case of sunflower, 83.4 5% of the production variation is caused by yield variation;
-in case of soybean, 96.1 5 of the production change is sustained by the variation of the cultivated surface (Table 2).

CONCLUSIONS

Both cultivated area, seeds yield and production of rape and turnip rape, sunflower and soybean increased in the EU-28 in the period 2008-2018.
Rape and turnip rape looks to be the most important oil crop as proved by its high share in cultivated surface and seeds production. Sunflower comes on the second position both in cultivated area and production, and finally, soybean is ranked the third.
Yields are different from a crop to another, the highest yield being achieved by rape and turnip rape, followed by soybean and sunflower is on the third position.
For increasing oil seeds production in the EU, it is very important to grow yield mainly in case of sunflower and rape and also to increase cultivated surface with soybean.
The key intensive factor is yield, as it is unanimous proved, the higher yield, the higher production and, in consequence, the efficiency of production will also be higher, because, per one Euro spent per ha, the revenue will be higher.
However, the green measures recently adopted by the EU Commission for Agriculture will affect farmers taking into account the incentives offer to plant more soybean and pulses for extending agricultural practices with a beneficial effect on climate and environment.
Also, the fact that the oilseeds producers do not receive any direct payments, but CAP provides to offer higher payments for protein crops production in order to balance the protein deficit on the EU market and reduce imports, will also affect oilseeds producers and production. As a result, it is expected as soybean to be cultivated on larger surfaces and sunflower cultivated area to decline.

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TRENS IN THE WORLD PRODUCTION OF NATURAL FIBERS OF ANIMAL ORIGIN- SILK AND WOOL

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Abstract

The paper analyzed the trends in natural fiber production pointing out the changes in silk and wool production, export and import worldwide and in the main producing, exporting and importing countries in the period 2007-2018 using official statistical data which were processed using Fixed Index, Trend Method based on polynomial and linear models, Descriptive statistics, and comparisons. The production of natural fibers was 111.3 million tons, representing 35 % of the global fiber production. Cotton accounts for 80 % of the natural fiber output, while wool 3.3% and silk 0.2 %. The demand for natural fibers is increasing due their special qualities which satisfy the best people desire to wear and use natural things and the large range of products which could be obtained. In 2018, the world silk output was 159,648 metric tons by 32.11 % more than in 2007. China and India produce 97.19 % of the world silk output, and also are exporting and importing countries. The USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany are the principal importing countries. The global wool production (clean) declined from 1,202 thousand tons in 2007 to 1,155 thousand tons in 2018, due to the reduction of sheep population and new orientation to meat production. The main wool (clean) producing countries are: Australia, China, New Zealand, CIS, Argentina, United Kingdom, South Africa and Uruguay. The consumption is represented by 48 % apparel wool, 31 % interior textiles and 21% industrial wool. Australia exports garments, sweaters, men suits and women overcoats, China exports yarn and knitwear, Italy is the 2nd exporter of wool yarn, fabric, men's and women's woven wear and knitwear, India is the largest exporter of carpets and rugs, the United Kingdom is profiled on fabric, knitwear, women's wear and carpets. The main importing countries of wool products are: the United Kingdom, Italy, the USA, Japan, China, Australia, and Germany. As a conclusion, natural fibers of animal origin are desired by consumers and their increasing demand stimulates producers and traders to intensify their business to better satisfy clients' needs.

Key words**:** *silk, wool, world production, main producing, exporting and importing countries, trends*

INTRODUCTION

Natural fibers are produced by plants, animals, and geological processes [43].
FAO classifies natural fibers in two categories: ***(i) Plant fibers*** subdivided into three sub classes: *seed hairs* including: cotton, stern (bast) fibers (flax and hemp); *leaf fibers:* sisal etc; *husk fibers*: coconut; ***(ii) Animal fibers:*** wool, hair and secretions (silk) [16].
Another classification divides natural fibers into three categories: (i) ***Cellulose/lignocellulose fibers***, including: *Bast***:** flax, hemp, jute, kenaf, ramie; *Leaf*: abaca, banana, pineapple, sisal; *Feed*: cotton, kapok; *Fruit:* coir; *Wood*: hard and soft wood; *Stalk*: wheat, maize, oat, rice; *Grass/reed*: bamboo, corn. (ii) ***Animal fibers***, divided into: *Wool/hair*: cashmere, goat hair, horse hair, lamb wool; *Silk*: Mulberry silk produced by silk worms, but also by other types other insects. (iii) ***Mineral***: asbests, ceramic fibers, metal fibers [48].
Natural fibers have been and still are important in our life and economy grace to their qualities: naturalness, comfort, breathability, pleasant touch, resistance, durability, elasticity, sensitivity to water and heat, biodegradability, friendly with the environment, and multiple uses [68].
However, the actual market is invaded and dominated by the artificial synthetic fibers whose production cost is low, the synthetic products have a selling price which assures a high profit to producers and also is suitable to

the consumers' pockets**.** In 2013, of the world fiber production, about 65 % were represented by synthetic fibers and 35 % by natural fibers, accounting for 33 million tons, of which the highest share, 30.4 %, i.e. 26 million tons, belonged to cotton, and just 1.3 % to wool and 0.2 % to silk [63, 71]. According to DNFI, Production of Fibers 2008-2018, Bremer-Baumwolle Börse, in 2018, the world fiber production was estimated at 111.3 million tons, by 50.3 % more than in 2008, when it was 74 million tons. Of the global fiber production in 2018, natural fibers production accounted for 32.2 million tones being by 9.2 % higher than in 2008. In the interval 2008-2018, it was appreciated that the share of the global natural fiber production in the world fiber output declined from 39.8% in 2008 to 28.9% in 2018 (Table 1).

Table 1.The natural fiber production by fiber type in 2018 versus 2008

	2008		2018		2018/2008 Growth rate (%)
	Production (Thousand tons)	Share (%)	Production (Thousand tons)	Share (%)	
World fiber production	74,024	100.0	111,300	100.0	150.3
World natural fiber production	29,479	39.8	32,200	28.9	109.2
of which:					
Raw cotton	23,584	80.00	26,120	81.12	110.75
Jute, kenaf etc	2,588	8.78	2,500	7.76	96.59
Dried wool	1,198	4.06	1,080	3.35	90.15
Cocos fiber	1,056	3.58	970	3.01	91.85
Linen	533	1.80	310	0.96	58.16
Sisal etc	296	1.00	210	0.65	71.18
Raw silk	164	0.55	164	0.5	100.00
Hemp	61	0.20	70	0.22	114.75

Source: Own adaptation based on the data from [20].

As observed, in 2018, the contribution of various types of natural fibers to the global production was: 81.12 % cotton, 7.76 % jute, kenaf etc, 3.35 % dried wool, 3.01 % cocos fiber, 0.96 % linen, 0.65% sisal, 0.5 % raw silk and 0.22 % hemp. Compared to 2008, in 2018 it was expected an increase by +10.75 % for cotton, +14.75 % for hemp and stable level for silk, and a decrease in case of wool by -9.85 % and also in case of linen, sisal, cocos, jute and kenaf.

In this context, when the demand for natural fibers is increasing, the paper aimed to study the dynamics of production for the natural fibers of animal origin: silk and wool in the period 2008-2018 in order to identify the main trends at the global level and in the main producing exporting and importing countries.

MATERIALS AND METHODS

For setting up this paper it was needed to use empirical data provided by various official international and national data bases such as: FAOSTAT, Eurostat, International World Textile Organization, INSERCO, NSW Government, Wool Industry, Department of Primary Industry, Economic Service, Statistics of New Zealand, USDA, American Sheep Industry Association, China National Bureau of Statistics etc, the period of analysis being in general 2007-2018, but also 2008-2018 depending of the availability of the data sources.

The aspects analyzed in this study have been:

(i)The importance of silk and wool and their qualities which justify production;

(ii)The main sorts of silk and wood products achieved and commercialized as well;

(iii)The dynamics of raw silk and wool production (greasy and clean) at the world level;

(iv)The main producing countries of silk and wool and their share in the global production;

(v)The main exporting and importing countries of silk and wool products worldwide.

The aspects mentioned above were studied using the following methods:

-***Fixed Index Method*** to point out the increase or decrease in the final year compared to the basic year of comparison;

-***Trend Method*** to identify the tendency in the studied interval by means of the graphic illustration of the polynomial regression equation: $Y = ax^2 + bx + c$ and linear regression equation, $Y = bx + a$ as well as the coefficient of determination, R^2.

-***Descriptive statistics*** including mean, standard deviation and the coefficient of variation.

-***Structural analysis*** to show the contribution of different countries to the world production, export and import.

-***Comparison method*** was used to analyze the differences among various producing, exporting and importing countries.

The results are presented in tables and illustrated in graphics, of which just a part are included in this article.

RESULTS AND DISCUSSIONS

Silk Production

Silk is a natural fiber consisting of fibroin 75 %, sericin 22.5%, fat and wax 1.5%, ash 0.5% and salts 0.5% [5].

Silk is produced by silk worms and also by other insects such as: spiders, crickets, bees, ants etc. Therefore, silk is of various types and quality, the best one being considered from silk worms fed with Mulberry leaves [65]. Silk is named "the queen of textiles" as it has been and still is a raw material for producing elegant and luxury clothes (blouses, dresses, suits, skirts, shirts, trousers, dressing gowns, bathrobes, house coats, jackets, blazers, sports-wear etc), accessories (ties, scarves, gloves, collars etc) and house textiles such as: carpets, draperies, wallpapers, furniture covers, blankets, bed sheets, table cloths etc. Also, silk is useful in medicine for catgut used in surgery, in aeronautics for parachutes, in electronics as insulation coils etc [56, 74].

Silk is appreciated very much for its special qualities such as: aesthetic aspect, fineness, pleasant touch, natural brightness, light weight, toughness, durability, high absorbance capacity, isothermal properties and affinity for dyes [3, 11].

Silk is also important because the highest part of its production comes from silk worms which are easily grown in small family farms. Sericiculture is an agricultural activity with a beneficial impact on rural population in many countries. Silk worms rearing needs just small investments, a summary endowment and equipment, work is suitable both for men, women and children, mulberry trees could be cultivated on various soil types and climate areas (temperate, sub tropical and tropical). Therefore, silk worms growing reduce unemployment and migration to cities, involves low production costs, provides a satisfactory income, contributes to the development of the rural economy, assures environment protection and biodiversity preservation being an eco-friendly activity. Silk industry has been developing due to the high demand which creates opportunities for the growth of international trade. The producing countries of raw silk are interested to carry out a higher production and to intensify their deliveries to the processing industry. For the emerging economies, silk production contributes to the alleviation of poverty and improving the living standard of the population [3, 10, 26].

Of the total amount of global natural fibers, silk represents just 0.2 %, but its output is largely spread in more than 60 countries, most of them being situated in Asia (China, India, Uzbekistan, Koreas, Thailand, Vietnam, Japan and Turkey, but also in South America (Brazil), Africa (Egypt and Madagascar) and Europe (Bulgaria, Italy, Spain) [27, 74].

In 2018, the world silk production accounted for 159,648 metric tons being by 32.11 % higher than in 2007. During the period 2007-2018, silk production registered variations ranging between the minimum level of 105,278.94 metric tons in 2009 and the maximum level of 202,072.88 metric tons in 2017 (Fig.1). The average of the global silk production in the analyzed interval was 153.03 thousand metric tons, the standard deviation was +8.89, and the coefficient of variation accounted for 5.8 %.

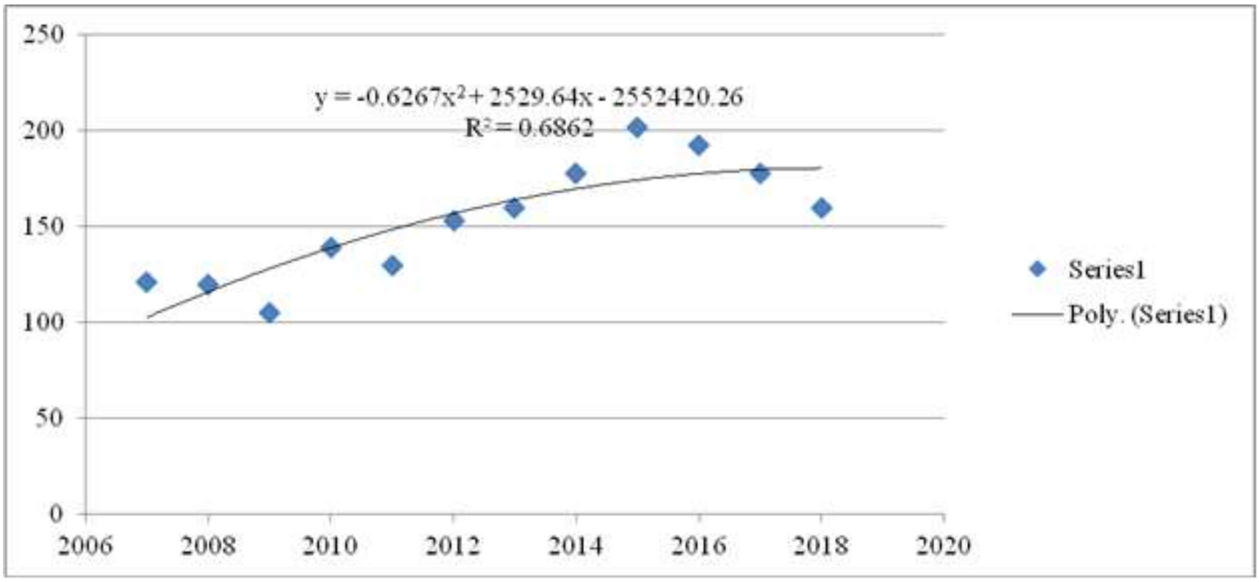

Fig.1.Dynamics of world silk production, 2007-2018 (Thousand Metric Tons)
Source: Own design based on the data from [27, 29].

The main producing countries in 2018 have been, in the decreasing order: China, India, Uzbekistan, Thailand, Vietnam, Brazil, North Korea, Iran, Turkey and Japan. The most substantial contribution to global silk production have China and India, which together produced 155.26 thousand metric tons, representing 97.19 % of the world output (Table 2).

Table 2. The contribution of the main silk producing countries to the global silk production, 2018 (Metric tons; %)

	Silk Production (Metric tons)	Share (%)
World	159,548	100.0
China	120,000	75.11
India	35,261	22.08
Uzbekistan	1,800	1.12
Thailand	680	0.42
Vietnam	680	0.42
Brazil	650	0.40
North Korea	350	0.21
Iran	110	0.06
Turkey	30	0.02
Japan	20	0.01
Total		99.84

Source: [29].

China is the major silk producer at the global level and also a silk exporter. ***India*** is also both a producing and exporting country, but it on the top position as a silk importing country, while China is the top exporting country at the global level.

The international trade with silk is facing a higher and higher competition among the Asian countries and also between the Asian countries and the rest of the world.

China's export is represented mainly by final products sold to the USA, and yarn, fibers and woven fabrics to India. But, China also imports silk from India.

India's exports consist especially of pure silk fabrics, silk filament and raw silk, therefore, less processed products, and imports bring yarn and fibers and woven fabrics on the internal market from China. The exchange of silk products between China and India is not balanced, as Chinese export exceeds India's export, and more than that, silk price in the Indian market is higher than in China, advantaging the Chinese companies and disadvantaging the Indian farmers and processors [25].

India is country producing four types of silk: 89 % Mulberry, 8 % Eri, 1.9 % Tasar, and 0.6% Muga, for the last one India keeping the monopoly [2].

Indian silk and silk products are also required in the international market, and silk yarn and fabrics are the major products imported by this country [4, 10, 44].

In 2019, India produced more Mulberry silk, representing 95% of its total raw silk production. India's exports are mainly oriented to Germany, Italy, the USA and

Turkey, while its imports are coming from China as mentioned above and consists especially of raw silk and other fibers, basic fabrics and garments [11].

Sericin and pupae are also successfully carried out and commercialized by the producing countries [3].

The USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany and United Arab Emirates are the principal importing countries of silk products in the world [29].

The USA is the top importing country of Indian silk products (yarn, fabrics, made-ups, and RMG).

Italy and France prefer to import raw silk, silk yarn, but also silk garments. In general, they are importers of raw silk but high-quality processors.

Italy has a high developed industry specialized in silk processing (finishing, dyeing and printing silk fabrics). Italian silk neckties and scarves are well known in the world for their high quality.

France has also a well developed silk processing industry producing especially clothing and also silk fabrics have started to be used for interior decorations (wall covers, curtains, bed spreads, upholstery) which are well sold on the internal market but also in the USA.

Germany imports especially garments, accessories and interior textiles from China, India and Thailand.

Japan is an important importer of silk merchandises; more than 50 % silk being used especially for kimonos. The imports are coming from China and Brazil [64].

Europe has not an important contribution to the world silk production, the only silk producing country being Bulgaria whose production is very small but it increased from 8 metric tons in 2014 to 10 metric tons in 2018 (+25%). The share of Bulgarian silk in the global silk production is non significant, just 0.00627 %.

The EU is a silk importer as in Italy, France and Spain silk processing industry is well developed.

The silk trade in Europe is run by a few countries. Among the top silk exporting countries in the world it is China with the highest market share (54%), Italy (13.5%), India (4.2%), Romania (4%) and France 93.8%), all these five countries summing 80 % of the world silk export value.

The most exported silk products in the world are: woven fabrics, raw silk non thrown, silk waste, silk yarn and yarn spun from silk waste [53].

In 2016, the value of world silk export was USD 2.1 Billion by 31.4% lower than in 2012, while the global silk import reached USD 1.8 Billion, being by 29% smaller than in 2012.

The share of the most required silk products for import at the global level is: woven fabrics 57%, raw silk non thrown 23%, and silk yarn 13 %.

The top silk importing countries worldwide are: Italy, the top importer, with 18.5% market share, India 12%, Japan 7%, Romania 7%, China 7%, Vietnam 6%, USA 6%, France 5 %, Germany 3% [53, 56].

Romania had a developed sericulture keeping a valuable collection of over 60 silk worms races and hybrids and carrying out a high raw silk production. The silk pipeline from farm to the final product was well organized, silk processing industry was running well and the country made important exports [37, 39, 40].

At present, silk worms rearing is developed as a small business in small family farms, a part of them being vertically integrated from silk cocoons till the final product, because the industry along the pipeline failed since 2007. A part of the farms are endowed with reeling machines and then silk filament is transformed into traditional products, mainly handicrafts such as: rustic scarves or veils, peasant blouses named "ii", decorative products etc, which are preferred by the Romanians in the domestic market and abroad. Sericultural farms are economically efficient, production cost being covered by returns and assuring a satisfactory income for the silk worm breeders [38, 41,42, 50, 58, 59, 60, 61, 62].

At present, Romania has a good position in the international trade with silk, being ranked the 4th both as a silk exporting country and as a silk importing country [57].

Wool production

From a chemical point of view, wool consists of keratin 33%, grease 28%, suint 12%, impurities 26%, and mineral water 0.1 % [6].

Wool is a natural fiber which contains pure organic carbon transformed from plants by sheep at the moment of feeding. As long as carbon is stored in wool or wool garments and other textiles, the atmosphere is protected against pollution and this mitigate climate change. Wool is also highly resistant, having a long lifespan, it is an eco-friendly fiber, being easily biodegradable and suitable for recycling [31].

Wool has a large range of properties, the main ones being: naturalness, fineness of touching, luxury aspect, comfort, durability, wrinkle resistance, color maintenance, protective against heat and cold, biodegradability, water absorption power, easy contamination [73].

Taking into consideration the diameter of the fiber, wool is classified into the following classes: fine wool having less than 24.5 microns, medium wool with a diameter ranging between 24.6 and 32.5 microns and coarse wool with over 32.5 microns' diameter.

Fine wool represents more than 50 % of the global wool production and is largely used in apparel, while medium and coarse wool is destined for interior textiles [32].

Wool is a raw material for processing industry which transforms it into a large range of products: woolen fabrics, worsted fabrics, clothes (suits, coats, pants, sweaters, dresses, shirts, skirts, gloves, mittens, collars, shawls, hats, toques, underwear, coat lining, shoes, socks, saddle clothes), interior goods (furniture coverings, blankets, carpets, rugs, upholstery, pillows, duvets, ornaments, slippers), tote bags, backpacks, dog coats, horse rugs etc [7, 47].

Wool is a fleece resulting from the sheered animals. The main species producing wool are sheep and goats (cashmere and mohair), but also camels (hair), rabbits (angora wool), alpacas (Huacaya fiber), llamas (fleece) and musk ox (qivint) [23].

Sheep population is responsible for the largest amount of wool produced in the world. "From one sheep, it could be obtained about 4.5 kg wool/year of which one produces 10 meters of fabric or six sweaters" [21, 30].

Wool production is sustained by sheep and goats grown in various countries, the highest number of sheep being in China, Australia, New Zealand, United Kingdom, South Africa, Brazil, Argentina, Peru and Uruguay.

In 2013, there were 1,206 million sheep in the world by 5.3 % less than in 1990, reflecting a decreasing trend due to the global warming which reduces fodder resources and the new orientation of breeders to meat production. In 2018, at the global level, there were 1,177 million sheep by 2.5 % less than in 2013, but by 2 million more than in 2017, reflecting a slight increase. The year 2018 is recognized as the year with the highest number of sheep since 1992 (Table 3) [33].

Table 3. The distribution of sheep by main growing countries in the world, 2018 (million heads, %)

	2013, World sheep number = 1,206 million heads	2018, World sheep number = 1,177 million heads
China	13.2%	14.0 %
Australia	6.6 %	6.0 %
New Zealand	2.7 %	2.0 %
United Kingdom	2.9 %	3.0 %
South Africa	2.2 %	2.1%
Brazil	1.3 %	
CIS	4%	8 %
India	2 %	5%
Turkey	2%	3%

Source: Own calculations based on the data from [17, 32].

The decline of the sheep livestock started in the year 2000, when global warming has become more present and showed its effects: long periods of droughts, less rainfalls, reduced fodder production, all these resulting in a diminished wool production, affecting sheep breeders income, raw wool inputs for processors and the price growth. This was the reason why sheep breeders moved to mutton and cotton production to survive [75].

However, wool demand and consumption continue to increase despite that production trend was a sinuous one. Consumers are highly interested mainly in merino wool for its specific qualities such as: comfort, soft touching, breathability, elasticity, durability, which sustain exports and the compensation of the fall in wool price [23].

After the fall of wool market in 2018, by USD Billion since 2014, wool industry started to apply a new strategy involving more innovation and research for sustaining wool production. In 2019, it is expected as wool market to reach USD 35 Billion and in 2029 USD 48 Billion, taking into account the increasing trend in consumers' preference for natural fibers, despite of the invasion of synthetic fibers in the market. Always, high quality and luxury articles will be highly attractive for consumers with a refined taste and this encourage producers to do the best for satisfying their needs to wear natural healthy, comfortable and high quality clothes [73].

The world wool production (greasy) registered in general a descending trend, from 2,192.6 thousand tons in 2007 to 2,125.8 thousand tons in 2013, according to FAOStat, (Production, lack of data for the period 2014-2018), meaning by 3.1 % less. In the period 2007-2013, the maximum production was 2,192.6 thousand tons in 2007 and the minimum level was 2,021 thousand tons in 2010.

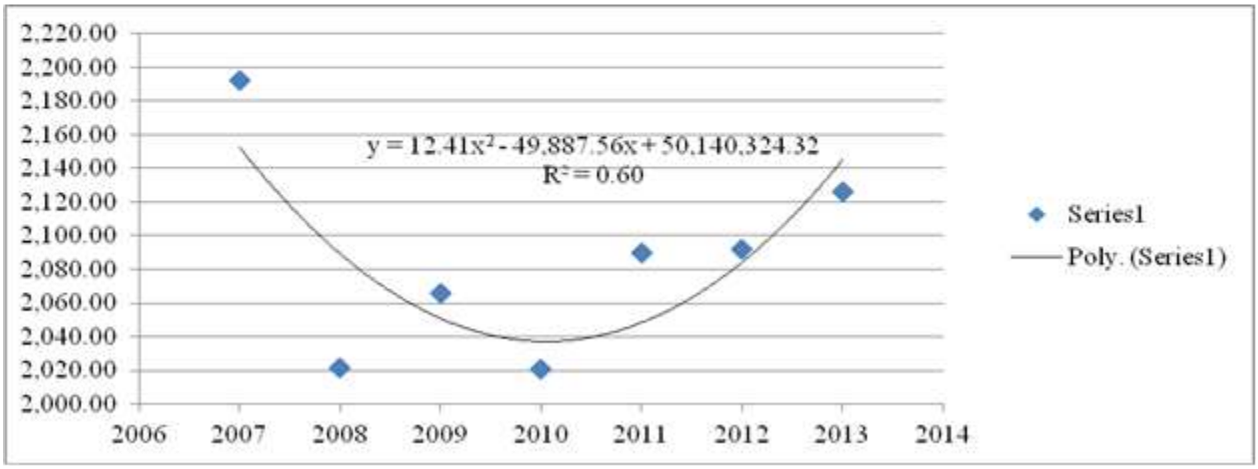

Fig.2. Dynamics of world wool production (greasy), 2007-2013 (Thousand tons)
Source: Own design based on the data from [18].

In 2013, the contribution of the main producing countries to the world wool production (greasy) was: China 22.1 %, Australia 16.9%. New Zealand 7.7 %, United Kingdom 3.2 %, Iran 2.9 %, Morocco 2.6 %, Russian Federation 2.5 %, Turkey 2.4 %, India 2.2 %, Argentina 2.1 %, summing 1,379.3 thousand tons, representing 64.88 5 of the global output (Table 4).

In 2015, the world wool output (greasy) accounted for 2,128 thousand tons, of which Australia 20.1 %, China 20.1 %, CIS 10 %, New Zealand 7.3 %, South Africa 2.3 %, Argentina 2.2 %, United Kingdom 1.4 % and Uruguay 1.3 % (Table 5).

Table 4. The contribution of the main producing countries to the world wool production (greasy), 2013 (Thousand tons)

	Wool production ((Thousand tons)	Share (%)
World	2,125.8	100.0
China	471.1	22.1
Australia	360.5	16.9
New Zealand	165.0	7.7
United Kingdom	68.0	3.2
Iran	61.5	2.9
Morocco	56.0	2.6
Russian Federation	54.6	2.5
Turkey	51.1	2.4
India	46.5	2.2
Argentina	45.0	2.1
Total	1,379.3	64.88

Source: Own calculation based on the data from [18].

The world wool production (clean) registered a general declining trend in the analyzed period from 1,202 thousand tons in 2007 to 1,155 thousand tons in 2018, meaning by 4% less. This was due to the dynamics of sheep livestock which also declined from 1,100 million heads in 2007 to 1,075 million heads minimum level in 2010, but then, it was noticed a slight recover so that in 2018, world sheep number accounted for 1,177 million heads (FAOStat, Poimena Delta Analysis, 2019) (Fig. 3). World wool production is not equally distributed in apparel and interior textiles. Since 2009, it was noticed a declining trend in apparel wool, while the interior textile wool was increasing till present [46].

Table 5. The contribution of the main producing countries to the world wool production (greasy), 2015 (Thousand tons)

	Share in the global wool production (%)
World wool production (Greasy)- Thousand tons	2,128
Australia	20.1
China	20.1
CIS	10.0
New Zealand	7.3
South Africa	2.3
Argentina	2.2
United Kingdom	1.4
Uruguay	1.3

Source: Own calculation based on the data from [18].

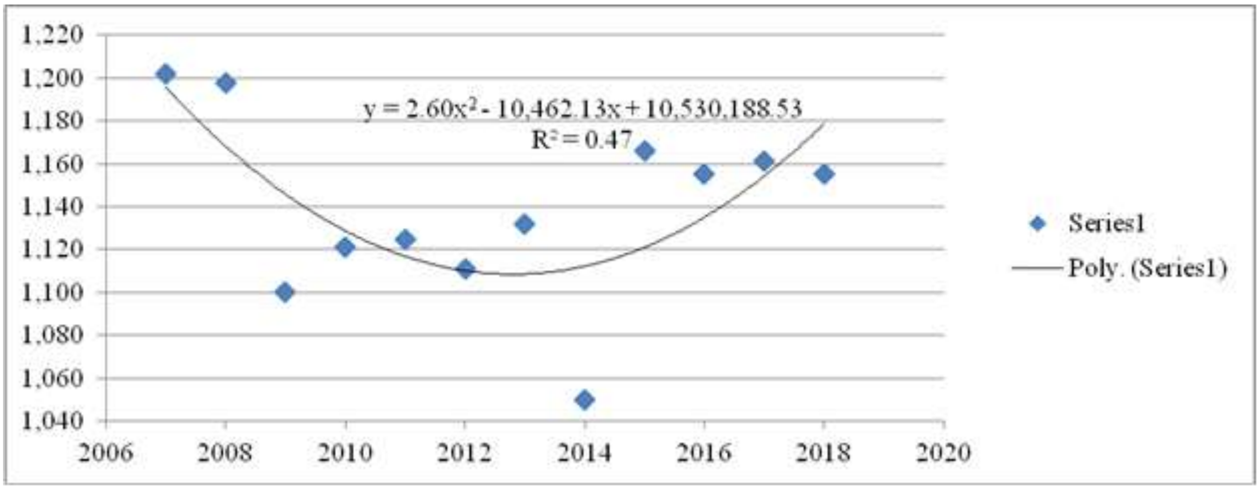

Fig.3. Dynamics of world wool production (clean), 2007-2018 (Thousand tons)
Source: Own design based on the data from [18].

In 2018, the weight of the main producing countries in the global wool production (clean equivalent) was: Australia 23.4 %, China 15.5%, New Zealand 9.1 %, CIS 11.4%, Argentina 2.3 %, United Kingdom 2.2 %, South Africa 2.2 % and Uruguay 1.6 %. Compared to the share recorded in 2007, it was noticed an increasing position in case of CIS from 7.5 % in 2007 to 11.4 %, a decline in New Zealand from 13.7% to 9.1 % and in Uruguay from 3 % in 2007 to 1.6 % in 2018 (Table 6).

Of the global wool production (clean), merino wool production represents 98.04 % in 2017, 98.8 % in 2018 and it is expecting to reach 98.95% in 2019 (1,143.1 thousand tons), by 0.42 % more than in 2017 (1,138.3 thousand tons) [76].

The main producing countries of Apparel wool of the world amount in 2018, accounting for 1,141.3 thousand tons, Australia produced 269.2 (23.5%), Argentina 25.9 (2.26%), South Africa 25.1 (2.19%), Uruguay 18.3 (1.6%0 and USA 6.4 (0.5%).

The main producing countries of interior textiles achieved in 2018: China 179 thousand tons (15.6%), New Zealand 104 (9.1 %), United Kingdom 25.8 (2.3%), India 33.4 (1.9%), and Mongolia 20.5 (1.7%) [34].

As a consequence of the higher and higher wool demand, in many countries, the wool textile pipeline is intensified and diversified in all its technological key points:"processing, spinning, weaving, knitting, garments making and internal textile" [72].

Table 6. World wool production (clean) and the contribution of the main producing countries in 2007, 2008, 2012, and 2018 (%)

	World wool production (clean)- Thousand tons			
	2007*	2008**	2012***	2018****
WORLD	1,202	1,200	1,111	1,155
of which (%)				
Australia	25.0	24	21.8	23.4
China	14.8	15	15.1	15.5
New Zealand	13.7	13	11.1	9.1
CIS	7.5	8	10.6	11.4
Argentina	4.0	3	2.6	2.3
Uruguay	2.9	3	2.1	1.6
South Africa	2.3	2	2.5	2.2
United Kingdom	2.0	2	2.1	2.2

Sources: Own conception based on the data from [1****, 19***, 76*, 77**].

The consumption of wool fibers is distributed as follows: 48 % apparel wool, 31 % interior textiles and 21% industrial wool.

The main importing countries of processed wool are: China (64%), Italy (6.2%), India (5.5%), Germany (3.9%), and Czechia (3.4%) [1].

Australia is the leader producing country accounting for about 24% of the global wool output, whose value is about USD 3 Billion. However, in the period 2007-2018, the sheep flock declined by 21.2 % from 11,158 thousand heads in 2007 to 8,800 thousand heads in 2018 and in 2018 it is expecting to reach 7,400 thousand heads. As a result, wool production (grease) also declined by about 15 % from 450 tons in 2007 to 383 tons in 2018, due to the changes of the climate in Australia (Fig. 4) [14].

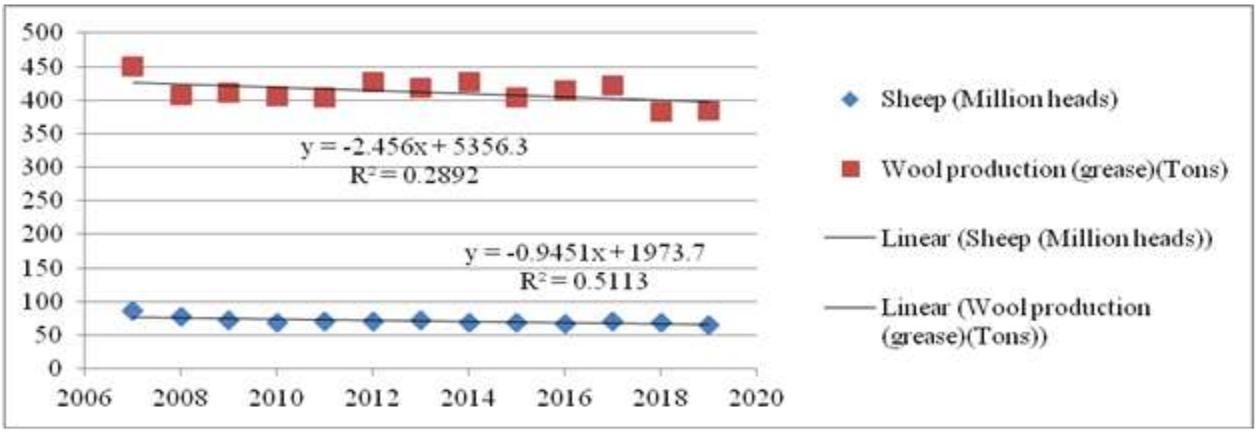

Fig.4.Dynamics of sheep flock and wool production (grease equivalent) in Australia, 2007-2019
Source: Own design based on the data from [14].

The main use of wool in Australia is for apparel [47].

Australia is the leader in merino wool producing about 77% of the global production of fine wool. Also, other countries like South Africa, Argentina and Uruguay contributes to the fine wool production in lower percentages: 11 %, 7 % and, respectively, 2 %.

Of the wool products exported by Australia, garments represent 45%, sweaters 38%, men suits 14% and women overcoats 13.8% [21].

China is ranked the 2nd for its contribution to the world wool production, but it comes on the 1st position for sheep population, whose number increased by 3.6% from 286 million heads in 2007 to 297.1 million heads in 2018, with a peak of 302.3 million heads in 2017.

This is due to the fact that sheep rearing is an important income source for the rural population [13].

While in China, sheep flock increased by 24.6% since 1990 till 2013 and also continued till 2018, in other countries sheep population decreased, being affected by climate change. It is about Australia, where in the period 1990-2013, the sheep flock declined by -56.4 %, in New Zealand by -46.7%, in Argentina by -58 % and in Uruguay by -67.2 % [12].

China's contribution to the world wool production is about 20 % and this proves that wool sector plays an important role in the economy. The main wool products exported by China are clothes and textiles [47].

Chinese wool quality does not compete with the Australian one. That is why about 65 % of China's import of wool comes from Australia and the remaining from New Zealand and Uruguay. China imports all the wool types [73].

New Zealand comes on the 3rd position among the top wool producing countries worldwide, having a market share of 11 %. Its production is distinguished by the high weight of wool blankets, yarn and upholstery [21, 47].

In New Zealand like in Australia, the sheep flock declined. In 2018, it accounted for 27,296 thousand heads being by 20.1 % smaller than in 2007 (38,460 thousand heads). And this diminished wool production by 37.8% from 224.5 tons in 2007 to 139.8 tons in 2018 (Fig. 5) [8, 9].

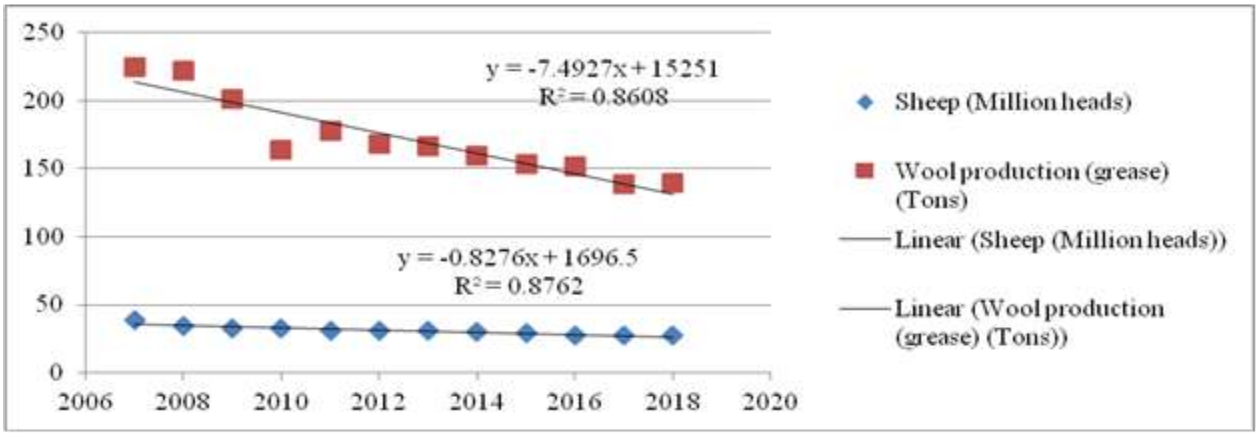

Fig. 5. Dynamics of sheep flock and wool production (grease equivalent) in New Zealand, 2007-2018
Source: Own design based on the data from [9].

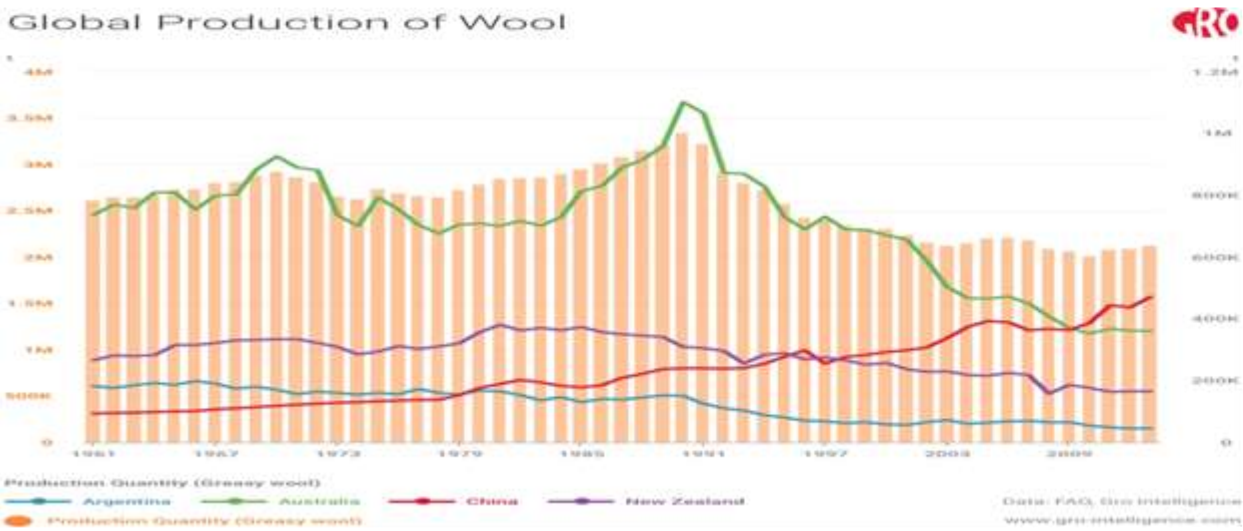

Fig. 6. Wool production (grease) in Australia, China, New Zealand and Argentina, 1961-2009
Source: [70].

A suggestive graphic reflecting a comparison regarding wool production (greasy) in Australia compared to China, New Zealand and Argentina is presented in Fig.6.

According to NSW Government, 2015, Wool Industry, Department of Primary Industry, Wool Industry and Future Opportunities, Supporting Papers, Paper 1: Trends and drivers for the global and Australian wool industry, besides Australia and China, there are other important wool processing and exporting countries such as:

-"Italy (second largest exporter of wool yarn, fabric, men's and women's woven wear and knitwear);
-India (largest exporter of carpets and rugs);
-Hong Kong (yarn and knitwear);
-the United Kingdom (fabric, knitwear, women's wear and carpets);
-Germany (fabric and men's wear);
-Bangladesh (knitwear);
-Turkey (men's wear, carpets);
-Romania (men's and women's wear);
-Spain (women's wear);
-USA (carpets);
-Belgium (carpets)".

The principal importing countries of wool products are: "the United Kingdom, Italy, the USA, Japan, China, Australia, and Germany". Their imports are oriented to:

- "the United Kingdom (men's wovenwear, women's wovenwear, knitwear, yarn, carpets);
-Japan (men's wovenwear, women's wovenwear, knitwear);
-Italy (yarn, fabric, knitwear);
-The USA (men's wool woven wear and women's wool woven clothing; wool carpets):
-China (yarn and fabric);
-Australia (carpets);
-Germany (men's and women's wovenwear, knitwear, yarn, carpets)" [46].

In the EU-28, wool has a different status and importance in the economy, practically it occupies almost the last position among the agricultural products, in fact, being considered a by-product.

In 2017, the EU-28 had 99.5 million sheep and goats, of which 86.8 million sheep and 12.7 million goats, the ratio being 6.8 sheep per one goat [15].

The sheep number declined since 2010 by 1.7% till 2017, the lowest level representing 96.4% of the 2010 level in 2012 and 2013.

In the EU-28, five countries are rearing 64.8 million sheep and 9.7 million goats, representing 75% of the EU sheep number and 76.5 % of its number of goats. It is about United Kingdom, which is on the top position, followed by Spain, Romania, Greece and France. While United Kingdom is the leader for the number of sheep (26.8%), Greece is the leader for the number of goats (29.9%). Smaller sheep and goats flocks are raised in other EU countries (Table 7).

Table 7. The number of sheep and goats in the EU-28 in 2017 (million heads)

	Sheep		Goats		Total sheep and goats	
	Million heads	Share (%)	Million heads	Share (%)	Million heads	Share (%)
EU-28	86.8	100.0	12.7	100	99.5	100.0
United Kingdom	23.3	26.8	0.1	0.8	23.4	23.5
Spain	16.0	18.4	3.1	24.4	19.1	19.2
Romania	10.0	11.5	1.5	11.8	11.5	11.5
Greece	8.6	9.9	3.8	29.9	12.4	12.5
France	6.9	7.9	1.2	9.4	8.1	8.1

Source: Own calculation based on Eurostat Data [15].

Despite of the existence of these species, in the EU, wool declined as importance, more than this climate change effects have become more visible year by year reducing the fodder production. As a result, the sheep number decreased, and the breed structure has been changed being oriented much more to meat production and milk production in the most rearing countries [49, 51, 54, 55].

For this reason, despite that sheep must be annually sheered in spring season to assure animal health, wool is not appreciated and collected officially and it is not subsidized like other agricultural products.

To compensate the decline of the livestock during the last decade, the EU imports sheep and goats mainly from New Zealand and Australia. The two species are considered important only for maintenance of the landscapes and biodiversity preservation.

Sheep breeding is still running well in United Kingdom, Spain, Romania and France, but in United Kingdom wool accounts for 4% of all the kinds of fibers.

France is profiled on merino breeds producing high quality wool, while in Germany the number of sheep breeders decline as sheep are just hold for decorating and keeping the landscapes.

In the Central and Eastern European countries, sheep continue to be raised and the highest wool performance is carried out in Bulgaria, Hungary and Poland, and in a few measure in other countries like the Baltic ones, Czechia, Romania and Slovakia [45].

Sheep farming and wool processing is in a critical situation with a negative impact on the breeders' income, rural population living standard and rural economy. Transhumance is difficult to be practiced as long as the urban civilized penetrated in the rural areas.

Wool crisis continue to affect sheep breeders, and looking for solutions how to valorize wool, farmers started to process it locally into traditional products such as: carpets, blankets, coats, skirts, trousers, hats, gloves, collars, slippers etc. The products are traded locally or on the occasion of various organized fairs or folk events. Wool has become a marginalized product, despite the history proved that it contributed to the development of civilization in Europe, and still is the most important fiber of animal origin. The actual situation and future perspective of sheep and goats sector is discussed in the European Parliament in order to decide measures for sustaining sheep farming [22, 35].

In 2018, the ***United Kingdom*** had 34 million sheep producing 22, 000 tons wool, but the imports accounted for 42 million kg to cover the non manufactured textile wool fibers (greasy wool, degreased wool, carbonized wool and waste) [67]. The United Kingdom is one of key exporting countries in the world of woolen fabric, knitwear, women’s wear and carpets, and an importing country of woolen men’s and women’s wovenwear, knitwear, yarn, carpets [46].

Italy is the 2nd exporting country in the world of wool yarn, fabric, men’s and women’s woven wear and knitwear, being far away from Germany, Japan, South Korea and Czechia. Italy is alos an important importing country of yarn, woolen fabrics and knitwear, mainly from China, Germany, Romania, Japan, Turkey and Morocco [24].

Germany is an exporting country of fabric and men’s wear, and an importing country of men’s and women’s wovenwear, knitwear, yarn, carpets [46].

France is both an importing and exporting country of wool yarn or fine animal hair, the exports being oriented mainly to the USA, United Kingdom, Germany and small amounts to China. France also exports yarn of carded wool to Spain, Morocco, Switzerland, Romania, China, Netherlands, Germany and Italy.

Spain produced 4.7 k tons wool in 2018, by 34% more than in 2017, after the decline in 2012. In 2018, Spain exports increased by 52 % compared to 2017, about 62 % wool being sold in Italy, Denmark, Portugal, Belgium, United Kingdom, France and Germany. In 2018, Spain's wool import was by 29.7% smaller than in 2017, the main suppliers being Portugal, United Kingdom, and Morocco [66].

Romania had in 2018 a number of sheep and goats accounting for 10.17 million heads, and, respectively, 1.51 million heads, from which it was obtained a total unwashed raw wool production of 24.4 thousand tons. In 2017, it obtained 36 thousand tons.

Taking into account the new orientation to meet and milk production, wool remained on the 3rd position, and wool price become very low leading to the dissatisfaction of the sheep breeders who had no opportunities to sell wool [49, 51, 54].

For sustaining the sheep breeders, the Romanian Government decided since 2017 to offer a financial aid of Lei one per commercialized wool and established the centers for wool collection [36].

Raw wool is processed by industrialized companies into woolen men's and women's wear which are successfully exported [28, 46]. Because of the huge amount of wool produced in the country, scientific research developed new projects for identifying other opportunities for wool valorization. In this respect, it was launched a business in producing wool thermo isolations in buildings industry [79]. In Romania there is also a private company named TOLGA dealing with wool cleaning. Wool of various types is collected from the local producers and also imported from Hungary, Libya, Bulgaria, Georgia, Greece and Turkey. The company's export is represented raw unwashed and raw cleaned wool to the United Kingdom, Italy, Spain, Portugal, Germany, Hungary, Pakistan, Ireland and China [69]. Also, raw wool is locally manufactured into traditional handicrafts: sheepskins coats, carpets, blankets, pullovers, trousers, skirts, collars, gloves, slippers etc which are well appreciated by consumers.

CONCLUSIONS

Despite that the world market is dominated by the synthetic fibers, natural fibers still account for 35 % in the global fiber production. The demand for natural fibers is increasing grace to their special qualities: naturalness, comfort, pleasant touch, breathability, durability, elasticity, moisture absorbance, protection against heat and cold, suitability for recycling and environment protection, and also due to their large range of products. Cotton is the most utilized natural fiber of plant origin and wool and silk are the most important fibers of animal origin.

The paper analyzed the dynamics of natural fibers production of animal origin in the period 2007-2018 to identify the major trends in production, but also in export and import.

In 2018, the world silk production accounted for 159,648 metric tons being by 32.11 % higher than in 2007. The main producing countries are China and India representing 97.19 % of the world silk output. China and India are also exporting and importing countries, while the USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany are the principal importing countries of silk products. Romania is also among the top silk exporting and importing countries.

The world wool production (clean) declined from 1,202 thousand tons in 2007 to 1,155 thousand tons in 2018, due to the reduction of sheep population from 1,100 million heads in 2007 to the lowest level in 2015 but then it started a slight recover in 2018, reaching 1,177 million heads. The new orientation in Europe to meat production has deeply affected sheep breeders' income as wool price declined, sheep farming being justified just foe meat and milk but also for maintaining the landscapes and environment protection.

The main wool producing countries worldwide (clean equivalent) are: Australia, China, New Zealand, CIS, Argentina, United Kingdom, South Africa and Uruguay.

The consumption of wool fibers is distributed as follows: 48 % apparel wool, 31 % interior textiles and 21% industrial wool.

Australia exports garments, sweaters, men suits and women overcoats, China exports yarn and knitwear, Italy is the 2nd exporter of wool yarn, fabric, men's and women's woven wear and knitwear, India is the largest exporter of carpets and rugs, the United Kingdon is profiled on fabric, knitwear, women's wear and carpets.

The main importing countries of processed wool are: the United Kingdom, Italy, the USA, Japan, China, Australia, and Germany.

The analysis allowed to draw the conclusion that natural fibers of animal origin are required by consumers and their demand is increasing and this encourages producers and traders to intensify production and international trade to better satisfy clients' needs.

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MANAGING THE INTELLIGENT TOOLS IN THE STUDY OF SOIL BIODIVERSITY ACTIVITY AS AN ECOSYSTEM SERVICE PROVIDER

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Abstract

Two important intelligent tools were used in the present paper: low temperature ashing (LTA) and SEM-EDAX to investigate qualitatively and quantitatively the redox features generated by the soil biodiversity activity as an important provider of ecosystem services. The LTA was applied on uncovered soil thin sections to „ashing", in situ, organic components, in order to qualitatively identify the organic components from the mineral ones, as well as their spatial distribution into the dark amorphous redox features. The SEM-EDAX was used to quantitatively identify (in situ in soil thin sections) the constituents of the dark amorphous redoximorphic features, before and after LTA treatment. The soil is a drained Gleysol with mollic epipedon, formed in the alluvial stratified deposits. Oriented uncovered soil thin sections were analyzed and treated following the sequence: micromorphological study → LTA treatment → SEM-EDAX micro-analysis. The results of the micromorphological observation emphasize the presence of many types of redoximorphic features, which appear in plain polarized light as black amorphous redox concentrations. While in the oblique light, the Fe features clearly distinguish by their reddish colour, whereas the Mn and the organic matter showed black colours. During the LTA treatment, the black organic matter was oxidized (with the minimum disturbance of the thin section) revealing the presence of mineral compounds. In contrast to the micromorphological observation and despite of the very spread blackish features (which could suggest high quantities of Mn), the SEM-EDAX micro-analysis had been detected only few percent of Mn. In this respect the combined use of the intelligent tools (LTA and SEM-EDAX) proved to be a valuable technique for in-situ investigation (on thin sections) of the amorphous redox features generated under aquic conditions, by the biodiversity as an ecosystem services provider.

Key words*: *Low temperature ashing, redox features, hydromorphic soils

INTRODUCTION

In hydromorphic soils, the formation of redoximorphic features is used for the identification of aquic conditions [10]. „Although redoximorphic features are visible in the field with both the naked eye and a hand lens, micromorphological analysis can further enhance our understanding of how these features form and how to interpret them correctly" [7].

Organic matter (OM) occurs in a large variety of forms and combinations into the soil with aquic conditions. Thus, very often, dark isotropic OM was mixed with dark Fe-Mn oxihydroxides or coated redoximorphic features. In these cases it is extremely difficult to distinguish between organic and inorganic components.

The Gleysols have feri±mangano±organic pedobioplasma; and the genesis of the redoximorphic pedofeatures depends not only by the activity of microorganism but also by the macro- and mezofauna activity which is highly impressive in Gleysols [8].

The formation of the redoximorphic pedofeatures with the amorphous organic matter into the hydromorphic soils (as a result of the biological activity) provided important ecosystem services as regulation of the nutrients and their uptake and C sequestration. The interaction between the biotic (soil life) with the abiotic constituents are provided with the „regulation of the nutrients and their uptake‟, one of the most important ecosystem services, as soil fertility [9].

While, increasing soil C sequestration at a global scale, represents one of our best tools in the fight against climate change; but it is still unclear how these C stocks are currently changing so it is difficult to establish meaningful sequestration targets [4]. One of the greatest threats to global C sequestration is rising atmospheric temperatures: if warming drives the loss of even a small proportion of soil C into the atmosphere, it could initiate a positive land C-climate feedback that could cause additional planetary warming [1, 6].

Among all soil groups, Haplic phaeozems had the highest soil organic carbon (SOC) density and Endogleyic solonchaks had the largest carbon sequestration potential (CSP) [3].

D'Acqui et all [5], showed that „a relatively recent promising approach to disentangle the role of physical protection to SOM (soil organic matter) is based on Low-Temperature Ashing (LTA) by oxygen plasma, which enables a controlled removal of SOM from the surface of soil samples inwards without damage of the inorganic constituents‟. Low-Temperature Ashing (LTA) by oxygen plasma, is a technique able to progressively remove SOM with minimal or no damage to mineral constituents and soil fabric.

The approach used in a study provided insights into the amount of "physically protected C" „in minesoils confirmed that the LTA technique could give an important help for the assessment of the potential of soils in sequestering C‟ [5].

The aim of the paper was to emphasize the efficiency of using intelligent tools based on modern and excusive techniques (low temperature ashing and SEM-EDAX, together with the micromorphological observation) to investigate qualitatively and quantitatively the redoximorphic features formed due to the aquic conditions and under the influence of soil biodiversity activity as an important provider of ecosystem services.

MATERIALS AND METHODS

The soil is a drained Gleysol from Romania, with mollic epipedon, formed in the alluvial stratified deposits, reclaimed for cropping. The water table is at 1.5 depths.

Oriented uncovered soil thin sections were analyzed and treated following the sequence: micromorphological observation → LTA treatment → SEM-EDAX micro-analysis.

The LTA is a new technique used in premiere in Romania. It was applied on uncovered soil thin sections to oxidize (ashing), *in situ*, organic components, with minimum disturbance of soil thin sections, making possible the observation of the inorganic constituents (covered by the black organic accumulations).

Uncovered soil thin sections were treated with oxygen plasma during 150 minutes.

While the SEM-EDAX was used to identify and quantify (also *in situ* in soil thin sections) the constituents of the dark amorphous redoximorphic features, before and after LTA treatment.

Undisturbed soil had been sampled from each pedogenetic horizon, in micromorphological boxes, air drayed and impregnated with epoxidic resins. After hardening, oriented thin sections (25–30 μm and 5/7 cm) had been made from each sample and studied with Documator (20 X) and optical microscope (50–100 X) in PPL (plain polarized light) and XPL (cross polarized light), as well as in oblique light.

Also oriented uncovered soil thin sections (25–30 μm and 2/4 cm) were made for LTA treatment and SEM-EDAX micro-analysis.

The terminology used for micromorphological description was according to [2, 10].

RESULTS AND DISCUSSIONS

Each type of soil has its own pedofeatures (pedological features or pedological neoformations). The pedofeatures may also represent taxonomic criteria for the classification of different types of soils.

This is also the case of the studied Gleysol, to which characteristic pedofeatures, as redoximorphic features, generated by the waterlogging of soil, are the criteria for taxonomic classification.

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The studied soil is a Gleysol, which belongs to the large group of Hydromorphic soils, and is usually located to the slope foot and occupy 1.51% of the Romanian territory (359769.82 ha – Fig. 1).

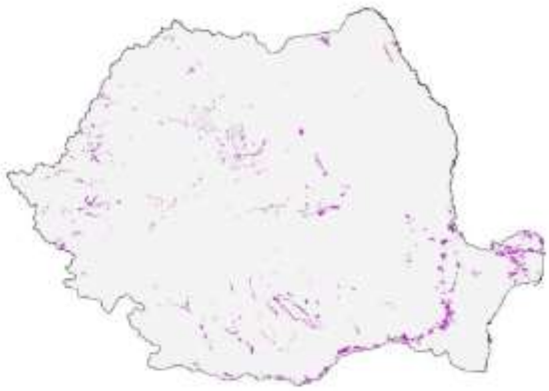

Fig. 1. Gleysol distribution in Romania
Source: Own determination.

The redoximorphic features are not specific to Gleysols, because they also form in other soil types, but they are characteristic, due to their abundance and spatial extension in the matrix of pedogenetic horizons affected by aquic conditions.

The oxidation-reduction (redox) processes are the dominant pedogenetic processes in Gleysols being favoured by the hydromorphic conditions, processes that generated two main types of redoximorphic features:

- redox depletions (in clay, organic matter, Fe, Mn, etc.), and
- redox concentrations (in Fe, Mn, organic matter, etc.).

Micromorphological observation

The results of the micromorphological study emphasize the presence of many types of redoximorphic features (Fig. 2), which appear in plain polarized light as black amorphous coatings, hypo-coatings and quasi-coatings; as well as accumulations, nodules and concretions into the soil matrix. While in oblique light, the Fe features clearly distinguish by their reddish colour, whereas the Mn and the organic matter showed black colours.

Ferric pseudomorphosis on vegetal remains is frequent in many biopores (Fig. 2).

The genesis and the evolution of the redoximorphic features is dependent on the biological activity of the hydromorphic soils.

Fig. 2 Black redoximorphic features in soil matrix and red ferric pseudomorphosis on a bio-pore wall
Source: Own determination.

The activity of macro- and mesofauna in Gleysols is rarely mentioned in pedological literature, the priority being reserved to micro-biodiversity due to its influence on the oxidation/reduction processes.

The biological activity of the studied Gleysol is high, although the specific water regime of these soils may suggest the opposite.

In the pedogenetic horizons, the presence of biopores (both with and without coprolites) had a positive effect on the soil drainage. The soil solution and the air circulation through poral space generated textural and amorphous coatings and hypo-coatings.

The genesis of the pedobioplasma organic components is closely linked, practically dependent, on the microbial activity.

The microbiological activity was pointed out (in the soil thin sections) by the fungi fruiting (mycelium fragments and spores) and resistance (sclerotium) bodies that appear mainly in the surface horizons, either in the poral space or in the soil matrix.

The humified organic matter in the studied soils is hydro-mull or anmoor. It was formed under the excessive hydromorphic conditions followed by seasonal periods of dryness (and oscillation of groundwater level) which favoured the humification and the rapid polycondensation of humic compounds. Consequently, the organic matter is dominated by the humic acids and humines present in relatively high quantity.

The black organic compounds coated amorphous redox features and/or are mixed with Fe and Mn oxihydroxides.

Due to the similar optical properties of the black organic matter (melanized) and the Mn oxihydroxides and some Fe oxihydroxides respectively, the distingtion between them is very difficult.

Furthermore, the presence of Mn in some redoximorphic features is questionable, given that some of these features were initially plant residues.

The nodules are, usually, composed of Fe±Mn oxihydroxides. If the Fe oxihydroxides are easily detected by their reddish colour, the identification of Mn presence into the redox features is difficult. In this respect, the need for other detailed techniques as chemical micro-analysis *in situ* on soil thin sections arises.

SEM-EDAX micro-analysis *(before the LTA treatment)*

The SEM-EDAX (electron microscope equipped with an energy dispersive X-ray spectroscopy) micro-analysis revealed the complex composition of the redox concentrations.

Thus, together with Fe and Mn, other elements such as Al, Si, K, Ca has been detected (Fig. 3).

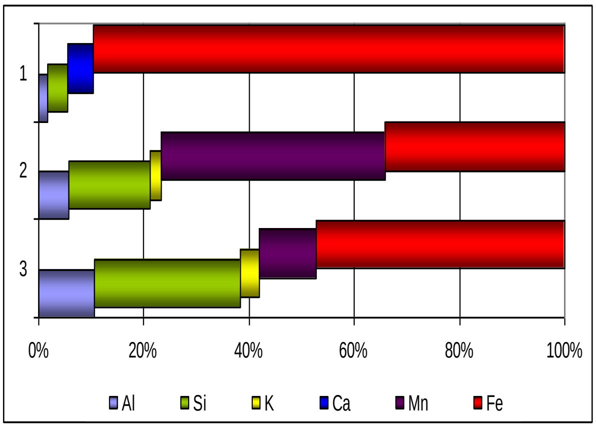

Fig. 3. EDAX micro-analysis of Fe pseudomorphosis on a vegetal remains (1); matrix (2); and redoximorphic feature (3)
Source: Own calculation.

The micro-analysis (Fig. 3/1) of a Fe pseudomorphosis on a vegetal remain (Fig. 3 and 4) detected the presence of Ca (5.07%), while into the soil matrix (Fig. 3/2) and the redoximorphic feature (Fig. 3/3), the Mn appeared in relatively high quantities (42.69% and 10.81% respectively).

The LTA treatment

When black, isotropic organic matter covers the redoximorphic features or is mixed with the oxihydroxides (ferric and manganese) become difficult, if not impossible to distinguish between the organic and the inorganic components (due to their optical properties which are similar).

In this respect, the LTA became a useful tool.

The LTA treatment was applied to the soil from the oriented uncovered thin sections. After the treatment the dark amorphous redoximorphic features practically disappeared (Fig. 3).

During the LTA treatment, the black organic matter (abundant into the soil matrix – Fig. 2) was oxidized (with the minimum disturbance of the thin section) which make possible the observation of the mineral constituents (Fig. 4).

The colour of ferric oxihydroxides in the matrix accumulation became bright red, being accentuated by acquiring intense tones during the oxidizing treatment.

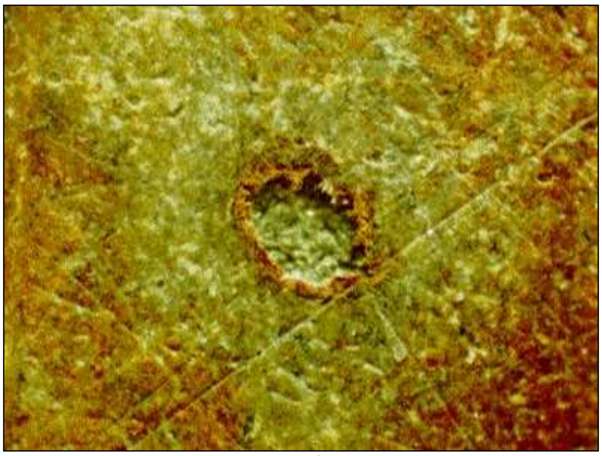

Fig. 4. The soil thin section after LTA treatment
Source: Own determination.

In addition, the organic matter that covers the oxihydroxides has also a protective role, against the dissolving soil solution.

SEM-EDAX micro-analysis *(after the LTA treatment)*

The SEM-EDAX micro-analysis had been applied after the LTA treatment to detect the presence of mineral constituents (Fig. 5).

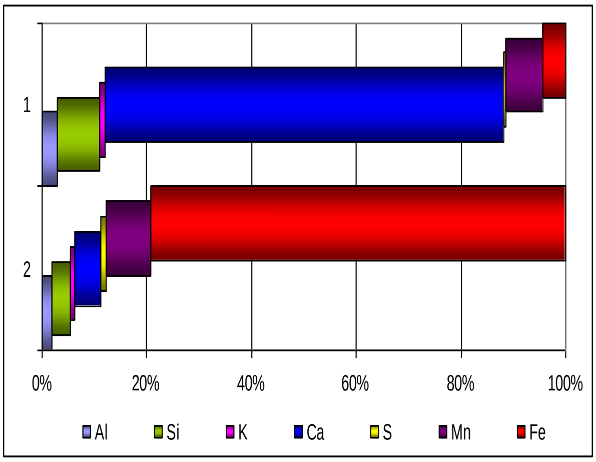

Fig. 5. SEM-EDAX micro-analysis before (1) and after (2) LTA treatment
Source: Own calculation.

In contrast to the micromorphological observation and despite of the very spread blackish features (which could suggest high quantities of Mn), the SEM-EDAX micro-analysis had been detected only few percent of Mn: 7.03% before LTA and 8.33% after LTA (Fig. 5).

The results showed that the combined use of the intelligent tools (LTA and SEM-EDAX) proved to be a valuable technique for *in-situ* investigation (on thin sections) of the amorphous redox features generated under aquic conditions.

CONCLUSIONS

The use of intelligent tools for the study of the characteristic features of a Gleysol concluded:

The applied LTA new technique was useful to study *in situ* on thin sections the amorphous organic matter (having the same optical characteristics as Mn and some Fe oxihydroxides).

Biological activity plays an essential role in the formation of the redoximorphic features (by digging channels that control the soil solution circulation and concequently drained the soil, and melanized organic matter).

The Gleysol biodiversity activity generated redoximorphic features and provided important ecosystem services as regulation of the nutrients and their uptake, as well as C sequestration.

The complex study using intelligent tools (micromorphology → LTA → SEM-EDAX) proved to be useful in the qualitative and quantitative study of the soil specific characteristics as redox features generated by aquic conditions.

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INVESTIGATING THE EFFECTIVENESS OF LEADER HORTICULTURAL PRODUCERS IN KERMAN PROVINCE FROM GARDENERS' PERSPECTIVE

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Abstract

The use of local leaders and leader farmers in extension programs has been common in most countries. Through the analysis of a case study, this paper aims to evaluate the effectiveness of leader horticultural producers in increasing the quantitative and qualitative efficiency of horticultural products in Iran from the gardeners' perspective. The statistical population of the study was composed of horticultural producers in Kerman province in 2015-2016 (=310). Sixty gardeners were picked up by Cochran formula and random cluster sampling. The research instrument was a questionnaire and the research used a descriptive-correlational design. More than half of the gardeners had no knowledge about the leader producers in their area, and had never visited any sample farm. The leader producers were the fifth source of information, with only 11.1% of gardeners had received information from them. Overall, more than 60 percent of gardeners cited the effectiveness of leader producers as average. Gardeners who had less experience, higher education, more area under cultivation, and a high number of visits to agricultural departments, and were more satisfied with agricultural profession found leader producers to be more effective. The findings confirm the weak position of the leader producers among gardeners.

Key words: *effectiveness, extension programs, horticultural producers, increase production, Iran, leader gardeners*

INTRODUCTION

Effectiveness refers to the degree to which objectives are accomplished and the extent to which targeted problems are tackled. In contrast to efficiency, effectiveness is determined without reference to costs [4]. The results of the surveys show that there is, in many cases, a significant gap between the average yield and that of the leader producers. Much of this difference is due to their work experience as well as use of technical and extensional findings and recommendations. The use of local leaders and leader farmers in extension programs, with goals such as modelling for other farmers and producers and using them to disseminate useful innovations as well as extensional notifications, has been common in most countries, and there has always been a place for them to play an extensional role in extension programs. Perhaps the most important goal of selecting leader agricultural producers is to increase the quantitative and qualitative and sustainable production of agricultural products by transferring the technical knowledge and applied research findings, relevant and appropriate technologies and scientific experiences of sample producers to other producers. The success of leader farmers is because they have combined knowledge with experience and they have been able to achieve much more than the national average with better management. One of the reasons for the gap between leader farmers and others, is in the utilization of agricultural research results. Since in our country, leader producers aimed at conducting extension activities, have been selected and introduced as an extensional strategy in various specialized fields of agriculture and natural resources, this question has been raised by the relevant authorities to what extent the leader selected farmers are able to carry out extension activities; in other words, what are the extension functions of a leader farmer and do the leader farmers have the necessary and sufficient effectiveness in carrying out the extension activities?

The effectiveness of agricultural extension activities has been subject to limited research in Iran and other countries, of which the followings can be mentioned.

The results for the impacts of educational extension delivery in agricultural cooperatives in Iran (Tehran and Alborz Provinces), showed a significant correlation between awareness of cooperation sector, motivation of membership in cooperatives, and literacy with the variable of using educational extension services. In addition, applying Mann–Whitney test showed that participation in agricultural educational extension course had a statistically significant effect on awareness of the cooperation sector and motivation of membership in cooperatives [6].

The effectiveness of in-service training courses for agriculture-Jihad staff in Iran (Qom province) has been investigated based on Kirkpatrick model using JAM software. The results showed that these courses were effective at three levels of Kirkpatrick model, namely, reaction, learning and behaviour, but were not effective at the results level [9].

In another research, the effectiveness of agricultural television programs from the Fars province perspective was examined using Percy's model. Findings revealed that low percent of farmers were as the programs audiences. From the viewpoint of the audience, the effects of agricultural television programs were moderate regarding direct, conditional and overall effects and below average in terms of cumulative and cognitive effects. Satisfaction toward provincial television network; audiences' goals to pay attention to programs and trust in provincial programs had the most important roles in predicting the effectiveness of the programs. Also, among the audiences' agricultural information resources, television had the forth rank [10].

The role of paddy rice farmers' education under the project of Attendant with Farmer (AWF) has been evaluated based on Kirkpatrick's model in the Amol Township in Iran. The Results showed that AWF project had influenced in much level on learning and behavioural characteristics of the farmers. In addition, most of paddy rice farmers had good reaction toward the project. Also, the AWF project was effective in improving knowledge of paddy rice farmers and increasing rice production [11].

The perceived effectiveness of agricultural extension techniques used to promote the adoption of improved technologies by rice growers in Kogi state of Nigeria has been assessed. The results indicated that 99.1% of the growers were informed of the presence of extension workers in their area and 87.7% visited every two weeks. Also, extension workers were perceived to be more capable in performing field demonstration activities and the individual contact method was perceived as the most effective extension teaching method in the study area [1].

Another study dealt with the effectiveness of agricultural extension education methods as perceived by vegetable growers in Jordan was evaluated. The most preferred extension methods by farmers were farm visit, meeting groups of farmers, result demonstrations and farm tours. Low rated methods included information and communications technologies [2].

A study on assessing the effectiveness of different agricultural technology transfer methods in the Northern and Upper East regions of Ghanait reported that farmer-to-farmer approach, technology demonstration fields, household promotion, and radio constituted the main agricultural promotion methods employed in the study area. There was a significantly low support of the Information and Communication Technology (ICT) and mass media mechanisms such as mobile phone, video, posters, newspapers, and drama. Demonstration, farmer-to-farmer, and household promotion methods were regarded as the most effective agricultural promotion methods [3].

The results of the study on the effectiveness of agricultural promotion methods employed in the adoption of recommended rice production technologies by growers in Nigeria, showed that majority of the respondents had their major source of farm information from radio programs. The major problems encountered by the farmers were: irregular visits by extension agents, lateness of information flows, lack of adequate trained extension agents, and their localities outside network coverage among others [5].

The effectiveness of extension delivery methods was graded on a five-point Likert scale in the Central region of Vietnam, showing that extension methods including training, farmer-to-farmer extension, farmers' group meetings, and farm/home visits were the most effective. However, extension methods including the use of radio programs, posters, and booklets were found to be ineffective [7].

The effectiveness of the demonstration alone, the meeting alone, and the pamphlet alone and all methods together on the knowledge and skills levels of poultry farmers in Egypt was surveyed.

The sample was classified into four equal groups in terms of providing extension recommendations by various extension methods with help from extension poultry experts in the studied districts. The major findings of the study revealed poultry farmers' exposure level to the studied information sources to be, on average, moderate at 59.8%. Furthermore, the all methods group had received the maximum knowledge and skills (55.8% and 48.3%, respectively) followed by the demonstration method, the meeting method, and the pamphlet method [8].

Given the role of the leader producers in the transmission of agricultural information and lack of study in this area, this study was aimed to shed light on the effectiveness of leader horticultural producers in Iran (a case study: Kerman province). Other objectives of this study were:

-Investigation of demographic characteristics of the studied gardeners,

-Identification and classification of gardeners based on the studied parameters,

-Investigation the impact of leader horticultural producers on the yield and production of other gardeners,

-Investigation the impact of leader horticultural producers on the application of new technologies at the farm level.

MATERIALS AND METHODS

The research used a descriptive-correlational design and was a survey type. Given the variety and expanding fields of activity in the agricultural sector and, therefore, the diversity of leader agricultural producers, as well as the fact that about 23% of the area under cultivation is located in Kerman province, the horticultural sector and related producers, were the target of the present survey. The statistical population of the study was composed of horticultural products in Kerman province in 2015-2016 (=310). Sixty gardeners were picked up by Cochran formula and random cluster sampling. The research instrument was a questionnaire. Data were analyzed using SPSS software. Descriptive statistics (mean, contingency table, percentage, frequency, standard deviation, median and mode) and inferential statistics (Pearson and Phi correlation coefficients, t-test and regression analysis) were used.

RESULTS AND DISCUSSIONS

The demographic characteristics of the studied gardeners are listed in Table 1.

Table 1. Demographic characteristics of the studied gardeners

Characteristic	Groups	Percent	Other statistical indicators
Gender	Man	96.2	
	Female	3.8	
	Total	100	
Age (years)	≤30	11.5	Mean=45.9 Standard Deviation=11.2 Median=45 Mode=52 Minimum=20 Maximum=68
	31-40	19	
	41-50	30.5	
	51-60	35.2	
	≥61	3.8	
	Total	100	
Level of education	Illiterate	7.7	
	Reading and writing literacy	19.2	
	Under the diploma	23.1	
	diploma	30.8	
	Higher than diploma	19.2	
	Total	100	

Source: Own calculation.

According to this table, gardeners were predominantly male (96.2%), mostly in the age group of 51-60 years (35.2%) and had a high school diploma (30.8%). The youngest and oldest were aged 20 and 68 years, respectively, and their average age was 45.9 years. Also, about 7.7% of them were illiterate and 19.2% had higher diploma education.

Based on the business characteristics presented in Table 2, gardeners had an average of 20 years of gardening experience. The highest belonged to the age group of 11-20 years (30.7%) and the lowest (11.5%) belonged to those with 6-10 years of experience.

Table 2. Business characteristics of the studied gardeners

Characteristic	Groups	Percent	Other statistical indicators
Experience (years)	5≤	19.3	Mean=20.1 Standard Deviation=13.2 Median=20 Mode=20 Minimum=1 Maximum=50
	6-10	11.5	
	11-20	30.7	
	21-30	23.2	
	31≥	15.3	
	Total	100	
Activities in organizations	City and village councils	11.5	
	Production cooperatives	7.7	
	board of trustees of the mosques	26.9	
	Other organizations	38.5	
	Non-membership	15.4	
	Total	100	
Total area under crop and horticulture (ha)	5≤	15.4	Mean=17.4 Standard Deviation=18.7 Minimum=2 Maximum=100
	5.1-10	34.6	
	10.1-20	27	
	61≥	23	
	Total	100	
Area under horticulture (ha)	1≤	27	Mean=8.25 Standard Deviation=15.4 Minimum=0 Maximum=80 The average number of garden pieces is 3 and the maximum is 12
	1.1-5	30.9	
	5.1-10	23	
	10≥	19.1	
	Total	100	
Area under crop (ha)	5≤	42.4	Mean=8.9 Standard Deviation=7.6 Minimum=0 Maximum=30 The average number of the garden pieces is 4.5 and the maximum is 20
	5.1-10	34.5	
	10.1-20	15.3	
	20≥	7.8	
	Total	100	

Source: Own calculation.

Meanwhile, about 19.3% of gardeners had less than 5 years of experience. Survey of activity status in organizations also showed that about 85 percent of gardeners were members of social institutions including the city and village councils, the production cooperatives, the board of trustees of the mosques, and 15.4 percent were not members of any organization. The average area under crop and horticulture was 17.4 hectares with minimum and maximum, 2 and 100 hectares, respectively, and the highest frequency (34.6%) belonged to gardeners with areas ranging from 5.1 to 10 hectares. The average area under horticulture and crop were 8.25 and 8.90 ha, and the maximum were 80 and 30 ha, respectively.

All of the studied gardeners had at least two jobs (horticulture, agriculture, animal husbandry, non-agricultural self-employment, and government jobs). The most important source of income was ‘gardening’ (57.7%) and the least important source belonged to the two groups of ‘non-agricultural self-employment’, and ‘government jobs’ (3.8% each) (Table 3). In terms of income status, 23.1% of those survived described themselves as above average, 42.3% on average and the rest (34.6%) rated themselves below the average.

Table 3. Income characteristics of the studied gardeners

Characteristic	Groups	Percent
The most important source of income	horticulture	57.7
	agriculture	26.9
	animal husbandry	7.7
	non-agricultural self-employment	3.8
	government jobs	3.8
	Total	100
Comparison of income status with other people	Very desirable	7.7
	desirable	15.4
	In Average	42.3
	Inappropriate	26.9
	Very inappropriate	7.7
	Total	100

Source: Own calculation.

According to the results of Table 4, more than 30% of the gardeners were unaware of their area experts/extension workers and more than 34% did not participate in any extension program. The average participation in extension programs was 2.4 times a year, and about 11.4% of producers participated in extension activities more than five times a year.

Table 4. Education-Extension characteristics of the studied gardeners

Characteristic	Groups	Percent	Other statistical indicators
Recognition of regional agricultural Expert/extension worker	Yes	69.2	
	No	30.8	
Participation in extension programs (number per year)	None	34.6	Mean=2.4 Standard Deviation=2.8 Minimum=0 Maximum=10
	Once	15.4	
	Twice	19.2	
	Three to five times	19.2	
	More than five times	11.4	
	Total	100	
Visits of Agriculture-Jihad organization (number per year)	None	3.8	Mean=7.4 Standard Deviation=6.5 Minimum=0 Maximum=30
	1-3	23	
	4-10	57.6	
	>10	15.2	
	Total	100	
Consultation with experts of the Agriculture-Jihad Bureau (number per year)	None	34.6	Mean=3.8 Standard Deviation=4.7 Minimum=0 Maximum=20
	1-3	30.8	
	4-10	26.9	
	>10	7.6	
	Total	100	
Recognition of regional leader gardener	Yes	46.2	
	No	53.8	
Sample farm visits (number)	None	53.3	Mean=1.7 Standard Deviation=2.3 Minimum=0 Maximum=7
	1-4	30.4	
	>4	16.3	
	Total	100	
Adoption of leader gardener as a model	Yes	69.2	
	No	30.8	
Adoption of leader gardener as Agriculture-Jihad representative/extension worker	Yes	26.9	
	No	73.1	

Source: Own calculation.

The findings of Table 4 also show that the average visit to the Agriculture-Jihad organization was 7.4, with minimum and maximum zero and 30 times per year, respectively. The purpose of these gardeners from visiting Agriculture-Jihad organization was different, and it is noteworthy that about 34.6% of the gardeners had not visited Agriculture-Jihad organization for expert advice and guidance. More than half (53.8%) of the gardeners were unaware of their area leader producers, and more than 53.3% of those surveyed had never visited any sample farm. Average number of visits was 1.7 times a year. At the same time, nearly 70 percent of gardeners stated that they see 'leader producers' as their role models, but only 26.9 percent of respondents tended to adopt them as Agriculture-Jihad representative/extension worker. Taken together, these findings confirm the weak position of the 'leader producers' among gardeners.

The findings in Table 5, illustrate the gardeners' perspective on scientific validity and influential characteristics of leader producers. The average of these ten items in the range of 1–5, indicated an average view of the gardeners. In this ranking, ‘gardeners' trust in the recommendations of leader producers’ had the highest score ($\bar{x} = 3.46, \mathrm{sd.} = 0.86$) and ‘rate of knowledge transfer from experts to gardeners by leader producers’ had the lowest score ($\bar{x} = 2.8, \mathrm{sd.} = 0.80$).

Table 5. Gardeners' perspective on scientific validity and influential characteristics of leader producers

Rank	Item	Very Little	Little	Average	Much	Very Much	Mean*	Sd.
1	Gardeners' trust in the recommendations of leader producers	3.8	0	53.8	30.8	11.5	3.46	0.86
2	Skill level of leader gardeners	0	7.7	61.5	19.2	11.5	3.35	0.80
3	Impact of leader producers on the use of machinery and equipment	0	11.5	50	30.8	7.7	3.35	0.80
4	Compatibility of leader producers 'actions with other farms	0	7.7	57.7	30.8	3.8	3.31	0.68
5	Effect of leader producers on use of appropriate seeds and seedlings	0	11.5	61.5	19.2	7.7	3.23	0.74
6	Effect of leader producers on use of new irrigation methods	0	19.2	46.2	26.9	7.7	3.23	0.87
7	Impact of leader producers on increasing production	0	7.7	73.1	15.4	3.8	3.15	0.61
8	Accuracy of information and knowledge from leader producers	0	11.5	69.5	15.4	3.8	3.10	0.65
9	Up-to-date knowledge of leader producers	0	11.5	73.1	11.5	3.8	3.07	0.63
10	Rate of knowledge transfer from experts to gardeners by leader producers	7.7	19.2	57.7	15.4	00	2.8	0.80
Mean		1.2	10.8	60.4	21.5	6.1	3.2	0.74

* In the range (1-5)

Source: Own calculation.

Overall, more than 60 percent of gardeners, mentioned the effectiveness of leader producers as average.
The results of gardeners' job satisfaction rate (Table 6) show that their satisfaction rate was slightly above average ($\bar{x} = 3.13, \mathrm{sd}$ = 1.04). Over 34.6% (19.2+15.4) had a little desire to continue farming with their children, and 38.4% (19.2 + 19.2) had a low tendency to stay in this job.

Table 6. Gardeners' job satisfaction rate

Rank	Item	Very Little	Little	Average	Much	Very Much	Mean*	Sd.
1	No fatigue from agriculture	3.8	3.8	38.5	38.5	15.4	3.58	0.93
2	Interest in (agriculture, horticulture, animal husbandry, etc.)	0	23.1	34.6	26.9	15.4	3.35	1.02
3	Willingness to continue farming with their children	15.4	19.2	30.8	34.6	0	2.85	1.08
4	Willingness to stay in farming	19.2	19.2	34.6	23.1	3.8	2.73	1.13
Mean		9.6	16.3	34.6	30.8	8.7	3.13	1.04

* In the range (1-5)
Source: Own calculation.

Studying the information and knowledge sources of producers can help to understand the position and role of the leader producers among gardeners. Table 7 shows that, in total, gardeners had relied heavily on input sellers (25.5%) and government experts (20.7%) for information on the four areas of ‘pesticides, agricultural fertilizers, livestock medicines and animal nutrition’. In this ranking, the leader gardeners were the fifth source of information, with only 11.1% of gardeners had received information from them. Separate results of information sources in the above four areas showed that in the field of agricultural pesticides, ‘input sellers’ (34.6%), in the fields of fertilizers and livestock medicines, ‘input sellers’ and ‘government experts’ (23% each), and in the field of animal nutrition, ‘farmers and local friends’ (26.9%) were the most important sources of information. The results show that in none of these areas, the leader producers had a high status as a source of information and the highest information related to agricultural pesticides was only 11.6%.

Table 7. Sources of information for the studied gardeners (%)

	Information field	Input sellers	Consulting companies	Government experts	Leader producers	Farmers and local friends	Farmers in other areas	Radio and TV	Magazine and newspaper	Virtual electronics	Others
1	Agricultural pesticides	34.6	19.3	17.3	11.6	5.8	3.8	1.9	1.9	0	3.8
2	Fertilizers	23	13.5	23	11.5	13.5	5.8	4	3.8	1.9	0
3	Livestock medicines	23	13.5	17.3	15.5	23	5.8	0	0	0	1.9
4	Animal nutrition	21.3	7.6	25	5.8	26.9	7.7	3.8	0	0	1.9
Mean		25.5	13.5	20.7	11.1	17.3	5.7	2.4	1.4	0.5	1.9
Rank		1	4	2	5	3	6	7	8	9	–

Source: Own calculation.

Pearson correlation coefficient and t-test were used to examine the relationships between the research variables and the variables ‘influence of leader producers’, ‘scientific validity of leader producers’, ‘Job satisfaction’ and ‘effectiveness of leader producers’. It is recalled that the variable ‘Influence of leader producers’ was derived from the combination of five items with the Likert scale (in the range of 1-5), the variable ‘Scientific validity of leader producers’ from the combination of five items with the Likert scale (in the range of 1-5), the variable ‘Effectiveness of the leader Producers’ from the combination of ten items with the Likert scale (range 1-5) and the ‘Job satisfaction’ was derived from the combination of the four items with the Likert scale (range 1-5) and were measured from the point of view of gardeners.
Based on Table 8, gardeners' perceptions of ‘influence of leader producers’ had negative and significant relationships with age (r= -

0.304, Sig.= 0.000) and experience (r= -0.275, Sig.= 0.002) and positive and significant relationships with education (r= 0.314, Sig.= 0.000), participation in extension classes (r=0.316, Sig.= 0.000), number of visits to agricultural offices (r= 0.411, Sig.= 0.000), and job satisfaction in agriculture (r= 0.520, Sig= 0.000). In other words, gardeners who had less age and experience, more education, and more participation in extension classes and visits to agricultural departments, as well as more job satisfaction, found the leader producers to be more influential. Also, the gardeners' perspective on 'scientific validity of leader producers' show positive and significant relationships with the garden area (r= 0.325, Sig= 0.000) and expert consultation (r= 0.339, Sig= 0.000).

Gardeners' perspective on 'effectiveness of leader producers' also had a negative and significant relationship with producer's experience (r= -0.243, Sig. = 0.005) and positive and significant relationships with education (r= 0.206, Sig. = 0.019), garden area (r= 0.272), number of visits to agriculture-Jihad organization (r= 0.238, Sig. = 0.006), consultations with experts (r= 0.287, Sig. = 0.001), and job satisfaction (r= 0.410, Sig. = 0.000). In other words, farmers who had less experience, higher education, more land, more visits to agricultural departments, and further consultation with experts and were more satisfied with their job have found the 'leader producers' to be more effective. Satisfaction with occupation was negatively and significantly correlated with age, experience and garden area, and was positively and significantly correlated with variables of education level, participation in extension classes, and number of visits to Agriculture-Jihad organization.

Table 8. Relationships between individual, educational and economic variables of the leader producers and dependent variables

Independent variables	Job satisfaction		Effectiveness of leader producers		Scientific validity of leader producers		Influence of leader producers	
	Correlation coefficient	Significance level	Correlation coefficient	Significance level	Correlation coefficient	Significance level	Correlation coefficient	Significance level
Age	-0.253	0.004	-0.095	0.280	0.162	0.065	-0.304	0.000
Education level	0.396	0.000	0.206	0.019	0.022	0.800	0.314	0.000
Experience	-0.232	0.008	-0.243	0.005	-0.129	0.142	-0.275	0.002
Garden area	-0.190	0.031	0.272	0.002	0.325	0.000	0.143	0.105
Participation in extension classes	0.307	0.000	0.119	0.178	-0.135	0.127	0.316	0.000
Number of visits to agricultural offices	0.446	0.000	0.238	0.006	0.026	0.765	0.411	0.000
Consultation with experts	-0.149	0.092	0.287	0.001	0.339	0.000	0.156	0.077
Visits to leader producer farms	0.040	0.654	-0.082	0.354	0.040	0.649	-0.179	0.053
Job satisfaction	-	-	0.410	0.000	0.158	0.072	0.520	0.000

Source: Own calculation.

As mentioned earlier, there were two positive and negative views among gardeners as to whether the leader producers could be models. According to the results of Table 9 from T-test, there was no significant difference between the two groups of gardeners regarding the leader producers influence (t= 0.068, Sig. =0.946). But gardeners who were willing to adopt the leader producers as extension workers ($\bar{x} =$ 3.49, sd. =0.73) compared to the other group ($\bar{x} =$3.03, sd. = 0.44), had a significant difference in their belief that the leader producers were influential (t= 3.472, Sig. =0.001). The difference between the gardener groups was different about the scientific validity of the

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leader producers. Those who considered the leader producers as models also provided more scientific validity for them ($\bar{x}$ =3.37, sd. =0.57), and the difference was statistically significant (t= 4.807, Sig. =0.000); however, adoption ($\bar{x}$ = 3.29) or non-adoption ($\bar{x}$ =3.25) of leader producers as extension workers by the gardeners did not differ significantly in their view of scientific validity of leader producers (t= 0.321, Sig. =0.748) (Table 9).

The findings in Table 9 also indicate that the gardeners who considered the leader producers as models also found the leader producers to be more effective ($\bar{x}$ = 3.26, sd. = 0.52), and in this respect with another group that did not considered them as models ($\bar{x}$ = 3.09, sd. =0.25) had a statistically significant difference (t= 2.573, Sig. = 0.011). There was also a statistically significant difference (t =2.413, Sig. =0.020) between the two groups of gardeners (those who adopted the leader producers as extension workers ($\bar{x}$ = 3.39, sd. =0.54) and those who did not adopt them ($\bar{x}$ = 3.14, sd. =0.41). The first group considered the leader producers to be more effective and rated their effectiveness at 3.39 (Table 9).

Table 9. Influence, scientific validity, and effectiveness of leader producers from the viewpoints of different gardener groups

Variable	Gardener groups	Mean*	Sd.	Equality of variances (Levene's Test)		t	Sig.	df
				f	Sig.			
Leader producers influence	recognition Leader producers as models	3.16	0.66	43.923	0.000	0.068	0.0946	1,277.931
	Non-recognition Leader producers as models	3.15	0.28					
Leader producers influence	Adoption leader producers as extension workers	3.49	0.73	28.985	0.000	3.472	0.001	43.474
	Non-adoption leader producers as extension workers	3.03	0.44					
Scientific validity of Leader producers	recognition Leader producers as models	3.37	0.57	21.183	0.000	4.807	0.000	127.504
	Non-recognition Leader producers as models	3.02	0.23					
Scientific validity of Leader producers	Adoption leader producers as extension workers	3.29	0.42	0.090	0.765	0.321	0.748	128
	Non-adoption leader producers as extension workers	3.25	0.55					
Effectiveness of Leader producers	recognition Leader producers as models	3.26	0.52	22.242	0.000	2.573	0.011	127.067
	Non-recognition Leader producers as models	3.09	0.25					
Effectiveness of Leader producers	Adoption leader producers as extension workers	3.39	0.54	10.289	0.002	2.413	0.020	48.807
	Non-adoption leader producers as extension workers	3.14	0.41					

* In the range (1-5)
Source: Own calculation.

CONCLUSIONS

The results of the present study showed that more than half of the studied gardeners (53.8%) had no knowledge about the leader producers in their area, and more than 53.3% of those surveyed had never visited any sample farm. At the same time, nearly 70 percent of gardeners stated that in their view, the ‘leader producer’ could be their agricultural model; however, only 26.9 percent stated that they preferred the ‘leader producer' as representative of Agriculture-Jihad or extension worker. The leader producers were the fifth source of information and only 11.1% of the gardeners received information from them. Therefore, they do not have a high status as a source of information. Taken together, these findings confirm the weak position of the 'leader producers' among the gardeners. Overall, more than 60 percent of gardeners cited the effectiveness of leader producers as average. Gardeners who had less experience, higher education, more area under cultivation, and a high number of visits to agricultural departments and consultations with experts and were more interested in the agricultural profession also found the 'leader producers' to be more effective. According to the results of the research the following suggestions can be made:

- Using 'leader Producers' as representative of the Agriculture-Jihad or extension worker in areas covered by agricultural activities
- Planned visits from the 'leader Producers' farms in the application of new technologies, including modern irrigation, monthly, seasonally, etc.
- Organizing extension and training classes on the optimal use of inputs and marketing of agricultural products with the presence of 'leader producers'.

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PROBLEMS OF THE AGING OF THE FARMERS' POPULATION IN SMALL FARMS IN POLAND

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Abstract

Population aging phenomena are noticed in many branches of the economy. The human factor plays a very important role in the manufacturing processes of enterprises. Its importance is also currently significant in many sectors of the national economy and in the economic development of local communities, regions and countries. Not only the population, but also age and the related ability to work are important. In the knowledge-based economy, formal and informal qualifications of employees, their level of education and professional experience are also very important. All these factors affect the competitiveness of the business entities in which they work and which they manage. The aging of the population with a large intensity also negatively affects the development of agriculture and rural areas. However, they can also become a reason for developing previously unknown forms of activity, e.g. care farms.The research carried out concerned the group of owners of small farms operating in south-eastern Poland. They were implemented as part of the SALSA project "Small farms, small food and sustainable food and nutrition security". As indicated by the conducted research, most of the small farms were managed by people at a mature or older age. The share of people aged up to 40 years was at the level of 20.2%. This shows that young people are mostly not interested in running small farms. The level of education of farmers was also low, which was particularly evident in older age groups. Many older farmers also spoke negatively about the future of their farms, which was often associated with the lack of successors. The presented results prove the existence of many problems resulting from the aging of small farm owners and the need to undertake remedial actions.

Key words*: *aging, economics, demography, farms

INTRODUCTION

Currently, the human factor plays an increasingly significant role in the economic development of the societies of many countries [2, 17]. Relevant qualifications of populations cause them to display a more active attitude towards the environment and to have definitely better adaptation skills to changing economic conditions. These phenomena occur also in rural areas. In the conditions of increased competition in agriculture both at the national and at the global level, the role of the quality of labour resources becomes significant [8]. Unfortunately, population aging has been observed in the last decades in many developed economies of the world. On one hand, this is a consequence of an increasing average lifespan, which is the result of, among other things, progress in medicine and health care development, which should be viewed positively. However, on the other hand, the process of population aging causes a restriction of workforce resources, and thus the manufacturing capacity of enterprises, and also has negative consequences for the social security system.

The processes of population aging occur also in rural areas and concern also agriculture. In user structure of farms, senior citizens prevail. In many countries of Europe, the share of small farms run by young farmers is relatively low. In recent years, a downward tendency has been observed for this indicator. Counteracting those negative tendencies is a big challenge for the economic policy, particularly the agricultural policy and the development policy for rural areas. In addition, migration phenomena are observed among young people with higher education from rural areas [20, 4].

The noted deficit of young farmers is part of the ongoing discussion in Europe about population aging [21]. However, the systems of earlier retirement are quite commonly considered ineffective in increasing the real intergenerational transfer [14, 5, 9] and are currently being withdrawn. Correlations are also noted among the farmers' age, farm management methods, proclivity to implement innovations and adopted attitudes in terms of the directions of farm development [11].

It will be definitely easier for young farmers to cope with new challenges of the rapidly changing world. This is because they have a better understanding of the current developmental challenges and mechanisms of change, and because they have greater adaptation skills in comparison with the older, mature generation [12, 10]. Highly dynamic changes taking place in agriculture and in rural areas can also be a factor attracting the younger generation to work there, because high variability reflects the current preferences of young people and the declared lifestyle.

The processes of succession occurring in farmers' families are significant for increasing the share of young people in taking over farms and managing them. Research has shown that successors are definitely more willing to take over profitable farms with a stable market standing and good development perspectives [6, 7]. The fact of running the farm by the successor before its formal takeover is also very significant [13]. Such experience provides an opportunity to familiarise oneself with the farm, which results in limiting the risk and a swifter takeover.

The model of life shaped in recent times, along with the high mobility of young people, are features that do not encourage young people to stay in rural areas [23, 3] and engage in farming, particularly in small, low-profit farms [19]. All these arguments justify the existence of support from public funds for young people engaging in running a farm for the first time, and also speak in favour of using a preferential payment system in selected measures of agriculture and rural development support programmes co-financed from European Union structural funds allocated under the Common Agricultural Policy.

The aim of the article is to present the phenomenon of population aging with special consideration for rural areas. In this aspect, small farm owners were subjected to detailed analysis.

MATERIALS AND METHODS

The conducted research concerned a community of small farm owners active in south-eastern Poland. Detailed survey studies were carried out on a community of 148 farms located in the so-called reference regions (of Nowy Sącz, Nowy Targ and Rzeszów). They were carried out as part of the project SALSA "Small farms, small food businesses and sustainable food and nutrition security". Surveys were conducted using a standardised survey questionnaire which contained questions on various spheres and aspects of farm functioning. The survey studies were conducted in 2017-2018.

Another source of data on demographics were publicly available statistics published by the Main Statistical Office (GUS). Both general data on the country's demographics and specialist data published in Statistical Yearbooks of Agriculture were used. The results of conducted analyses are shown in graphs and tables.

RESULTS AND DISCUSSIONS

Nationwide demographic phenomena

Demographic aging means a systematic increase in the percentage of old people in the population [15]. In such a situation, the dynamics of growth of the number of elderly people is higher than the pace of growth of the total size of the population. The processes of demographic aging can lead to workforce deficiency and an increased demand for the services of the health and social care sector. An important economic effect of that process in the long-term will be, among other things, providing for the not working majority by the professionally active minority [10].

Analysis of demographic data indicates that in Poland in 2005-2017 the number of people in two youngest age groups significantly decreased (a fall of about 940,000 among under 17s; a fall of 1.96m people among 18-30-year-olds).

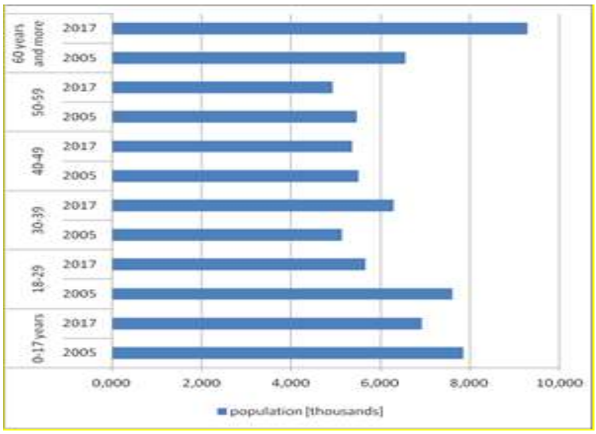

Fig. 1. Population by age groups in Poland in 2005-2017 (in thousands)

Source: own study based on the data of the Main Statistical Office.

The biggest rise in the number of people, by over 2.7m people, was noted during that time in the group of people over 60 years of age. Such changes prove that the Polish society is undergoing big demographic changes.

General characteristics of agricultural holdings

Poland, besides Romania and Bulgaria, belongs to those EU countries where the fragmentation of farms is the highest [16, 18]. In the total number of approximately 1.41 million units, farms in the smallest size ranges prevail (Table 1). Farms with an area not exceeding 5 ha in Poland were less than 760 thousand. There are especially many farms with an area of 1-2 ha. A large group (around 310,000) was also represented by a group of farms with an area of 5-10 ha. It is worth noting, however, that farms with a larger area have the largest share in food production.

Table 1. The diversity of agricultural holdings in Poland, by area groups and voivodships in 2016

Voivodships	*Total*	*Area groups of agricultural land*										
		up to 1 ha	1.01-1.99	2.00-2.99	3.00-4.99	5.00-9.99	10.00-14.99	15.00-19.99	20.00-29.99	30.00-49.99	50.00-99.99	100.00 *and more*
Dolnośląskie	55,993	1,207	11,952	6,571	7,903	12,240	5,529	2,454	2,488	2,362	1,891	1,396
Kujawsko-pomorskie	63,830	995	6,732	6,043	7,769	14,218	9,870	5,554	5,817	3,990	1,943	899
Lubelskie	179,994	1,084	27,031	29,578	42,327	45,580	15,725	7,095	5,747	3,553	1,701	573
Lubuskie	20,236	503	3,542	3,033	2,672	3,685	1,953	1,167	1,065	954	833	829
Łódzkie	124,032	2,056	19,838	13,959	27,462	34,543	13,042	5,576	4,262	2,265	768	261
Małopolskie	139,923	2,074	50,522	30,687	32,002	18,280	3,318	1,077	869	513	382	199
Mazowieckie	212,917	1,027	30,152	28,021	37,997	59,306	26,801	11,461	10,330	5,008	2,130	685
Opolskie	26,919	659	4,406	3,133	4,031	4,903	3,106	1,549	1,842	1,588	1,087	616
Podkarpackie	132,851	3,203	47,159	28,929	30,177	16,505	2,874	1,081	1,209	847	545	322
Podlaskie	81,181	846	5,372	6,468	10,061	21,777	14,161	8,235	7,581	4,504	1,672	504
Pomorskie	39,049	918	4,336	3,721	4,595	9,140	5,743	3,096	2,969	2,170	1,419	941
Śląskie	54,503	2,525	16,633	10,348	9,444	8,642	2,643	1,390	1,138	875	576	288
Świętokrzyskie	85,308	1,968	17,323	13,680	22,615	19,293	5,636	2,052	1,551	733	346	110
Warmińsko-mazurskie	43,165	876	3,837	3,298	4,809	7,473	5,870	4,176	4,730	4,189	2,579	1,327
Wielkopolskie	121,157	2,219	18,564	11,352	16,713	28,593	17,754	8,620	7,962	5,166	2,741	1,472
Zachodniopomorskie	29,646	608	3,832	2,929	3,613	5,736	3,253	2,316	1,906	1,839	1,922	1,693
P O L A N D	**1,410,704**	**22,767**	**271,232**	**201,749**	**264,191**	**309,914**	**137,277**	**66,900**	**61,466**	**40,556**	**22,536**	**12,116**

Source: Statistical Yearbook of Agriculture in 2017. CSO.

The area structure of farms in Poland varies regionally. Larger production entities occur mainly in the northern and western part of the country [1]. Small farms dominate in south-eastern Poland. Their largest share is characteristic of the Malopolskie and Podkarpackie voivodships. The reasons for this state should be sought in historical conditions, and nowadays they are connected with the barriers to leaving agriculture which are justified in transaction costs [22].

Aging process in rural areas in Poland

The demographic changes occurring in rural areas also prove the existence of a gradual process of population aging. They can be differentiated, however, from changes occurring in cities by a slower rate of population increase in the most senior age groups. When analysing the demographic structure of rural areas, it is worth noting that it is slightly more favourable than the one discussed earlier for the entire country. This is because there is no such an explicit dominance of people representing the most senior age category (Fig. 2).

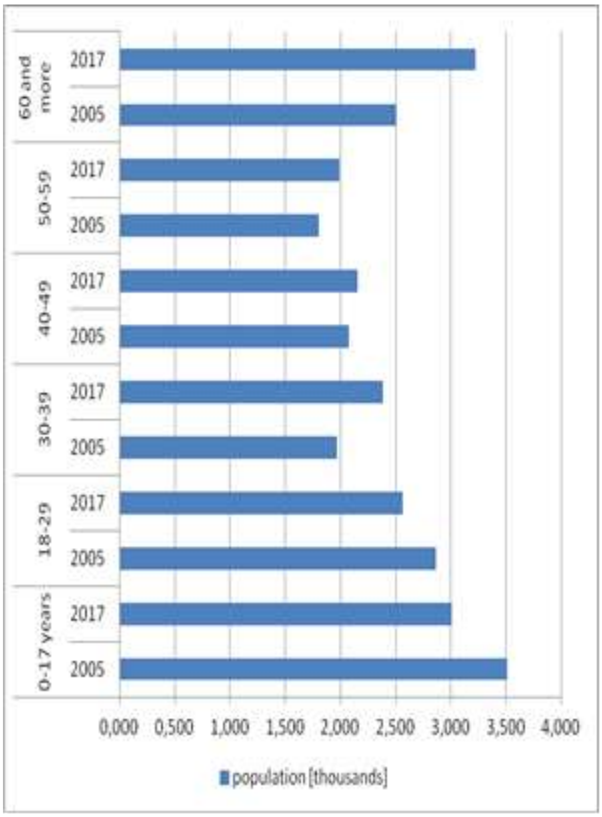

Fig. 2. Population of rural areas of Poland by age groups in 2005-2017 (in thousands)

Source: own study based on the data of the Main Statistical Office.

The analysed community of 148 farmers running small farms in south-eastern Poland was dominated by elderly people. Farm owners aged 50 or over made up 58% of respondents in total. There were only 17% of farmers under 40 years of age, and only 1% were under 30 (Fig. 3). These results indicate a relatively late takeover of small farms by young farmers. The group of owners of the smallest farms is dominated by elderly people. This translates into a weaker proclivity for investment and innovation in this group, which is particularly unfavourable considering the fact that these entities must increase their competitiveness.

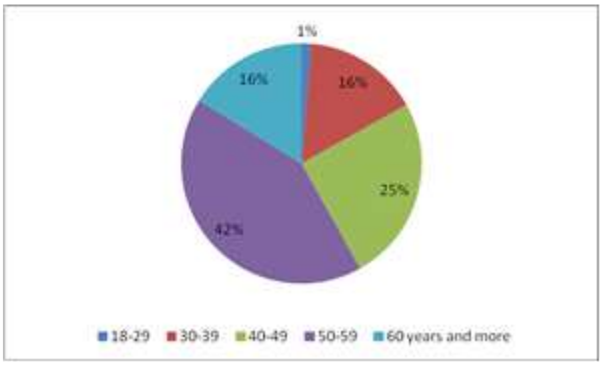

Fig. 3. Share of surveyed small farm owners by age groups

Source: own elaboration based on questionnaire research.

The big share of elderly farmers had negative consequences for their level of education. A big part of older age groups were people with vocational education (sometimes even primary education), while the percentage of people with higher education was minimal. Younger farmers were characterised by a higher level of education.

Research has shown that younger farmers were more involved in running their own farms, obtaining all or most of their income from them. This is proof that their farms are their main source of income and they are more inclined to invest in its development. Among older farmers the income from the farms did not form such a big part; some treated their farms as a hobby. They had income from other sources, including social benefits, and treated their farms as a secondary source of earnings or as a way to obtain cheaper food for their families.

Young farmers significantly more often declared that their aim is to develop and modernise the farm. In this group there were also ideas to purchase land in order to increase one's farming area, and to invest in one's machine park. Responses about maintaining production or reducing it to the level covering only one's own food supply needs dominated among the eldest farmers. Old-age farmers were also less interested in cooperation as part of producers' groups and had a less positive view of their abilities to acquire funds for farm development [24]. Young farmers were definitely better prepared to use external funds and open to cooperation.

CONCLUSIONS

Demographic changes occurring in many countries of the world have consequences affecting many areas of the economy. An increasing group of elderly people requires, among other things, greater involvement of public funds in the sphere of pensions, healthcare or social care. Population aging has also negative consequences for agriculture and rural areas. Elderly farmers are unable to adjust their farms to modern requirements to the extent required by the competitive environment. The younger generation is more prepared for changes; however, it is not very interested in running small farms.

In Poland population aging is slightly less severe in rural areas than in cities. However, people running small farms are mostly elderly people. For many of them, the income obtained from farms forms only part of their total income. In this case they do not invest in the development of their farms; they aim only to preserve production at the current level or reduce it only to meet the food supply needs of their families. As a consequence, they are not interested in cooperating with other farmers or in acquiring external funding. In order to stimulate young people's interest in running farms, one should provide relevant preferences for young people in the implemented support programmes. Another factor which could spark a greater interest of the younger generation in undertaking work in agriculture would be a higher profitability of that sector of the economy. This is, however, a separate multi-strand aspect which goes beyond the size of this paper.

ACKNOWLEDGEMENTS

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THE MARKET DYNAMICS OF THE TOURISM DEMAND IN BOTOȘANI COUNTY DURING THE PERIOD 2009-2018

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Abstract

The absolute and relative dynamics of the tourist arrivals in Botoșani County in the period 2009-2018 highlights the increase with 68.21% of the number of tourists in the year 2018 compared to 2009. The highest difference reported to the number of tourists arrived in the county during the base year has been recorded in the year 2017 (+87.3%). Compared to the previous year,it had been recorded increases up to 31.21% (in 2011). Overall, the average level of arrivals was 38,192 thousand persons, with an absolute average increase of 2.12 thousand persons, respectively a relative increase of 5.9%. The analysis of the absolute and relative dynamics of overnight stays in the same period, in Botoșani County, reveals that their number grew significantly in 2018 compared to 2009 (+48.68%), the highest increase compared to the base year being achieved in 2017 (+69.38%); compared to the previous year it have been recorded increases up to 32.54% (in 2014). During the whole analysed period, the average level of the overnight stays had the value of 68,795 thousand persons, with an absolute average growth of 2.93 thousand persons, respectively a relative growth of 4%. The average length of stay was about 1.81 days, with an absolute average decrease of 0.024 days. The analysis of the absolute and relative dynamics of tourist density in the period 2009-2018 indicates that this has almost doubled in 2018 compared to 2009 (+97.09%), the highest increase compared to the base year being obtained in the year 2017 (+116.47%). Compared to the previous year, it have been recorded increases up to 31.79% (in 2011). Overall, the average level of turist density had the value of 9.34 tourists/100 inhabitants, with an absolute average increase of 0.66 tourists/100 inhabitants, respectively a relative increase of 7.8%.

Key words**:** *arrivals, overnight stays, average length of stay, density of tourist movement*

INTRODUCTION

The studies regarding the demand for tourist services are anytime actual and necessary. The main reasons for which the tourists choose a certain tourist destination and tourism form are the income of tourists, consumer habits and the prices of tourism services [16]. But also the macro-economic and political factors exert their influence on the decision relating to tourism consumption [7, 17]. By the other hand, significant differences are registered between the image of tourism services before consumption and the satisfaction perceived after their consumption. These differences substantially alters the demand by the dissemination made by the consumers directly among the potential customers – phenomenon known as" through word of mouth" [8]. Beside these, it have been identified some means of using local resources that occupy an important place within the dynamics of demand for tourist services. For example, the use of cultural resources represents a driver of growth for the demand of tourist services [8]. In the same time, the use of agricultural resources might also significantly influence the tourism market [9, 20].

Some studies developed a taxonomy of tourism service providers in order to better understand their role and their involvement in tourism [21]. Also, it has been analysed the tourism demand specific for the customer profile, starting with the young people who are strongly influenced by the social-media phenomenon (they are known as "Generation X") [4] and up to the so-called „senior"

tourists, who occupy an increasingly important place on the tourism market [18].
Botoșani County is registered on the Romanian tourism market with an outstanding tourism potential. The main tourist destination is represented by the headquarters of county, Botoşani Municipality, this being the main economic and tourism drive of the analysed region. Within the county, Ipoteşti Village is a tourist destination recognized at national level, as the place of birth of the great Romanian poet Mihai Eminescu [16]. The tourism activity, through its complexity, determines the existence of a system of indicators for tourist movement [2, 3], this representing the actual expression of tourism demand [5].

MATERIALS AND METHODS

The research presented in the current paper has been acomplished in Botoșani County during the period 2009-2018, consisting in the determination and forecasting of the main macro-economic indicators (displayed both in structure and dynamics) that express the demand for tourism services: level of total arrivals; average length of stay (total and per tourist type); level of total overnight stays; tourist density.
Within the number of tourists arriving in tourist boarding units are included all the persons (Romanians and foreigners) who travel outside their own residence locality, for a period less than 12 months and who stay at least one night in a tourist boarding unit in areas which they visit within the country, the main reason of the journey being other one than to have a paid activity in the visited place [22].
The tourist overnight stay is a 24-hour period, starting with the accommodation time of the tourist boarding unit, for which a person is registered in the tourist unit record, being hosted for the price paid, even if the actual stay is shorter than the mentioned period. The overnight stays related to the supplementary installed beds (paid by customers) are also included [22].

The average length of stay (D_s) is determined by the ratio between the number of days/tourist (NTZ) and the number of tourists (T) and reflects the possibility of the tourism offer to retain a tourist into a certain area, region or country [5, 11].

$$D_s = \frac{\Sigma NTZ}{\Sigma NT}$$

The density of tourist movement (D) is the indicator that directly interconnects the tourist movement with the resident population in the concerned area or country. It is calculated as a ratio between the number of tourists (T) and the number of inhabitants (P) [14, 20]:

$$D = \frac{\sum T}{P}$$

Absolute indicators represent a basic form of dynamic series and the ground to obtain general indicators [10, 14]. The level indicators are terms of series formed by absolute indicators ($y_1 \ldots y_t \ldots y_{t-1}$).
Total level of terms $\sum_{t=1}^{n} yt$, only for interval time series with absolute measures.
Absolute change (increase or decrease), calculated:

- with fixed base ($\Delta_{t/1}$)
  $\Delta_{t/1} = y_t - y_1$ where: t = 2, n
- with the base chained (mobile or variable base) ($\Delta_{t/t/1} = y_t - y_{t-1}$)
  $\Delta_{t/t/1} = y_t - y_{t-1}$ where: t = 2, n

Relative indicators:
They are a tool for presentation, mainly in percentage.
Dynamic index, calculated:

- with the fixed base ($I_{t/1}$):
  $I_{t/1(\%)} = \frac{yt}{y1} x100$
- with the base chained ($I_{t/t-1}$):
  $I_{t/t-1(\%)} = \frac{yt}{yt-1} x100$

Rate of change (increase or decrease), calculated:

- with the fixed base ($R_{t/1}$):
  $R_{t/1} = I_{t/1(\%)} - 100\ \%$
- with the base chained ($R_{t/t-1}$):
  $R_{t/t-1(\%)} = I_{t/t-1(\%)} -100\%$, t = 2, n

Average indicators:
$\bar{y}$ – the average level of the interval time series:

$$\bar{y} = \frac{\sum_{t=1}^{n} yt}{n}$$

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$\bar{\Delta}$ – the average level of the absolute change (increase or decrease):

$$\bar{\Delta} = \frac{yn - y1}{n-1}$$

$\bar{I}$ – the average index of dynamics:

$$\bar{I} = \sqrt[n-1]{\frac{yn}{y1}}$$

$\bar{R}$ – the average growth rate: $\bar{R} = \bar{I}$ - 100

The method of trend adjustment has been used to adjust the number of tourists according to the linear trend for the time interval 2009-2018. The linear model has the shape of: *y* = a + bt.

R is the coefficient of regression between the forecasted values and the actual values. R^2 is used to indicate the change in values compared with the trend line [13, 15].

The adjustment on the basis of graphical reproduction represents an instrument for assessing the development trend, under which might be chosen the proceeding that has to be used to estimate the long-term and short-term trend [1].

RESULTS AND DISCUSSIONS

Analysis of tourism demand. With the help of the statistical data regarding the tourist demand, which were provided by the National Institute of Statistics, the analysis of the structure and dynamics of the following indicators was carried out: total arrivals; total overnight stays; average length of stay (total and per tourist type); tourist density.

Level and dynamics of arrivals and overnight stays. The absolute dynamics of tourist arrivals during the period 2009-2018 is highlighted by an average growth of 68.21% (Table 1).

Table 1. Absolute and relative changes of the indicator "arrivals" in the period 2009-2018

Years	Arrivals (thousand pers.)	Absolute change		Dynamic index (%)		Rate of change (%)	
		$\Delta_{t/1}$	$\Delta_{t/t-1}$	$I_{t/1}$	$I_{t/t-1}$	$R_{t/1}$	$R_{t/t-1}$
2009	27,946	-	-	-	-	-	-
2010	28,092	0.146	0.146	100.52	100.52	0.52	0.52
2011	36,862	8,916	8,77	131.90	131.21	31.90	31.21
2012	34,830	6,884	-2,032	124.63	94.48	24.63	-5.52
2013	33,349	5,403	-1,481	119.33	95.74	19.33	-4.26
2014	39,848	11,902	6,499	142.59	119.48	42.59	19.48
2015	37,670	9,724	-2,178	134.79	94.53	34.79	-5.47
2016	43,972	16,026	6,302	157.34	116.72	57.34	16.72
2017	52,343	24,397	8,371	187.30	119.03	87.30	19.03
2018	47,009	19,063	-5,334	168.21	89.80	68.21	-10.2
	$\bar{y}$	$\bar{\Delta}$		$\bar{I}$		$\bar{R}$	
	38,192	2.12		1.059 (105.9 %)		5.9	

Source: Own calculation, according to www.insse.ro

The average level of arrivals registered 38,192 thousand persons, with an absolute average growth of 2.12 thousand persons, respectively a relative growth of 5.9%.

In order to estimate the number of arrived tourists in the next five years (2019-2023), it has been used the adjustment function: y = 2,420.3x – 5,000,000, obtained through the graphical method according to the linear trend. R^2 = 0.9458 has been used to indicate the changes in value compared to the trend line (Fig. 1).

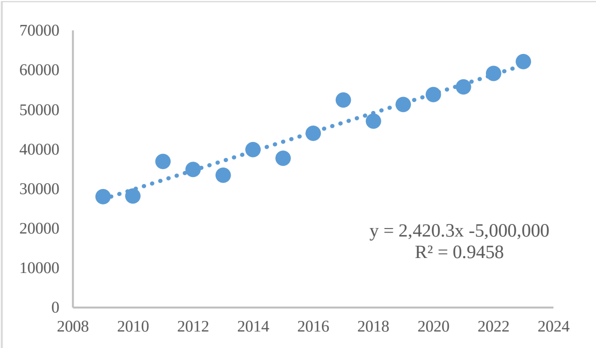

Fig. 1. Dynamics and estimation of arrivals in the period 2009-2023
Source: Own calculation.

The number of overnight stays has increased in 2018 compared to 2009 with 48.68%, the highest growth compared to the base year being obtained in 2017 (69.38%) (Table 2). The average level of overnight stays has registered 68,795 thousand persons, with an absolute growth of 2.93 thousand persons, respectively a relative growth of 4%.

Table 2. Absolute and relative changes of the indicator "overnight stays" in the period 2009-2018

Years	Over night stays (thous and)	Absolute change		Dynamic index (%)		Rate of change (%)	
		$\Delta_{t/1}$	$\Delta_{t/t-1}$	$I_{t/1}$	$I_{t/t-1}$	$R_{t/1}$	$R_{t/t-1}$
2009	54,288	-	-	-	-	-	-
2010	49,436	-4,852	-4,852	91.06	91.06	-8.94	-8.94
2011	67,348	13,060	17,912	124.05	136.23	24.04	36.23
2012	61,623	7,335	-5,725	113.51	91.50	13.51	-8.5
2013	58,801	4,513	-2,822	108.31	95.42	8.31	-4.58
2014	77,935	23,647	19,134	143.55	132.54	43.55	32.54
2015	68,055	13,767	-9,880	121.67	87.32	21.67	-12.68
2016	77,790	23,502	9,735	143.29	114.30	43.29	14.30
2017	91,954	37,666	14,164	169.38	118.20	69.38	18.20
2018	80,718	26,430	-11,236	148.68	87.78	48.68	-12.22
	$\bar{y}$	$\bar{\Delta}$		$\bar{I}$		$\bar{R}$	
	68,795	2.93		1.04 (104%)		4.0	

Source: Own calculation, according to www.insse.ro.

The adjustment according to the linear trend of the overnight stays for the period 2019-

2023 has been achieved with the adjustment function with the shape of: y = 3,859.7x-8,000,000, where R^2 = 0.9131 (Fig. 2).

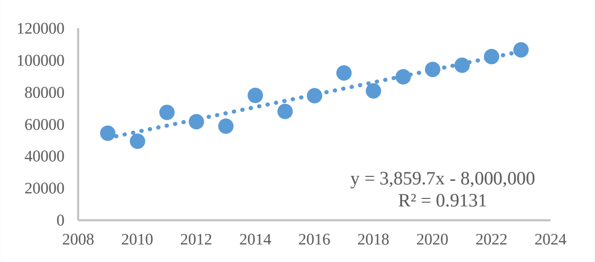

Fig. 2. Dinamycs and estimation of overnight stays (2009-2023)
Source: Own calculation.

Under the conditions where the factors of influence on the tourism activity will keep the same rate and trend in the next five years, it can be estimated that in the year 2023, Botoşani County will be visited by 62,000 tourists, who will cumulate about 106,400 of overnight stays (Table 3).

Table 3. Estimation of arrivals and overnight stays in the period 2019 – 2023

Years	t(x)	Arrivals y = 2,420.3x - 5,000,000	Overnight stays y = 3,859.7x-8,000,000
2019	11	51,255.20	89,666.00
2020	12	53,748.15	94,146.00
2021	13	55,723.26	96,765.60
2022	14	59,116.67	102,228.91
2023	15	62,068.17	106,389.70

Source: Own calculation.

Analysis of tourist circulation. The number of foreign tourists has recorded a maximum level of 3,138 thousand persons in the year 2014, with a share of 6.44% in the total arrivals in the county.

Table 4. Structure of tourist circulation by tourist type, in the period 2009-2018

Years	Arrivals			Overnight stays		
	T*	TR**	TS***	T*	TR**	TS***
2009	27,946	25,861	2,085	54,288	49,866	4,422
2010	28,092	25,850	2,242	49,436	44,919	4,517
2011	36,862	34,032	2,830	67,348	60,566	6,782
2012	34,830	31,965	2,865	61,623	55,770	5,853
2013	33,349	30,786	2,563	58,801	53,025	5,776
2014	39,848	36,710	3,138	77,935	67,765	10,170
2015	37,670	35,137	2,533	68,055	61,885	6,170
2016	43,972	42,015	1,957	77,790	72,832	4,958
2017	52,343	49,788	2,555	91,954	85,865	6,089
2018	47,009	45,173	1,836	80,718	76,553	4,165
	$\bar{y}$			$\bar{y}$		
	38,192	35,731.6	2,460.4	68,794.8	62,904.6	5,890.2

* Total tourists; ** Romanian tourists; ***Foreign tourists
Source: own calculation, according to www.insse.ro.

On average, in the period 2008-2018, only 8.56% of the total number of overnight stays belonged to foreign tourists (Table 4).

The average length of stay displayed fluctuations in the analysed period, for the foreign tourists increasing with cu 7.07% in the year 2018 compared to the base year. The highest increase compared to the base year has been achieved in the year 2014 (52.83%).

In the case of Romanian tourists, it has been noticed a permanent decrease in the average length of stay compared to 2009 (Table 5).

Table 5. The absolute changes of the average length of stay, by tourist type, in the period 2009-2018

Year	Average length of stay (Ds)			Absolute change $\Delta_{t/1}$		
	T*	TR**	TS***	T*	TR**	TS***
2009	1.94	1.93	2.12	-	-	-
2010	1.76	1.74	2.01	-0.18	-0.19	-0.11
2011	1.83	1.78	2.40	-0.11	-0.15	0.28
2012	1.77	1.74	2.04	-0.17	-0.19	-0.08
2013	1.76	1.72	2.25	-0.18	-0.21	0.13
2014	1.95	1.84	3.24	0.01	-0.09	1.12
2015	1.80	1.76	2.43	-0.14	-0.17	0.31
2016	1.77	1.73	2.53	-0.17	-0.20	0.41
2017	1.76	1.72	2.38	-0.18	-0.21	0.26
2018	1.72	1.69	2.27	-0.22	-0.24	0.15
	$\bar{y}$			$\bar{\Delta}$		
	1.81	1.76	2.17	-0.024	-0.026	0.016

* Total ** Romanian tourists *** Foreign tourists
Source: Own calculation, according to www.insse.ro.

Overall, the medium level of the average length of stay recorded 1.81 days, with an absolute average decrease of 0.024 days, respectively a relative drecrease of 2% (Table 6).

Table 6. The relative changes in the average length of stay by tourist type, in the period 2009-2018

Years	Dynamic index (%) $I_{t/1}$			Rate of change (%) $R_{t/1}$		
	T*	TR**	TS***	T*	TR**	TS***
2009	-	-	-	-	-	-
2010	90.72	90.15	94.81	-9.28	-9.85	-5.19
2011	94.32	92.22	113.20	-5.68	-7.78	13.20
2012	91.23	90.15	96.22	-8.77	-9.85	-3.78
2013	90.72	89.11	106.13	-9.28	-10.89	6.13
2014	100.51	95.33	152.83	0.51	-4.67	52.83
2015	92.78	91.19	114.62	-7.22	-8.81	14.62
2016	91.23	89.63	119.33	-8.77	-10.37	19.33
2017	90.72	89.11	112.26	-9.28	-10.89	12.26
2018	88.65	87.56	107.07	-11.35	-12.44	7.07
	$\bar{I}$			$\bar{R}$		
	0.98 (98%)	0.98 (98%)	1.00 (100%)	-2	-2	0

* Total; ** Romanian tourists *** Foreign tourists
Source: Own calculation, according to www.insse.ro

In order to estimate the average length of stay in the period 2019-2023, it is has been applied the adjustment function: y = -0.0124x +

26.648, obtained through the graphical method according to the linear trend.

The indicator R^2 = 0.5955 shows a relatively acceptable approximation of the trend, by the linear function. In order to estimate the average length of stay in the case of Romanian tourists, the adjustment function obtained through the graphical method after the linear trend was: y = -0.0114x+24.692, where R^2 = 0.4514, which represents a relatively modest value.

The adjustment function to estimate the average value of the foreign tourists' stay has the shape: y = 0.0317x-61.437. In this case, also, the value of the regression coefficient is low (R^2 = 0.2191) (Fig. 3).

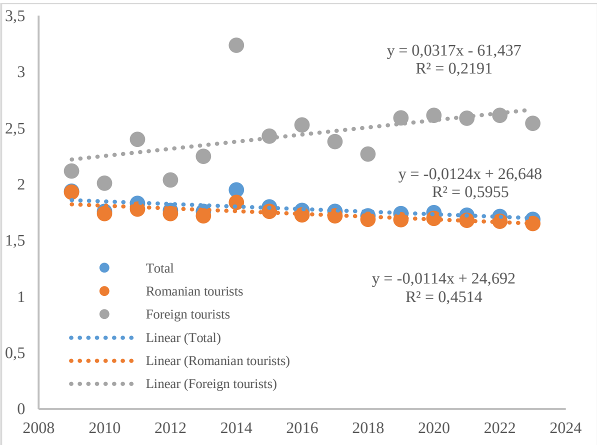

Fig. 3. Dynamics and estimation of the average length of stay in the period 2009-2023
Source: Own calculation.

Under the conditions where all the factors of influence on the tourism activity will keep the same rate dring the next five years (Table 6), in the year 2023, in Botoșani County, the average length of stay for Romanian tourists is estimated at 1.7 days and for the foreign tourists, at about 2.6 days.

Table 6. Estimation of the average length of stay, by tourist type, in the period 2019 – 2023

Years	t(x)	Average duration of stay		
		T* y = -0.0124x + 26,648	**TR**** y = -0.0114x + 24,692	**TS***** y = 0.0317x-61,437
2019	11	1.74	1.69	2.59
2020	12	1.75	1.70	2.62
2021	13	1.73	1.68	2.59
2022	14	1.72	1.67	2.61
2023	15	1.69	1.65	2.54

* Total ** Romanian tourists *** Foreign tourists
Source: Own calculation.

The density of tourist movement is the indicator that directly interconnects the tourist circulation with the resident population of a zone or country. Normally, this indicator has a a value bellow 1 in the areas with average and low tourist movement [19].

This situation applies also to Botoșani County, where the highest value (0.13 tourists/inhabitant) was registered in the year 2017 (Table 7).

Table 7. Tourist density in the period 2009-2018

Years	Resident population	Arrivals	Dt pop (tourists/100 inh.)
2009	451,193	27,946	6.19
2010	448,749	28,092	6.26
2011	446,456	36,862	8.25
2012	410,706	34,830	8.48
2013	406,330	33,349	8.20
2014	403,205	39,848	9.88
2015	399,273	37,670	9.43
2016	394,625	43,972	11.14
2017	390,404	52,343	13.40
2018	385,046	47,009	12.20

Source: Own calculation, according to www.insse.ro.

When the dynamics of the average length of stay recorded a continous decrease, the density registered significant increases: if in the year 2009, at every six inhabitants existed a tourist, at the level of the year 2018, this ratio has doubled, becoming 12.2:1. The increase in the number of tourists and the decrease of the population in Botoșani County represent the causes of this situation.

Examining the absolute and relative dynamics of tourist density (Table 8) indicates an increase with 97.09 %.

Table 8. Absolute and relative changes in tourist density in the period 2009-2018

Years	Dt pop tourists /100 inh.	Absolute change		Dynamic index (%)		Rate of change (%)	
		$\Delta_{t/1}$	$\Delta_{t/t-1}$	$I_{t/1}$	$I_{t/t-1}$	$R_{t/1}$	$R_{t/t-1}$
2009		-	-	-	-	-	-
2010	6.19	0.07	0.07	101.13	101.13	1.13	1.13
2011	6.26	2.06	1.99	133.28	131.79	33.28	31.79
2012	8.25	2.29	0.23	137.00	102.78	37.00	2.78
2013	8.48	2.01	-0.28	132.47	96.69	32.47	-3.31
2014	8.20	3.69	1.68	159.61	120.48	59.61	20.48
2015	9.88	3.24	-0.45	152.34	95.44	52.34	-4.56
2016	9.43	4.95	1.71	179.96	118.13	79.96	18.13
2017	11.14	7.21	2.26	216.47	120.28	116.47	20.28
2018	13.40	6.01	-1.2	197.09	91.04	97.09	-8.96
	$\bar{y}$	$\bar{\Delta}$		$\bar{I}$		$\bar{R}$	
	9.34	0.66		1.078 (107.8%)		7.8	

Source: Own calculation, according to www.insse.ro

The average level of the tourist density recorded 9.34 tourists/100 inhabitants, with an absolute average increase of 0.66 tourists /100 inhabitants, respectively a relative increase of 7.8%.

In order to estimate the tourist density in the period 2019-2023, it has been applied the adjustment function y = 0.7559x – 1,512.6 obtained through the graphical method according to the linear trend. R^2 has been used to indicate the change in values compared to the trend line (R^2 = 0.9696) (Fig. 4).

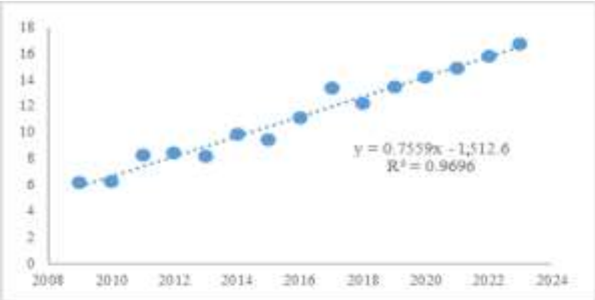

Fig. 4. Dinamycs and estimation of the tourist trend in the period 2009-2023
Source: Own calculation.

Under the conditions where the factors of influence on tourist activity will keep the same rate during the next fixe years, too, in the year 2023 the tourist density will be of approximatively 17 tourists/100 inhabitants (Table 9).

Table 9. Estimation of tourist density for the period 2019 – 2023

Year	t(x)	Tourist density y = 0.7559x – 1,512.6
2019	11	13.44
2020	12	14.24
2021	13	14.90
2022	14	15.81
2023	15	16.71

Source: Own calculation.

CONCLUSIONS

The average level of tourist arrivals in Botoșani County was about 38,192 thousand persons, with an absolute average increase of 2.12 thousand persons, respectively a relative increase of 5.9%.

The average level of overnight stays recorded 68,795 thousand persons, with an absolute average increase of 2.93 thousand persons, respectively a relative increase of only 4%.

The structure of tourist movement by tourist type shows that, in the period 2009-2018, the foreign tourists represented a share of only 6.44% in the total arrivals, respectively 8.56% in the total overnight stays at the county's level.

Under the conditions where all factors of influence on tourism activity will keep the same rate and the same trend during the next five years, also, then it might be forecasted that in the county, in the year 2023 will arrive about 62 thousand tourists who will record approximatively 106,4 thousand overnight stays.

In the interval 2009-2018, the average length of the foreign tourists' displayed significant variations, by the end of the considered period being accomplished an increase with only 7.07% compared to the year 2009. The highest increase compared to the base year has been recorded in the year 2014 (52.83%).

In the case of Romanian tourists, the average lenght of stay decreased permanently up to the year 2018, so that, by the end of the analysed period, the decrease of this indicator reached 12.44% compared to the year 2009.

Overall, the average length of stay recorded 1.81 days, with an absolute average decrease of 0.024 days, respectively a relative decrease of 2%.

If the factors of influcence on tourist activity will not change, it can be estimated that, at the level of the year 2023, the average length of stay will not undergo important alterations and will have the value of approximatively 2.6 days for the foreign tourists and of 1.7 days for the domestic tourists.

The average level of tourist density recorded a value of 9.34 tourists/100 inhabitants, with an absolute average increase of 0.66 tourists/100 inhabitants, respectively a relative growth of 7.8%. According to the same prediction algorithm, in the year 2023 the tourist density will be of approximatively 17 tourists/100 inhabitants, meaning 2.6 times more compared to the year 2009.

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STUDY ON THE TABLE GRAPES MARKET IN ROMANIA

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Abstract

The present study highlights aspects regarding the evolution of the table grape market in Romania, between 2014-2018. Table grapes are appreciated on the one hand, because of the pleasant taste, and on the other hand for the therapeutic value offered by them. At the national level the areas cultivated with vines specialized in table varieties are much smaller, compared to the areas cultivated with vines specialized in varieties for wine. In this study, a series of indicators were analyzed, such as: the total area occupied by vineyards in bearing; the surface of vineyards specialized in table varieties; total table grapes production; average prices for table grapes; consumption of table grapes; valoric imports and exports. The statistical data analyzed in the present study were provided mainly by the National Institute of Statistics.

Key words**:** *table grapes; total production of table grapes; market; Romania*

INTRODUCTION

Nowadays, the vine is cultivated on all continents.
The growth of grapes production and trade at the global level was sustained by the increased demand and changes in consumer's tastes, improvement of technologies in vine growing, transportation and storage, and grapes quality [6]. International trade with grapes requires a deep study of the main competitors' profile and performances and in the EU market the PAC regulations vine growing and grapes standard quality on the internal common market [5].
A very important aspect is the fact that, this crop makes good use of sandy lands, as well as other lands that are not suitable for agricultural crops [1]. Vine growing is an agricultural activity of high intensity and production efficiency [10]. Worldwide, grapes, as well as grape products are highly appreciated by the population. Due on the one hand, to the climatic differences, and on the other hand, to the intensification of international exchanges, the Romanian market is constantly supplied with grapes for human consumption. Several varieties of table grapes are sold on the Romanian market. In the regions of Romania, where we find areas occupied with vineyards specialized in table varieties, are cultivated mainly 10-12 varieties, although in the official catalog, for the varieties of culture in our country for the year 2019 are included 22 assortments of grapes [3]. Of these assortments we mention only a few that have a greater popularity among consumers: Auriu de Ștefănești; Chasselas roz; Coarnă neagră selecționată; Muscat de Hamburg; Afuz Ali, etc. Currently, the main objective of the producers of table grapes and respectively wine is to cultivate the most popular varieties and with the highest quality. It is necessary to remember that the quality conditions of the table grapes, and respectively for wine are different also on the world map [8]. Romania does not stand out at the European Union level for the production of table grapes, but according to the published data, in 2014, it ranked 6th in the production of grapes for wine [10].

MATERIALS AND METHODS

In order to carry out the current study, were analyzed and consulted, on the one hand, the data taken from the National Institute of

Statistics and on the other hand a series of specialized materials. The period analyzed in this study is 2014-2018. In order to capture the evolution of the table grapes market, the indicators related to this market were analyzed.

Of the most representative indicators we mention: the surface of the vineyards in bearing; the total area of the vineyards specialized in table varieties; table grapes production; average prices recorded for table grapes; consumption of table grapes; valoric imports and exports for the category "Grapes, fresh or dried". In this study the data is presented in dynamics and has been graphically illustrated.

RESULTS AND DISCUSSIONS

According to the statistical data regarding the surface of the vineyards in Romania, in the period 2014-2018, a change is observed (Fig. 1). The largest area occupied by vineyards at national level during the period under review was 178,151 ha (2016). In opposition, the smallest area cultivated with vines in bearing was registered in 2014 (176,675 ha). In 2018, in Romania the area with vines in bearing increased by 4.38% compared to the year 2014. There was a decrease of 0.40% of the areas with vines in bearing in 2018, compared to 2016, when there was a maximum level of vineyards in bearing for the analyzed period.

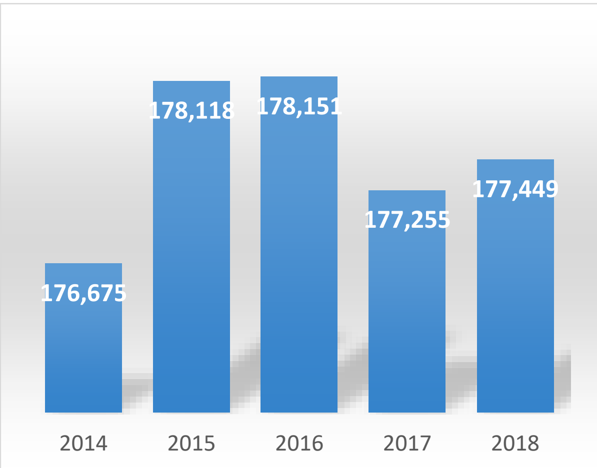

Fig. 1. Evolution of surface for the vineyards in bearing in Romania, between 2014-2018 (ha)
Source: own processing [9].

Regarding the area of specialized vineyards in table varieties for the analysed period, it was found that they varied from year to year (Fig. 2).The smallest area with specialized vineyards in table varieties was in 2018 (6,335 ha), and the largest in 2014 (7,183 ha). At the national level, in 2018, the area of specialized vineyards in table varieties reduced by 11.81%, compared to 2014. This aspect shows that, the Romanian wine growers were less oriented towards growing table grapes and more oriented towards the vineyards specialized in wine varieties.

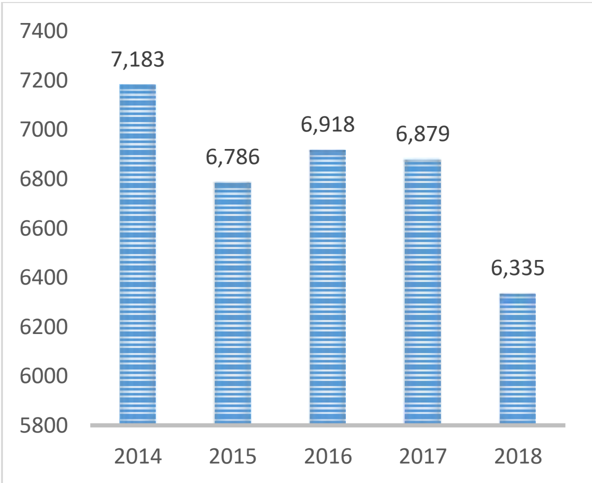

Fig. 2. Evolution of the specialized vineyards in table varieties, between 2014-2018 (ha)
Source: own processing [9].

Over 50% of the area of vineyards specialized in table varieties from Romania is occupied with the Chasselas Dore variety. This is a mixed variety that can be used for both table consumption and wine [7].

The cultivation of this variety reduces the risks of the producers, especially when the domestic market is selling large quantities of grapes from other countries.

The table grapes production made at national level has been noticed through modifications from one period to another. The statistical data showed that in 2014 there was a minimum for the production of table grapes, of 35,959 tonnes and a maximum of 71,405 tonnes (2018) (Fig. 3).

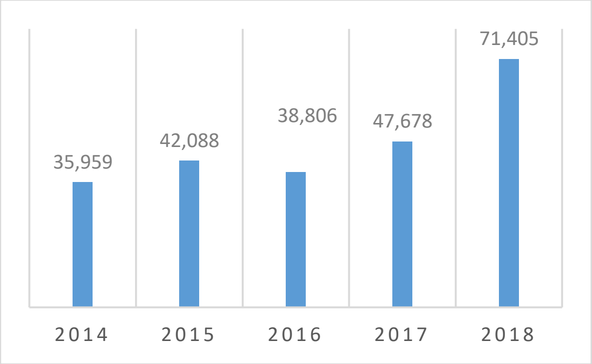

Fig.3. Evolution of table grapes production at national level, in the period 2014-2018 (tonnes)
Source: own processing [9].

The table grapes production in 2018 increased substantially, by 98.57%, compared to 2014. According to the specialists in the field, the year 2018 represented a very good year, in which substantial grape production was obtained. This year is considered a reference year [4].
The average annual consumption of grapes per inhabitant in Romania, during the analysed period was different (Fig. 4). The lowest average annual consumption per inhabitant was reached in 2014 (6.2 kg/ inhabitant). In 2015, we saw an increase of 11.29%, reaching 6.9 kg / inhabitant. In 2016, the average annual consumption of grapes per inhabitant did not exceed the threshold of 6.9 kg/inhabitant. In 2017, consumption increased to 7.9 kg / inhabitant. The consumption in 2017 increased by 14.49% compared to 2015 and 2016. In 2017, the average annual consumption per inhabitant of grapes increased by 27.41%, compared to 2014. The increase of the average annual consumption of grapes per inhabitant was due to several factors, of which we mention: the increase of the population's income and the awareness of the population that the consumption of grapes contributes directly to the health of the organism, due to their properties [2].
Between 2014 and 2018, average prices for table grapes nationwide fluctuated (Fig. 5). The highest average price for table grapes at the national level was registered in 2017 (4.56 lei / kg), and the lowest average price was in 2018 (3.7 lei / kg).

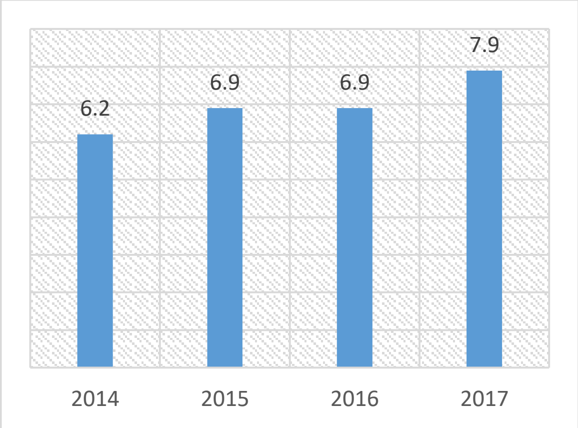

Fig. 4. Dynamics of the average annual consumption of grapes in Romania, between 2014-2017 (kg/ inhabitant)
Source: own processing [9].

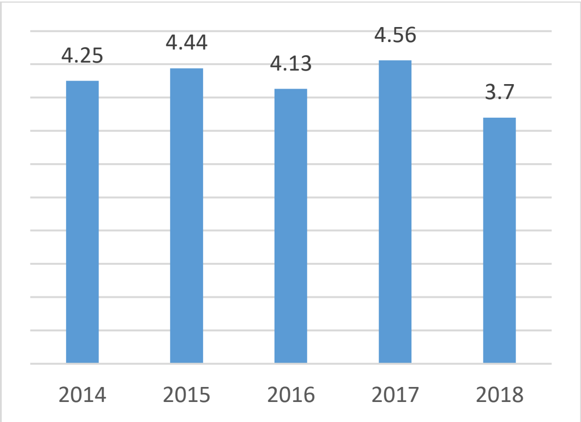

Fig. 5. Dynamics of the average price for table grapes in Romania, between 2014-2018 (lei/ kg)
Source: own processing [9].

The value of imports for the category “Grapes, fresh or dried” in the period 2014-2018, registered changes (Fig. 6).
According to the analysis of the statistical data, the most significant value imports were registered in 2017 (48,376 thousand euros), and the smallest ones were registered in 2014 (18,430 thousand euros). In 2017, the value of exports for the category "Grapes, fresh or dried" registered a significant increase, with 162.48%, compared to 2014.
In 2018, the value of imports increased by 153.78%, compared to 2014. Also, in 2018, it was noted that the value of imports for the category "Grapes, fresh or dried" registered a decrease of 3.32%, compared to the year 2017.
The value of exports for the category "Grapes, fresh or dried" related to Romania during the

period under analysis has changed from one period to another (Fig. 7).

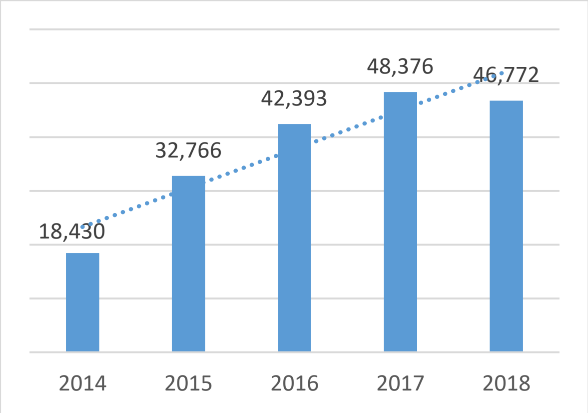

Fig. 6. The imports of value for the category „Grapes, fresh or dried" of Romania in the period 2014-2018 (thousands of euros)
Source: own processing [9].

In 2016, the value of exports reached the maximum value of 920 thousand euros, and the minimum value was registered in 2015 (300 thousand euros).

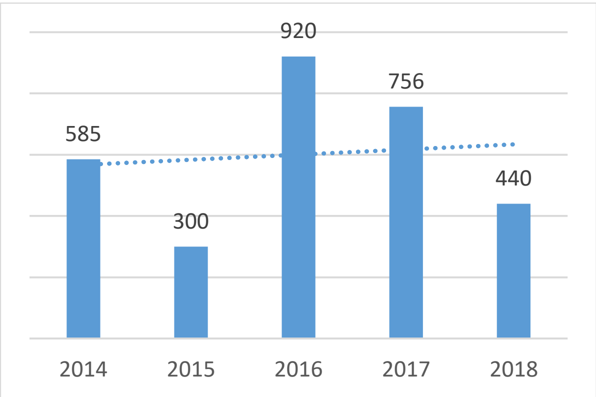

Fig.7. Value of exports for the category „Grapes, fresh or dried" in Romania during 2014-2018 (thousands of euros)
Source: own processing [9].

In 2018, the value exports for the category "Grapes, fresh or dried" decreased by 24.79%, compared to 2014.
From the data presented and analysed in terms of import and export value, it can be seen that the import value for the category "Grapes, fresh or dried" is significantly higher than the value of exports. This aspect shows that Romania is a country that imports significant quantities of grapes in fresh or dried state. This situation can represent an opportunity for the producers in the field, in order to increase the area of vineyards specialized in table varieties.

CONCLUSIONS

According to the analysis of the main indicators specific to the table grapes market in Romania for the period 2014-2018, the following aspects are obtained:
-The area occupied with vines in bearing registered a maximum point in 2016 (178,151 ha);
-The most significant area with specialized vineyards in table varieties was of 7.183 ha (2014);
-The highest table grapes production was recorded in 2018 (71,405 tons);
-In 2014, the lowest annual average consumption per inhabitant was registered, respectively 6.2 kg / inhabitant;
-In 2017, the highest average price for table grapes was registered, of 4.56 lei / kg;
-The value of the imports related to the category "Grapes, fresh or dried" reached a maximum point in 2017 (48,376 thousand euros);
-The value of exports is much lower compared to the value of imports for the category "Grapes, fresh or dried". In 2016, the highest value of exports was realized, of only 920 thousand euros;
-For the category "Grapes, fresh or dried" Romania has a negative balance;
-The Romanian producers grow mixed varieties, which gives them the possibility to reduce the risks.
In the medium and long term, a greater increase in the consumption of table grapes is expected, which may boost the domestic producers in order to increase the areas occupied by vineyards specialized in table varieties.

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THE IMPACT OF CLIMATE CHANGES ON THE VILLAGES NEAR COMANA PROTECTED AREA, GIURGIU COUNTY, ROMANIA

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Abstract

The main atmospheric climate parameters are important for the daily and seasonal variation of the parameters of the Comana Puddle aquariums. The anomalous variation of temperatures, precipitation and evaporation induces a fluctuation in the volume of water from the pond and the river Neajlov. Atmospheric temperature and precipitation directly affect winter phenomena and breakdown processes during the summer period, with significant effects on the agriculture, the most vulnerable domain on climate changes. In the hilly or hill area, the amount of rainfall decreases, thus influencing the water intake in these aquariums. The high warming time of the heat season leads to an increase in evaporation values, so that a water deficit is recorded in the hillside, hillside and plain areas, which also entails a loss in the volume of water in the lagoons. These seasonal fluctuations directly affect the limbic or aquatic fauna, but also the agriculture. In the cold season winter phenomena (ice bridge, ice on the shore, slopes, snowballs) and blocking water as snow, creates a deficiency in the water supply of lakes, ponds, puddles and swamps. This paper analysed the impact of climatic changes but also the possibilities of the recovery a part of the gloss of water, a gloss that existed years ago and which was greatly diminished after the work done downstream changed the hydrological balance of the area. This effect adds to the fact that climate change has made it possible for the volume of evaporation to be increased and sometimes to exceed the volume of precipitation.

Key words**:** *climate changes, floods, draughts, wet area*

INTRODUCTION

Experts' forecasts for the average air temperature increase of only 3^{0}C by 2070 show that more than 30% of the Giurgiu County's territory will be affected by desertification and ca. 38% of increased aridity. Geographical location of Giurgiu County in the South of Romania makes this threat to be one of great impact for socio-economic development and quality of life in the county. The main types of risks identified in the Giurgiu County are: storms and blizzards, floods, heavy snowfalls, tornadoes, drought, extreme temperatures, forest fires, landslides, earthquakes of land, accidents, damage, explosions and fires in industry, water pollution, collapse of buildings, installations or facilities, public utilities failure, falling objects and the space atmosphere, remaining unexploded ordnance during military conflicts, epidemics, epizootic diseases/zoonotic risk radiologic - induced by ionizing radiation, fire [5].

The absolute maximum temperatures are 39.0°C in Greaca and 42.4°C in Giurgiu, values which highlights the phenomena of dryness and deep drought. The average annual air temperature is 11ºC. The coldest month is January with average values below -2ºC. The warmest month is July, when average temperature is over 23ºC.

According to STAS 6054/84, the depth of freezing in the area is 70-80 cm. In winter, due to arctic cold air invasions, the absolute minimum temperatures are - 32ºC in Greaca and -30.2ºC in Giurgiu [4].

In terms of global solar radiation, it has annual values of 127.5 kcal/cm^2 of the horizontal surface. The sunshine duration has average annual values of over 2,250 hours of sunshine and the relative humidity of the air is approx. 76%.

Due to the particularities relatively uniform plains, days with different thermal characteristics do not tolerate too much changes in its extent: approx. 30 days of winter, 90 -110 days with frost (are possible from middle of September to late May), 115-120 days of summer, etc., the most numerous being in the field, where the winter - summer thermal contrast is bigger.

MATERIALS AND METHODS

In this paper, time series have been used with regard to the evolution of meteorological parameters.

Analysis of mean annual temperature in the Giurgiu County in the year 2013 shows an increase of 1.1^{0}C, higher than normal standard climatological (1961-1990).

The same change was seen in the years 2014, 2015 and 2017 when the annual average temperature in the county (10.2ºC) was higher than normal climatological 1.3ºC standard (1961-1990).

In April 2015 Giurgiu County joined freezing conditions, with negative deviations from the annual average of 10°C. In the same year, in July, was recorded in Giurgiu County the peak of the heat wave was 41ºC. In 2017, the annual average annual temperature (9.9^{0}C) was 0.7^{0}C higher than normal climatological (1981-2010).

Temperature fluctuations during the day are key factors conditioning for the maintenance of habitats and species dynamics/stocks of Comana Puddle. Water temperature is a major factor that contributing to selection of species of fish, most fish species present in the Comana Puddle is euriterme that supports the wide variations in water temperature.

Thus, the low water level and the exposure to direct solar radiation, associated with the low water flow, causes a strong heating during the summer, between 2 pm and 6 pm, when maximum water temperature values of 24-26^{0}C are recorded.

The high temperature of the water allows the penetration of the sunlight and the heating of the water in depth, so that the entire volume of water has approximately the same temperature.

In the villages of Călugăreni, Comana and Mihai Bravu the annual temperature was not monitored so for analysis was taking into account the values recorded in Giurgiu.

Atmospheric precipitations have annual average values of 500-575mm: 530mm in Greaca and 575mm in Giurgiu.

Precipitation is spread throughout the year, with some accents in early summer (average rainfall of June reaching 76 mm). The decrease in precipitation volume is recorded early in autumn and in winter (especially in February).

The maximum rainfall in the 24 hours has reached or even exceeded 90 mm. Such values were recorded in Greaca (99.4 mm) and Giurgiu (96.6mm).

The number of days with snow is an average of 50 days; the average thickness of a decade is 8-15 cm, and the absolute maximum of more than 120 cm.

In non-periodic climate variations were recorded particularly rainy years the annual amounts were recorded almost double.

In 2014, the annual quantity to the national average precipitation (67.3 mm) was higher by 26.6% than the normal climatological standard (1961-1990). The year 2014 will remain in history as one of the rainiest years for the south part of the country since 1961 until present. Decreasing the amount of precipitation in February 2014, compared to normal climatological (1961-1990), and calculated as a percentage, was negative. Negative deviations of more than 85% were recorded in the Southern half of the Giurgiu County, with the highest values being 99%. In Giurgiu there were exceedances of the absolute maximum precipitations in 24 hours (58.4 mm in November 2014) [2].

In 2015, in Giurgiu County the water quantities in July had values of 58 mm and 61 mm in September.

Hydrological regime affects fish populations by frequency, intensity and duration of floods. The highest flows of the river are recorded during the spring period, being caused mainly

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by the sudden melting of the snow in the river Neajlov river basin and by the rainfall that falls more frequently during this period. The increase in river flow and the flooding of important floodplain areas overlap with the reproduction period of fish species. Adult fish use submerged vegetation, roots and stems of emerging plant species as underwater supports for their pontoons.

The annual average relative air humidity is 72%. Concerning the lowest value, that is recorded in July (61%); the highest value characterise December (80%). During the growing season the relative humidity is 64%.

The dominant wind is the east and the west with the highest annual average frequency Danube corridor (21.3% and 23.2% east west).

Table 1. The main types of risks identified in Călugăreni, Comana and Mihai Bravu villages

Village	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Călugăreni									
Călugăreni	x	x	x	x	x	x	x	x	x
Brăniștari	x	x	x	x	x	x	x		
Crucea de Piatră	x	x	x	x	x	x	x		x
Hulubești	x	x	x	x	x		x		
Uzunu	x	X	x	x	x		x		x
Comana									
Comana	x	X	x	x	x	x	x		x
Budeni	x	X	x	x	x		x		
Falaștoaca	x	X	x	x	x	x	x		
Grădiștea	x	X	x	x	x		x		x
Vlad Țepeș	x		x	x	x	x	x		x
Mihai Bravu									
Mihai Bravu	x	X	x	x	x	x	x		x
Village	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Călugăreni									
Călugăreni	x	X	x	x	x	x	x	x	x
Brăniștari	x	X			x	x	x	x	x
Crucea de Piatră	x	X			x	x	x	x	x
Hulubești	x	X			x	x	x	x	x
Uzunu	x	X			x	x	x	x	x
Comana									
Comana	x	X	x	x	x	x	x	x	x
Budeni	x	X		x	x	x	x	x	x
Falaștoaca	x	X		x	x	x	x	x	x
Grădiștea	x	X		x	x	x	x	x	x
Vlad Țepeș	x	X		x	x	x	x	x	x
Mihai Bravu									
Mihai Bravu	x	X		x	x	x	x	x	x

Legend: 1 - storms and blizzard; 2 – flooding; 3 - heavy snow, drought; 4-5 - extreme temperature; 6 - forest fires; 7 – earthquake; 8- accidents, damage, explosions and fires industry; 9- accidents, damage, explosion or fire in storage and transport activities dangerous products; 10 - accidents, damage, explosion and fire in transportation activities, pollution of waters; 11, 12 - collapse of the building, installation or arrangement; 13 - the failure of public utilities; 14 - falling objects in the atmosphere or space; 15- unexploded ammunition; 16 – epidemics; 17- epizooties;18 – fires.

Source: Data from the Territorial Risk Scheme in the Giurgiu County, 2018, I.S.U. Giurgiu.

Overall, however, the wind is more common in the field (where calm is 17- 35%) than in the Danube corridor, where calm is 34-38%. Speeds annual average values 2.7-3,7m / s in the Danube corridor and around. 2.9-3.3m / s in the field.

The correlation between temperature and precipitation revealed the presence of only phenomena in the dry plain. The peculiarities of the active surface structure require local changes of the climatic parameters, allowing the individualization of several natural and anthropic topoclimate.

The effects of the extreme weather events have affected Giurgiu County through the significant economic losses suffered in agriculture, water management, energy supply and transport.

Since the last century, in the south of Romania there has been a significant increase in the temperature, accompanied by a sharp decrease in precipitation. Expected weather for the period 2061-2090 growth trends of the same average temperature during the summer months and reducing the annual precipitation in the summer months.

RESULTS AND DISCUSSIONS

In Giurgiu County most villages are at the risk of flooding.

In 2013, strong winds and torrential rains from 30 September to 1 of October caused important damages in Giurgiu County.

After ecological restoration of Comana Puddle, the number of recorded floods decreased considerably in Comana Commune by 85.71% compared to the reference year 2013 and in the village Mihai Bravu there were no interventions to remove the effects of floods [3].

Table 2. Flooding registered products during 2013-2018

Location	2013	2014	2015	2016	2017	2018
Călugăreni	3	4	11	3	1	26
Comana	7	3	1	2	4	1
Mihai Bravu	1	-	-	-	-	-

Source: Inspectorate for Emergency Situations "Vlasca" of Giurgiu County.

As with floods, the severity of droughts in the last decade has increased, so that situations with a probability of 1% (once in a hundred years) occur at intervals of only a few years.

For example, the drought of 2003, when the flow of the Danube was so low that it reached a new record, was followed by catastrophic floods in 2005.

At the level of Giurgiu County, the drought is a dramatic problem and it manifests, especially, in the southern part of the county. The driest years, recorded in the period 2006 – 2014, were: 2007, 2008, 2009, 2012, 2013 and 2014.

In Giurgiu County, landslides are caused by triggers earthquakes and periods of prolonged and/or intense rainfall. Another important problem is deforestation, that may increase the likelihood of landslides. Therefore, the frequency of landslides may increase as a result of climate change and changes in precipitation associated with them, patterns of flow of water and vegetation.

Giurgiu County is located in terms of landslides in the area A, with flat land with perfect stability, in general the land are not affected by landslides.

The highest probability of occurrence of landslides exists in Izvoru, in the vicinity of localities Vieru, Ghizdaru, Daia, Băneasa, Pietrele and Puieni, on the right side of Câlniştei river (tributary right Glavacioc), in the locality Naipu, on the right side Glavacioc, in the south of the Bila commune, in Tangâru locality, on the right side of Neajlov between localities Călugăreni and Radovanu.

Wildfires are extreme natural events that can be triggered by natural causes such as lightning or human activity, whether deliberate or not.

The probability of wild fires is influenced by climatic variability of several periods of time. For example, the inter-annual variability of relatively moist climate and determines the period during relatively dry.

In wet periods, there is an accumulation of vegetation, which provides fuel for fires in dry periods. The projected increase in seasonal variation in rainfall could lead to an intensification of favourable conditions for wildfires.

The frequency of these fires in Giurgiu County increased lately. The damage caused by wildfires can be substantial, especially from the economic point of view.

In villages Comana, Călugăreni and Mihai Bravu there were wild fires, according to data provided by the Inspectorate for Emergency Situations of Giurgiu County, as follows: in 2017, 1 fire vegetation in common Mihai Bravu and 1 fire vegetation village Brăniştari (6 ha of dry vegetation and underbrush outlet).

Concerning the agriculture activities, the total land area in Giurgiu County and in the three communes analysed remained the same in 2011-2014.

Table 3. Total land area 2011-2014 (ha)

Localization	2011	2012	2013	2014
Giurgiu County	352,602	352,602	352,602	352,602
Călugăreni	11,937	11,937	11,937	11,937
Comana	10,335	10,335	10,335	10,335
Mihai Bravu	6,654	6,654	6,654	6,654

Source: www.insse.ro.

In Călugăreni Commune of the total area of 11,937 hectares, 79.87% are agricultural lands, 70.73% are arable lands, 7.43% are pastures, 1.71% are alive, 20.13% are non-agricultural land, 6.44% are forests and forest vegetation, 4.43% is occupied by water and ponds, 4.99% is occupied with construction. 2.44% is occupied by railways and communications, 1.81% are degraded and unproductive land.

Table 4. Land area in Călugăreni, 2014

Călugăreni, 2014		
Mode of use:	Total area (ha)	Percentage of total joint (%)
Agricultural	9,534	79.87
Arable	8,443	70.73
Pasture	887	7.43
Hayfields	-	-
Wine vineyards and tree nurseries	204	1.71
Orchards and nurseries	-	-
Total non-agricultural land	2,403	20.13
Forest and other forest vegetation	769	6.44
Busy waters, pools	529	4.43
Busy construction	596	4.99
Means of communication and railways	292	2.44
Degraded and unproductive lands	217	1.82

Source: www.insse.ro.

In the commune of Comana, from the total area of 10,335 hectares, 47.75% is the agricultural land, 43.49% are arable land, 3.11% pastures, 1.13% are vineyards and viticulture nurseries, 52, 25% are non-agricultural lands, 34.99% are forests and forest vegetation, 9.70% of the area is occupied by water, ponds, 4.45% are occupied with constructions, 2.87% are roads and railways, 0.22% are degraded and non-productive land.

Table 5. Land area in Comana, 2014

Comana, 2014		
Mode of use:	Total area (ha)	Percentage of total joint (%)
Agricultural	4,935	47.75
Arable	4,495	43.49
Pasture	322	3.12
Hayfields	-	-
Wine vineyards and tree nurseries	117	1.13
Orchards and nurseries	1	0.009
Total non-agricultural land	5,400	52.25
Forest and other forest vegetation	3,617	34.99
Busy waters, pools	1,003	9.70
Busy construction	460	4.45
Means of communication and railways	297	2.87
Degraded and unproductive lands	23	0.22

Source: www.insse.ro.

In the Mihai Bravu commune, of the total area of 6,654 hectares, 50.19% is the agricultural area and 30.73% is the arable land. Wine vineyards and nurseries occupy an area of 1% of the total land, 49.80% are non-agricultural land, 38.83% are forests and other forest vegetation, 5.77% is a surface occupied by waters and ponds, 3.27% is occupied with construction, communications and railways hold 1.90%, and degraded and non-productive land occupy 0.01%.

Table 6. Land area in Mihai Bravu, 2014

Mihai Bravu, 2014		
Mode of use	Total area (ha)	Percentage of total joint (%)
Agricultural	3,340	50.26
Arable	2,045	30.73
Pasture	1,228	11.46
Hayfields	-	-
Wine vineyards and tree nurseries	67	1
Orchards and nurseries	-	-
Forest and other forest vegetation	3,314	49.80
Păduri și altă vegetație forestieră	2,584	38.83
Busy waters, pools	384	5.77
Busy construction	218	3.28
Means of communication and railways	127	1.91
Degraded and unproductive lands	1	0.01

Source: www.insse.ro.

CONCLUSIONS

Climate change impacts on biodiversity and ecosystems and often exacerbates other pressures such as pollution, over-exploitation, invasive species, fragmentation, degradation and deterioration of habitats [6].

Ecosystems play an important role in regulating climate. At the same time, climate changes affect more and more natural systems. The continuous decline of biodiversity and degradation of ecosystems reduce their ability to provide essential services. By actions for conserving nature and restoring ecosystems it is possible to reduce their vulnerability and increase the level of resistance [7].

Peatlands, wetlands, soil, and forests play a crucial role in absorbing and storing carbon, thus helping local communities to protect themselves against climate changes [8].

Wetland plants and soils play an important role in the purification of water, removing high levels of nitrogen and phosphorus, and in some cases even toxic chemicals. This role is important in preventing eutrophication process, which leads to a rapid increase in algae, which means that sometimes the surface is completely covered by plants, is completely covered by the plants, so that the mass of water decreases much light and therefore photosynthesis, which is why it is no longer can produce enough oxygen, although demand is increasing by multiplying organisms. This can lead to fish death and other unwanted phenomena. The protected area of Comana has significant potential for reducing future emissions of greenhouse gases through maintaining healthy ecosystems and restoring degraded environments by restoring peatlands and wetlands, by reforestation and reducing other pressures on nature. In addition, semi-natural and managed ecosystems, including those used for agriculture, offer many opportunities for active carbon sequestration and reduction of emissions. The wetlands tend to slow down the force of the water, encouraging storage that will reach the sediment water. Nutrients are often associated with sediments and can be stored at the same time. These nutrients, especially nitrogen and phosphorus derived from agricultural sources, but also downloads the industrial accumulate into the ground and can be converted by chemical and biological processes or may be made by vegetation wetland can then be removed effectively from system. These areas act as purification systems for drinking water, protecting land from floods and are considered the most productive ecosystems in the world, their structure and functions are determined mainly hydrology of the area. This type of ecosystem is about ten times more productive than usual ecosystems because, in addition to supplying solar energy they receive additional energy intake represented by entries in areas that are in permanent contact, water and land. Thus, water movement is crucial to ensure their productivity. The excess of organic matter (biomass) can be stored or can be exported to the surrounding ecosystems.

The wetlands contribute to the recharge of groundwater which stores about 97% of fresh water unfrozen a third party.

Wetlands often fulfil a crucial role in preventing floods. By storing water in the soil surface or by stopping it in lakes or marshes, wetlands reduce the need for expensive construction.

Decreases power wetlands rain, preventing downstream flooding producing, storing or retaining water in the soil on the surface of a lake, so that wetlands advantageously replaced by artificial structures constructed at great expense. They allow the recharging underground aquifers are of vital importance to humans, their only source of drinking water or water for irrigation, slow down the passage of water, nutrient, and sediment deposition favouring the flowing water conveyed.

These areas plays a double role in terms of climate change and management of greenhouse gas emissions (carbon dioxide) and buffering the impact of climate change, by plants and soil purifies water, removing high concentrations of nitrogen and phosphorus in the some cases of chemical compounds being able to remove the highly toxic biodegradable.

During the period 2013-2017, in the communities of Comana, Călugăreni and Mihai Bravu, the effects of climate change have stagnated compared to the reference year 2013, but also to previous years.

A positive aspect of the ecological reconstruction of Comana Puddle is the decreasing the number of floods. After the ecological reconstruction of Comana Puddle, the number of recorded floods decreased considerably in Comana commune by 85.71% compared to the reference year 2013 and in Mihai Bravu there were no interventions for removing the effects of the floods.

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METHODOLOGICAL FEATURES OF CALCULATION OF THE LEASE VALUE OF AGRICULTURAL LANDS

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Abstract

We have proposed to use the inverse matrix method when calculating the value of the lease right of an agricultural land plot in the context of a methodological approach based on comparing the sale prices of such rights at land auctions for similar land plots. The reflection its use for the determination of rental rights when comparing their sales prices at land auctions using the system of linear algebraic equations provides the application of the quantitative and qualitative analyses to measure differences between comparison elements. The proposed method allows taking into account the qualitative characteristics of the objects of comparison, such as the land plot shape or the presence of restrictions and burdens on its use.

Key words: *value of the lease right, expert evaluation, regulatory evaluation, inverse matrix method, land plot*

INTRODUCTION

The moratorium on the agricultural lands sale in Ukraine has created the conditions for the market principles implementation due to the lease of land, which is calculated on the basis of the normative monetary valuation – capitalized rental income, determined by established and approved standards [8]. According to the calculation algorithm proposed in it, the value of lands has decreased. This fact has had a negative effect on the lease relations.

Leading scientists, in particular, O. Hutorov [5], A. Martyn [6], M. Stupen [10; 11], A. Tretyak [12] and others made a significant contribution to the development of theoretical and methodological foundations of regulatory monetary valuation of agricultural lands. An analysis of their research indicates that there are gaps in regulatory evaluation methods. One should mention the authors investigating the use of mathematical modeling methods in estimating the value of land plots, mainly Yu. Dekhtiarenko, Yu. Mantsevych, Yu. Palekha [2], O. Drapikovskyi [3], I. Ivanova [4].

We have a task of calculating the value of agricultural land plot using expert evaluation with mathematical modeling, comparing it with the value determined in accordance with the regulatory monetary valuation methodology to select the most practical and reliable valuation method.

MATERIALS AND METHODS

In the research one has used the inverse matrix method to calculate the value of the leasehold right using expert judgment [7], which is based on the comparison of prices for the sale of such rights for similar land lots at land auctions.

The method of sales prices comparison allows using the mathematical apparatus of matrix algebra.

To apply this method, the comparison objects (a_{i1}, a_{i2}, …, a_{im}) must be as similar as possible to the object of evaluation ((a_{01}, a_{02}, …, a_{0m}).

To represent the basic information as a state matrix A, its first line must correspond to the elements of the comparison of the object of evaluation, and the following ones – to the objects which have been selected for comparison:

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$$\begin{pmatrix} à_{01} & à_{02} & \dots & à_{0m} \\ a_{11} & a_{12} & \dots & a_{1m} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nm} \end{pmatrix} = A$$

The ΔA comparison matrix has the form n × m and shows the difference between the object and the comparison analogues as $\Delta a=a_{0j}-a_{ij}$, where i=1, n; j=1, m.

$$\begin{pmatrix} \Delta à_{11} & \Delta à_{12} & \dots & \Delta à_{1m} \\ \Delta a_{21} & \Delta a_{22} & \dots & \Delta a_{2m} \\ \dots & \dots & \dots & \dots \\ \Delta a_{n1} & \Delta à_{n2} & \dots & \Delta à_{nm} \end{pmatrix} = \Delta A$$

The difference between a comparison object and evaluation not only has a natural value, but also a value that reflects ΔV_{ij} - a monetary adjustment for the difference between the ith comparison object and the evaluation object by the jth comparison element:

$$\begin{pmatrix} \Delta V_{11} & \Delta V_{12} & \dots & \Delta V_{1m} \\ \Delta V_{21} & \Delta V_{22} & \dots & \Delta V_{2m} \\ \dots & \dots & \dots & \dots \\ \Delta V_{n1} & \Delta V_{n2} & \dots & \Delta V_{nm} \end{pmatrix} = \Delta A$$

Since the monetary amendment ΔV_{ij} reflects the difference in the jt^{h} element of comparison between the object of evaluation and the ith object of comparison in natural Δa_{ij} indicators, it will look like:

$$\Delta V_{ij}=(a_{0j}-a_{ij})\times V_j=\Delta a_{ij}\, V_j$$

where:
a_{ij} is the natural indicator of the jth element of comparison for the ith object of comparison;
a_{0j} - the natural indicator of the jth element of comparison for the ith object of evaluation;
Vj is the value of the jth element of comparison, according to which the matrix of comparison ΔA will be:

$$\begin{pmatrix} \Delta a11V_1 & \Delta a12V_2 & \dots & \Delta a1mV_m \\ \Delta a21V_1 & \Delta a22V_2 & \dots & \Delta a2mV_m \\ \dots & \dots & \dots & \dots \\ \Delta an1V_1 & \Delta an2V_2 & \dots & \Delta anmV_m \end{pmatrix} = \Delta A$$

where:
$\Delta a_{ij}V_j$ – the product a single indicator of the characteristic of the jth element of comparison by the difference in the values of that indicator between the ith object of comparison and the object of evaluation.
The size of the $\Delta a_{ij}V_j$ amendments adjusts the sale price for each object to minimize the difference in the jth element of comparison with the evaluation object, taking into account differences in their characteristics according to the formula:

$$\Delta V^a_i=P_i+\sum_{j=1}^{m}\Delta\, a_{ij}\ V_j$$

where:
V^a_i is the adjusted sales price;
P_i is the sales price;
$\Delta a_{ij}V_j$ – sales price amendment.

RESULTS AND DISCUSSIONS

Previous studies have based their criteria for selection on the methodological approach of comparing sales prices (market approach to evaluation) [9] as the most objective concerning the end result is the methodological approach of comparing sales prices (market approach to valuation), because it is based not on the appraiser’s subjective assumptions, but objective information. A methodical approach of comparison of sales prices (market approach to valuation) is the most objective one concerning the end result, since it is based not on the subjective assumptions of the appraiser, but on information about the sale of land leases of agricultural land plots of state ownership of land auctions (8 % of regulatory monetary valuation) [1]. We have collected information on the sale value of the right to lease at land auctions to apply the methodological approach of comparing selling prices, as the most reliable method, which causes the comparison of the estimation object with analogues by the selected elements of comparison in Table 1.

She below illustrates source data on the sale of the lease on land auctions and the characteristics of such objects by comparison elements, which has been collected in order to determine the lease rate for agricultural land plots of 1 ha for object of evaluation.

It can be seen from the source data that object of the evaluation of lease right and comparison objects have a similar location. The implementation of the offer objects is not compulsory, the exposure time limit has not been revealed, since the information on all the comparison objects is reliable and proposed as of 2019. Closer inspection of the table shows the object of evaluation and the comparison objects have the same functional use – agricultural purpose for maintenance of commodity agricultural production. The selected land plots are free of development but have different characteristics in terms of land form, existence of restrictions or burdens on its use and the term of the lease agreement.

Table 1. Source data for the value calculation of the lease right of the valuation object, 2019.

Location of object of evaluation (comparison)	**Lease payment, UAH/ha/year**	**Comparison objects**				
		size, ha	**location (distance from Lviv (Ukraine), km)**	**physical characteristics (land plot shape)**	**existence of restrictions or burdens on its use**	**the term of the lease agreement**
Object of evaluation (the village of Nadychi, Zhovkva district, Lviv region (Ukraine)		6.0	19	Regular	no	10
Object of comparison 1	2,078	4.5	17	Irregular	yes	7
Object of comparison 2	6,948	11.0	22	Regular	no	7
Object of comparison 3	8,377	19.54	39	Irregular	no	10
Object of comparison 4	2,244	6.0	35	Regular	yes	7
Object of comparison 5	3,780	17.2	32	Irregular	no	7

Source: it is done by the author on the basis of data [1].

A methodical approach to comparing the sale prices of the right to lease in land auctions with the help of the matrix apparatus of construction of a system of linear algebraic equations involves the use of both quantitative and qualitative analysis for measuring the differences between the elements of comparison.

Explicitly, a crucial element in the methodological approach of price comparison is to outline the elements of comparison and the magnitude of the amendments [4]. When assessing the value of the right to lease, we formalize the qualitative features, marking the regular form of the land as 1, and the irregular one – 0, and existence of restrictions or burdens on its use: if there are not ones – 1, if there are ones – 0. Thus, we present the source data for the value determination of the lease right of the valuation object as matrix A, where the first line corresponds to the comparison elements for the valuation object, and the following lines – to the analogues selected for comparison:

$$\begin{bmatrix} 6.0 & 19 & 1 & 1 & 10 \\ 4.5 & 17 & 0 & 0 & 7 \\ 11.0 & 22 & 1 & 1 & 7 \\ 19.54 & 39 & 0 & 1 & 10 \\ 6.0 & 35 & 1 & 0 & 7 \\ 17.2 & 32 & 0 & 1 & 7 \end{bmatrix} := A$$

We subtract the corresponding elements of all subsequent lines from the value of the first line of the matrix in order to reflect the differences between each comparison object and the evaluation object. Consequently, we get a comparison matrix:

$$\begin{bmatrix} 1.5 & 2 & 1 & 1 & 3 \\ -5 & -3 & 0 & 0 & 3 \\ -13.54 & -20 & 1 & 0 & 0 \\ 0 & -16 & 0 & 1 & 3 \\ -11.2 & -13 & 1 & 0 & 3 \end{bmatrix}$$

Next, we do the calculation matrix:

$$\begin{bmatrix} -1.5 & -2 & -1 & -1 & -3 \\ 5 & 3 & 0 & 0 & -3 \\ 13.54 & 20 & -1 & 0 & 0 \\ 0 & 16 & 0 & -1 & -3 \\ 11.2 & 13 & -1 & 0 & -3 \end{bmatrix}$$

Then we construct a coefficient matrix for the variables ΔA. According to it, in matrix form $\Delta A \times V = P$, where V is a vector of variables, P is a vector of free terms.

$$\begin{bmatrix} -1.5 & -2 & -1 & -1 & -3 \\ 5 & 3 & 0 & 0 & -3 \\ 13.54 & 20 & -1 & 0 & 0 \\ 0 & 16 & 0 & -1 & -3 \\ 11.2 & 13 & -1 & 0 & -3 \end{bmatrix} := \Delta A, \quad \begin{bmatrix} 2{,}078 \\ 6{,}948 \\ 8{,}377 \\ 2{,}244 \\ 3{,}780 \end{bmatrix} := \Delta P$$

We calculate the matrix inverted to the matrix ΔA using the methods of matrix algebra with the help of MS Excel functions, which greatly simplifies the procedure of their calculation:

$$\begin{bmatrix} 0.0778 & 0.2957 & 0.2179 & -0.0778 & -0.2957 \\ -0.0571 & -0.1170 & -0.0599 & 0.0571 & 0.1170 \\ -0.0887 & 1.6629 & 0.7516 & 0.0887 & -1.6629 \\ -1.1315 & -1.9997 & -1.8682 & 0.1315 & 2.9997 \\ 0.0726 & 0.0424 & 0.3032 & -0.0726 & -0.3758 \end{bmatrix} := \Delta A^{-1}$$

We can find the solution $V = \Delta A^{-1} \times P$, where ΔA^{-1} – is a matrix inverted to the matrix ΔA.

$$\begin{bmatrix} 2{,}749 \\ -863 \\ 1{,}1578 \\ -20{,}260 \\ 1{,}402 \end{bmatrix} := V$$

Thus, having solved the inverse matrix system, we calculated the value of the lease right for the evaluation object in the villag of Nadychi of Zhovkva district of Lviv region (Ukraine), amounting to 2,749 UAH per 1 hectare per year in 2,019 (99 euros), or 10.7 % of the average normative monetary evaluation of arable lands in Zhovkva district as of September 01, 2019 (25,637 UAH or 923 euros).

CONCLUSIONS

Based on the obtained results, it is advisable to calculate the rent as to our proposed algorithm of calculation. So, the provided method allows you to quickly obtain a result due to the analysis and processing of information on the starting amount of the annual fee for the land plot use for sale at land auctions, and to form a justified conclusion about the market value of the lease right. The reason for this is that the current practice of determining the rent in the amount of 3-12 % of the regulatory monetary valuation in Ukraine does not reflect its fair value and is lower in terms of market relations.

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THE POTENTIAL OF MANNOPROTEIN EXTRACTED FROM *CANDIDA APICOLA* CELL WALL AS EMULSIFICATION AGENT

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Abstract

Yeast has enormous potential as a biological agent in producing protein, one of that is Candida apicola. The cell wall of yeast Candida apicola generally contains 90% mannoprotein. Mannoprotein is bond between manna with protein. Mannoprotein can be used as an emulsifier at some food products and also has antimicrobial character. This research is aim to obtain the growth curve and to know the emulsification activity, and also the level of produced protein. This research was begun by creating the growth curve, and the parameter used to know the growth curve of yeast cell Candida apicola was optical density (OD), pH and dry biomass. The optimum incubation time was generated at 70th hour marked by the highest absorbance value as much as 1.9044 A, at pH 4.6, and the amount of biomass 0.0177 g/mL. Then, it was followed by measuring the emulsification activity and protein. The emulsification activity, which was generated, was 42% with the protein level of 1.6850 mg/ml.

Key words**:** *Candida apicola, emulsifier, mannoprotein, yeast*

INTRODUCTION

Indonesia has abundant biodiversity, including microorganism, animal, and plant. The microorganism is the most used resource because it has enormous potential in producing protein. Various advantages of microorganism include having a short life cycle, fast growth, high productivity, and facilitate us to do manipulation genetic or manipulation in the fermentation process.
Yeast has the capability of producing protein and its product, including amino acid and peptide [1]. One of the yeast types *Saccharomyces cerevisiae* produces some protein that has an antimicrobial character such as organic acid and protein1. Protein is generated as many as 0.023 U/mg, Optimum pH 5, Optimum temperature 25°C, and the molecule weight 97.4 kD [2]. That organic acid produced from yeast can be used as the food preservative. Besides the biocomponent based on protein, a research report that there is the dissolved mannoprotein in water (hydrophilic) and extracted from the cell wall of yeast *Saccharomyces cerevisiae*. Its molecular weight is as many as 76kDa with the composition of mannoprotein carbohydrate as much as 58% and protein 42% (Dikit et al., 2010). Mannoprotein produced can be used as an emulsifier at various food product while *Candida* has a capability in secreting protease extraceluler [3]The utilization of protease enzyme is to reduce protein fog in the last process of making beer and wine.
Mannoprotein is an important part of yeast cell wall. It is a bond between mannan and protein forming glycoprotein called mannoprotein. Besides carbohydrate, there are also protein (6-25%) and fat (1-7%). Manna generally consists of D-mannose and some components such as D-glucose/D-galactose/D-xylose and phosphate, which bind with protein [9].
Commercialization of local yeast isolate from non-*saccharomyces* strain has not many been explored. Currently, only *Saccharomyces cerevisiae* is considered in the context of application on the industry because *Saccharomyces cerevisiae* has clearer information starting from cell composition and also this species has provided as a yeast industry. Then, the local species of Indonesia

yeast can be a better source in the industry, with the condition that is acceptable and safe in the context of health.

Candida apicola is a type of *ascomycetes* yeast, which has a high osmotolerant and is naturally found in the fermentation of wine [14]. In the prior research, this yeast can be found in a traditional product like shrimp paste. The research about cell wall of *Candida apicola* has not specifically been done yet. Based on other studies, *Candida* cell walls generally contain 90% mannoproteins, which mainly are mannose located in the outermost layer functioning as a structural component. Based on another research, the cell wall of *Candida* generally contains 90% mannoprotein, which comprises of mannose (hydrophilic) and protein (hydrophobic). Candida has potential in its utilization as an emulsifier by extracting mannoprotein contained in the cell. Protein serves as a stabilizer of emulsion oil in the water while mannose is a hydrophilic polymer that can create the amplified structure of mannoprotein [10].

The produced emulsifier is the surface activity that can decrease surface pressure between air and liquid or liquid and liquid, which is there in the emulsion system. To obtain mannoprotein, which can be used as an emulsifier, is created the growth curve that is information about the life phase of yeast including adaptation phase, exponential phase, stationer phase, and death phase. The growth curve is used to know the velocity of yeast cell growth and the environmental impact on yeast growth. The parameter used includes the value of Optical Density (OD), pH, and biomass. The measurement of biomass in yeast is to know the amount of mannoprotein. The growth can be declared as an increase of cell mass. pH can affect a cell growth so that it is needed optimum pH for its growth. Biomass production will increase along with an increase of incubation time. Based on that explanation, the author has the desire to study and to conduct research in analyzing the origin of cell wall *Candida apicola* as emulsifier agent.

MATERIALS AND METHODS

Research Material

This research used several tools such as Petri dish, phalcon tube, beaker glass, Erlenmeyer tube, Schott bottle, micropipette (1,000µL), incubator, spectrophotometer, cuvett, pH meter, analytical scales, centrifuge, autoclave, aluminum foil, plastic wrap, laminar, 2 ml and 1 Eppendorf, 5 ml, pan, stirring rod, oven and parafilm, magnetic stirrer, dropper pipette, centrifuge.

The material, which was used in this research, was the yeast culture of *Candida apicola*, which isolated from shrimp paste by Faculty of Agricultural Industrial, Universitas Padjadjaran. The material, which was used in this research, was the yeast culture of *Candida apicola*, which isolated from shrimp paste by Faculty of Agricultural Industrial, Universitas Padjadjaran. Media used in this research was Yeast Mould Agar (YMA), which was used as growth media, Malt Extract Broth (MEB), which was used as production media, methylated, ammonium sulfate (NH4) 2SO4), phosphate buffer, alkaline EDTA (Na2CO2 10 g/ L, EDTA 1 mmol/ L), benzoic acid, 0.1 M HCl, acetate buffer 0.05 M pH 5, Comasie Briliiant Blue (CBB) G-250, standard solution of BSA (Bovine Serum Albumin), Bradford reagent.

Propagation of *Candida apicola* isolate

Isolate of *Candida apicola* obtained in yeast mold agar (YMA) was taken 2-3 ose, and then, it was moved in Malt Extract Broth (MEB), which had been filled in the test tube as much as 5 ml. After that, the test tube containing isolates was closed and wrapped by plastic wrap to avoid contamination, and then it was stored in an incubator on temperature 25 for 48 hours [13].

The Growth of *Candida apicola*

The testing a growth curve of *Candida apicola* was carried out to see the optimization of growing time from isolates. The planting time was used from 0 hours to 75 hours with the time interval of 5 hours for each isolate. Isolate of *Candida apicola*, which has been planted in Malt Extract Brotch (MEB), was take as much as 50 µl (1%) then stored into 5 ml media MEB according to the planting time (from 0 hours to 75 hours). After incubation in media, then it was carried out checking of the resulted optical density (OD), pH, and Biomass.

Mannoprotein Extraction

Yeast cell of *Candida apicola* in the form of centrifuged deposits was previously weighed and added potassium citrate 0.1 M 20 gram/ 100 ml then entered to autoclave at 121^{oC} for 2 hours. The results of autoclaved yeast cell were centrifuged on 6,000 rpm for 15 minutes at 4C, and then it was conducted the separating process of supernatant and deposit on yeast *Candida apicola*. The obtained supernatant was added cold ethanol and stored on 4°C until the precipitation process completed for 12-16 hours. After the precipitation process had completed, it was carried out again centrifugation process at 6,000 rpm for 1 minute at 4c, and then it was followed by washing with ethanol 2 times [11].

Measurement of Emulsification Activity

Measurement of emulsifier activity was determined by taking inserted liquid isolate in microtube, which had been carried out mannoprotein extraction and oil substrate within the same amount from each sample. Those two ingredients were inserted into microtube and stirred by using vortex at high speed for 2 minutes. Stabilization of emulsion was calculated on 1st and 2nd hours by calculating EA.

Determination of Protein Level

Determination of protein level was begun by determining the wavelength of standard solution BSA. Determination of maximum wavelength of standard solution BSA was done by making BSA solution 2.00 mg/mL and reacted by Bradford reagent then measured its absorption by using spectrophotometer UV-Vis at a range of wavelength 595

RESULTS AND DISCUSSIONS

The Growth of *Candida apicola*

The growth curve (Fig. 1) gives a description that in the yeast life cycle has 4 phases that is adaptation phase, exponential phase, stationer phase, and death phase [4]. Based on the growth curve can be determined the right incubation time by *Candida apicola* in producing mannoprotein.

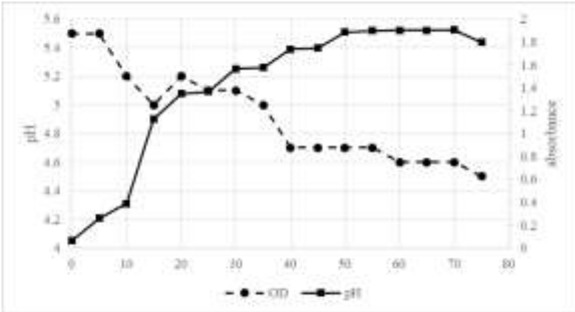

Fig. 1. The growth curve based on the value of OD and pH
Source: Own results.

The growth phase of *Candida apicola* shows that the adaptation time of *Candida apicola* has a relatively short time that grows in 0-10 hours. In the 10th-20th hours occurs exponential phase, marked by significant growth in the growth of the cells. In the exponential phase, the cell begins to divide and enters into the most active period of cell reproduction, and its regeneration time is constant. According to [12] in the stationary phase, the growth rate is slow so that the amount of yeast, which lives and dies, is a balance, and its population is stable. Meanwhile, the death phase happens in the 70th -75th hours in forming a new cell. The reason for the growth yeast stops in this phase because cell happens lack of nutrients. The optimum incubation time in this research is obtained at 70th hours, marked by the highest absorbance value 0.90440 A.

The rate acidity or pH are one of the important factors, which affect the growth of microorganism in media because every microorganism has a range optimum pH on its environment. The measurement of pH directly uses pH meter. The average of pH in this research can be shown in figure 1. In this research pH in the initial media is not regulated. The resulted pH begins from 0 to 75th hours ranging between 5 to 4. Based on the pH curve, the growth of *Candida apicola* yeast shows the decreased value (Figure 1). The longer the incubation time, the lower the generated pH. This can be seen in the 75th hours in which pH attains 4.5 (acid). This condition is caused by the presence of acids such as lactic acid, acetate, and pyruvate. The rate of acidity will affect the increase of biomass. pH 4 corresponds to [8], which declares that yeast generally can growth in the range of pH 4-6. pH in the *Candida s*p can grow optimally on 4, but it can also grow at pH 3-7. Roostita et al [1] have stated that *Saccharomyces cerevisiae* needs optimum pH in producing some protein, which as an antimicrobial compound. While according to [5] mannoprotein, which is generated from *Saccharomyces cerevisiae* and *Kluyveromyces marxianus*, is stable at pH 3-11. This indicates optimum pH, resulted by *Candida apicola*, is not significantly different from its prior research in producing protein.

The biomass production of yeast cell *Candida apicola* in MEB scale 800 ml. The biomass calculated is the dry biomass weight (g/ml). The result of biomass production can be shown in Fig. 2.

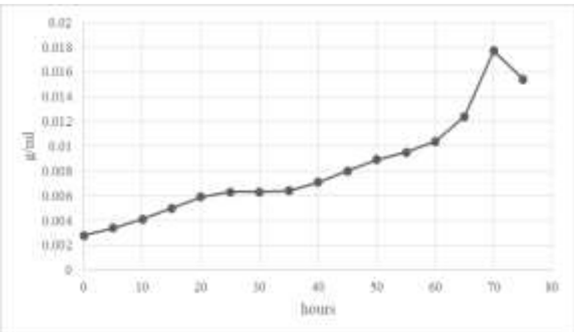

Fig. 2. The growth curve of *Candida apicola* based on dry biomass (g/ml)
Source: Own results.

Biomass production of *Candida apicola* yeast in media MEB as much as 0.10085 g/ml, attained at 5th hours incubation time. At 70th hours, yeast isolate of *Candida apicola* generates the highest biomass as much as 0.104900 g/ml. Moreover, to know the biomass production of *Candida apicola* yeast, the determination of biomass can also be used to know yeast growth. The growth has been defined as the increase of cell mass[15]. The growth of yeast is observed every 5 hours until 75 hours. This is due to the slower growth of yeast compared to bacterial growth. Besides that, the time used generally has a range between 72 hours to 96 hours [7]. Based on the observation result of yeast growth, the optimum incubation time to produce crude extract of mannoprotein is at 70th hours, marked by the highest absorption value as much as 1.9166 A in pH 4-6 with the amount of dry biomass as much as 0.0177 g/mL.

Mannoprotein is an important part of the yeast cell wall [6]. Its protein has bound with a sugar molecule, especially mannose residue ranging from 50-90% (Pablo et al.2018). Mannoprotein can be extracted from yeast wall by adding potassium citrate and sterilized by using an autoclave (121°C) for 60 minutes at 4°C [12]. *Candida apicola* cell can be extracted as much as 500 ml, obtained from 70th hours at pH 4. *Candida apicola* yeast can be isolated form shrimp paste. The result of mannoprotein extraction from *Candida apicola* is obtained 3.0086 g/mL.

Emulsification Activity and Protein Level of *Candida apicola* Mannoprotein

The emulsifier is a surface activity, which can decrease surface pressure between air and liquid or liquid and liquid in one emulsion. Emulsion serves to stop a separation between droplet oil and water so that it reduces the strength of repulsion among a different phase on the surface, and it makes both of phase can blend easily. The crude extract of mannoprotein from Candida apicola is tested its emulsifier activity and protein level. Table 1 shows data regarding the value of emulsifier activity and protein level.

Mannoprotein can be used as an emulsifier, caused by its composition consisting of hydrophilic mannose and protein, which can emulsify hydrophobic oil in water. In the prior research, *Saccharomyces cerevisiae* cell well has the dissolved mannoprotein where this mannoprotein can be used as bio emulsifier on some food products.

Table 1. The level protein of *Candida apicola* extract (mg/ml) and emulsification activity

Fraction	Protein (mg/mL)	Emulsification Activity (%)
Crude Extract	1.685	42

Source: Own results.

Table 1 showed that *Candida apicola* generates a protein level of 1.685 mg/mL with the emulsifier activity 42%. The usage of mannoprotein as a bio emulsifier has been done by Dikit et al in 2010 in which it is obtained from *Saccharomyces cerevisiae* in salad dressing by adding some other emulsifiers such as Arab gum and lecithin. The addition 0.6% of mannoprotein generates an emulsion activity 41% so that the usage of mannoprotein commercially in food can allow. The emulsifier in mannoprotein has a non-toxic character and can be used in the food industry [3]. Bioemulsifier character in mannoprotein can be used in food processing and beverage because it can stabilize the coexistence of different phases in a product. The resulted protein is effective as oil stabilization in water. In a wine product, the consumer usually refuses to the wine bottle, which contains a crystal deposit, so it can reduce the commercial value of that wine. The usage of mannoprotein extract from *Saccharomyces cerevisiae* greatly contributes to the chemical stability of wine by preventing crystallization of tartrate salt and protein fog.

CONCLUSIONS

The growth curve is created to determine the right incubation time for producing mannoprotein. The optimum value of OD (Optical Density) is obtained in 70^{th} hours, marked by the high absorption value 1.90440 A, pH 4.6 , with the amount of dry biomass 0.01770 g/mL. The crude extract of mannoprotein *Candida apicola* has emulsification activity 42 % and its protein level 1.6850 mg/mL.

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STUDY REGARDING PECULIARITIES OF INTRODUCING AND DEVELOPING EFFECTIVE DIGITAL TECHNOLOGIES IN THE AGRI-FOOD SECTOR

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Abstract

The constantly increasing world population, climate change, water depletion and soil degradation challenges the agriculture of the 21st century. Despite the fact that people practice farming for millennia, classical production methods are becoming less effective in the current conditions of growing demand. Thereby digital and communication technologies are designed to assist farmers to turn agriculture into high-tech industry. The introduction of Unmanned Aerial Vehicles is one of the most progressive and perspective trends in the agricultural sector. In addition to improving of efficiency, productivity and rationalization of the production processes, the technology is expected to bring a wide share of jobs opportunities. Drones are used for monitoring of the fields which may contribute to digitalization of agriculture. The high-quality of data collection and processing, engage the further development of the aircrafts, allowing them to become more multitasking in the future.

Key words**:** *innovation, communication technologies, digitalization of agriculture Romania*

INTRODUCTION

Agriculture is one of the most perspective areas for the use of Unmanned Aerial Vehicles (UAVs). Despite the fact that the technology is not a new one, it is becoming more popular and available for the agrarian sector since last decade.

The significant progress of adopting of the drones in agriculture was caused by several factors, particularly miniaturization of the aircraft, battery capacity enlargement, significant improvement in the quality of data collection and remote communications.

According to the report provided by The UN Department of Economic and Social Affairs, published in 2019, world population will increase to 9.8 billion people by 2050 [13]. To avoid the world food crisis, the current production volume should be doubled.

Taking into account fast-increasing population, the decline of arable land, environmental and climate changes, food security will be of key importance, while provisioning the masses would demand innovation for agricultural technologies and the vast introduction of the Unmanned Aerial Vehicles.

MATERIALS AND METHODS

In this work, a systematic analysis is carried out to justify and identify priority mechanisms of impact on modern agriculture. The authors identified promising areas of digitalization of the agri-food complex based on the systematization of theoretical and analytical sources, which was carried out in conjunction with the processing of statistical information on agriculture using special methods. Obstacles have been identified in the digitalization process in agriculture, where the secrecy of some aerial photography data, the lack of clear rules for the use of unmanned aerial vehicles, the difficulties in obtaining state subsidies for the introduction of precision farming technologies still hinder.

RESULTS AND DISCUSSIONS

Growing demand for agricultural products created a strong necessity in rationalization of the agricultural methods.

In the same time, climate changes also affect the agriculture, making it harder to grow crops. With order to satisfy world growing demand for food, there should be a strong collaboration between garment, technology innovations, and industry.

Today the trends in agriculture underline the five main areas. Precision Farming and Automation play a key role in the industry development, affecting agricultural practices through 2030, leaving behind labor shortage, consolidation and professionalism issues [7].

The latest report of European Commission Digital Transformation Monitor states that the global drone sales value reached USD $8.5 billion in 2016 and is anticipated to overcome USD $12 billion by 2021 [9].

The digital transformation of farming should provide new jobs, improve professionalism, rationalize management.

Today Precision agriculture using Unmanned Aerial Vehicles, GPS or GNSS allows farmers to minimize the impact of negative factors, to reduce the risks, to maximize the productivity, efficiency and profitability. PwC predicts the market of UAVs powered solutions in agriculture industry at $32.4 billion [10].

The Unmanned Aerial Vehicles are equipped with highly sensitive detectors and high-precision cameras, which allows farmers to control the fields from a bird's eye view and identify the factors what is impossible to see with the naked eye. Drones are used for monitoring of the fields, providing more complete information about geological conditions [2].

Having collected the data using drone and special highly sensitive infrared sensors, specialists can determine the presence of stress in the plants, the seeding uniformity, the exact calculation of the usable area with regard to uncultivated areas, the exact contours of the fields, as well as predict and evaluate the yield and product quality.

Monitoring the field by drones allows to identify stress of plants, which can be caused by various reasons: diseases, pests lack of fertilizers and other nutrients, lack of moisture mechanical damage, etc.

In the last century, it was noticed that plants that feel comfortable and plants that are under stress absorb and reflect light differently. In the 1980s, this feature was transformed by NASA into aerial imaging technology and image analysis. Even then, the principle itself worked correctly. The lush tropical forests "gleamed" with one color, the steppes with their modest vegetation - with another, almost lifeless deserts - with the third. However, the level of technology at the that time was not perfect, and the error is quite significant [1].

Now the situation is different. Modern equipment allows you to very accurately collect data from the surveyed agricultural area and determine the so-called NDVI (*Normalized Difference Vegetation Index*).

The **NDVI** index is calculated by the formula:

$$NDVI = \frac{NIR - RED}{NIR + RED};$$

where:

NIR is the reflection in the near infrared region of the spectrum,

-***RED*** is the reflection in the red region of the spectrum.

The basis of this indicator is the concept that the leaves absorb and reflect light in different ranges, and the ratio of reflected and absorbed waves differ depending on the health of the plant and the total amount of green mass [1].

The drone operates in automatic mode, the operator sets only the boundaries of the field and the route of its flight. The captured data is transferred to a computer and analyzed by a special program. At the output of the system, we get a NDVI geo-profile - a map with marked areas: green - the plants feel good, yellow - the plants are under stress, red - the vegetation is dead or not at all.

Previously Satellite imagery was the most advanced tool of crop controlling. Unfortunately, this technology had a number of disadvantages:

-Satellite imagery is very expensive;

-It requires more time as the order must be made in advance;

-Bad weather worsens image quality

Now the UAVs is becoming one the main instrument for 3-D mapping, recognition of soil composition, identification of the most suitable crop for the particular lands.

The pictures and maps can be also used as evidence for insurance agencies for getting compensation in case of loss of a crop. Specific approach helps to predict the problems before they become visible and take action on their regulation.

Unmanned Aerial technologies are wildly used for irrigation. It is widely known that the agriculture is the biggest water consumer, it takes 70% total world stock of freshwater [3]. The aircrafts help to provide the right amounts to the needy plots. That is why the issue of efficient use of water resources must be addressed by Unmanned Aerial Vehicles [5]. This allows avoiding wasteful field application techniques.

This technology also has a very high potential for planting as Michal Mazur, the Head of Drone Powered Solutions states: ”*Startups have created drone-planting systems that achieve an uptake rate of 75 percent and decrease planting costs by 85 percent. These systems shoot pods with seeds and plant nutrients into the soil, providing the plant all the nutrients necessary to sustain life*” [8].

According to Gerard Sylvester, Regional Knowledge and Information Management Officer of FAO, “In the current milieu, use of sustainable information and communication technology in agriculture is not an option. It is a necessity” [11].

Jenkins & Vasigh predict that Unmanned Aerial technologies around 100,000 jobs $80 billion. in economic growth by 2025 [6].

As for Moldova, Agriculture is the basis of the state economy. Despite the high fertility soils, the yields and agricultural production is constantly influenced by natural disasters such as drought, hail, frost, severe storms. These factors multiply existing processes of land degradation and erosion and unstable market conditions.

Some of these issues can be addressed to drones. Unpressurized watering system, big water losses, these issues could be avoided by aircrafts. The system is highly automated. It is able to recognize the part of the field what is dry and needs intervention. This option could be a perfect solution for the arid regions of the country.

Despite all the advantages of the Unmanned Aerial Vehicles, currently only large farms have the possibility and willingness to purchase this technology, especially in Moldova [12]. According to statistics, most farmers of the Republic of Moldova are small-scale, they represent 97.7%, with farm sizes between 0.85 and 10 hectares [14].

Since the professional equipment and analytical program is expensive, entrepreneurs are forced to seek agency consulting services.

In 2018, a local company Fenix-Agro SRL, specializing in the supply of fertilizers and agrochemical products to Moldova, launched a new project - comprehensive consulting in the field of nutrition and plant protection based on monitoring and diagnostics of its customers' fields using Unmanned Aerial Vehicles [1]. The company covers more than 20 regions of Moldova.

The project was started in April 2018, nevertheless, more than 2.5 thousand hectares of farmland have been covered by close “air observation”.

Fig.1. Unmanned Aerial Vehicles in Moldova
Source: http://www.fenix-agro.md, Accessed on Oct. 5, 2019.

On average, Fenix-Agro drones are capable of circling around 400 hectares of land in one working day. Usually, the commercial price of the service is about 1 euro/ha [4].

Due to the relatively low price, the service is becoming popular among local producers.

It should be emphasized the importance of use of the professional equipment. Today it can be found a wide share of analogues on the market. Experts warn that no amateur apparatus gives the same result as a specialized drone. Unfortunately, due to the high cost of professional equipment, some farmers are trying to use cameras and drones which are not intended for industrial works. This affects the results greatly, making data gathering and processing more difficult. The information can be significantly distorted. This can have serious consequences, including loss of harvest. Moreover, due to the sharp increase in the number of drone-owners, the government has developed a number of laws and regulations for the aircrafts. In addition, all drones must be registered, the commercial use without the permission is forbidden and can be punished by a large fine. Nevertheless, the close cooperation of politicians and farmers, together with financial support from the government, beneficially effect the promotion of this innovation in Moldova.

CONCLUSIONS

The drones tend to resist the main challenges of the 21st century. The industry of Drones will be developing in the future, allowing agriculture to become more data driven. This will lead to the shift in productivity and efficiency of farming. The aircrafts have relatively low cost, they are easy to use, have a very high mobility and are very useful for crop monitoring. The regular analysis can reduce inefficiencies and improve agricultural management, transforming it into high tech industry. The introduction of artificial intelligence into UAVs should play a big role in automatization of agricultural processes. According to this fact, the priority must be given to the data collection quality and abilities rather than device specifications. Thus, developing institutions require more complex sensors and cameras. A further trend may be creation of hybrid aerial-ground drone, what is capable not only to collect data, but perform a share of tasks.

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ASSESSMENT OF THE EFFECTIVENNES OF LAND USE ACCORDING TO PUBLIC LAND INTERESTS AS A COMPONENT OF RURAL DEVELOPMENT

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Abstract

The authors investigate the effectiveness of land use management in Ukraine for public land interests. Since any relationship to land as a natural resource is a combination of personal, economic and environmental interests, so land interests that arise in society in the land use management system are considered according to social, economic and environmental interests. Assessment of the effectiveness of land use carried out by the authors, showed the presence of both positive and negative tendencies in the development of land use. In particular, positive changes have occurred according to social and economic land interests and negative ones concerning the ecologisation of land use. The proposed distribution of interest groups allows us to identify the potential of land distribution and transformations for effective land management and to implement the measures required for Ukraine, which will also enhance the country's social well-being in the context of sustainable development.

Key words**:** *public interest, land interests, land distribution, agricultural land, land use*

INTRODUCTION

One of the most important aspects of life-sustaining activity of our and any other country is land as a cumulative natural resource.

Multifunctional land use defines land management and land use as one of the main factors for the balanced development of rural and urban territories and the country as a whole, which should aim to ensure cost-effective and environmentally friendly land use to achieve public welfare. Analyzing the specificity of land as an aggregate natural resource, it should be noted that it is considered in the following main ways [9]:

-Land is the territory of the country, the main state-forming component (national security);

-Land is a universal spatial basis that is constantly supported by a certain correlation of land categories and land use types (spatial security);

-Land is the main means of production in agriculture and forestry (food security);

-Land is a major component of nature (environmental safety);

-Land is a stockpot of water, mineral, forest, recreational and other resources (economic security).

The basis of virtually any human relationship to land is the combination of personal and economic interests. This feature was also noted by A. Smith: «Every individual is continually exerting himself to find out the most advantageous employment for whatever capital he can command. It is his own advantage, indeed, and not that of the society which he has in view. He intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was not part of his intention by pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it» [5].

However, due to the sharp exacerbation of the environmental situation in the 21st century, such public interests that are at the forefront of the world community are particularly relevant, namely the effective management of land resources to ensure the implementation of environmentally stable land use as the main criterion for human survival, in particular agricultural land [1, 2, 4, 6, 7]. This does not mean that the interests of high-profit development of land and territorial resources have lost their importance. However, the development of land resources is increasingly subject to the objective need for greening land use, finding the most reasonable forms and methods of cost-effective use of land resources, in particular agricultural land to landowners and land users (in particular, shareholder-farmers and small farmers). As the process of splitting the land into parcels (shares) in Ukraine has led to the small contours of the land plots and their parcel placement, which makes it difficult to use them effectively in conditions of insufficient financial resources to make the necessary land improvements (including irrigation, drainage, buildings for storage and processing of products, etc.)

The relevance of the selected study is caused by the environmental, economic and social problems that exist in Ukraine regarding the adopted Sustainable Development Goals 2016-2030, in particular, the rational use of land-resource potential, in particular agricultural land.

MATERIALS AND METHODS

The official database of the survey was the official statistical materials and reports of the State Service of Ukraine for Surveying, Cartography and Cadastre.

The research uses common scientific methods, namely: monographic analysis - to study scientific domestic and foreign publications on the effective use of land resources and rational land use, in particular agricultural land; grouping - for grouping forms of ownership by social, economic, environmental interests by major land groups; comparative and statistical analysis - to investigate the state of land use for economic, environmental and social interests.

RESULTS AND DISCUSSIONS

Land is a public domain and cannot be used solely for the benefit of individuals. Therefore, there is an urgent need for the development of state and public institutions for the regulation (administration) of land use, with the aim of balancing different interests and solving a number of problems, such as the nature conservation on the land shares divided by farmers and villagers.

Each category of land declared by the Ukrainian legislation (Article 19 of the Land Code of Ukraine) has its own functional orientation on economic, environmental and social interests between landowners (citizens: farmers, villagers, etc. and legal entities: enterprises, organizations, institutions, etc.).

Therefore, land interests that arise in society can be divided into three groups [1, 2, 4, 6, 7]:

Social - regarding the satisfaction of physical, psychological, intellectual and other needs, both rural and urban;

Economical - regarding commodity and monetary parameters of land ownership;

Environmental - relating to the efficient development of the land resource and natural properties.

According to these groups the study was carried out to estimate the efficiency of land interests in the sphere of distribution and redistribution of land resources. Accordingly, in the process of land use development, the first group of public land interests *(social)* focuses on the size of property for different social groups and forms of land use. In accordance to the assessment of the trends of land use of Ukraine for social interests in the period 2000–2016, no significant changes in this area occurred (Table 1). Thus, for the period under review, the total area of land use by citizens increased by 676.9 thousand hectares and legal entities by 983.5 thousand hectares, respectively of agricultural land by 618.6 thousand hectares and by 661.2 thousand hectares, which is positive tendency in terms of their land provision. However, the average size of land parcel owners (shares) in Ukraine is 4 hectares. Such a small scale, parcel layout and non-optimal configuration require land management measures to improve the economic efficiency of their use.

Table 1. Assessment of Ukrainian land use trends according to social interests

Ownership	Number of land owners and land users	Total area of land, ha	Agricultural land, ha	Forests and other wooded areas, ha	Land under buildings, ha	Water, ha	Other, ha
2000							
Citizens	22,356,958	5,180.3	4,806.6	2.2	369.2	0.3	2.0
Legal entities	158,389	5,018.7	1,267.4	824.1	1,115.7	1,301.4	510.1
Total	*2,2515,347*	*10,199.0*	*6,074.0*	*826.3*	*1,484.9*	*1,301.7*	*512.1*
2016							
Citizens	22,376,584	5,857.2	5,425.2	2.9	424.8	0.2	4.1
Legal entities	182,014	6,002.2	1,928.6	933.8	1,128.5	1,472.2	539.1
Total	22,558,598	11,859.4	7,353.8	936.7	1,553.3	1,472.4	543.2
Changes for the period 2016 - 2000							
Citizens	19,626	676.9	618.6	0.7	55.6	-0.1	2.1
Legal entities	23,625	983.5	661.2	109.7	12.8	170.8	29
Total	*43,251*	*1,660.4*	*1,279.8*	*110.4*	*68.4*	*170.7*	*31.1*

Source: calculated by the authors on the basis of the operative data of the form No. 6-зем of the State Service of Ukraine for Geodesy, Cartography and Cadastre.

The economic group of public land interests in the field of distribution and redistribution of land and territorial fund is aimed at the structure of land ownership in composition, combination and proposals, which form its economic forms. At the same time, the interests of society are oriented not only to preserving under control of the state the necessary part of land for solving the general problems of development of land and territorial resources, but also to the fact that this vital factor is generally owned by those owners who are able to use the most wisely and useful land for all members of society. The interests of individual owners are aimed at preserving for each of them the rights of ownership, use and disposal of the land property, regardless of the efficiency of its operation. Therefore, contradictions about the actual use of land need to be resolved [1, 3]. An analysis of the data of this interest group shows that during 2000–2016 significant changes in the distribution of land by economic interests took place in Ukraine. Thus, the total land use area of citizens increased by 7,103 thousand hectares, mainly due to agricultural land (7,000.8 thousand hectares), which is positive for the development of small and medium-sized businesses (farmers, villagers). At the same time, the land area of legal entities was reduced by -1,824.9 thousand hectares due to the optimization and reorganization of land use. In particular, the decrease of agricultural land by -1,212.6 thousand hectares and lands of forest fund -657.9 thousand hectares (Table 2). Most of these lands were transferred to the use of citizens for peasant-based agricultural production and other entrepreneurship.

In the field of distribution and redistribution of land resources, the group of public land environmental interests focuses on the parameters of the functional and economic structure of the land fund, namely the extent, proportions and priorities of its distribution by the degree of economic development (developed, poorly developed and undeveloped), types and categories (hayfields, pastures, areas under construction, forests, shrubs, swamps, etc.), intensity of operation and anthropogenic effects.

Table 2. Assessment of Ukrainian land use trends according to economic interests

Ownership	Number of land owners and land users	Total area of land, ha	Agricultural land, ha	Forests and other wooded areas, ha	Land under buildings, ha	Water, ha	Other, ha
2000							
Citizens	752,436	2,321.6	2,308.4	1.2	2.6	9.1	0.3
Legal entities	122,352	39,031.6	34,648.7	1,922.8	908.1	512.6	1,039.4
Total	*874,788*	*41,353.2*	*36,957.1*	*1,924.0*	*910.7*	*521.7*	*1,039.7*
2016							
Citizens	2,532,217	9,424.6	9,309.2	2.9	23.9	79.7	8.9
Legal entities	141,457	37,206.7	33,436.1	1,264.9	933.8	614.8	957.1
Total	2,673,674	46,631.3	42,745.3	1,267.8	957.7	694.5	966.0
Changes for the period 2016 - 2000							
Citizens	1,779,781	7,103	7,000.8	1.7	21.3	70.6	8.6
Legal entities	19,105	-1,824.9	-1,212.6	-657.9	25.7	102.2	-82.3
Total	1,798,886	5,278.1	5,788.2	-656.2	47	172.8	-73.7

Source: calculated by the authors on the basis of the operative data of the form No. 6-зем of the State Service of Ukraine for Geodesy, Cartography and Cadastre

Public and individual interests, as a rule, are equally focused on maintaining the most effective environmental structure of the land fund formed in the process of land management. Significant changes in the distribution of land according to environmental interests in Ukraine during 2000-2016 have not occurred. Thus, the total area of land use of legal entities increased by 605.2 thousand hectares, mainly the increase of land due to the forest fund of 771.8 thousand hectares. Speaking about agricultural land, no significant changes occurred during the specified period, so in 2000 the area was 2.6 thousand hectares, and yet in 2016 - 2.3 thousand hectares (Table 3).

Table 3. Assessment of Ukrainian land use trends according to environmental interests

Ownership	Number of land owners and land users	Total area of land, ha	Agricultural land, ha	Forests and other wooded areas, ha	Land under buildings, ha	Water, ha	Other, ha
2000							
Citizens	35,528	3.3	2.6	0.0	0.7	0.0	0.0
Legal entities	5,313.0	9,668.6	899.2	7,657.9	62.4	607.9	441.2
Total	*40,841.0*	*9,671.9*	*901.8*	*7,657.9*	*63.1*	*607.9*	*441.2*
2016							
Citizens	46,043	4.2	2.3	0.0	1.9	0.0	0.0
Legal entities	10,473.0	10,273.8	937.1	8,429.7	63.9	338.2	504.9
Total	56,516.0	10,278.0	939.4	8,429.7	65.8	338.2	504.9
Changes for the period 2016 - 2000							
Citizens	10,515	0.9	-0.3	0	1.2	0	0
Legal entities	5,160	605.2	37.9	771.8	1.5	-269.7	63.7
Total	15,675	606.1	37.6	771.8	2.7	-269.7	63.7

Source: calculated by the authors on the basis of the operative data of the form No. 6-зем of the State Service of Ukraine for Geodesy, Cartography and Cadastre.

Such unsatisfactory condition of greening of land use in general and agricultural in particular, is explained by the non-implementation of measures for creation of ecological network of Ukraine (measures from the national program of formation of ecological network for 2000-2015 were fulfilled only by 14.5%).

Considering the changes and the fact that, according to our research [8], land use in Ukraine is considered to be permanently unstable (Kec.st. = 0.4), such an existing tendency is negative in relation to the management of lands of an environmental interest group.

While exposing the above aspects of public interest in the effective use of land resources, in the first case, they focus on social issues, such as reducing the proportion of the poor to meet the intellectual and other needs of people, both rural and urban.

In the second case, it is about sustainable, low-cost and high-productivity use of land resources, in particular agricultural land, the results of which are achieved due to the most complete compliance with public consumer demand, and costs tend to decrease due to the active implementation of scientific and technological advances to high-performance work. In addition, society is interested in the fact that high productivity of development and use of land combined with the maximum preservation and multiplication of its useful properties and qualities. Public interest in the effective use of land, in the third case concentrates around the maximum permissible anthropogenic load on the environment and land resources [1, 3].

CONCLUSIONS

In the process of implementing land reform measures in Ukraine, namely with the adoption of the new Land Code of Ukraine, which came into force in 2002, a land use system was formed, which basically corresponds to the new land structure of Ukraine, which focuses mainly on economic and social interests. Taking into account the conditions of Sustainable Development Goals 2016-2030 adapted for Ukraine, an important issue is the transformation of land policy towards a group of environmental and social interests and the improvement of the social well-being of rural and urban populations in the context of sustainable development. Assessing the effectiveness of land use management in the public interest allows us to understand that, at present, transformational changes in land allocation in Ukraine are incompletely effective in terms of sustainable development and require institutional transformations in line with European requirements. Since only with the unity of all three groups of social, economic and environmental interests can we achieve the social welfare of the rural and urban population and overcome threats of a particularly environmental nature. This determines the development of a state program for land management in rural areas.

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THE ROLE OF PHOSPHORUS IN MODERN AGRICULTURE OF THE CHERNOZEM STEPPE OF UKRAINE

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Abstract

The article analyzes the change in the content of mobile phosphorus in the arable and subarable horizons of southern chernozem with systematic fertilization in the conditions of the Chernozem Steppe of Ukraine. Thus, the efficiency of using phosphate fertilizers is closely related to the absorption of phosphorus by the soil. If the absorption capacity is full, the additional doses of phosphorus that are supplied remain mobile and are easily used by plants. However, the absorbed phosphorus, under certain conditions, is able to pass into the soil solution, to acquire mobility. The study showed that the absolute content of mobile phosphorus increases with increasing of phosphate fertilizers doses. Its highest content (8.8 mg/100 g) was observed with the mineral system of fertilizers - the average annual increase was 0.16 mg/100 g of soil. With the systematic use of phosphate fertilizers, the following dependence is observed: the higher the rate of their application, the higher the content of mobile compounds in the soil, the lower the payback of a unit of active substance by the harvest increase and vice versa.

Key words**:** *mobile phosphorus, southern chernozem, ordinary chernozem*

INTRODUCTION

In modern conditions, it is important to develop the most beneficial from both economic and environmental points of view, methods of preserving and improving the soil fertility. One of the most important measures to maintain fertility and increase crop yields is the rational use of mineral fertilizers. However, in the recent years, due to a number of objective and subjective reasons, significantly fewer fertilizers, especially phosphate fertilizers, are applied.

Thus, over the past 25 years, the amount of phosphorus applied per hectare of arable area has decreased from 40 kg of active substance to 3-4 kg, nitrogen from 60 kg to 5-15 kg and potassium from 35 kg to 1.2 kg of active substance (a.s.). And although since 2006, the use of mineral fertilizers has gradually increased: from 2006 to 2010 - from 27.2 kg a.s./ha to 42.6, and by 2018 the average annual application has increased to 72.4 kg a.s./ha, - they remain far from scientifically-based norms and ratios [8].

Despite the prevailing trend of increasing the total number of applied fertilizers, a large proportion of their total amount is nitrogen fertilizers and the ratio N : P : K ranges from 1 : 0.17 : 0.10 to 1 : 0.26: 0.20. Therefore, the availability of the soils in the Odessa region with mobile forms of phosphorus has decreased even over the past five years compared with the previous by 4.7% [3].

The relatively low content of phosphorus in the composition of the applied mineral fertilizers reduces the effectiveness of nitrogen ones, increases the cost of means of protection against diseases [12]. Plant demand for phosphate is especially high in early periods of growth, and even excess nutrition in subsequent phases cannot compensate for its deficiency, which leads to a decrease in protein content in grains, vegetables, fruits, and root crops - sugar content, in potato starch tubers [14, 21, 23]. In this regard, the problem of using phosphorus in modern agriculture is quite acute.

Soil phosphorus is known to belong to biogenic elements and its accumulation in the humus horizon is the result of a centuries-old process of its biological transfer from deeper soil layers. The gross content of phosphates in different soils varies in a wide range (0.1-0.3%). In the arable layer of the southern chernozems under study, it contains 0.09% and, under the conditions of a long-term stationary experiment, increases to 0.13%.

In most soil types, phosphorus is found in slightly soluble mineral and organic forms inaccessible to plants. Numerous studies have shown that the accumulation of mobile phosphates is determined by a number of factors: the type of soil and its properties, the doses of fertilizers and the duration of their interaction with the soil, the hydrothermal regime, etc. [4, 7, 10, 13, 15].

Given the weak mobility of phosphorus and its negative balance in the agriculture of the black earth (chernozem) zone of the southern Steppe of Ukraine, the problem of phosphorus nutrition of plants is very relevant.

Optimization of the phosphorus regime is a significant part of the general problem of developing optimal parameters of soil quality and the main condition for the formation of stable high yields. In this regard, the study of the processes accompanying the conversion of phosphorus in chernozem has important theoretical and practical importance.

The research purpose was to study the fertilizers effect on the phosphate state of chernozems depending on the doses, combinations and regularity of their use.

To achieve the purpose, the following tasks were set:

- Identify the effects and after-effects of the systematic application of fertilizers on the phosphate state of the southern chernozems;
- Study changes in the content of soil phosphates under optimal (various) hydrothermal conditions with the application of fertilizers depending on their doses and combinations.

MATERIALS AND METHODS

The studies were carried out on the basis of a long-term stationary experience of the department of soil science, agrochemistry and organic production of the Odessa State Agricultural Experimental Station (certificate of state registration, No.80) on the southern low humus clayey-loamy chernozem.

The experience was founded in 1972; soil samples were taken in 2017 from the arable and subarable layers on the plots, where fertilizers were applied for 45 years and on the areas of the after-effect of fertilizer systems (where fertilizers were not applied for 14 years). For the model experiment, samples of the ordinary chernozem were used. A sample of the soil sample was placed in a glass container and saturated with distilled water (control variant) or fertilizer solutions.

***In the I model experiment*,** the duration of the composting was 21 days, while creating the optimal moisture and temperature: t = 28^0C, humidity - 70% of the Field Water-holding Capacity (FWC). Phosphorus and potassium were introduced in the solution form of potassium phosphate monosubstituted, and nitrogen in the solution form of ammonium nitrate at the rate of 200 kg a.s. on the 1 ha. However, in our research area, a hot, dry summer with insufficient precipitation is characteristic, that is, soil moistening alternates with drying. To recreate these conditions, we put the second model experience.

The II model experiment - composting for 90 days with periodic wetting to a humidity of 70% of the FWC and drying to an air-dry state, t = 28^0C. Creating such conditions made it possible to trace changes in the phosphate regime of the soil in conditions close to the arid conditions of the southern steppe. Phosphorus and potassium were introduced in the form of a solution of mono-substituted potassium phosphate, and nitrogen — in the form of a solution of ammonium sulphate at the rate of 400 kg a.s. on the 1 ha.

The scheme of model experiments is presented in table 1.

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Table 1. Schemes of model experiments

No	Variant	Composition
The first model experience		
1/I	Control	150 g of soil + 50 ml H_2O
2/I	N = 16.33 mg/100 g of soil	150 g of soil + 50 ml solution (50 ml H_2O + 0,07 g NH_4NO_3)
3/I	N = 16.33 mg/100 g of soil P_2O_5 = 31.31 mg/100 g of soil K_2O = 20.77 mg/100 g of soil	150 g of soil + 50 ml solution (50 ml H_2O + 0,07 g NH_4NO_3 + 0,09 g KH_2PO_4
The second model experience		
1/II	Control	150 g of soil + 50 ml H_2O
2/II	N = 112.0 mg/100 g of soil SO_4 = 384.0 mg/100 g of soil	150 g of soil + 50 ml solution (50 ml H_2O + 0,375 g $(NH_4)_2SO_4$)
3/II	P_2O_5 = 109.6 mg/100 g of soil K_2O = 72.7 mg/100 g of soil	150 g of soil + 50 ml solution (50 ml H_2O + 0,15 g KH_2PO_4
4/II	N = 112.0 mg/100 g of soil SO_4 = 384.0 mg/100 g of soil P_2O_5 = 109.6 mg/100 g of soil K_2O = 72.7 mg/100 g of soil	150 g of soil + 50 ml solution (50 ml H_2O + 0,15 g KH_2PO_4 + 0,375 g $(NH_4)_2SO_4$

Source: The schematic of experimental data is taken from the authors [10, 13].

Determination of the mobile phosphorus content was carried out in an extract ammonium carbonate extraction solution, pH = 9.0, according to Machighin method [1].

RESULTS AND DISCUSSIONS

Based on a number of experiments, it has been established that the systematic use of fertilizers on all types of soil increases the total phosphorus content in the arable layer, the reserves of its accessible compounds and the availability for cultivated plants [11, 20, 22]. According to the results of the research on the background of mineral fertilizer application in the 45th year, the total phosphorus content significantly increases (after 6 field crop rotation) and even in the 14th year of the after-effect of the fertilizers applied during the previous period, the total phosphorus content in the ploughed layer exceeds the control variant (Table 2).

Consider changes in the content of mobile phosphorus in the southern chernozem with systematic long-term fertilization - 45 years (Table 3) and after the termination of their application (Table 4).

The study of the phosphate state of southern chernozems made it possible to ascertain the results of its changes over time.

Table 2. The total P_2O_5 content in the chernozem in long-term field experience on different fertilizers backgrounds (fonds)

Experience Variant	Content of total P_2O_5, %			
	Fertilizer action		Fertilizer after-effect	
	0–30 cm	30–50 cm	0–30 cm	30–50 cm
Control	0.09	0.08	0.09	0.08
Fond 1 (F1) – Manure 45 t/ha (N_{300})	0.10	0.07	0.08	0.08
F1+ $N_1P_1K_1$ $N_{300}P_{150}K_{150}$	0.10	0.10	0.10	0.07
F1+ $N_0P_1K_1$ $P_{300}K_{300}$	0.10	0.08	0.10	0.08
$N_{1,5}P_{1,5}K_{1,5}$ $N_{600}P_{300}K_{300}$	0.13	0.09	0.11	0.08

Source: Own calculation.

Table 3. The mobile P_2O_5 content in the arable and subarable horizon of southern chernozem after long-term fertilization

No	Fertilizers applied for the period of research	Soil layer, cm			
		0–30	30–50	0–30	30–50
		Content of P_2O_5, mg/100 g soil			
1	Control	1.6	0.8	± to control	
2	Manure 385 t/ha + N_{600}	2.8	0.8	1.2	0.0
3	Manure 385 t/ha + N_{1650} $P_{1240}K_{1120}$	5.8	1.7	4.2	0.9
4	Manure 385 t/ha + $P_{1540}K_{1420}$	6.0	2.4	4.4	1.6
5	N_{4360} $P_{2035}K_{1855}$	8.8	2.2	7.2	1.4

Source: Own calculation.

Table 4. The mobile P_2O_5 content in the arable and subarable horizon of southern chernozem after-effect of fertilizers

No	Fertilizers applied for the period of research	Soil layer, cm			
		0–30	30–50	0–30	30–50
		Content of P_2O_5, mg/100 g soil			
1	Control	1.6	0.8	± to control	
2	Manure 265 t/ha	2.2	1.0	0.6	0.2
3	Manure 265 t/ha + N_{1050} $P_{940}K_{820}$	4.0	1.6	2.4	0.8
4	Manure 265 t/ha + $P_{940}K_{820}$	4.0	2.2	2.4	1.4
5	N_{1675} $P_{1435}K_{1255}$	4.9	2.5	3.3	1.7

Source: Own calculation.

The mobile phosphorus content in the arable soil depends on the amount of fertilizer applied. The highest amount of phosphorus (8.8 mg/100 g) was found in the application of mineral fertilizers - the annual increase constituted 0.16 mg/100 g of soil. Hence, the content of mobile phosphorus in soil increases with the increase in phosphorus fertilizers.

After the cessation of fertilization, the concentration of mobile phosphorus sharply decreased in the arable layer of the soil. The rate of decline (mg P_2O_5 per 100 g of soil per year) on the mineral system of fertilizers was maximum and amounted to 0.279; on organic system - minimal (0.043), organic-mineral fertilizer system occupied an intermediate position (0.129). Thus, phosphorus was "lost" much faster than its accumulation occurred.

To establish the quantitative dependences of the soil phosphate content on the dose of fertilizers, laboratory experiments I and II were carried out. Under optimal conditions while maintaining 70% of moisture content from the full moisture capacity of the soil and a temperature of 28ºC, soil samples were composting and collected from different genetic horizons of ordinary chernozem with mineral fertilizers.

Research results show that the content of phosphorus mobile forms, extracted by Machighin method, in the control variant of the I model experiment decreased throughout the profile, and in the control variant of the II experience decreased in the arable horizon (Table 5).

Table 5. The content of mobile phosphorus in the model experience (control)

P_2O_5 balance in model experiments		
Sampling depth, cm	I experience (control)	II experience (control)
0-30	-1.81	-3.15
30-49	-0.54	0.06
49-64	-0.22	0.18
64-90	-0.11	0.39
90-125	-0.32	0.18
125-150	-0.32	0.38

Source: Own determination.

The same situation is noted in the variants with the introduction of nitrogen fertilizers (Table 6). A decrease in the phosphate content in soil occurs, apparently, due to their biological absorption.

The results of model experiments also showed that the optimal conditions of temperature (28^0C) and humidity (70% of the FWC) contribute to the binding of phosphates. Biological binding P_2O_5 has been pointed out more than once by both classics and scientists of subsequent generations [2, 5, 6, 17-19].

Table 6. The content of mobile phosphorus in the model experience (nitrogen fertilizers)

P_2O_5 balance in model experiments		
Sampling depth, cm	I experience (with NH_4NO_3)	II experience (with $(NH_4)_2SO_4$)
0-30	-1.59	-2.85
30-49	-0.54	0.16
49-64	-0.22	0.28
64-90	-0.11	0.59
90-125	-0.19	0.18
125-150	-0.13	0.18

Source: Own determination.

In the composition of the cells of microorganisms in large quantities are carbon, oxygen and nitrogen, in much smaller phosphorus and sulphur. Phosphorus-potassium fertilizer application into the soil enhances the activity of nitrogen-fixing microorganisms [24].

Table 7. The content of mobile phosphorus in the model experience (phosphorus-potassium fertilizers)

P_2O_5 balance in model experiments	
Sampling depth, cm	II experience (with KH_2PO_4)[2)]
0-30	-44.05
30-49	-101.99
49-64	-80.92
64-90	-69.96
90-125	-73.52
125-150	-72.32

Source: Own determination.

Table 8. The content of mobile phosphorus in the model experience (complex fertilizers)

P_2O_5 balance in model experiments		
Sampling depth, cm	I experience (c KH_2PO_4 + NH_4NO_3) [1)]	II experience (with KH_2PO_4 + $(NH_4)_2SO_4$) [2)]
0-30	-25.41	-64.25
30-49	-30.22	-108.94
49-64	-29.99	-86.92
64-90	-29.88	-81.91
90-125	-31.63	-81.22
125-150	-31.12	-86.92

[1)] *the difference between the content of P_2O_5 before composting (initial in soil + 31.31 mg/100 g of soil P_2O_5 of fertilizers) and after.*
[2)] *the difference between the content of P_2O_5 before composting (initial in soil + 109.6 mg/100 g of soil P_2O_5 of fertilizers) and after.*
Source: According to recommendations [10].

On the variants with only phosphorus-potassium fertilizers introduction and jointly nitrogen and phosphorus-potassium fertilizers (variant P_{200} - 31.31 mg/100 g, P_{400} - 109.6 mg/100 g of soil) after 30 and 90 days of soil composting the content of phosphorus mobile forms turned out to be lower than calculated (Table 7 and 8).

According to the results of the laboratory experiment, we established a high correlative dependence of the content of nitrate nitrogen on the presence of mobile phosphates and potassium in the soil, which is emphasized by the correlation coefficients obtained by us for

$$r_{P_2O_5} = -0.552 \text{ at } t_{r\,P_2O_5} = 4.28 \text{ and}$$

$$r_{K_2O} = -0.532 \text{ at } t_{r\,K_2O} = 4.08.$$

The results indicate antagonism of nitrates and phosphates, nitrates and potassium, which is consistent with data from other researchers [9, 16]. One of the reasons for the antagonism of accessible phosphates and nitrates noted by Lebyadintsev [9] lies in the fact that in the composting process phosphorus is bound by nitrification bacteria producing nitrates. Phosphate fertilizers applied into the soil during composting increased by 28–61% the content of mobile phosphorus in the arable layer (Table 9).

Table 9. The mobile phosphorus accumulation in soil of model experiments with fertilizers use, %

Sampling depth, cm	I model experience	II model experience	
	with KH_2PO_4 + NH_4NO_3	with KH_2PO_4 + $(NH_4)_2SO_4$	with KH_2PO_4
0-30	28	43	61
30-49	5	1	7
49-64	5	21	26
64-90	5	25	36
90-125	0	26	33
125-150	2	21	34

Source: Own determination.

When only phosphorus-potassium fertilizers are applied during composting, the greatest increase in mobile phosphates is obtained. At the same time, 61% of the total amount of mineral phosphates was found in the arable horizon, i.e., more than half of the phosphorus of fertilizers in chernozem during composting for 90 days is found in the form of mineral phosphates.

The content of phosphorus mobile forms in the soil depends on many factors, including its level, which is associated with different biota activity. So, when the soil dries out, the content of phosphorus mobile forms decreases, and after wetting it tends to increase. This pattern is observed when soil moistening alternates with drying periods (II model experiment), when soil dries out, and the availability of phosphorus decreases due to the rapid formation of insoluble anion complexes (PO_4^{3-}, HPO_4^{2-}, H_2PO^{4-}) with cations (CaO, Fe, Al and others) and due to its inclusion in organic compounds by microorganisms.

Studies have shown that the most intense accumulation of mobile forms of phosphorus occurred in the first experiment with composting for 21 days under optimal conditions. The utilization rate of phosphorus from mineral fertilizers of the arable horizon in the first model experiment is 28%, whereas in the second experiment, with changing conditions and an increase in the duration of composting, its proportional increase was not observed.

In order to find the reasons for the seasonal variability of the P_2O_5 mobility, we carried out another model experiment: the soil samples were composted at optimum humidity (70% of the FWC) and temperature (28^0C) for 14 days. To suppress microbiological activity, a few drops of toluene were introduced into a portion of compostable soil (Table 10).

Table 10. The composting effect on the mobile phosphates content in southern chernozem

Symbols and their meanings	Before compos-ting - X_1	After compos-ting - X_2	After composting with toluene - X_3	X_1-X_2	X_2-X_3
P_2O_5 in mg per 100 g of soil	3.1	1.9	3.2	1.2	1.3
	18	12	12	-	-
	0.52	0.36	0.47	-	-
*$t_{0,05}$ = 2,07	-	-	-	2.25	2.34

Source: Own determination.

From table 10 it can be seen that in the case when the soil sample is placed under normal conditions, the mobility of phosphates is significantly reduced. If composting was carried out under sterile conditions, it did not affect the amount of mobile P_2O_5. Consequently, a significant decrease in phosphate mobility in soil in the spring months is most likely due to the fact that in this time the optimum conditions for active microbiological activity are created in the soils. Summer samples are characterized by a lower content of mobile forms of P_2O_5 due to the lack of atmospheric moisture.

An analysis of the correlative relationship between the productivity of winter wheat with fertilizer doses confirms [12] the crucial role in optimizing its nutrition - balancing nitrogen with phosphorus (Table 11).

Table 11. Effect of fertilizer rates on root rots infestation and winter wheat harvest

Factors that influence	The number of affected plants	Cumulative disease progression	Number of plants per m²	Productive tillering	Harvest
The number of affected plants	–	–	–	–	- 0.087
Cumulative disease progression	–	–	–	–	+ 0.330
Number of plants per m²	–	–	–	–	- 0.350
Productive tillering	–	–	–	–	+ 0.212
Nitrogen dose	+ 0.314	+ 0.298	+ 0.076	- 0.033	+ 0.421
Phosphorus dose	- 0.216	+ 0.100	- 0.068	+ 0.357	+ 0.748
Potassium dose	+ 0.111	+ 0.060	+ 0.104	+ 0.319	+ 0.310
Total amount of fertilizer	0.000	+ 0.070	- 0.054	+ 0.094	+ 0.465
(Required value $r_{0.5}$ ±0.46)					

Source: Own determination.

With the required value $r_{0.5}$, the actual indicator of the relationship of phosphorus doses with the yield was +0.748, and total fertilizers with the exception of phosphorus +0.465. As the research results showed, the connection between the winter wheat yield and the nitrogen doses only approaches the reliable one (+0.421) As is known, the total phosphorus content in plants depends on the level of phosphate nutrition, the phase of plant development, the degree of provision with other elements. As a result of the statistical processing of empirical data (correlation and regression analysis), a model of dependence of the P_2O_5 content in soils (Machighin's method) on the variation of phosphorus in plants (leaf diagnosis by Tzerling) was obtained (Fig.1).

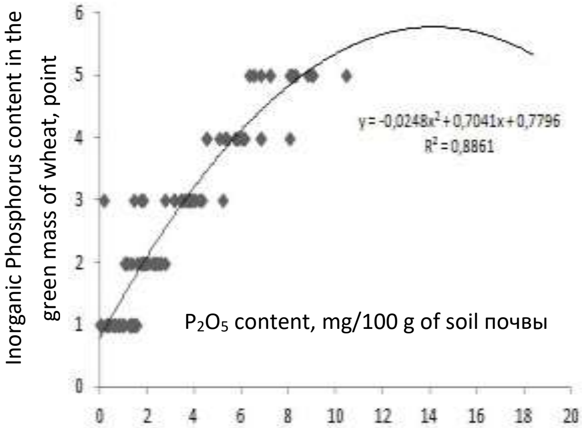

Fig. 1. The dependence of the P_2O_5 content in the green mass of winter wheat on the mobile phosphorus content in the arable layer of southern chernozem
Source: Own determination.

Step-by-step analysis by enumerating mathematical functions from a linear pair to nonlinear and graphical analysis made it possible to choose the second order parabola as the most reliably reflecting the above dependence at the 95% probability level, the general form of which is described by equation (1):

$$Y_x = a_0 + a_1X + a_2 X^2 \quad (1).$$

In the case of the dependency we are investigating, based on the 93 observations made and using the Excel program in the calculations of the Regression function, the equation (2) is obtained:

$$Y_x = 1.7796 + 0.7041X - 0.0248X^2, \quad (2),$$

where:

Y_x – the content of P_2O_5 in the green mass of wheat, points;

X – the content of P_2O_5 according to Machighin, mg/100 g of soil.

Regression analysis confirms the presence of a very high correlation between the variation of the effective and factorial signs (according to the Cheddock scale). The preference of the parabolic function in comparison with the linear function was given on the basis of a comparison of the coefficients of determination R^2. In the case of a linear dependence, R^2 was 0.871, in the case of a parabolic dependence, R^2 = 0.886. This indicates that the parabolic function more adequately reflects the dependence between the studied traits and in this case almost 89% of the variation of the phosphorus content in the plant juice depends on the variation of its content in the soil.

The data is reliable at a given level of significance of 0.05, which corresponds to the 95% level of probability. The calculated value of the F-criterion significantly exceeds its critical (tabular) value, which confirms the hypothesis on phosphorus content in soils and plants. The data obtained showed that there is a great dependence on the variation between P_2O_5 content in soils and the phosphorus intake in plants.

Table 12. Payback dependence of the phosphate fertilizers on the dose of their application (kg of grain per 1 kg a.s. of phosphorus). Data from the stationary field experiences, average for 1972-2008.

Dose of phosphate fertilizers, kg/ha	Winter wheat predecessor			Corn for grain
	Black steam	Peas	Corn	
60	1.1	5.7	3.7	5.8
40	2.8	7.8	4.1	6.3
20	3.8	10.6	15.7	27.0
Crop	Peas	Sunflower on the after-effect of fertilizers		
30	1.7	Contributed during crop rotation, kg/ha		
20	7.4	330	210	110
10	28.5	0.18	0.72	1.24

Source: Own calculation.

In the model experiments, the 93 observations were made with phosphorus content in the soil from 0.0 to 10.4 mg/100 g. In the observation process it was established that, when the mobile phosphorus content increased from 0.0 to 14.0 mg in soil, increases its content in plant juice. Additional increase of the mobile phosphorus content in the soil more than 14.0 mg decreases the efficiency of its absorption.

According to the results of production experience only on the variant with mineral fertilizer system (P_{60}), the calculated provision of winter wheat with phosphorus due to its reserves in southern chernozems corresponds to its high content in the juice of plants.

The results of production experience with applying of different doses of phosphate fertilizers and the obtained parabolic function confirm that the studied soils require the introduction of phosphate fertilizers and their phosphate regime regulation.

CONCLUSIONS

The study of the changes direction occurring in the soil under the fertilizers influence, allows adjusting the nutritive regime of plants, to develop measures of influence on the processes occurring in the soil and in plants in order to increase soil fertility, harvest and improve its quality. It is possible to restore the content of phosphorus available for plants in the soil by applying mineral fertilizers. With the systematic use of phosphate fertilizers, this dependence is observed: the higher the rate of their application, the higher the content of mobile compounds in the soil, the lower the return on the unit of the active substance by the yield increase and vice versa

After the termination of fertilization, the concentration of mobile phosphorus sharply decreased in the arable layer of soil. The rate of decline (mg P_2O_5 per 100 g of soil per year) on the mineral system of fertilizers was maximum and amounted to 0.279; on organic - minimal (0.043), organic-mineral fertilizer system occupied an intermediate position (0.129).

Conducting research in a model laboratory experiment with the creation of specified phosphate levels confirm the data obtained in the field. According to the results of the laboratory experiment, was established a high correlative dependence of the content of nitrate nitrogen on the presence of mobile phosphates and potassium in the soil, which is emphasized by the correlation coefficients obtained for:

$r_{P_2O_5} = -0.552$ at $t_{r\,P_2O_5} = 4.28$ and

$r_{K_2O} = -0.532$ at $t_{r\,K_2O} = 4.08$.

The results of production experience on the application of different doses of phosphate

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fertilizers and the obtained parabolic function of the dependence of the P_2O_5 content in the green mass of wheat on the content of mobile phosphorus (according to Machighin method) and the correlative relationship between the state and productivity of winter wheat with doses of fertilizers confirm that to obtain high yields with high quality the black soil of the Ukraine Steppes require the application of the phosphate fertilizers and the regulation of their phosphate regime.

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STUDIES ON MEAT SOURCES TO COVER PROCESSING, CONSUMPTION AND TRADE NEEDS IN ROMANIA

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Abstract

Meat processing is an important sector of the food industry, which has a special impact on increasing the competitiveness of the national economy, but also on ensuring the food security of Romania. The tradition of raising animals and the processing of agri-food raw materials can ensure the need for raw materials, satisfying the internal consumption, but also making income for the meat processing company in Romania. The meat market, at national level, is in deficit, being dependent on meat imports, while on the export live animals are valued, with a low added value. The purpose of this paper is to highlight the current situation in the meat processing sector in terms of production, consumption per capita and meat imports and exports, comparing with the number of meat processing units. The study highlights the decrease in domestic meat production of poultry, pigs and cattle, except for the production of sheep and goats that is increasing, between 2015 and 2017, where in beef production decreased by 18.99%, pork production decreased by 3.85%, poultry meat production decreased by 4.58%, and in sheep and goat meat production increased by 5.86%. Imports of meat from the analyzed species are increasing, also the consumption of meat per capita is increasing, but also the companies in the field of meat processing are increasing.

Key words: *meat production, meat processing, meat consumption, balance of meat, meat processing company*

INTRODUCTION

The evolution of the perception of romanian food has evolved rapidly in the last three decades, in response to the socio-economic changes. The generation of particular models of food consumption is due to the socio-economic status (SES) and the distribution of the settlement type of the population, because Romania is in a transition phase [8].

Romania faces certain vulnerabilities in terms of food security for the population, among these vulnerabilities is the lack of self-sufficiency of certain basic foods such as meat, fruit, sugar and fish, in which the systematic deficit is covered by imports [1].

Since the production of beef has decreased, imports have been made to cover the difference between production and consumption. The main cause is the decrease of the live stock of cattle, due to the high prices for agricultural inputs and the low price per kg of meat [9].

The pork sector in Romania has been and is still affected by African swin fever, with a significant loss, which takes several years to recover from this crisis. Pork is by far the one preferred by the Romanian consumer, this will increase the trade imbalance in the coming years, with a consequence on the prices on the position on the market of pork producers in Romania and the prices on the domestic market [2]. Pork production is influenced by many factors, among which consumer demand occupies an important place [11].

Romania ranks third in the EU28 in terms of sheep numbers (9.8 millions), having a self-sufficiency for sheep meat of 150 % and therefore exports are important at national level [4]. The Orthodox tradition during Easter is the reason why sheep and goat meat production has remained constant, with demand on the market [7].

Romania is an importing country of animal products, it is also not competitive with other EU countries in the animal production sector.

[5]. In order to avoid the dependence of Romania's agri-food market on imports and affecting local producers, a balance between animal production and crop production must be created in the future strategy [6].
Romania's potential for meat production for the domestic market and export is very high. In order to ensure high production and quality of sheep and goat carcasses, it is necessary to organize their breeding associations. Consistent aid for livestock breeders in this sector comes from national aid and coupled support [10].

MATERIALS AND METHODS

In this paper, a study was carried out regarding the current situation in the meat industry from the perspective of the production, consumption per capita and of the imports and exports of meat, but also the evolution of the number of meat processing units in Romania. The data were extracted by consulting the databases of the National Institute of Statistics and the Organization for Food and Agriculture, and were processed as interpreted in tabular and graphic form:
(i)Meat production in Romania 2015-2017
(ii)Trade balance of meat between 2015-2017
(iii)Annual average consumption of meat per capita between 2015-2017
(iv)The number of Romanian companies in the field of meat processing between 2015-2017

RESULTS AND DISCUSSIONS

Situations regarding the perspective of the number of meat processing companies, meat production, meat consumption per capita, meat import and export are presented in the following tables.

Table 1. Meat production in Romania, 2015-2017 (Tonnes)

Animal species	**2015**	**2016**	**2017**	**Total production**	**Dynamics (%)**		
					2016/2015	**2017/2016**	**2017/2015**
Cattle	118,851	116,177	96,270	331,298	-2.24	-17.13	-18.99
Swine	470,055	500,777	451,940	1,422,772	6.53	-9.75	-3.85
Sheep and goats	79,623	87,024	84,288	250,935	9.29	-3.14	+5.85
Poultry	410,783	418,720	391,958	1,221,461	1.93	-6.39	-4.58
Total	1,079,312	1,122,698	1,024,456	3,226,466	4.01	-8,75	-5.08

Source: http://www.fao.org/faostat/en/#data/QL, Accessed on Sept.20, 2019 [3].

Table 2. Trade balance of meat between 2015-2017 (tonnes)

Animal species	**2015**	**2016**	**2017**	**Total import**	**2015**	**2016**	**2017**	**Total export**
Cattle	4,468	5,018	2,708	12,194	873	3,134	5,163	9,170
Swine	88,934	88,891	77,693	255,518	9,944	8,353	19,226	37,523
Sheep and goats	381	350	380	1,111	3,623	6,795	5,395	15,813
Poultry	90,836	100,412	107,825	299,073	56,341	63,092	63,229	182,662
Total	184,619	194,671	188,606	567,896	70,781	81,374	93,013	245,168

Source: http://www.fao.org/faostat/en/#data/TP, Accessed on Sept.20, 2019 [3].

As shown in Table 1, the sheep and goat meat industry is the most dynamic field in meat production, where it registered a growth of 5.85% in 2017 compared to 2015. In 2016 it increased by 9.29% compared to 2015, and in the following year, 2017, production decreased by 3.14% compared to 2016. Beef production has a decrease of 18.99% in 2017 compared to the production of 2015.

In the case of pigs, there is a 6.53% increase in meat production in 2016, compared to 2015, and then, in 2017, the production variation registered a decrease of 3.85% compared to 2015. Poultry recorded a slight increase of 1.93% in 2016 compared to 2015, followed by 2017 having a deficit of 4.58% compared to 2015.

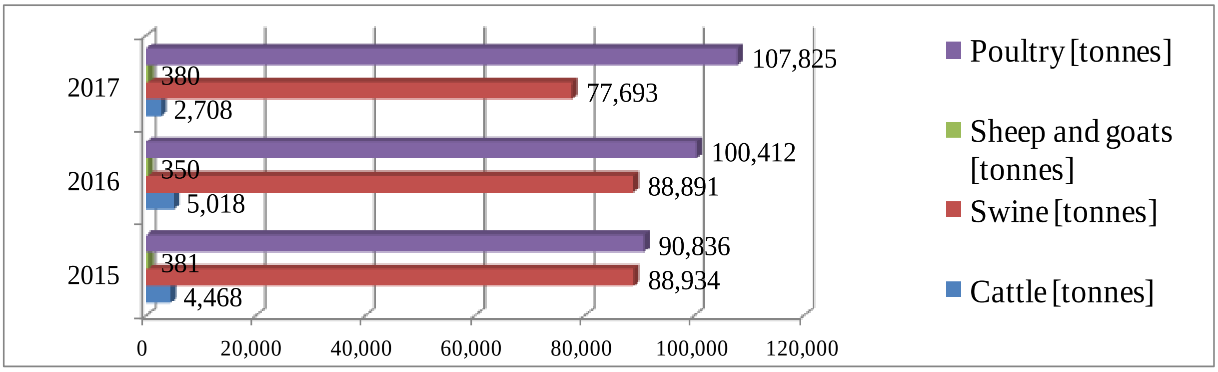

Fig. 1. Evolution of meat imports between 2015-2017
Source: Processed by the author based on the data FAO (2019) [3].

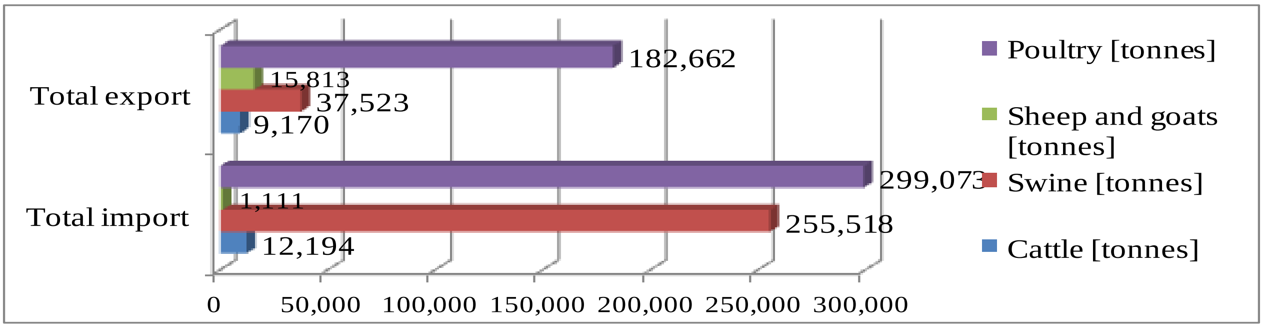

Fig. 2. Evolution of meat exports between 2015-2017
Source: Processed by the author based on the data FAO (2019) [3].

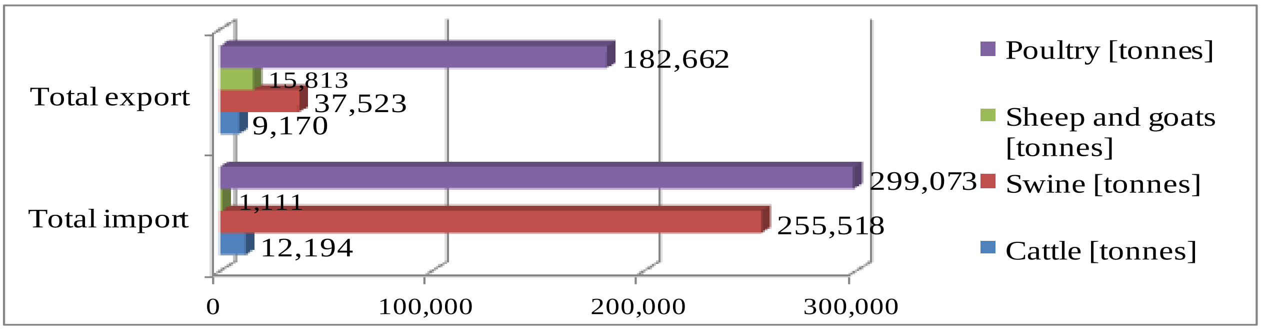

Fig. 3. Trade balance between 2015-2017
Source: Processed by the author based on the data FAO (2019) [3].

Figure 1 shows the data from Table 2 on the situation of meat imports in the period 2015-2017. The poultry meat has a constant evolution regarding the situation of the imports having a value of 90836 tonnes in 2015, 100,000 tonnes in 2016, respectively in 2017 reaching 107825 imported poultry meat.
Import of sheep and goat meat remained approximately constant in this period, in 2015 381 tonnes were imported, in 2016 it decreased to 350 tonnes, and in 2017 reaching 380 tonnes. Pork has decreased in import, reaching from 88,934 tonnes in 2015 to 77,693 tonnes in 2017. As regards the import of cattle, it has decreased during this period, with a value of 4,468 tonnes in the year 2015, and in the year 2017 having a value of 2,708 tons.
Figure 2 shows the data from Table 2 on the situation of meat exports for the period 2015-2017. Poultry meat registered the highest value of exports, rising from 56,341 tonnes in 2015 to 63,229 tonnes in 2017. Sheep and goat meat has a positive evolution, with a value of 3,623 tonnes in 2015, and in 2017 it reaches the value of 5,395 tonnes. Also, the

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pig meat has a positive evolution regarding the export with a value of 9,944 tonnes in 2015 and reaching 19,226 tonnes in 2017.

Beef has evolved with an export value of 873 tonnes in 2015 and reached 5,163 tonnes in 2017.

Figure 3 shows the total imports and exports of meat between 2015-2017. The poultry meat registered a total import of 299,073 tonnes, well above its export which had a value of 182,662 tonnes. The meat of sheep and goats has a total export greater than its import, which has a value of 15,815 tonnes, respectively 1,111 tonnes. The total import of pigs has a value of 255,518 tons, as well as over its export, which has a value of 37,523 tons.

Table 3. Average annual consumption of meat per capita (kg / capita)

Animal species	2015	2016	2017
Cattle	6.3	6.1	4.9
Swine	31.3	32.9	36.1
Sheep and goats	2.2	2.3	2.3
Poultry	23	24.1	24.9
Total	**62.8**	**65.4**	**68.9**

Source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, Accessed on Sept.20, 2019 [12].

The beef has a total import of 12,194 tons, and its total export has a value of 9,170 tons.

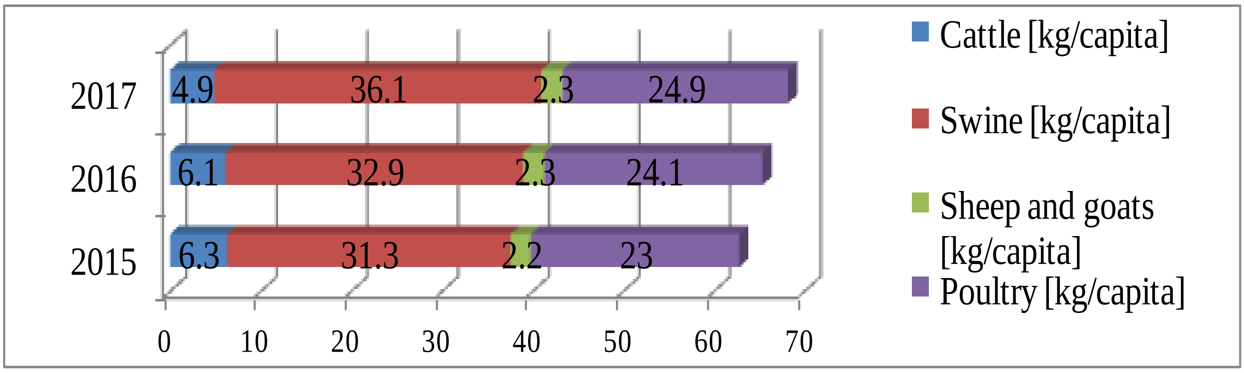

Fig. 4. The situation of the average annual consumption per capita (kg / capita), in Romania, between 2015-2017
Source: Processed by the author based on the data INS (Tempo online, 2019) [12].

Figure 4 shows that the trend of meat consumption is constantly increasing, except for the consumption of beef where in 2015 it had a value of 6.3 kg / capita and in 2017 it decreased to 4.9 kg / capita. Pork was the first ranking in consumer preferences, rising from 31.3 kg/capita (2015) to 36.1 kg/capita (2017).

Then comes the poultry meat with a consumption of 23 kg/capita in 2015, reaching 24.9 kg/capita in 2017.

The sheep and goat meat is the last place with a consumption of 2.2 kg/capita in 2015 and reaching 2.3 kg. per capita in 2017.

The situation of the meat processing companies, in Romania, between 2015-2017 is presented in Table 4.

Table 4. The situation of the meat processing companies, in Romania, between 2015-2017

Domain of activity of the company	Number of companies in Romania		
	2015	**2016**	**2017**
1011 - Meat production and preservation	448	453	476
1012 - Processing and preserving of poultry meat	50	51	66
1013 - Manufacture of meat products (including poultry products)	349	349	394

Source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, [12].

Figure 5 shows an increase in the number of companies in the field of meat processing, between 2015-2017, in Romania. At Activity 1013 - Manufacture of meat products (including poultry products) in 2015, there were 349 companies, and in 2017 the number increased to 394 companies with this activity.

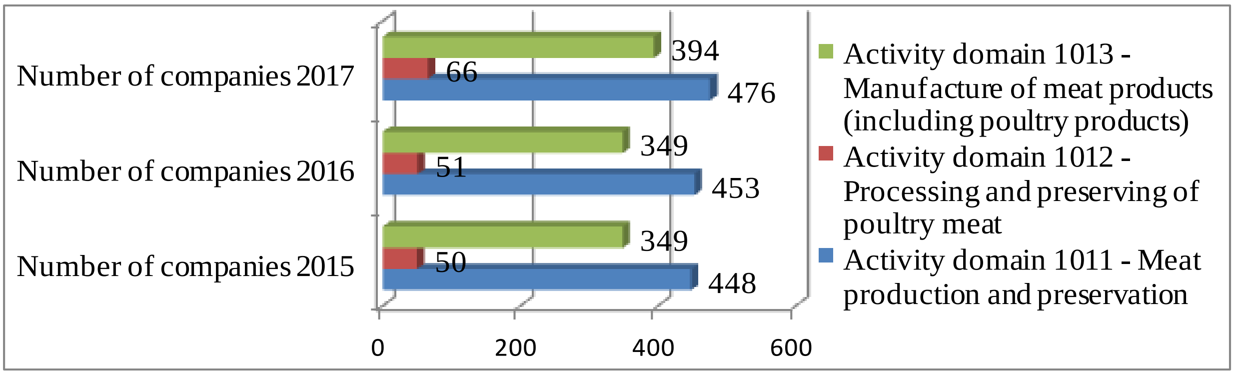

Fig. 5. The situation of the meat processing companies, in Romania, between 2015-2017
Source: Processed by the author based on the data INS (Tempo online, 2019), [12].

Regarding Activity domain 1012 - Processing and preserving of poultry meat, in 2015 there were 50 companies, and in 2017 the number increased to 66 companies. In the case of Activity Area 1011 - Meat production and preservation, if in 2015 there were only 448 companies, in 2017 their number increased to 476 companies with this activity.

CONCLUSIONS

It is concluded that, in the period 2015-2017, in Romania, the domestic production of sheep and goat meat is increasing, while the domestic production of pigs, poultry and cattle is decreasing. During this time, sheep and goat meat production increased by 5.86%, poultry production fell by 4.58%, beef production fell by 18.99%, and pork production decreased by 3.85%.

Total meat imports are very high compared to total meat exports, with the exception of sheep and goat meat, which has increased.

The total meat consumption of the analyzed species is constantly increasing, in 2015 there was a consumption of 62.8 kg/capita, in 2016 there was a consumption of 65.4 kg/capita, and in 2017 it reached 68.9 kg/capita. Also, the number of meat processing companies is constantly increasing between 2015 and 2017.

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STUDIES ON THE SITUATION OF INVESTMENTS SUPPORTED IN ROMANIA BY THE "THEMATIC SUB-PROGRAM FOR THE TREE FRUIT SECTOR", PART OF THE NATIONAL RURAL DEVELOPMENT PROGRAM, IN THE SOUTH WEST OLTENIA REGION, ROMANIA

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Abstract

The National Rural Development Program is a program coordinated by the Ministry of Agriculture and Rural Development, in consultation with representatives of bodies, organizations and social partners active in this field and approved following consultations with the European Commission, which provides European non-reimbursable funds for investments private and public projects that ensure the development of rural areas in Romania. Sub-measure 4.1a of NRDP 2014-2012 - Investments in fruit holdings - the purpose of the investments supported under this sub-measure is to increase the competitiveness of the fruit farms by endowing with equipment and equipment, setting up, modernizing and / or expanding the processing units, setting up fruit plantations, existing plantings and the growth of areas occupied by fruit nurseries. The main purpose of this paper is an analysis of the investments with European funds regarding the development of the fruit sector in the South-West Oltenia Region in the period 2015-2017. We propose, in this paper, to follow the funded projects of the fruit holdings through sub-measure 4.1 a, in of the South-West Oltenia Region, which have an eligible value of 20,138,023 euros, and the public value is 17,027,919 euros, with 34 projects, in relation to nationally funded projects with an eligible value of 289,236,406 euros and a public value of 233,371,337 euros and a number of 461 projects.

Key words: *public value, eligible value, fruits tree, species, variety, funded project, measure*

INTRODUCTION

Currently, most orchards of fruit trees and small fruits are abandoned, aged, have low productivity and are dominated by only two species. Aging crops with low yields and reduced assortment affect the quality and quantity of fresh fruit supply on domestic markets, favor the emergence of imported products and reduce exports. It is necessary to establish the establishment of fruit plantations, including protected areas and the rejuvenation of existing fruit plantations.

In Romania, in this rather long period of transition, there are still many fruit tree orchards with old (classical) varieties which do not fully meet today's market and consumer's criteria [9].

The country is one of the main ten important European producers of horticultural products in terms of production volumes and acreage. Results showed that over the last seven years (2007-2014), the sectorial production drawbacks have not been improved very much [5].

Also, in order to ensure the need for planting material, adapted to the pedoclimatic conditions in Romania, it is necessary to increase the area occupied by the fruit nurseries. Expanding the areas under fruit plantations and diversifying the range would have a positive effect on the supply of fresh fruit to the domestic and foreign markets, increase the degree of processing of raw materials produced internally and have a positive effect on the development of the fruit sector in general. In Romania, the low level of investments in fruit holdings was strongly influenced by the low financial capacity of primary producers, the high cost of loans and investments, and the lack of guarantees. The high costs of setting up orchards, and their maintenance, have limited the interest of investors in this area. Over the last 23 years, the fruit sector has been in a steady decline, with negative consequences not only on the economic development of the rural environment but also on the quality of life of traditional fruit-growing communities and on the contribution of the sector to environmental protection [11]. Weak association and cooperation, with the purpose of producing but especially of the joint exploitation of fruit production, is another important factor that negatively influenced the capitalization of production, the quality of products, the supply of inputs and implicitly the fruit growers' incomes. The association of Romanian cultivators represents an opportunity for them to become competitive and to value their production at a convenient price. The orchards with the size between 0 and 5 hectares represent 52% of the total area. Obtaining smaller production than the European average is due to technology and outdated equipment [7]. Farmers need to partner in horticulture for better yield and higher income in terms of workload [8].

The super-intensive technology is the most expensive and requires very large investments per hectare, having a very good economic performance, compared to the intensive technology that needs smaller investments per hectare, and the traditional technology which is very easy to implement, and does not require large investments, having a minimum profitability [16].

Through the National Program for Rural Development grants are granted for the development of rural areas in Romania, granted by the European Union together with the Government of Romania. Technical and financial implementation is provided by the Agency for Rural Investment Finance (ARIF). Sub-measure 4.1a "Investments in fruit holdings" falls under Measure 4 - Investments in physical assets - from NRDP 2014-2020 and contributes to improving the economic performance of all farms and facilitating farm restructuring and modernization, especially with a view to increasing participation and orientation towards market, as well as agricultural diversification [2].

The main priorities for rural development are to modernize and increase the viability of agricultural holdings by strengthening them, opening up to the market and processing agricultural products, encouraging the renewal of farmers generations by supporting the setting up of young farmers, promoting the fruit sector as a sector with specific needs.

MATERIALS AND METHODS

In this paper, a statistical study was carried out to highlight the investments made under Sub-measure 4.1a of the NRDP on the study period 2015-2017 regarding the projects financed for the development of the fruit sector in the counties of Dolj, Gorj, Mehedinti, Olt, Valcea that make up the Region of development SW Oltenia.

The list of the fruit plantations / fruit tree shrubs plantations from the Agriculture Directorates in Oltenia counties was consulted, taking over the authorized species, varieties and hybrids. The data regarding the number of projects and their amounts were extracted from the selection reports of the contracting authority.

Thus, the situation of the fruit farms in the counties of Oltenia, the numerical situation of the selected projects, the public value (non-refundable) and the eligible value of the selected projects in Oltenia were analyzed.

There have been several correlations such as: Correlation between projects number and orchard area, Correlation between projects number and eligible value, Correlation between eligible value and new orchards area.

Romania occupies the eighth position for the production of apples and the third position for the area of apple orchards, being an important fruit producer in the EU, occupies the ninth position for the consumption of apples [12].

In order to improve producers' competitive conditions, the 2007 reform of the Common Market Organization for fruit and vegetables provides measures in favor of growers who are members of Producer Organizations (POs) [3].

After analyzing the correlation between the value of fruit production, the GDP of agriculture and the import of fruits, it is observed that there is a correlation, and the increase of their production would lead to the increase of the GDP, and also to the decrease of the imports [10]. With the EU funding the groups of fruit and vegetable producers have specialized equipment for harvesting, storage and preparation of fruits for sale. The groups have their own storage bases, specialized for cleaning, sorting, packaging and conditioning of fruits as well as means of transport for delivery of products to customers, while maintaining their quality. Through group actions agricultural producers are able to obtain benefits, which are very hard to achieve by acting alone [4].

This study uses the following indicators: orchards area and investments (eligible value) public investment reported on orchards area,at Oltenia level were calculated using the formulas:

$$\mathbf{I_{no}} = \frac{\sum_{i=1}^{n} V_e}{N_{no}};$$

I_{no}– Public investment reported on new orchards area;

V_e – Eligible value;

N_{no} - The value of new orchards area;

N - Number of projects ranging from 1 to 34.

$$\mathbf{I_{np}} = \frac{\sum_{i=1}^{n} V_e}{N_p};$$

I_{np} – Medium investment value reported on number of projects;

V_e – Eligible value;

N_p - The value of the number of projects;

N - Number of projects ranging from 1 to 34.

To highlight the correlations we used:

- the Equation for the correlation coefficient:

$$r = \frac{\sum (x_i - \overline{X})(y_i - \overline{Y})}{\sqrt{\left(\sum (x_i - \overline{X})^2\right)\left(\sum (y_i - \overline{Y})^2\right)}},$$

where $\overline{x}$ şi $\overline{y}$ -are the averages for samples, AVERAGE (matrix1) and AVERAGE (matrix2).

-form linear and polynomial function of second degree:

Linear – linear model (simple regression): y = a + bx;

Polynomial – the second order polynomial model: $y = a_0 + a_1x^1 + a_2x^2$;

RESULTS AND DISCUSSIONS

The Oltenia region is located in the SW of Romania, and is bordered by the Southern Carpathian Mountains in the North, Olt river in the East and Danube river in the South and West. and Dolj, Gorj, Mehedinţi, Olt and Vâlcea counties). Oltenia region covers a surface of 29,015 km^2, which reprezents up to 12.2 % of the surface of Romania [6].

Oltenia region is characterized in general by favorable climatic and soil conditions for fruit, nut and small trees growing from the foot of the Carpathian Mountains, which correspond to the Sub-Carpathian area of Oltenia, to the Mehedinţi Plateau and the Severin Basin, Getic Piedmont (Plateau) and the Oltenia Plain, which is a subunit of the Romanian Plain.

The climate is temperate continental, with some Mediterranean influences. Eastern and the Southern parts of Oltenia are subject of important thermic amplitudes induced by the continental cold air masses coming from the East and North East.

The areas were most of the fruit growing was located in the past are in Vâlcea (13,145 ha), Gorj (4,756 ha), Mehedinţi (4,635 ha), Dolj (2,833.62 ha) and Olt (861.90 ha) counties. Total number of hectares covered by fruit tree, nut crops and small fruits in Oltenia was 26,231.52 ha [15].

The situation of the regional distribution of the approved and financed projects, their sum, as well as the existing fruit growing area, as well as the newly established area, are presented in the tables below.

Table 1. Number of projects funded in Oltenia and at national level

Year	County					Total	Total national
	Dolj	Gorj	Mehedinți	Olt	Vâlcea		
2015	0	0	0	0	1	**1**	**16**
2016	1	0	1	3	4	**9**	**116**
2017	6	5	2	8	3	**24**	**329**
Total	**7**	**5**	**3**	**11**	**8**	**34**	**461**

Source: https://www.afir.info/

We observe that in the Oltenia Region, under sub-measure 4.1a, in the period 2015-2017, 34 projects were financed, representing 7.4% of the total number of projects financed at national level, so far (461 projects), which represents a small number in relation to the region's horticultural potential. Olt County has the largest number of projects financed, with 11 projects, followed by Valcea county with 8 projects financed, Dolj county 7 projects, Gorj County 5 projects, and Mehedinti County with the last 3 projects financed (Table 1).

Table 2. Fruit tree and nut crops situation in Oltenia and funded projects by NRDP(The National Rural Developement Program) through Submeasure 4.1.a - Support for *investments in fruit-growing* holdings

Counties	Situation	Pip fruits			Stone fruits					Nut crops		
		Apple	Pear	Quince	Plum	Apricot	Peach and Nectarine	Sweet cherry	Sour cherry	Walnut	Hazelnut	Almond
Dolj	Orchard area[A] (ha)	511.37	11.00	No data	1,580.35	269.90	139.00	296.00		11.00		
	Projects on new orchards by NRDP (ha)	5.80	0	0	0	0	1.90	9.90	0	55.30	66.20	0
Gorj	Orchard area[A] (ha)	694.00	106.00	No data	3,588.00	0	0	118.00		77.00		
	Projects on new orchards by NRDP (ha)	12.80	2.00	9.50	2.00	0	0	0	0	0	0	0
Mehedinți	Orchard area[A] (ha)	2,010.00	0	No data	1,580.00	80.00	130.00	685.00		150.00		
	Projects on new orchards by NRDP (ha)	3.30	0.26	0.26	0.26	0.26	0.26	7.80	0.26	7.00	0	0
Olt	Orchard area[A] (ha)	40.86	0	No data	735.68	45.21	10.00	27.05		0		
	Projects on new orchards by NRDP (ha)	34.20	0	0	17.10	0	0	2.90	0	0	9.20	0
Vâlcea	Orchard area[A] (ha)	2,940.00	240.00	No data	9,484.00	11.00	2.00	95.00		92.00		
	Projects on new orchards by NRDP (ha)	0	0	4.00	0	0	0	3.10	0	46.70	0	0
Total	***Orchard area[A] (ha)***	***6,196.23***	***357.00***	No data	***16,968.03***	***406.11***	***281***	***1,221.05***		***330.00***		
	Projects on new orchards by* NRDP*(ha)	***56.10***	***2.26***	***13.76***	***19.36***	***0.26***	***2.16***	***23.70***	***0.26***	***109.00***	***75.40***	***0***

A Source: [15].

Table 3. Small fruits situation in Oltenia and approved projects by NRDP through Submeasure4.1.a - Support for *investments in fruit-growing* holdings

Counties	Situation	Small fruits				Other crops	Total orchard surface (ha)
		Strawberry	Raspberry	Blueberry	Sea buckthorn		
Dolj	Orchard area[A] (ha)	0	0			15.00	2,833.62
	Projects on new orchards by NRDP (ha)	0.40	0	20.10	0	0	159.60
Gorj	Orchard area[A] (ha)	170.00	0			3.00	4,756.00
	Projects on new orchards by NRDP (ha)	0.50	5.90	0	0	0	32.70
Mehedinti	Orchard area[A] (ha)	0	0			0	4,635.00
	Projects on new orchards by NRDP (ha)	0	0	0	0	0	19.66
Olt	Orchard area[A] (ha)	1.50	0			1.60	861.90
	Projects on new orchards by NRDP (ha)	0	5.70	33	2.70	0	104.80
Vâlcea	Orchard area[A] (ha)	179.00	8.00			94.00	13,145.00
	Projects on new orchards by NRDP (ha)	0.30	0	2.60	5.60	0	62.30
Total	***Orchard area[A] (ha)***	***350.50***	***8.00***			***113.60***	***26,231.52***
	Projects on new orchards by* NRDP *(ha)	***1.20***	***11.60***	***55.70***	***8.30***	***0***	***379.06***

A Source: [15].

Table 4. The cultivars' assortment of the fruit tree funded projects for Oltenia region NRDP (The National Rural DevelopementProgram) through Submeasure 4.1.a - Support for *investments in fruit-growing* holdings

Counties	Fruit tree crops							
	Pip fruits			Stone fruits				
	Apple	PEAR	Quince	Plum	Apricot	Peach	Sweet cherry	Sour cherry
Dolj	'Luna'[T], 'Rozela'*, 'Orion'*, 'Starkrimson', 'Red Topaz'[T], 'Florina', 'Generos'	-	-	-	-	'Florin', 'Alexia', 'Redhaven', 'Cardinal'	'Kordia'[T], 'Regina'*, 'Lapins'*, 'Skeena'[T], 'Early Red'*	-
Gorj	'Prima', 'Jonathan', 'Golden 'Delicious', 'Florina', 'Starkrimson', 'Generos', 'Idared',	'Napoca', 'Williams', 'Ina Estival'**, 'Curé', 'Conferance', 'Haydeea'	'Bereczki', 'Adonia', 'Aromate'	'Stanley', 'Centenar', 'Anna, Späth', 'RenclodAlthan', 'D'Agen'	-	-	-	-
Mehedinţi	'Idared', 'Florina', 'Goldspur' and *Malus floribunda* (pollinator)	'Williams', 'Red Williams', 'Beurré Bosc', 'Abate Fetel'**	'Bereczcki'	'Stanley'	'Ceamaibună de Ungaria' ('Hungary's Best')	'Redhaven'	'Kordia'[T], 'Regina'*, 'Stella', 'Hedelfinger', 'Carmen'*, 'BigarreauBurlat', 'Valeri Cikalov'*, 'Boambe de Cotnari', 'BigarreauDönissen'	'Morella Neagră' ('Schattenmorelle'), 'Ilva', 'Nana'**
Olt	'Golden Delicious'	-	-	'President'[T], 'Anna Spath', 'TopendPlus'*	-	-	'Kordia'[T], 'Regina'*	-
Vâlcea	-	-	'Bereczki', 'Aromate'	-	-	-	'Rivan'[T], 'Stella', 'Ludovic'**	-

[T] – Tested officially in Romania, but not listed in the Romanian Official Catalogue of Cultivars [1]

* - not listed in the Romanian Official Catalogue of Cultivars

** - cancellation of listing in the Romanian Official Catalogue of Cultivars

Table 5. The cultivars' assortment of the nut tree and small fruits approved projects for Oltenia region by NRDP (The National Rural DevelopementProgram) through Submeasure4.1.a - Support for *investments in fruit-growing* holdings

Counties	Nut tree and small fruits crops					
	Nut crops		Small fruits			
	Walnut	Hazelnut	Strawberry	Raspberry	Blueberry	Sea buckthorn
Dolj	'Jupânești', 'Valcor', 'Valrex', 'Velnița', 'Anica', 'Șușița', 'Sibișel 44', 'Geoagiu 65'	'Vâlcea 22', 'Romavel', 'Halle's Giant', 'Cozia', 'Fertile de Coutard'*, 'Ennis'^{T}, 'Tonda Gentile delle Langhe'(T.G.D.L.), 'Tonda di Giffoni'*, 'Tonda Gentile Romana'*	No data available	-	'Duke', 'Blue Gold'*, 'Elliott'^{T}, 'Simultan', 'Bluecrop'^{T}	-
Gorj	-	-	No data available	'Polonez'*, 'Poemat'*	-	-
Mehedinți	'Chandler'*, 'Franquette'	-	-	-	-	-
Olt	-	'Vâlcea 22', 'Romavel', 'Tonda Gentile delle Langhe' (T.G.D.L.), 'Cozia', 'Halle's Giant'	-	'Polana'*, 'Sokolica'*, 'Laszka'*	'Duke', 'Bluegold'*, 'Bluecrop'^{T}	'Clara','Andros', 'Mara'
Vâlcea	'Jupânești', 'Velnița', 'Valrex', 'Orăștie'**, 'Valcor', 'Valmit', 'Mihaela'**, 'Roxana'**, 'Geoagiu 65', 'Valcris'	-	No data available	-	'Elliott'^{T}, 'Legacy'*	'Clara', 'Mara', 'Cora', 'Andros'

^{T} – Tested officially in Romania, but not listed in the Romanian Official Catalogue of Cultivars [1]
* - not listed in the Romanian Official Catalogue of Cultivars
** - cancellation of listing in the Romanian Official Catalogue of Cultivars

Table 6. The total value of the selected projects in the S-V Oltenia Region and national value (€)

Year	DJ		GJ		MH		OT		VL		Total e.p.* [€]	Total p.v.** [€]	Total e.p.* National [€]	Total p.v.** National [€]
	E*	P**	E*	P**	E*	P**	E*	P**	E*	P**				
2015	0	0	0	0	0	0	0	0	413,641	362,290	**413,641**	**362,290**	**10,190,088**	**7,530,941**
2016	656,934	591,243	0	0	251,121	175,784	1,074,174	913,025	1,463,004	1,188,281	**3,445,233**	**2,868,333**	**66,251,199**	**51,198,300**
2017	4,361,036	3,667,078	3,840,566	3,258,879	1,737,543	1,563,787	5,106,288	4,233,778	1,233,716	1,073,774	**16,279,149**	**13,797,296**	**212,795,119**	**174,642,096**
Total	**5,017,970**	**4,258,321**	**3,840,566**	**3,258,879**	**1,988,664**	**1,739,571**	**6,180,462**	**5,146,803**	**3,110,361**	**2,624,345**	**20,138,023**	**17,027,919**	**289,236,406**	**233,371,337**

* - eligible value;
** - public value;
Source: Own calculation.

Out of the region the largest number of hectares were recorded in case of plums and apples and plums in Vâlcea county (9,484 ha and 2,940 ha respectively), sweet and sour cherries in Mehedinți (685 ha), apricots in Dolj (269.90 ha), pears and strawberries in Vâlcea (240 ha and 179 ha respectively), nut crops in Mehedinți (150 ha), peach and nectarines in Dolj (139 ha), etc (Tables 2 and 3).

As result of projects funded in Oltenia by NRDP (The National Rural Developement Program) through Submeasure 4.1.a - Support for investments in fruit-growing holdings, the following ranking of future plantings occured: 109 ha of walnut, 75.4 ha of hazelnut, 56.1 ha of apples, 55.7 ha of blueberries, 23.7 ha of sweet cherries, 19.36 ha of plum, 13.76 of quince, 11.6 ha of raspberries, 8.30 ha of sea buckthorn, 2.26 ha of pears, 2.16 ha of peach and nectarines, 1.20 ha of strawberries, 0.26 ha of apricots and 0.26 ha of sour cherries (Tables 2 and 3). On first place is Dolj county with 159.60 ha of future orchard plantings, followed by Olt with 104.90 ha, Vâlcea with 62.30 ha, Gorj with 32.70 ha and Mehedinți with 19.66 ha.

The new orchards will have to be established using "certified" virus free planting material of domestic or E.U. origin. In the case of walnut and hazelnut, a lack of biological material was observed, on a national scale.

The assortment to be used in the case of these approved projects is generally composed of domestic and foreign cultivars that are included into the Romanian Official Catalogue of Cultivars or have been officially tested in Romania.

As it can be observed in table 4, the assortment to be used for establishing apple orchards is based on classical cultivars such as 'Golden 'Delicious', 'Florina', 'Idared', 'Starkrimson' and the Romanian cultivar 'Generos'. Besides the tested cultivars, two new patented cultivars: 'Rozela' and 'Orion' have been declared chosen to be planted in Dolj.

The pear assortment is also composed by old cultivars such as as Williams', 'Red Williams', 'Beurré Bosc', 'Curé', 'Conferance'. The assortment comprise also Romanian cultivars like 'Napoca' and 'Ina Estival'.

Since there is a high potential for developing the apple production and marketing sector in Romania, a series of measures are required at both macroeconomic and microeconomic level [14].

Apple production in the EU is typified by intensive production practices, involving high investment costs both during the orchard establishment period and during the operational life of the orchard [13].

The assortment comprise also Romanian cultivars like 'Napoca' and 'Ina Estival'. In the case of quince, new domestic cultivars 'Aromate' and 'Adonia' are taken into account along the classic one 'Bereczki'.

Plum cultivars to be planted are also on the market from long time ('D'Agen', 'Anna Späth', 'RenclodAlthan', 'President' and 'Stanley' and domestic one 'Centenar'). The only exception is the newer German cultivar, 'Topend Plus', but this one was not officially tested in Romania, so its behaviour is not known for the area where it is intended to be used.

Sweet cherry cultivars to be planted are generally in accordance with the trends, most of the cultivars being international ones. There are some ones not yet officially studied regarding their behavior in Romania as 'Valeri Cikalov', 'Early Red', etc. Assortments used for the projects on establishing new orchards of apricot, peach and sour cherries are based also on older cultivars, with the insertion of domestic cultivars such as 'Florin' and 'Alexia' for peach and 'Ilva' and 'Nana' for sour cherry.

Walnut cultivars to be planted are mostly Romanian, with the exception of 'Franquette', an old French variety of very good quality, but less productive and the variety 'Chandler' from U.S.A. This Californian cultivar has lateral bearing habit and is extensively planted in many countries with milder climate due to its productivity and fruit and kernel quality. The extensive use of this cultivar into continental temperate climate areas characterized by high thermic amplitudes should be done with care, due to its susceptibility to low temperatures during winter. 'Chandler' was not yet tested officially in Romania, so its behavior in Oltenia it is not known.

For hazelnut orchards, domestic and introduced cultivars have been proposed for planting, some of the proposed cultivars are originated from central Italy, where the climate is milder then in Romania.

In the last years, the interest for planting walnut and hazelnut orchards increased a lot. The demand for planting material of these nut crops was not covered by the domestic nurseries and imported material from France, Hungary, Italy, Bulgaria, Turkey and Republic of Moldova was used. With this occasion many cultivars, which were not prior tested in the local ecological conditions, have been planted. Such orchards established with the support of E.U. and national public funds should be monitored not only during the 5 years period after establishing of the investment (which is generally carried out for the funded projects), but additional at least 3 years of yielding, knowing that hazelnut is coming into bearing in the 5^{th} year after planting and walnut in the 7^{th} year after planting. In this respect, valuable data should be collected, suitable and productive cultivars will be promoted and the not successful ones will be avoided in the future for planting into the areas where they did not perform.

Lack of availability of planting material is affecting also the assortment to be used for planting in Oltenia in the case of strawberry. The varieties proposed of raspberry and blueberry are new and originated from Poland and U.S.A. respectively.

Also, in the last decade, the interest for growing sea buckthorn (*Hippophaërhamnoides* L.) exploded. Many orchards have been established all over Romania, using Romanian cultivars. Although it has valuable nutritional fruits and being considered a „cash crop" in some countries, its extension on very large scale as fruit crop is problematic due to difficult harvesting.

Taking into account the issues regarding the use of listed into Official Catalogues, tested or not tested cultivars and lack of availability of quality planting material adequate decisions are requiured.

According to the legislation and NRDP guide for Submeasure 4.1.a - Support for investments in fruit-growing holdings, orchards can be also established with cultivars and rootstocks which are listed in the official catalogues of any other E.U. country. Such option can be risky when are chosen species and cultivars not adapted to the ecological conditions. As long as the risk is taken only by the farmer who decides what to plant on his property is fine, but problems might occur when financial support of 50 to 90% of total investment is granted from public domestic and E.U. funds and the choices of species and cultivars are not based on reccomandations of the extension and research services and decisions prove not to be appropriated. Use on extensive scale of cultivars and rootstocks that have not been tested officially in Romania should be carefully analysed in advance.

In the South-West Oltenia Region, projects amounting to 20,138,023 euros (eligible value - 6.9% of the national total) were financed, where the public value is 17,027,919 euros, between 2015-2017. At the national level, projects with a value of 289,236,406 euros (eligible value) were financed with a public value of 233,371,337 euros, between 2015-2017 (Tabel 6).

The Olt County obtained the most funds, with an eligible value of 6,180,462 euros (public value being 5,146,803 euros), and 11 projects financed, being the county where most investments were made through sub-measure 4.1a, in the Oltenia area. In Dolj county investments were made of 5,017,970 euros (eligible value) where the public value is 4,258,321 euros, we can say that this county has a good score comparing with the number of projects submitted (7 projects). The third place is occupied by Gorj with an eligible value of 3,840,566 euros, and the public value is of 3,258,879 euros. Although Valcea County has 8 projects financed, their value is relatively small, having an eligible value of 3,110,361 euros (the public value being 2,624,345 euros). In Mehedinti County, the least investment was made in this area, 1,988,664 euro - eligible value and 1,739,571 euros' public value (Table 6 and 1).

Table 7. Eligible value reported on new orchard area and average project value

County	Orchard area	New orchards area	Projects number	Eligible Value	Public Value	Eligible value / New orchards area [€/ha]	Average value/ Project [€]
DJ	2,833.62	159.60	7	5,017,970	4,258,321	31,440.91	716,852.86
GJ	4,756	32.70	5	3,840,566	3,258,879	117,448.50	768,113.20
MH	4,635	19.66	3	1,988,664	1,739,571	101,152.80	662,888.00
OT	861,90	104.80	11	6,180,462	5,146,803	58,973.87	561,860.18
VL	13,145	62.30	8	3,110,361	2,624,345	49,925.54	388,795.13
Total	**26,231.52**	**379.06**	**34**	**20,138,023**	**17,027,919**	**53,126.21**	**592,294.79**

Source: Database of the Agricultural Directorate of Dolj County

From the analysis of Table 7, we find that Gorj County has invested the most money in relation to each newly-built hectare, namely on an area of 32.70 ha, invested an average of 117,448.50 euro/
hectare, being followed by Mehedinti county 101,152.80 euro/hectare, followed by Olt county with 58,973.87 euro/ha and Valcea county with 49,925.54 euro/ha, and the last place is the Dolj county, which on an area of 159.60 hectares invested 31,440.91 euro.

The average value of the projects in Gorj is 768,113.20 euro / project, representing the county with the highest average, followed by Dolj county with 716,852.86 euro/project, Mehedinti county with 662,888 euro/project, Olt county with 561,860.18 euro/project, and the lower average value of the projects is in Valcea county of 388,795.13 euros.

Using linear and polynomial formulas, several correlations are made between the number of storage spaces, the total storage capacity and the arable land surface in the counties of SW Oltenia.

Table 8 presents the coefficients of correlation and coefficients of determination both for the linear functions and polynomial functions of the grade 2 and 3.

It was found a weak correlation between the number of projects and orchards area, but a positive and strong correlation between the number of projects and the eligible value and the eligible value and the new orchards area.

The determination coefficients confirmed that the variation of the dependent factors has a high influence on the variation of the independent factors for the 2nd and 3rd pair of variable in case of linear model, respectively between the number of projects and the eligible value and the eligible value and the new orchards area.

In case of all the polynomial functions, grade 2 and grade 3, it was noticed a high variation of the dependent factor on the variation of the independent factor for all the three pairs of variable, respectively: projects number and orchards area, projects number and eligible value and eligible value and new orchards area (Table 8).

Table 8. Values of regression coefficient and R^2

Correlation	r	R^2 Linear function	R^2 Polynomial function grade 2	R^2 Polynomial function grade 3
Projects number – Orchards area	-0.109	0.011	0.936	0.936
Projects number – Eligible value	0.819	0.671	0.671	0.852
Eligible value – New orchards area	0.751	0.565	0.722	0.788

Source: Own calculation.

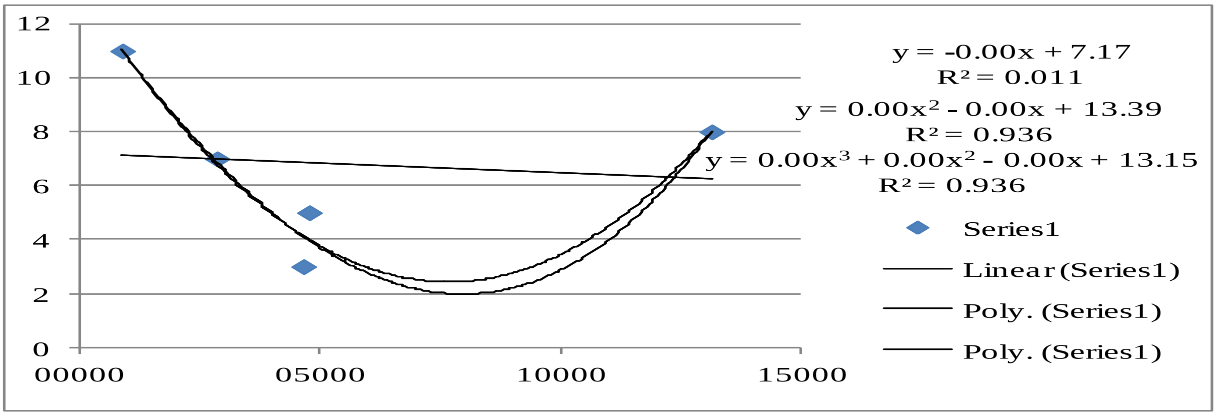

Fig. 1 Correlation between projects number and orchard area (r= -0.109)
Source: Own design.

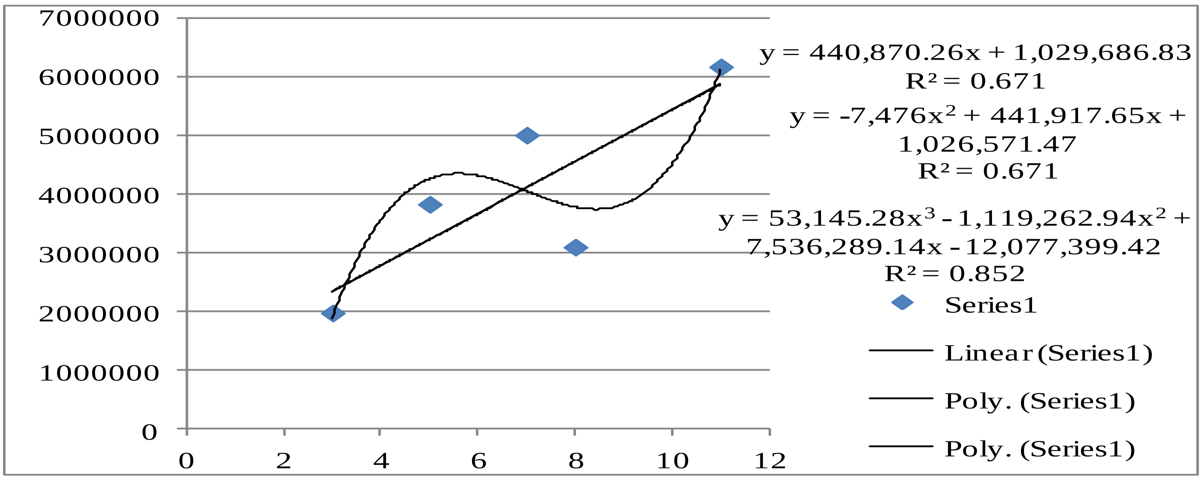

Fig. 2 Correlation betweenprojects number andeligible value (r= 0.819)
Source: Own design.

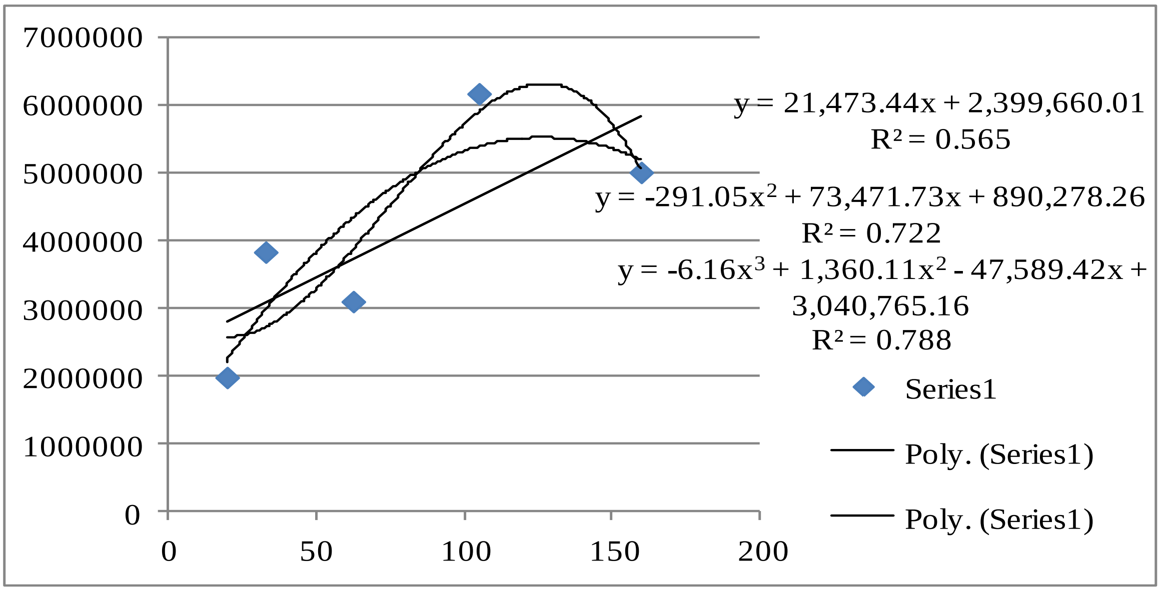

Fig. 3. Correlation between eligible value and new orchards area (r= 0.751)
Source: Own design.

Applying the correlation coefficient formula it is observed that there is a correlation between the number of projects and their eligible value (Figure 2) with a value of 0.819, respectively between the eligible value and the new surface created in the fruit sector (Figure 3) with a value of 0.751 from the counties of South-West Oltenia Region.

CONCLUSIONS

According to the study, in the SW Oltenia Development Region, the dynamics of the investments in the fruit sector is small compared to the investments made at the national level, and it is concluded the necessity of setting up new fruit plantations by using the European funds made available through the NRDP, it is also recommended introduction into the cultivation of varieties and species tested in the region.

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THE EFFECT OF PALM SUGAR SUPPLEMENTATION ON FEED CONSUMPTION AND PERCENTAGE OF SILKWORMS (BOMBYX MORI L.) IN THE END OF INSTAR V

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Abstract

Mulberry (Morus sp.) leaves used in this research were mulberry leaves, is a silkworm feed whose leaf production and quality affect the growth of larvae, cocoon production and quality. The availability of mulberry feed becomes an important factor in the business of silk because of the high demand for silk thread as raw material for silk. To increase the growth of larvae and the production of cocoons and silk thread, an alternative feed is made. The feed consists of mulberry leaf added with palm sugar as an energy source. The purpose of this study was to see the effect of mulberry leaf added with palm sugar on feed consumption and the percentage of silkworm moths (Bombyx mori L) on the 6th day of instar V. This research was conducted at the Perhutani Soppeng Public Corporation in South Sulawesi. 1000 silkworms were used in this research and were divided into 20 boxes. The mulberry leaves used were M. multicaulis leaves and palm sugar was added to the leaves by spraying sugar solution to the fresh leaves. The experimental design uses a Completely Randomized Design (CRD) followed by Least Significance Different (LSD) test. The treatments given are fresh mulberry leaves without palm sugar (G0), mulberry leaves + palm sugar and water (1: 2) (G1), mulberry leaves + palm sugar and water (1: 4) (G2), mulberry leaves + palm sugar and water (1: 6) (G3), and mulberry leaves + palm sugar and water (1: 8) (G4) with four replications. Results indicated that the treatments of feed gave significantly different results ($P<0.05$) on feed consumption and gave very significantly different results ($P<0.01$) to the percentage of larvae that still consumed the feed at 6th day of instar V.

Key words**:** *Bombyx mori. L, mulberry leaves, palm sugar, consumption*

INTRODUCTION

The development of silk textiles in Indonesia is experiencing a decline in silk production so that it has not been able to meet the needs of the weaving industry. This was stated by the Chairman of Indonesian Silk Association (ASIA) that Indonesia in 2014, was only able to meet the supply of domestic silk thread by 5% of the total requirement of 900 tons/year and 95% in imports from China. The fact that there are silkworm rearing areas have difficulty in supplying mulberry feed in quality and quantity. Allegedly extreme climate and weather globally has resulted in disruption of silk maintenance activities. In this season, silkworms are susceptible to continuous mulberry feed constraints.

Silkworm (*Bombyx mori* L) larvae, are included in the Order Lepidoptera. Silkworm is the main producer of silk fibers used as raw material for silk thread. This insect have a complete metamorphosis life cycle by undergoing perfect shape changes from hatching egg to larvae, larvae turn into pupae in cocoon and then the pupae turn into moths. Silkworm will pass the I-V instars for 25-27 days, cocoon periods for 4 days, and from pupae to imago for 10 days [10]. The life activity of silkworm is highly dependent on feed that has a harmony of nutrients to regulate metabolic processes. This process will take place in a digestive device that functions to synthesize or removes the food consumed.

Palm sap is a raw material for producing palm sugar that has a sweet taste that is different from white sugar. In addition to its sweet taste, palm sugar also tastes delicious so that it can stimulate appetite. Palm sugar, also called brown sugar, has advantages over other sugars, namely its organoleptic properties [6].

Besides, palm sugar is beneficial for health, if consumed will strengthen the Anti-Pathogenic Factors (APF), namely increasing stamina/ vitality or defense factors of the body [5]. The nutritional content of palm sugar is quite complete and has a total energy of 368 kcal. Mulberry leaf is the only food consumed by Bombyx mori caterpillar and is a determining factor for the success of silkworm cultivation, therefore various methods are pursued such as genetic improvements of mulberry and silkworm plants. Mulberry leaves, as the main feed of silkworm, will directly influence affect the amount of feed consumption and subsequently affect the growth, production, and quality of cocoon. Mulberry leaves have high palatability [4]. The content of mulberry leaf protein greatly affects the quality of the cocoons and silk fibers produced. In addition, other important nutrients that have the potential to influence the life cycle of silkworms are carbohydrates as an energy source.

Silkworm feed nutrition is one of the important factors that influence the growth of silkworm [9]. However, the silkworms energy needs during one life cycle are thought to be insufficient if it is in a critical / extreme climate. The calorie value of mulberry leaves decreases as the age of the leaves increase, whereas the calorie utilization by larvae increases according to age: young larvae, large larvae, pupae, moths. In this research, palm sugar as an energy source is given as additional feed on mulberry leaves to see the effect of palm sugar supplement on the final consumption of instar V and the percentage of silkworms caterpillar (Bombyx mori L.).

MATERIALS AND METHODS

This research uses 1,000 silkworms from Japanese and Chinese crosses obtained from Perum Perhutani Soppeng, South Sulawesi, aa well as silkworm feed, namely mulberry leaves (*Morus multicaulis*). The research was carried out at Perum Perhutani Soppeng, South Sulawesi Indonesia. Research procedure including preparation and implementation referred to [1]. The research site was prepared by disinfecting the room five days before silkworms were treated. Disinfection was performed by spraying a chlorine solution (0.5%) throughout the room (1-2 L / m2). The hatching chamber was set at 75-80 % humidity and at a temperature of 20-25ºC. Instar I-III caterpillars were kept in 10 boxes of a density of 100 individuals / box and were transferred to 20 boxes when the instar IV-V was reached. The silkworms' body was disinfected with a mixture of 0.5 g 95% fine lime and 5% chlorine. Mulberry leaves feed were given three times a day, in the morning, afternoon and evening. Mulberry leaves sliced into a size of about 0.5-1.0 cm, 1.5-2.0 cm and 3.0-4.0 cm were given as feed for instar I, II, and III caterpillars, whereas unsliced leaves were given for instar IV and V caterpillars. The feed was given to instar I, II, III, IV, and V caterpillar on an *ad lib* basis. The amount of the feed given and that remained was weighed. Treatments at molting. At each molting stage, the caterpillars were spread with a mixture of 95% fine lime and 5% chlorine. The amounts of the mixture were about 0.5, 1.0, and 1.5 g respectively at changes form instar I to II, II to III, III to IV, and IV to V. Box pads replacement and disinfection on instar I-III caterpillars were done after they woke up, while that on instar IV-V caterpillars were performed every day. The cocooning silkworms were placed in serial frame and the cocoons were harvested five days after the silkworms start to cocoon. The observed parameters were temperature, feed consumption, and percentage of cocooning silkworms. Treatments were classified into five groups with four replications for each treatment. Base ration G0: fresh mulberry leaves. Ration G1: mulberry leaves + palm sugar and water (1:2), Ration G2: mulberry leaves + palm sugar and water (1:4), Ration G3: mulberry leaves + palm sugar and water (1:6), Ration G4: mulberry leaves + palm sugar and water (1:8). Design used in this research was Completely Randomized Design after [2]:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

where:

Yij: observation value of treatment feed,
μ: average *i*-th and replication *j*-th,
αi: effect of treatment feed *i*-th level (*i* = G0, G1, G2, G3, G4),
εij: effect of feed experimental error on treatment *i*-th and replication *j*-th.
Data obtained were analyzed using Analysis of Variance (ANOVA) and followed by Least Significance Different (LSD) test.

RESULTS AND DISCUSSIONS

Feed consumption was obtained from the difference between the weight of mulberry leaves given at the beginning of the sixth day and that of the remaining mulberry leaves at the end of the sixth day in instar V and divided by the number of larvae at the sixth day on instar V. Feed consumed by silkworm in the sixth day on instar V is presented in Table 1. The treatments gave significantly different results ($P<0.05$) on feed consumption. Basically, as long as the larvae are still active the larvae will continue to eat and the feed needed by the silkworms increases with the increasing instar. The amount of food consumed by larvae depended on the instar and the quality of the mulberry leaves, as well.

The addition of palm sugar to mulberry leaves could affect the number of calories consumed. Palm sugar as an energy source is needed by silkworms in the last day of instar V in preparation for cocooning where the caterpillar changes into a pupa. Feed consumption gradually decreases in the last day of instar V after the energy needs are met. The energy is used for physiological processes in metabolism where the protein is converted into silk threads and after that, the energy is used for cocooning activities. This could explain why the treatments have a significant effect ($P<0.05$) on feed consumption.

Table 1. Average feed consumption by silkworms at the sixth day on instar V using different type of feeds

Replication	Treatments				
	G0	G1	G2	G3	G4
	Gram/larva				
U1	0.713^{a}	0.654^{ab}	0.441^{b}	0.230^{b}	0.951^{ab}
U2	0.998^{a}	0.370^{ab}	0.372^{b}	0.305^{b}	0.250^{ab}
U3	0.490^{a}	0.470^{ab}	0.091^{b}	0.245^{b}	0.174^{ab}
U4	0.709^{a}	0.246^{ab}	0.049^{b}	0.131^{b}	0.259^{ab}
Average	0.727	0.435	0.238	0.228	0.408

Note: different superscript a, b, c, and d in the same row represents significantly different value ($P<0,05$). ($a>b>c>d$).
Source: Own results in the laboratory.

LSD test (Figure 1) shows that G0 treatment gave a very significantly higher effect ($P<0.01$) than G2 and G3. The amount of feed consumption of 0.727 gram/silkworminG0 treatment (mulberry without the addition of sugar palm) is more than that in mulberry added with sugar palm due to the unmet energy needs in G0and, as a consequence, silkworms continue to consume. In instar V, there should be an increase in consumption because the silk glands in the body are fully developed [3]. The lowest feed consumption was in the G2 treatment (0.238 gram/caterpillar) and in the G3 treatment (0.228 gram/caterpillar). It is assumed that the level of consumption of silkworms was decreased because the silkworms were about to approach the cocooning stage which indicated by the emerge of silk thread from their mouth and resulted in the decrease in consumption. Feed consumption in GO treatment continued to grow in the sixth day of instar V and there was a delay in cocooning. This was different from those in G2 and G3 treatments where the feed consumptions were decreased and the caterpillars were prepared to enter cocooning phase.

The percentage of consuming larvae on instar V was obtained from the difference between the remaining amount of larvae at the beginning of instar V and the number of larvae at the end of instar V and multiplied by 100%.

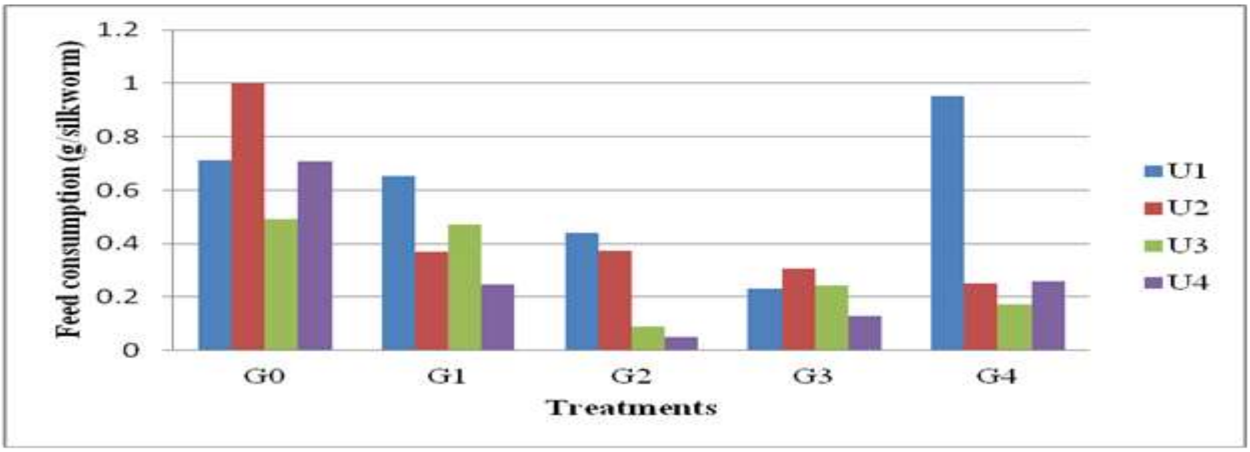

Fig. 1. Histogram of feed consumption in the sixth day of instar V using different type of feeds.
Source: Own results in the laboratory.

Table 2 shows that the treatment gave very significantly different results (P <0.01). Physiologically, changes in nutrition in the body of an insect result in an increase or decrease in the amount of food consumed [8]. The theory supports the results obtained through the treatment of mulberry leaves added with palm sugar which gave effect on the number of consuming silkworms at the end of instar V.

A decrease in the number of consuming larvae on the 6th day of instar V was due to more silkworms entered the pupa and cocooning phase at the end of instar V and, in consequence, decreased the consumption. In addition, the palm sugar supplement contains energy that could affect the rate of entering the pupa phase. The energy content of feed is very important especially at the end of instar V where silkworms undergo anabolism and catabolism. Both of these processes require energy for the formation of silk glands at the beginning of instar V and for the cocooning activity at the end of instar V.

Table 2. Percentage of consuming larvae in the sixth day of instar V

Replication	Treatments				
	G0	G1	G2	G3	G4
U1	84^{a}	46^{b}	44^{bc}	52^{c}	30^{bc}
U2	36^{a}	86^{b}	54^{bc}	30^{c}	38^{bc}
U3	90^{a}	54^{b}	32^{bc}	38^{c}	34^{bc}
U4	68^{a}	46^{b}	56^{bc}	38^{c}	30^{bc}
Average	69.500	58.000	46.500	39.500	33.000

Note: different superscript a, b, c, and d in the same row represents very significantly different value (P<0.01).
Source: Own results in the laboratory.

LSD test is presented in Figure 2 which shows that G0 gave a very significantly higher effect (P<0.01) than G1, G2, G3 and G4. In the G0 treatment the percentage of consuming silkworms on the 6th day of instar V was the highest. It was revealed that, by this treatment, silkworms were not physiologically ready to enter the cocooning phase, compared with other treatments where the number of consuming silkworms was reduced because they were ready to enter cocooning stage. [7] stated that the consumption of feed by larvae should increases rapidly from instar IV to instar V, where this is related to the formation of silk glands. It seems that the G0 treatment was not able to meet the nutritional needs, especially because the energy source from G0 was insufficient to meet the needs of silkworms compared to other treatments where the silkworms get palm sugar as an energy source supplement. As a result, more silkworms continued to consume the feed G0 and the number of larvae to enter the cocooning stage were low. It is clear that high energy feed could affect the metabolism in silkworms to enter the next phase in metamorphosis.

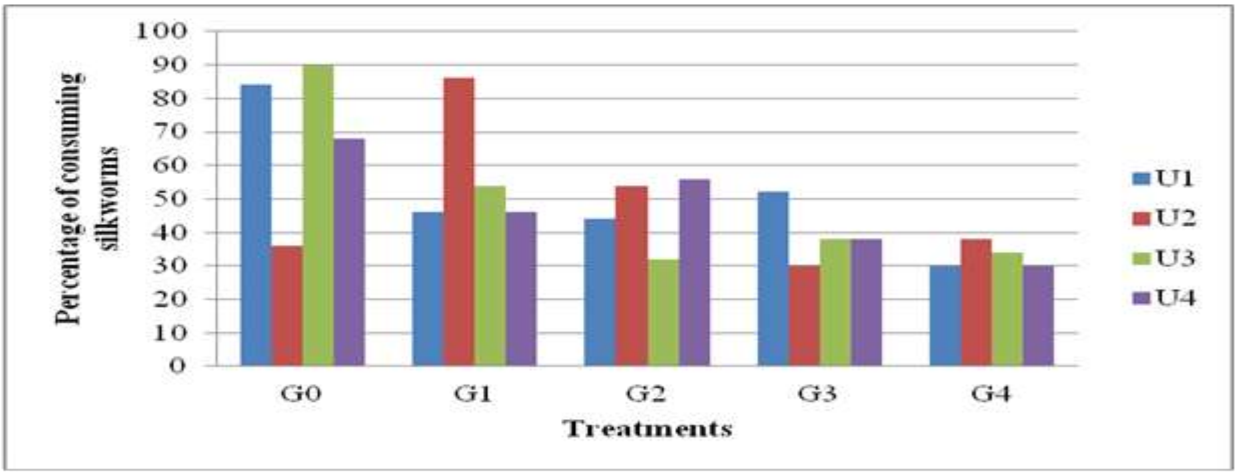

Fig. 2. Histogram of percentage of consuming larvae in the sixth day of instar V.
Source: Own results in the laboratory.

CONCLUSIONS

High energy feed in the form of formulated mixture of mulberry leaves and palm sugar had a significant effect ($P<0.05$) on feed consumption by silkworms and this, in turn, had a very significant effect ($P<0.01$) on the number of consuming silkworms in the sixth day of instar V.

Mulberry leaves without palm sugar added (G0) significantly resulted in the highest feed consumption and highest percentage of consuming larvae in the sixth day of instar V, but the lowest rate of cocooning silkworms. On the contrary, palm sugar-added mulberry leaves (G1, G2, G4. G4) resulting in the lowering feed consumption and percentage of consuming larvae, but the higher rate of cocooning larvae.

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